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Decision Rules in a Judicial Hierarchy

by

CHARLES M. CAMERON AND LEWIS A. KORNHAUSER*

This paper extends the analysis of the structure of judicial hierarchies to environments in which litigants may have asymmetric information about the merits of the case. We identify equilibria in which the error rate is zero. In each equilibrium, at least one of the inferior courts does not decide cases on the basis of its prior beliefs. Rather, in the absence of an informative signal, an inferior court *decides against the informed litigant in order to exploit that litigant's knowledge*. The optimal decisional rule with potentially uninformed litigants thus differs from that when, after trial, both litigants are fully informed. (JEL: D 79, H 10, K 41)

1 Introduction

In this paper, we pursue further the consequences of litigant selection on the structure of judicial hierarchies. In a prior paper (CAMERON AND KORNHAUSER [2005]), we constructed a simple model in which, under reasonable circumstances, the optimal judicial hierarchy had three tiers: a trial court, an intermediate appellate court and a supreme court. In that model, litigant selection of appeals creates a striking set of incentives. First, if a party knows it has lost improperly, it has a strong incentive to appeal, at least if the higher court is at all likely to correct the lower court's error. But the incentive to appeal an improper judgment is true at any level in the judicial hierarchy below the highest level. Therefore, a correctly winning litigant has a strong incentive to contest "improper" appeals by a correctly losing litigant, if the correct loser improperly prevails on appeal. Knowing this, a correctly losing litigant has little incentive to appeal in the first place. From this perspective, the Anglo-American system of appeals implicitly pits the two litigants against one another, encouraging them to police one another's improper appeals. As a consequence, the appellate process quickly sorts the litigants properly.

In this essay we examine the importance of litigant knowledge on the efficacy of litigation selection and the choice of decisional rules at the trial and appellate levels.

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Specifically, we weaken the assumption that the trial reveals to *both* litigants the appropriate decision in the case even when the court remains ignorant. A three-tiered hierarchy will now reduce errors to zero only under more restrictive conditions. More specifically, we identify three classes of equilibria in a three-tiered hierarchy in which the error rate is zero. The logic of these equilibria differs from the logic of the equilibrium identified in CAMERON AND KORNHAUSER [2005]. Here, in order to achieve equilibrium, at least one of the inferior courts must not decide cases on the basis of its prior beliefs. Rather, in the absence of an informative signal, an inferior court *should decide against the informed litigant in order to exploit that litigant's knowledge*. The optimal decisional rule with potentially uninformed litigants thus differs from that when, after trial, both litigants are fully informed.

Our model now distinguishes between public and private signals about a defendant's liability. An informative public signal (occasionally a "hard signal") provides public, legally admissible, and verifiable information combined with judicial reasoning that judges will see as determinative. If trial or appeal should yield an informative public signal, all the parties understand the correct judgment in the case. But trial preparation or the trial itself may yield informative private signals (occasionally "soft signals") as well. That is, discovery, research, or testimony may provide the plaintiff with certain knowledge of defendant's liability or freedom from liability. This knowledge may depend on evidence that is not legally admissible or information that is not legally verifiable but that was discoverable. Of course, adjudication may provide neither kind of information.

The change in the information structure does lead to some changes in optimal judicial strategies. In the equilibria studied in CAMERON AND KORNHAUSER [2005], judges always decide in accordance with their beliefs about the appropriate resolution of the case. Their beliefs rest on any public, informative signal they may have received and on the actions of the parties which may reveal information. This aspect of the model is unrealistic as court judgments generally do not rely on the litigants' decisions to appeal or not to appeal as signals of private information concerning the correct resolution of the case. When one litigant is potentially uninformed, decisions at the trial and intermediate appellate levels may no longer correspond to the judge's best belief about the merits of the case. These judges no longer rest their judgments on inferences from the litigants' decisions to appeal. This result is striking from a game-theoretic perspective though it more closely conforms to the legal understanding of the decision rules of inferior courts than acting on beliefs formed in part on the litigant's decisions to appeal.

The paper is organized as follows. Section 2 sets out the model and summarizes our prior results. Section 3 investigates behavior within a two-tiered hierarchy. Section 4 considers behavior in a three-tiered court system. Section 5 discusses our results. In particular, it considers the implications of our model when the quality of adjudication at each tier is endogenous; and it suggests how our results may be extended to the case of potentially two-sided asymmetric information of the litigants. All proofs are relegated to the Appendix.

The literature investigating litigant selection and the structure of adjudicatory systems is quite sparse. SHAVELL [1995] identifies a set of fees and penalties that insure that appeals are made only in wrongly decided cases. In his model, as SCHWARZ [1995] notes, judges do not treat litigant's decisions to appeal as signals.

DAUGHETY AND REINGANUM [2000] also use a game theoretic model to examine the informational properties of litigant selection of appeals. In this interesting model, the defendant and the appellate court both receive signals about the legal preferences of a superior court; the appellate court can make deductions about the defendant's private information from the appeal. A handful of theoretical papers examine other judicial appeals mechanisms.¹

2 The Model

As in CAMERON AND KORNHAUSER [2005], we model the judicial system as a team, a set of individuals who share objectives but may have different information.

2.1 Preliminaries

There are two classes of litigants – plaintiffs and defendants – and, depending on the game, one, two, or three tiers of judges. Defendants have a type $\beta \in \{l, nl\}$, (liable and not liable, respectively). Nature selects defendant's type as l with common knowledge probability p_0 . Plaintiff and defendant each have two actions open to them in the event the judicial system has more than one tier. Suppose the system has T tiers. If a judgment at tier $t < T$ is adverse to its interest, losing litigant j at level t may either appeal ($s_j^t = 1$) or not appeal ($s_j^t = 0$). (A judgment at tier T cannot be appealed.) Let σ_j^t denote the probability of an appeal by losing litigant j at tier t . A judge I at tier t reaches judgment $v_i^t \in \{l, nl\}$ (defendant held liable or not liable, respectively). Let ρ_i^t denote the probability that judge i at tier t reaches judgment $v_i^t = l$. Finally, let v_F denote the final judgment prevailing in the judicial system; *i.e.*, v_F is the decision of the judge at the highest tier in the system to hear the case.

In this team model, all judges wish to maximize the expected number of rightly decided cases in the system. The utility of judge I at level t is then given by

$$u_i^t = \begin{cases} 1 & \text{if } v_F = \beta, \\ 0 & \text{if } v_F \neq \beta. \end{cases}$$

Defendant pays damages d in the event that $v_F = l$ (that is, she is held liable in the end); otherwise she pays 0. In addition, a litigant incurs a cost c each time she appeals.

¹ CAMERON, SEGAL, AND SONGER [2000] consider strategic auditing, as do SPITZER AND TALLEY [2000]. CAMERON [1993] sketches a model of judicial tournaments (see also KORNHAUSER [1995]). Judicial tournaments are then explored in more detail in MCNOLLGAST *et al.* [1995]. SHAVELL [1995, footnote 2] provides citations to the literatures on appeals by employers and in administrative agencies.

Defendant's utility is then given by

$$u_D = \begin{cases} d - I_{DC} & \text{if } v_F = l, \\ 0 - I_{DC} & \text{if } v_F = nl, \end{cases}$$

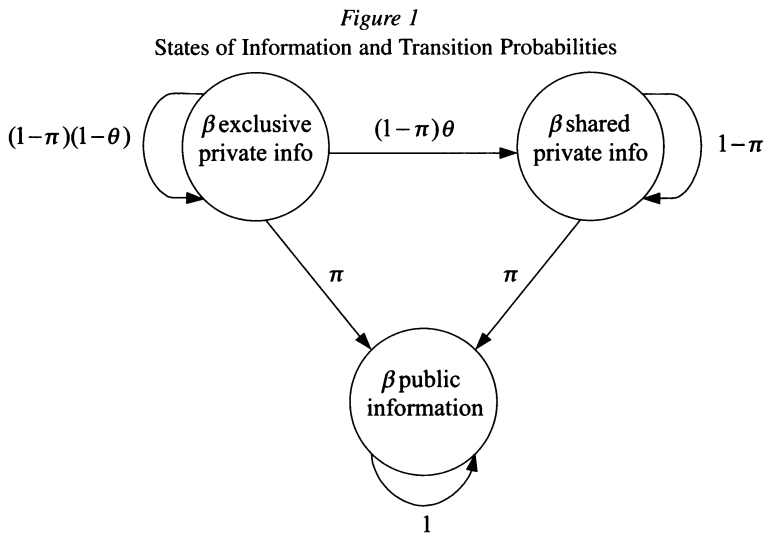
where I_D equals one plus the number of appeals the defendant makes.²

Plaintiff suffers a loss λ ; but this occurs regardless of the play of the game and so can be normalized to zero. Should plaintiff prevail in litigation he will receive damages d from defendant in the event that $v_F = l$; otherwise he receives 0. Plaintiff's utility is then given by

$$u_D = \begin{cases} d - I_{PC} & \text{if } v_F = l, \\ 0 - I_{PC} & \text{if } v_F = nl, \end{cases}$$

where I_P equals the number of appeals the plaintiff makes.

Information evolves during the course of play probabilistically. Reference to Figure 1 may prove helpful in understanding this evolution. Initially, defendant's type β is private information; hence, it may be rational for defendant and plaintiff to engage in litigation (however, we do not actually model the pre-trial settlement process). Trial results in two signals. The trial judge receives a public signal $x^1 \in \{0, \beta\}$ where the signal 0 is uninformative and the signal β is fully informative. The signal β is received with probability π_i^1 . More generally, the court at tier t receives a signal $x^t \in \{0, \beta\}$; the signal β is received with probability π_i^t . In addition, at trial, the plaintiff receives, independently, a private signal $y \in \{0, \beta\}$; the signal β is received with probability θ .



² We assume the defendant pays the court costs for the trial.

After trial, then, information about defendant's type may be in one of three states. In *state one*, which occurs with probability $(1 - \theta)(1 - \pi_i^1)$ knowledge of defendant's type is exclusive to defendant. In this case, the judge has received an uninformative public signal of defendant's type and the plaintiff has received an uninformative private signal. In *state two* which occurs with probability $\theta(1 - \pi_i^1)$, knowledge of defendant's type is shared by defendant and plaintiff alone. In this case, the Judge has received an uninformative public signal but plaintiff has received an informative private signal. In *state three* which occurs with probability π_i^1 , knowledge of defendant's type is public information, following the receipt of an informative public signal.³ Of course, if appeals occur, then state 1 or state 2 may evolve into state 3.

We assume information begins in state one, so it is rational for defendant and plaintiff to engage in litigation (we do not model pre- or post-trial settlement). Then, with probability π_i^1 , a public, fully informative signal emerges during trial. More specifically, as a result of the trial and the judge's deliberation concerning matters of fact and law, the judge at tier t receives a public signal x^t in $\{0, \beta\}$, where 0 denotes a non-informative signal.⁴ Independently, a fully informative private signal may emerge with probability θ again in the set $\{0, \beta\}$. If a public, fully informative signal emerges, information moves to state three. If the public signal is uninformative but a private, informative signal does emerge, information moves to state two. If neither signal is informative, information remains in state one.

We assume that if the plaintiff receives an informative private signal, both litigants know it. That is, it is common knowledge between them that defendant's type has been revealed to plaintiff and information is in state two.

We also assume that the judge cannot distinguish between states one and two, and this is common knowledge. That is, the judge does not know whether plaintiff has received an informative or uninformative signal. Finally, we let μ_i^t be the belief of judge I at tier t that the defendant is liable ($\beta = I$). Note that when defendant's type is revealed either $\mu_i^t = 1$ or $\mu_i^t = 0$.

The play of the game follows the obvious pattern. During trial the court (and the litigants) receive a public signal and the litigants receive a private signal. The trial court then renders judgment. The losing litigant then decides whether to appeal or not. If the losing litigant appeals, the appellate court, in the event the public signal received at trial was uninformative, receives a second public signal that will be either fully revealing or completely uninformative. The appellate court then renders judgment. If there is a third tier to the hierarchy, the litigant who loses at the intermediate appellate level has an opportunity to appeal. If the losing appellate litigant appeals and both public signals received at trial and on appeal were

³ In CAMERON AND KORNHAUSER [2005], only states 2 and 3 are possible after trial.

⁴ Obviously, this is a rather special judicial technology. In CAMERON AND KORNHAUSER [2005], we consider a technology in which trials and appeals are always somewhat informative but never perfectly so.

uninformative, the supreme court receives a public signal that, again, may be fully revealing or completely uninformative. The supreme court then renders judgment.

2.2 Comparison to the Basic Model

The model here modifies the model in CAMERON AND KORNHAUSER [2005] in two important respects. First, as previously noted, we have complicated the information structure. In the prior model, only states 2 and 3 were possible. The trial revealed defendant's type to both litigants; thus they were both completely informed at the end of the trial. The court, however, may not have received an informative public signal so it may be ignorant of the defendant's type.

Second, we have modified slightly the objective function of the judges. In the model here, judges act fully as a team. Each judge has a common objective function; each seeks to minimize errors in the judicial system. In the prior model, each judge had a secondary, personal concern of avoiding overruling.⁵ This secondary concern excludes the equilibria that we find in our current model.

It will be helpful to summarize the results from CAMERON AND KORNHAUSER [2005]. There we showed that, in a two-tiered hierarchy, two distinct equilibria were possible. First, if the probability of an informative public signal is sufficiently high (specifically, $\pi^2 > 1 - c/d$), a fully separating equilibrium occurs in which only incorrectly losing litigants appeal from the trial court judgment and the appellate court, in the absence of an informative public signal, reverses. (Otherwise it rules as dictated by the informative public signal received by the trial court or by itself.) Second, if the probability of an informative public signal on appeal is too low ($\pi^2 < 1 - c/d$) a partial pooling equilibrium results in which correctly losing litigants appeal with some probability and the appellate court reverses those cases in which no informative public signal was received with some positive probability.

In a three-tier hierarchy, we emphasized the existence of a fully separating, zero-error equilibrium. Again, its existence depends on the probability of an informative public signal in the supreme court being sufficiently high (again, $\pi^3 > 1 - c/d$). In this equilibrium the supreme court hears no cases. We then argued that the probability of an informative public signal should depend on the caseload of the court; as in this equilibrium, the caseload of the supreme court is minimal, the probability of an informative public signal is very high and the conditions for a fully separating equilibrium are satisfied.

In the separating equilibria in both the two and three-tiered models, the intermediate appellate and supreme courts exploit the information revealed by the fact that a litigant has appealed. That is, in the absence of an informative public signal that has revealed the defendant's type, the appellate court reverses the lower court judgment because it knows that only wrongly decided cases have, in equilib-

⁵ In an alternative formulation, the judicial team would seek to maximize social welfare understood as a function of the error rate and the social costs of appeals.

rium, been appealed. Similarly, when the trial court does not learn the defendant's type, it renders judgment according to its prior beliefs about the responsibility of the defendant. When this probability p_0 exceeds $1/2$, the trial court holds defendant liable, when $p_0 < 1/2$, it finds for defendant. As we shall see below, this feature of the equilibrium follows from the specification of judicial preferences; because judges prefer not to be overruled, they decide the cases based on their beliefs about the defendant's type and those beliefs are influenced by the litigants' actions.

2.3 Interpretation

Both this model and the basic model of CAMERON AND KORNHAUSER [2005] are models of error correction rather than law creation. An adjudication might err in at least two ways: it might find erroneous facts or it might misapply the law to agreed upon facts.

In the most direct interpretation of the current model, the trial yields public and private signals concerning the facts. Trials plausibly yield more accurate signals to private parties than to the courts because not all evidence discovered by the parties will be admissible in court. Each party is, moreover, likely to have private information that may be revealed during the course of trial preparation or trial.

In common law countries, of course, there is a reasonably strict division of labor between trial and appellate courts; trial courts find facts and appellate courts review the law. (Moreover, at trial, facts are often found by juries rather than courts.) A model of erroneous, judicial fact-finding subject to appellate review is thus inapposite. In civilian systems, however, intermediate appellate courts generally have the power to find facts *de novo*. Our model illustrates how this review of fact-finding might work and suggests that a third tier of review of facts might improve results.

The division between fact-finding and law application, however, is not as clear-cut in common law systems as this story suggests. Specifically, in many common law systems, "mixed" questions of law and fact arise; judgments of trial courts on these issues are subject to appellate review. In constitutional tort actions against federal officials, for example, the question of whether the official has acted as an official is a mixed question of law and fact. Similarly, in the review of governmental searches of persons and property, we might understand a variety of determinations as mixed questions of law and fact. Whether a particular location constitutes a "car" or a "home" which gives rise to some expectation of privacy is in part a legal determination.

The mixed character of these judgments suggests that our model captures at least part of the error correction functions of appellate review. The private parties are likely to have superior, and possibly asymmetric, knowledge of the factual aspect of the mixed judgment that the court must make. This knowledge may be revealed during trial or may become known to the uninformed party during trial or pre-trial discovery.

3 Equilibria in a Two-Tier Hierarchy

We search for perfect Bayesian equilibria in the adjudication game. Broadly speaking, strategies must be sequentially rational in each distinguishable information state, and beliefs must conform to Bayes' rule whenever possible. We exploit the results for two-tiered hierarchies in CAMERON AND KORNHAUSER [2005] briefly described in section 2.2 above. We focus on two sets equilibria that depend on the accuracy of the appellate tier: one when $\pi_i^2 > (d - c)/d$ and one when $\pi_i^2 < (d - c)/d$. Moreover, we consider the equilibria that are optimal from the perspective of the court system; that is, we look for equilibria that minimize errors conditional on the information structure.

3.1 High Quality of Appellate Adjudication: $\pi_i^2 > (d - c)/d$

When the appellate court is of sufficiently high quality, then the team of judges can eliminate error by exploiting the information of the defendant.

PROPOSITION 1 *If $\pi_i^2 > (d - c)/d$, the following strategies are a perfect Bayesian equilibrium:*

Trial judge: If there is an informative public signal, the trial judge rules according to the signal. If there the public signal is uninformative, the trial judge holds defendant liable.

Defendant: The defendant appeals if and only if the trial judgment is incorrect.

Plaintiff: Plaintiff acts only off the equilibrium path. An informed plaintiff does not appeal when there is an informative signal, public or private, that defendant is not liable but appeals if there is an informative signal, public or private, that defendant is liable. An uninformed plaintiff may appeal with any probability.

Appellate judge: The appellate judge reverses any appeal that she hears.

The proof appears in the Appendix. Here we indicate the intuition for the proof. This equilibrium exploits the knowledge of the defendant about the true state of the world. When the trial court receives an uninformative public signal about the defendant's type, the trial court places liability on the defendant. The defendant then must decide whether to appeal or not. Given the probability that the appellate court will learn defendant's type with sufficiently high probability, a correctly losing defendant has no incentive to appeal. Plaintiff has no incentive to appeal when he loses because he loses only in the event that defendant's type is publicly revealed.

3.2 Low Quality of Appellate Adjudication: $\pi_i^2 < (d - c)/d$

When the appellate court cannot identify defendant's type with sufficient accuracy, there is no equilibrium in which no errors occur. When $\pi_i^2 < (d - c)/d$, we saw that, in an equilibrium in a two-tiered hierarchy, correctly losing litigants chose to appeal the trial judgment with some positive probability. In the prior model, the equilibrium behavior depended on the prior probability p_0 that defendant was

liable. When $p_0 > 1/2$, the trial judge, when ignorant of the defendant's type, held the defendant liable. Conversely when $p_0 < 1/2$, the trial judge, when ignorant of defendant's type, ruled against plaintiff. This behavior both minimized error as it reflects the trial judge's best guess concerning the correct outcome of the case and it minimized the cost of appeals.

The best equilibrium for an error-minimizing team of judges may depend on two factors. First we saw in section 3.1 that it might be best for the trial judge, when ignorant of defendant's type, to hold defendant liable even though $p_0 < 1/2$ as holding defendant liable exploits defendant's superior knowledge. We must thus compare the error rates of equilibria in which the trial judge, when ignorant of defendant's type, holds defendant liable to those in which she holds against plaintiff. Second, the optimal equilibrium may depend on the quality of the private signal. As the quality of the private signal declines, the desirability of holding the defendant liable in the absence of an informative public signal may increase, regardless of the value p_0 . In fact, we show in Proposition 2, that a decision rule at trial that holds defendant liable when the public signal is uninformative is at least as good as any other decision rule.

PROPOSITION 2 *If $\pi_i^2 < (d - c)/d$, the following strategies constitute a perfect Bayesian equilibrium:*

Trial judge: If the public signal reveals defendant's type, the trial judge rules as dictated by the signal. Otherwise, she rules against defendant.

Plaintiff: If a public signal has revealed defendant's type and the trial court has ruled accordingly, plaintiff does not appeal. In the absence of an informative public signal, plaintiff has no move. Plaintiff's behavior in the event of off-the-equilibrium path actions by the trial court – i.e., the use of a different decisional rule that holds against her – are set out in the Appendix.

Defendant: If the trial court received an informative, public signal the defendant does not appeal. If the trial court did not receive an informative public signal, the defendant knows either that he was correctly held liable or that he was incorrectly held liable. When the trial judgment is incorrect, the defendant appeals with probability 1 (given the equilibrium probability that the appellate court will reverse). When the trial judgment is correct, the defendant appeals with probability $(1 - p_0)/p_0$ (again given the equilibrium probability that the appellate judge will reverse).

Appellate judge: If the trial judge or the appellate judge received a signal that reveals the defendant's type, the appellate judge rules accordingly. If the appellate judge is ignorant of the defendant's type, she reverses the trial court judgment with probability $\rho_i^2 = 1 - c[d(1 - \pi_i^2)]^{-1}$.

The proof appears in the Appendix. It is quite lengthy but reasonably straightforward in conception. First, we show that, on the equilibrium path, the above strategies are consistent. Second, we consider off-the-equilibrium path phenomena. The crucial step is to show that the trial court's decision rule is correct. To do this we characterize two sets of strategies for the litigants and the appellate court when faced by a trial

judge that deviates from the strategy stated in the proposition to one in which, when ignorant of the defendant's type, it rules against plaintiff when $p_0 < 1/2$. Which equilibrium applies depends on the value of θ . We then show that the systemic error rates are lowest when, in the absence of an informative signal at trial, the trial judge holds defendant liable.

4 Three-Tiered Hierarchy

As in CAMERON AND KORNHAUSER [2005], we focus on separating equilibria in which no errors occur. The situation with asymmetrically informed litigants is significantly more complex than the situation with symmetrically informed litigants. We identify three classes of equilibria, each of which exists only under more restrictive conditions than those that must apply in the fully informed case. In the first class, the trial judge, in the absence of an informative public signal, rules against defendant. In the second class, the intermediate appellate court, in the absence of an informative public signal, rules against defendant. In the third class, which we might regard as the limit of the second class of equilibria, both inferior courts rule against defendant in the absence of an informative public signal. We state these equilibria in turn.

PROPOSITION 3 *If $\pi_k^3 > (d - c)/d$ and $\theta \geq 1 - c[d(1 - \pi_i^2)]^{-1}$, the following is a perfect Bayesian equilibrium with zero errors:*

Trial judge: If she receives an informative signal she rules accordingly. If she receives an uninformative signal, she holds against defendant.

Defendant at trial: If there is an informative signal and the trial judge rules accordingly, defendant does not appeal. If there is an uninformative signal, correctly losing defendants do not appeal and incorrectly losing defendants do appeal.

Plaintiffs at trial: If there is an informative signal at trial and plaintiff loses she does not appeal. All other plaintiff actions are off-the-equilibrium path so we may specify them as we wish. The Appendix provides details.

Intermediate appellate court: If it receives an informative public signal, it decides accordingly. If it receives an uninformative signal, it reverses.

Defendant on appeal: Correctly losing defendants do not appeal; incorrectly losing defendants do appeal.

Plaintiffs on appeal: Incorrectly losing plaintiffs appeal; but neither correctly losing nor uninformed plaintiffs appeal (all of which are off-the-equilibrium path events).

Supreme court: If it receives an informative signal it acts accordingly, otherwise it reverses.

The proof is in the Appendix. At this stage we note only that, in equilibrium, after an appeal, all plaintiffs are informed, as only incorrectly losing defendants appeal and the act of appeal signals their type to the court and to the litigants. We shall call equilibria of this class, *trial-court-only* equilibria as only the trial court, in the

absence of an informative signal holds the defendant liable. Phrased differently, the trial court uses a defendant-liable default rule.

Second, this equilibrium replicates, for a restricted set of cases, the result for three-tiered hierarchies established in CAMERON AND KORNHAUSER [2005] but the logic of the equilibrium is quite different. The trial-court-only equilibrium is sustainable only if the private signal is sufficiently likely to yield an informative signal. This condition implies that trial court procedures have to be of sufficiently high quality or the equilibrium will not exist.

Further, in the trial-court-only equilibrium, the trial court adopts a decision rule that, in some circumstances – when $p_0 < 1/2$ – requires her to hold defendant liable even though she believes it more likely than not that defendant is not liable.

We now turn to the second class of equilibria in which only the intermediate appellate court adopts the default decision rule of ruling against defendant in the absence of an informative public signal. We have

PROPOSITION 4 *If $\pi_k^3 > (d - c)/d$, $\pi_k^2 \geq 2 - d/c$, and $p_0 > c/d$, then the following is a perfect Bayesian equilibrium with zero errors:*

Trial judge: If there is an informative public signal the trial judge rules accordingly. In the absence of an informative public signal, the trial judge rules against the party it believes more likely to be liable (i.e., according to its priors).

Defendant at trial: Incorrectly losing defendants appeal; correctly losing defendants do not appeal.

Informed plaintiffs at trial: Incorrectly losing, informed plaintiffs appeal, correctly, losing informed plaintiffs do not appeal.

Uninformed plaintiffs at trial: Given $p_0 > c/d$, these plaintiffs appeal with probability 1.

Intermediate appellate court: If there is an informative signal, the court rules as indicated by the signal; otherwise it holds against defendant.

Defendant on appeal: Incorrectly losing defendants appeal; correctly losing defendants do not appeal.

Informed plaintiffs on appeal: Incorrectly losing plaintiffs appeal; correctly losing plaintiffs do not appeal.

Uninformed plaintiffs on appeal: Under the conditions of the theorem, they appeal (again, an off-the-equilibrium path event).

Supreme court: If there is an informative public signal the court rules accordingly. Otherwise it reverses.

The proof is in the Appendix. We shall call equilibria of this class *appellate-only equilibria*. Note that the restriction on p_0 insures that rational uninformed plaintiffs do not appeal.

In the appellate-only equilibrium, the supreme court hears some cases. It thus differs from the trial-court-only equilibrium and the three-tiered, full-information equilibrium of CAMERON AND KORNHAUSER [2005]. As with the trial-only equilibrium, the decision rule adopted by the intermediate appellate court requires it to hold against defendant even if the court believes it more probable than not that plain-

tiff should not recover. This decision rule is necessary to maintain the equilibrium because it allows the judicial system to exploit the defendant's superior knowledge about the case.

PROPOSITION 5 *If $\pi_k^3 > (d - c)/d$ and $\pi_k^2 \geq 2 - d/c$, the following strategies are a perfect Bayesian equilibrium:*

Trial judge: If there is an informative public signal, the trial judge rules according to the signal. If the public signal is uninformative, the trial judge holds defendant liable.

Defendant: The defendant appeals the trial court judgment if and only if the trial judgment is incorrect. Similarly, the defendant appeals a judgment of the intermediate appellate court if and only if the appellate judgment is incorrect.

Plaintiff: Informed plaintiffs appeal if and only if the relevant judgment is incorrect; otherwise they do not appeal. Uninformed plaintiffs do appeal. (All these events are off-the-equilibrium path.)

Intermediate appellate judge: If the defendant's type is revealed to the intermediate appellate judge by an informative public signal at trial or on appeal, she decides as the signal indicates. If the court does not know the defendant's type, the intermediate appellate judge holds the defendant liable.

Supreme court: If the defendant's type is revealed to the supreme court by an informative public signal at trial, on the first appeal or on appeal to her, she decides as the signal indicates. If the court does not know the defendant's type, she reverses.

We call this equilibrium the *full-default equilibrium*. The proof appears in the Appendix. Its logic, however, is straightforward. As in the case of a two-tiered hierarchy, a final adjudicator of sufficiently high quality allows the judicial system to exploit the private information of the informed litigant. As in the case of the two-tiered hierarchy, only the highest court uses a decision rule that draws inferences about the correct resolution of the dispute from the litigants' decisions to appeal. The trial court and the intermediate appellate court must decide against defendant even if they believe that is more probable than not that defendant is not liable; this exploits the information available to the fully informed defendant.

The constraint on the quality of adjudication is unlikely to be binding. For $c \leq 0.5d$, the constraint is satisfied by any $\pi^2 > 0$.

5 Discussion

Sections 3 and 4 have shown that litigant selection is still a powerful force for minimizing error even when the trial does not necessarily fully inform both litigants about the appropriate resolution of the case. In this section we address three issues. First, we discuss various criteria for selection among the three, zero-error equilibria that exist in the three-tiered hierarchy. Second, we show that the information structure in this model may have an effect on the efficiency of adjudication. Third, we speculate on the effect of further weakening the assumption on litigant information.

5.1 Choosing among Equilibria

We have identified three classes of zero-error equilibria in three-tiered hierarchies. We might choose among them in at least two ways. First, we might consider the number of appeals that arise in each equilibrium. The equilibrium with the fewest number of appeals would impose the lowest social costs. Second, we might choose the more “robust” equilibrium.

The following corollary to Propositions 3, 4, and 5 determines the number of appeals in each equilibrium.

COROLLARY 1 (APPEALS RATE COROLLARY) (a) *In a trial-court-only equilibrium there are $n_{\text{trialonly}} = (1 - p_0)(1 - \pi_i^1)$ appeals. (b) In an appeals-only equilibrium (i) if $p_0 \geq 1/2$, there are $(1 - p_0)(1 - \pi_i^1)$ appeals from the trial decision and $(1 - p_0)(1 - \pi_i^1)(1 - \pi_i^2)$ appeals from the intermediate appellate court. (ii) If $p_0 < 1/2$, then there are $(1 - \pi_k^1)[p_0\theta + (1 - \theta)]$ appeals at level 1 and $(1 - \theta)(1 - \pi_i^1)(1 - \pi_i^2)(1 - p_0)$ appeals at level 2. (c) In the full-default equilibrium there $(1 - p_0)(1 - \pi_i^1)$ appeals from the trial decision and $(1 - p_0)(1 - \pi_i^1)(1 - \pi_i^2)$ appeals from the intermediate appellate court.*

The proof follows directly by calculation of the number of appeals from the equilibrium strategies specified in Propositions 3, 4, and 5.

On this criterion, the appeals rate corollary shows that the trial-only equilibrium is best; in that equilibrium there are no appeals to the highest court and only cases wrongly decided by the trial court are appealed.

Second, we might consider the “robustness” of the equilibria. The trial-only equilibrium minimizes appeals but it only exists if the private signal is sufficiently informative. If the costs of appeal are small and the amount at issue is large then the private signal must be nearly always informative. Similarly, the appellate-only equilibrium imposes the condition that the (pre-trial) likelihood that plaintiff prevail be sufficiently high. In this case, if the costs of appeal are high relative to the amount at issue, then this condition is relatively stringent. Thus on these grounds, we might opt for the full-default equilibrium as the equilibrium that will hold in the most general circumstances.

The full-default equilibrium, moreover, is more robust than the other two equilibria in a second sense as well. It withstands more litigant deviations from equilibrium behavior than the other equilibria.

5.2 The Efficiency of the Courts

In CAMERON AND KORNHAUSER [2005], we argued that the quality π^t of adjudication at tier t depended on the amount of judicial resources devoted to a case. The amount of resources devoted to a case depended in turn on the number of cases before the court, the number of judges on the bench, and the size of the panels that heard cases. We summarized this dependence of quality on adjudicatory resources in the variable of caseload per judge.

In that model, we argued that the separating equilibrium in the three-tiered hierarchy was sustainable because, in equilibrium, the supreme court hears no cases and thus has adequate resources to insure that any adjudication brought to it will have sufficient resources devoted to it to meet the quality condition in the proposition.

The situation in the model in this paper differs from that in the prior model. The prior model placed no constraints on the quality of adjudication in lower courts; they could be as bad as possible. Only the quality of adjudication at the supreme court level mattered. In this model of this paper, each class of zero-error equilibria in a three-tiered hierarchy places requires at least some minimal quality of adjudication by one or more of the inferior courts.

Consider first the trial-only equilibrium. Existence of this equilibrium requires that the private signal received at trial be sufficiently informative. The likelihood θ that defendant's type will be revealed at trial depends on the pre-trial discovery rules.

Similarly, when we pursue the same argumentative strategy that we pursued previously and consider the dependence of the likelihood π^t of an informative signal at tier t on the caseload at tier t , we see that a designer might well pay attention to the quality of adjudication in the inferior courts. For ease of exposition we focus on the full-default equilibrium but a similar argument applies to the appellate-only equilibrium.

Recall from Corollary 1 that only cases wrongly decided at trial are appealed; there are $\lambda^1 = (1 - \pi^1)(1 - p_0)$ of these. On appeal, the intermediate appellate court will receive an informative signal concerning π^2 of these cases so that on appeal $\lambda^2 = (1 - \pi^1)(1 - \pi^2)(1 - p_0)$ will be wrongly decided.

As long as the quality of review at the supreme court on each of these cases exceeds $(d - c)/d$, the supreme court case load will be only λ^2 cases. To insure this quality, the administration of the court system may devote resources to trial courts, thereby increasing π^1 , or to the intermediate appellate courts, thereby increasing π^2 , or to the supreme court, thereby increasing π^3 . Note that adding a fourth tier appears unnecessary. If we assume that the expenditures at any given tier t yield diminishing marginal benefits in the improvement of π^t , then we would expect that the judicial team to devote some resources to insuring the quality of adjudication at each tier. This result contrasts sharply with the result in CAMERON AND KORNHAUSER [2005]; there the quality of adjudication at trial and at the intermediate level was irrelevant to the quality of adjudication at the highest court of appeal.

5.3 Weaker Information Structures

Our model has shown the power of litigant selection in minimizing errors in adjudication. An appellate process may exploit private information available to litigants but not yet uncovered by courts to induce only losing litigants in wrongly decided cases to appeal. We have of course studied only a very special information technology.

We might extend our model in two directions. First, we might examine information structures in which a signal is only partially, rather than fully, informative. Here we

conjecture that as long as the signals available to higher courts are sufficiently informative our results will continue to hold.

Second, in our model unrevealed information need not be common knowledge among the litigants. It may be known only to one party. Our model requires only that the information be potentially verifiable. In some, perhaps many, instances, however, one might expect that no party has all the information relevant to the appropriate determination of a dispute. Consider, for example, accidents governed by a rule of negligence with contributory negligence. In these cases, the injurer may have private information concerning the reasonableness of her own care decisions while the victim may have private information concerning the reasonableness of his care decisions. A trial might reveal this information to the court (and hence to both parties) or to one or to both litigants.

Our model might, when slightly extended, shed some light on situations of two-sided, asymmetric information. To begin, we need to complicate the type space and hence the signaling space. As in the model outlined above, the defendant is either liable l , or not liable nl . Let plaintiff be either responsible r or not responsible nr . Trial now yields three signals: a public signal β with probability π^P , a private signal ζ^P with probability θ^P to plaintiff concerning defendant's type, and a private signal ζ^D with probability θ^D to defendant concerning plaintiff's type. Notice that the public signal is now more complex: it is an ordered pair (β^P, β^D) and may take the four values $(0, 0)$, $(\beta^P, 0)$, $(0, \beta^D)$ or (β^P, β^D) . Thus the signal β may be completely uninformative, completely informative or partially informative.

This structure has several implications. To guide our intuitions, we rely on the full-default equilibrium. If the signal is partially informative or fully informative, then the model developed in this paper applies. The fully informative case is obvious; the trial judge knows the correct resolution of the case and it should decide according. When the public signal at trial is partially informative, the trial judge ought to rule against the party whose type has not been revealed. The burden of appeal now lies on the litigant who is perfectly informed.⁶ Then, by the logic of Propositions 1 and 3, a sufficiently accurate final court will insure perfect sorting and an errorless court system. This result suggests that improving the quality of the trial process to increase the probability that the type of at least one litigant is revealed may be highly desirable.

When the public signal at trial is completely uninformative, the analysis is more complex and speculative. Consider a two-tiered hierarchy. Suppose that the public signal at the appellate level is sufficiently informative; *i.e.*, $\pi^2 > (d - c)/d$. Then it

⁶ A full analysis would consider the structure of the substantive legal rule before formulating the appropriate rule of decision. Suppose that the substantive rule has a structure parallel to the structure of a rule of negligence with contributory negligence. Under this rule, defendant is responsible if and only if $(\beta^D = l$ and $\beta^P = nr)$. Then if the trial court receives an informative signal about defendant, it should rule against plaintiff as only a plaintiff who is not responsible for her injury will appeal. Conversely, if the trial court receives an informative signal about plaintiff, it should hold defendant liable as only a non-responsible defendant will appeal.

seems probable that the results from the model developed here can be extended to this situation. Now, however, the reason for the trial court, when it receives a completely uninformative signal, ruling uniformly against defendant may no longer apply. Suppose that $\theta^P = \theta^D$. It might minimize both error and costs of appeal if the trial court rules according to its priors; *i.e.*, it rules against defendant if and only if $p_0 > 1/2$. On the other hand, for θ^P sufficiently close to 0 and θ^D sufficiently close to 1, it seems probable that the trial court should follow the practice of ruling against defendant when it has received a completely uninformative signal. When the likelihood of an informative signal is roughly the same for each party, however, it is less clear what the appropriate rule of decision for the trial court is. A definitive answer requires solving this more complex model.

Mathematical Appendix

This appendix proves the three propositions stated in the text.

A.1 Proof of Proposition 1

PROPOSITION 1 *In a two-tier hierarchy, if $\pi^2 \geq 1 - c/d$ then the following is a perfect Bayesian equilibrium: Judge i at tier 1 adopts the strategy*

$$\rho_i^1(x^1, p_0) = \begin{cases} 1 & \text{if } \mu_i^1 \neq 0, \\ 0 & \text{if } \mu_i^1 = 0. \end{cases}$$

A losing defendant j at tier 1 adopts the strategy

$$\sigma_j^1(v^1, x^1, \beta) = \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{if } v^1 = \beta. \end{cases}$$

An informed losing plaintiff j at tier 1 adopts the strategy

$$\sigma_j^1(v^1, x^1, \beta) = \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{if } v^1 = \beta. \end{cases}$$

An uninformed losing plaintiff j at tier 1 adopts the strategy

$$\sigma_j^1(v^1, x^1, \beta) = \kappa \text{ for any } \kappa \text{ in } (0, 1),$$

and an appellate judge i at tier 2 adopts the strategy

$$\rho_i^2(s_j^1, x^2, x^1, p_0) = \begin{cases} 1 & \text{if } \mu_i^2(s_j^2, x^2, x^1, p_0) \geq 1/2, \\ 0 & \text{otherwise,} \end{cases}$$

and $\mu_i^2(s_j^2, x^2, x^1, p_0)$ is determined by Bayes' rule whenever possible. If a public signal ever reveals β , the appellate judge believes the informative public signal regardless of an appeal.

PROOF We proceed to show, by backwards induction, that each player's strategy is in equilibrium given the strategies of other players.

Appellate judge: There are four possibilities to consider: (1) an incorrectly losing litigant appeals from a judgment based on an uninformative signal at trial but

the appellate judge receives an informative signal; (2) a (correctly or incorrectly) losing defendant appeals from judgment based on an uninformative signal to the trial judge *and* the appellate judge also receives an uninformative signal; (3) an incorrectly losing litigant appeals from a judgment based on an informative signal at trial; and (4) a correctly losing litigant appeals and either the trial judge or the appellate judge receives an informative signal. (Recall that an informative signal to a court reveals defendant's type with complete accuracy and becomes common knowledge to the judiciary.)

In case (1), the informative public signal on appeal fixes the appellate judge's beliefs at 0 or 1; obviously the appellate judge minimizes error by holding defendant liable if $\beta = l$ and by ruling against plaintiff if $\beta = nl$. In case (2), the defendant's strategy and Bayes' rule fix the appellate judge's beliefs at 0. Given these beliefs, the judgment again follows immediately. (Note that, given the strategy of the trial judge, there will be no losing plaintiffs when the trial judge receives an uninformative signal.) Case (3) is an out-of-equilibrium event so Bayes' rule has no bite. But the beliefs indicated in the proposition fix the appellant judge's beliefs according to the informative public signal, and again the indicated judgment follows. Now consider case (4), which occurs only off the equilibrium path, as the trial judgment is improperly appealed. Again, Bayes' rule has no bite, but the specified beliefs require the appellate judge to believe the informative signal. The appellate judge thus upholds the judgment of the trial court.

Informed losing litigant: There are two cases. (1) The trial court received an informative signal and (2) the trial court received an uninformative signal.

(1) Suppose no informative signal at trial ($x^1 = 0$). We consider the optimal responses of an incorrectly and correctly losing litigant in turn. (A) An incorrectly losing litigant will definitely appeal, since doing so will result in either (i) an informative public signal on appeal ($x^2 = \beta$) leading to reversal, or (ii) a believed signal of innocence in the absence of a hard signal ($x^2 = 0$), from Bayes' rule, again leading to reversal. (B) Given $x^1 = 0$, a correctly losing litigant will not appeal if the expected value from appeal is less than the sure value from not appealing. As the trial judge, in the absence of an informative signal, rules against defendant, we need only calculate the condition that insures that a correctly losing defendant will not appeal: $(1 - \pi^2)0 + \pi^2(-d) - c \leq -d \Rightarrow \pi^2 \geq 1 - c/d$. This is the condition indicated in the proposition.

(2) Suppose an informative signal at trial ($x^1 = \beta$). Again we consider the optimal responses of a correctly losing and incorrectly losing litigant in turn. (A) A correctly losing litigant will not appeal, given the specified off-the-equilibrium path beliefs (the appellate judge believes the informative public signal and thus will rule the same way as the trial judge, gaining the correctly losing litigant nothing but costing him an additional c). (B) An incorrectly losing litigant will definitely appeal, as the appellate judge's (off-the-equilibrium path) belief is that the informative public signal was correct, and so he reverses.

Now consider an uninformed losing litigant, which given the strategy of a the trial court and the information structure is an off-the-equilibrium path event.

Trial judge: Given separation by the informed litigants and the appellate judge's strategy, the trial judge knows that a correct outcome will occur as long as the informed litigant – here the defendant – is liable when the trial judge herself is uninformed. The off-the-equilibrium path behavior of uninformed plaintiffs implies that a trial ruling for plaintiff implies a positive number of expected errors. Consequently, the trial judge has an incentive to adhere to its strategy. *Q.E.D.*

A.2 Proof of Proposition 2

The proof involves 5 lemmata and a corollary. Lemma 1 establishes sequentially rational play, if the trial judge has held the defendant liable. Lemmata 2 and 3 establish sequentially rational play, if the trial judge has held the defendant not liable (there are two such lemmata, corresponding to values of θ above or below a critical value). Lemma 4 compares expected error rates in the three scenarios corresponding to Lemmata 1–3. The corollary to Lemma 4 indicates the optional decision rule for the trial judge, in light of Lemma 4. Lemma 5 addresses pooling equilibria. Proposition 2 ties all these results together. We assume throughout that the condition $\pi_i^2 < 1 - d/c$ that defines Proposition 2 holds.

LEMMA 1 (DEFENDANT HELD LIABLE) *In this case, the following constitute sequentially rational play thereafter. An incorrectly losing defendant plays the strategy*

$$\begin{aligned} \sigma_{D=\bar{l}}^1(v^1 = l, x^1, \rho_i^1(\cdot)) \\ = \begin{cases} 1 \text{ if } x^1 = \bar{l}, \text{ or if } x^1 = 0 \text{ and } \rho_i^2(v^1 = l, x^1 = x^2 = 0) \leq \frac{d-c}{d(1-\pi^2)}, \\ 0 \text{ if } x^1 = 0 \text{ and } \rho_i^2(v^1 = l, x^1 = x^2 = 0) > \frac{d-c}{d(1-\pi^2)}. \end{cases} \end{aligned}$$

A correctly losing defendant plays the strategy

$$\begin{aligned} \sigma_{D=l}^1(v^1 = l, x^1, \rho_i^1(\cdot)) \\ = \begin{cases} 1 \text{ if } x^1 = 0 \text{ and } \rho_i^2(v^1 = l, x^1 = x^2 = 0) < 1 - \frac{c}{d(1-\pi^2)}, \\ \frac{1-p_0}{p_0} \text{ if } x^1 = 0 \text{ and } \rho_i^2(v^1 = l, x^1 = x^2 = 0) = 1 - \frac{c}{d(1-\pi^2)}, \\ 0 \text{ if } x^1 = l \text{ or if } x^1 = 0 \text{ and } \rho_i^2(v^1 = l, x^1 = x^2 = 0) > 1 - \frac{c}{d(1-\pi^2)}. \end{cases} \end{aligned}$$

Finally, the appellate judge plays the strategy

$$\rho_i^2(v^1 = l) = \begin{cases} 1 \text{ if } \mu_i^2 > 1/2, \\ 1 - \frac{c}{d(1-\pi^2)} \text{ if } \mu_i^2 = 1/2, \\ 0 \text{ if } \mu_i^2 < 1/2. \end{cases}$$

Beliefs are determined by Bayes' rule whenever possible. If a public signal ever reveals β , the appellate judge believes the informative public signal regardless of an appeal.

PROOF The strategies follow straightforwardly from examination of incentive compatibility constraints. The analysis is virtually identical to that given in CAMERON AND KORNHAUSER [2005, Proposition 2b] and is omitted for brevity. *Q.E.D.*

LEMMA 2 (DEFENDANT HELD NOT LIABLE (1)) *If $\theta \leq [1 - 2p_0]/[1 - p_0]$ and the defendant is held not liable at trial, the following constitutes sequentially rational play thereafter. An incorrectly losing plaintiff plays the strategy*

$$\sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = l, \rho_i^1(\cdot)) = \begin{cases} 1 & \text{if } x^1 = \beta = l, \\ & \text{or if } y = \beta = l, x^1 = 0 \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) \geq \frac{c - d\pi^2}{d(1 - \pi^2)}, \\ 0 & \text{if } x^1 = 0, y = \beta = l \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c - d\pi^2}{d(1 - \pi^2)}. \end{cases}$$

A correctly losing plaintiff plays the strategy

$$\sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = \bar{l}, \rho_i^1(\cdot)) = \begin{cases} 1 & \text{if } x^1 = 0, \beta = \bar{l} \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) \geq \frac{c}{d(1 - \pi^2)}, \\ 0 & \text{if } x^1 = \beta = \bar{l}, \text{ or if } x^1 = 0, \beta = \bar{l} \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c}{d(1 - \pi^2)}. \end{cases}$$

An uninformed plaintiff plays the strategy:

$$\sigma_p^1(v^1 = \bar{l}, x^1 = 0, y = 0, \rho_i^1(\cdot)) = \begin{cases} 1 & \text{if } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) > \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}, \\ \frac{p_0 \theta}{(1 - 2p_0)(1 - \theta)} & \text{if } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) = \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}, \\ 0 & \text{if } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}. \end{cases}$$

Finally, the appellate judge plays the strategy:

$$\rho_i^2(v^1 = \bar{l}) = \begin{cases} 1 & \text{if } \mu_i^2 > 1/2, \\ \frac{c - \pi^2 p_0 d}{d(1 - \pi^2)} & \text{if } \mu_i^2 = 1/2, \\ 0 & \text{if } \mu_i^2 < 1/2. \end{cases}$$

Beliefs are determined by Bayes' rule whenever possible. If a hard signal ever reveals β , the appellate judge believes the hard signal regardless of an appeal.

PROOF The strategies follow straightforwardly from examination of incentive compatibility constraints. In all cases, if there has been an informative public signal, an appeal by plaintiff is not profitable as the appellate judge will believe the signal and sustain the trial judge's judgment. So consider the cases without an informative public signal.

(1) Suppose there has been an informative private signal at trial, and the plaintiff knows she has lost incorrectly. If plaintiff is to appeal it must be the case that $\pi_i^2 d + (1 - \pi_i^2) \rho_i^2 d - c \geq 0$, which will hold if and only if

$$\rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) \geq \frac{c - d\pi^2}{d(1 - \pi^2)}.$$

(2) Suppose there has been an informative private signal at trial, and the plaintiff knows she has lost correctly. If the plaintiff is not to appeal, it must be the case that

$\pi_i^2 0 + (1 - \pi_i^2)\rho_i^2 d - c < 0$, which will hold if and only if

$$\rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c}{d(1 - \pi^2)}.$$

(3) Suppose there has not been an informative private signal at trial, so the plaintiff remains unsure about defendant's liability. If the plaintiff is to appeal probabilistically, it must be case that $\pi_i^2(p_0 d + (1 - p_0)0) + (1 - \pi_i^2)\rho_i^2 d - c = 0$, which holds if and only if

$$\rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) = \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}.$$

(4) If the appellate judge is to reverse probabilistically (absent an informative public signal at trial or appeal), it must be the case that (using Bayes' rule)

$$\frac{p_0 (\theta \sigma_p^1(y = \beta = l) + (1 - \theta)\sigma_p^1(y = 0))}{p_0(\theta \sigma_p^1(y = \beta = l) + (1 - \theta)\sigma_p^1(y = 0)) + \sigma_p^1(y = 0)(1 - \theta)(1 - p_0) + \sigma_p^1(y = \beta = \bar{l})\theta(1 - p_0)} = \frac{1}{2},$$

where

$$\sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = \bar{l}, \rho_i^1(\cdot)) = 0 \text{ and } \sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = l, \rho_i^1(\cdot)) = 1.$$

Some algebra shows that this condition holds if and only if

$$\sigma_p^1(v^1 = \bar{l}, x^1 = 0, y = 0, \rho_i^1(\cdot)) = \frac{p_0 \theta}{(1 - 2p_0)(1 - \theta)}.$$

Q.E.D.

LEMMA 3 (DEFENDANT HELD NOT LIABLE (2)) *If $\theta > [1 - 2p_0]/[1 - p_0]$ and the defendant is held not liable at trial, the following constitutes sequentially rational play thereafter.*

An incorrectly losing plaintiff plays the strategy

$$\sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = l, \rho_i^1(\cdot)) = \begin{cases} 1 \text{ if } x^1 = \beta = l, \text{ or if } y = \beta = l, x^1 = 0 \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) \geq \frac{c - d\pi^2}{d(1 - \pi^2)}, \\ 0 \text{ if } x^1 = 0, y = \beta = l \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c - d\pi^2}{d(1 - \pi^2)}. \end{cases}$$

A correctly losing plaintiff plays the strategy

$$\sigma_p^1(v^1 = \bar{l}, x^1, y = \beta = \bar{l}, \rho_i^1(\cdot)) = \begin{cases} 1 \text{ if } x^1 = 0, \beta = \bar{l} \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) > \frac{c}{d(1 - \pi^2)}, \\ 1 - \frac{1 - 2p_0}{\theta(1 - p_0)} \text{ if } x^1 = 0, \beta = \bar{l} \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) = \frac{c}{d(1 - \pi^2)}, \\ 0 \text{ if } x^1 = \beta = \bar{l}, \text{ or if } x^1 = 0, \beta = \bar{l} \text{ and } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c}{d(1 - \pi^2)}. \end{cases}$$

An uninformed plaintiff plays the strategy

$$\sigma_p^1(v^1 = \bar{l}, x^1 = 0, y = 0, \rho_i^1(\cdot)) = \begin{cases} 1 \text{ if } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) \geq \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}, \\ 0 \text{ if } \rho_i^2(v^1 = \bar{l}, x^1 = x^2 = 0) < \frac{c - \pi_i^2 p_0 d}{d(1 - \pi^2)}. \end{cases}$$

Finally, the appellate judge plays the strategy

$$\rho_i^2(v^1 = \bar{i}) = \begin{cases} 1 & \text{if } \mu_i^2 > 1/2, \\ \frac{c - \pi^2 p_0 d}{d(1 - \pi^2)} & \text{if } \mu_i^2 = 1/2, \\ 0 & \text{if } \mu_i^2 < 1/2. \end{cases}$$

Beliefs are determined by Bayes' rule whenever possible. If a public signal ever reveals β , the appellate judge believes the informative public signal regardless of an appeal.

PROOF The strategies follow straightforwardly from examination of incentive compatibility constraints. Q.E.D.

LEMMA 4 (EX ANTE ERROR RATES) (1) If the trial judge commits to a decision rule that holds defendant liable absent an informative public signal, the ex ante error rate is $(1 - \pi_1)(1 - \pi_2)p_0$.

(2) If $\theta \leq [1 - 2p_0]/[1 - p_0]$ and the trial judge commits to a decision rule that holds defendant not liable absent an informative public signal, the ex ante error rate is $[p_0/1 - 2p_0](1 - \pi_1)(1 - 2p_0 - (1 - p_0)\theta\pi_2)$.

(3) If $\theta > [1 - 2p_0]/[1 - p_0]$ and the trial judge commits to a decision rule that holds defendant not liable absent an informative public signal, the ex ante error rate is $p_0(1 - \pi_1)(1 - \pi_2)$.

PROOF (1) Follows from Proposition 2d in CAMERON AND KORNHAUSER [2005], and from Lemma 1.

(2) Using the strategies in Lemma 2, the expected percentage of correctly resolved cases is

$$\pi^1 + (1 - \pi^1)\{\theta[p_0(1)(\pi^2 + (1 - \pi^2)\rho) + (1 - p_0)] + (1 - \theta)[\sigma(\pi^2 + (1 - \pi^2)(p_0\rho + (1 - p_0)(1 - \rho))) + (1 - \sigma)(1 - p_0)]\},$$

where

$$\rho = \frac{c - dp_0\pi_2}{d(1 - \pi^2)}$$

(the appeal's judge's probability of holding defendant liable absent a hard signal) and

$$\sigma = \frac{p_0\theta}{(1 - 2p_0)(1 - \theta)}$$

(the plaintiff's probability of appeal absent a hard or soft signal at trial). The error percentage is 1 less this quantity, which, after some algebra, is

$$[p_0/1 - 2p_0](1 - \pi_1)(1 - 2p_0 - (1 - p_0)\theta\pi_2).$$

(3) Using the strategies in Lemma 3, the ex ante probability of a correct outcome is

$$\pi_1 + (1 - \pi_1)\{\theta[p_0(1)(\pi_2 + (1 - \pi_2)\rho) + (1 - p_0)[\sigma(\pi_2 + (1 - \pi_2)(1 - \rho)) + (1 - \sigma)]] + (1 - \theta)(1)[\pi_2 + (1 - \pi_2)(p_0\rho + (1 - p_0)(1 - \rho))]\},$$

where

$$\rho = \frac{c}{d(1 + \pi_2)} \text{ and } \sigma = 1 - \frac{1 - 2p_0}{(1 - p_0)\theta}.$$

Again, the error percentage is 1 less this quantity, which after some algebra is $p_0(1 - \pi_1)(1 - \pi_2)$. Q.E.D.

COROLLARY *In the absence of an informative public signal at trial, the optimal decision rule for the trial judge is to hold the defendant liable.*

PROOF Using Lemma 4, the *ex ante* error rate from holding the defendant liable absent an informative public signal at trial is $(1 - \pi_1)(1 - \pi_2)p_0$. This is identical to the *ex ante* error rate from holding the defendant not liable, absent an informative public signal at trial, when $\theta > [(1 - 2p_0)/(1 - p_0)]$. The *ex ante* error rate from holding the defendant not liable, absent an informative public signal at trial, when $\theta \leq [(1 - 2p_0)/(1 - p_0)]$ is $[p_0/(1 - 2p_0)](1 - \pi_1)(1 - 2p_0 - (1 - p_0)\theta\pi_2)$. But this is always greater than $(1 - \pi_1)(1 - \pi_2)p_0$, when $\theta \leq [(1 - 2p_0)/(1 - p_0)]$. Because the objective of the trial judge is to minimize errors, he must (weakly) prefer the decision rule: hold the defendant liable, absent an informative public signal at trial. Q.E.D.

LEMMA 5 *No universally divine pooling equilibrium exists in the two-tier game.*

PROOF The proof is identical to that of Proposition 2c in CAMERON AND KORNHAUSER [2005] and is omitted for brevity.

PROPOSITION 2 *The following constitutes a perfect Bayesian equilibrium in the two-tier game, when $\pi_i^2 < 1 - d/c$. Trial judge i at tier 1 plays the strategy*

$$\rho_i^1(x^1, p_0) = \begin{cases} 1 & \text{if } \mu_i^1 \neq 0, \\ 0 & \text{if } \mu_i^1 = 0. \end{cases}$$

Strategies for correctly and incorrectly losing defendants are indicated in Lemma 1. Strategies for correctly losing, incorrectly losing, and uncertain plaintiffs are indicated in Lemmata 2 and 3, in the event the trial judge holds the defendant not liable.⁷ Finally, the appellate judge plays the strategy

$$\rho_i^2(v^1 = l) = \begin{cases} 1 & \text{if } \mu_i^2 > 1/2, \\ 1 - \frac{c}{d(1 - \pi_i^2)} & \text{if } \mu_i^2 = 1/2, \\ 0 & \text{if } \mu_i^2 < 1/2, \end{cases}$$

$$\rho_i^2(v^1 = \bar{l}) = \begin{cases} 1 & \text{if } \mu_i^2 > 1/2, \\ \frac{c - \pi_i^2 p_0 d}{d(1 - \pi_i^2)} & \text{if } \mu_i^2 = 1/2, \\ 0 & \text{if } \mu_i^2 < 1/2. \end{cases}$$

⁷ Note that these strategies are off the equilibrium path of play, unless there is an informative public signal at trial. If the trial judge holds the defendant liable, the plaintiff has no move.

Beliefs are determined by Bayes' rule whenever possible. If a hard signal ever reveals β , the appellate judge believes the hard signal regardless of an appeal.

PROOF Follows immediately from Lemmata 1–4 and Corollary.

Q.E.D.

A.3 Proof of Proposition 3

PROPOSITION 3 *If $\pi^3 \geq 1 - c/d$ and $\theta \geq 1 - c/[d(1 - \pi^2)]$, the following is an equilibrium with zero errors. Beliefs are determined by Bayes' rule where ever possible; hard and soft signals are always believed; and other beliefs off the equilibrium path are detailed below.*

(1) *The highest court employs the strategy*

$$\rho_i^3(p_0, x^1, v^1, s^1, x^2, v^2, x^3) = \begin{cases} 1 & \text{if } \mu_i^3(\cdot) \geq 1/2, \\ 0 & \text{otherwise.} \end{cases}$$

(2) *Following adverse judgment by the intermediate inferior court, defendant employs the strategy*

$$\sigma_D^2(p_0, x^1, y, v^1, s^1, x^2, v^2) = \begin{cases} 1 & \text{if } v^2 \neq \beta, \\ 0 & \text{otherwise.} \end{cases}$$

(3) *Following adverse judgment by the intermediate court, plaintiff employs the strategy*

$$\sigma_P^2(p_0, x^1, y, v^1 = l, s^1, x^2, v^2) = \begin{cases} 1 & \text{if } \mu_P^2 = 1 \text{ and } v^2 \neq l, \\ 0 & \text{otherwise.} \end{cases}$$

(4) *The intermediate inferior court employs the strategy*

$$\rho_i^2(p_0, x^1, v^1, s^1, x^2) = \begin{cases} 1 & \text{if } \mu_i^2(\cdot) > 1/2, \\ 0 & \text{otherwise.} \end{cases}$$

(5) *Following an adverse judgment by the trial court, defendant employs the strategy*

$$\sigma_D^1(p_0, x^1, y, v^1 = l) = \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{otherwise.} \end{cases}$$

(6) *Following an adverse judgment by the trial court, an informed plaintiff employs the strategy*

$$\sigma_P^2(p_0, x^1, y, v^1 = l) = \begin{cases} 1 & \text{if } \mu_P^1 = 1, \\ 0 & \text{otherwise.} \end{cases}$$

(7) *Following an adverse judgment by the trial court, a plaintiff who has NOT received an informative public or private signal employs the strategy*

$$\sigma_P^2(p_0, x^1, y, v^1 = l) = \begin{cases} 1 & \text{if } \mu_P^1 = 1, \\ 0 & \text{otherwise.} \end{cases}$$

(8) *The trial court employs the strategy*

$$\rho_i^1(p_0, x^1) = \begin{cases} 1 & \text{if } \mu_i^1(\cdot) > 0, \\ 0 & \text{otherwise.} \end{cases}$$

PROOF As before we proceed by backwards induction.

The supreme court: The high court should never hear cases, since defendants separate after trial and the intermediate court reverses. However, suppose the high court, absent an informative public signal, sees an appeal by a plaintiff. The court must believe that the plaintiff is an informed, incorrect loser (since we specify that uninformed plaintiffs believe defendant is not liable and thus do not appeal).

Defendant on appeal from an adverse judgment: Given the accuracy of the high court only incorrectly losing defendants appeal. Note that an appeal by defendant is off the equilibrium path, because defendant types separate below, and all mistakes are fixed by the intermediate court.

Plaintiff on appeal from an adverse judgment: Note that all plaintiffs are informed, either by an informative public or private signal or by observing (separating) defendant appeal. On the equilibrium path, the plaintiff will not appeal an adverse judgment by the intermediate court, as it believes the court's judgment is correct (and high court accuracy assures plaintiff separation). But critically, if a plaintiff who saw an informative private signal sees a bogus appeal and an erroneous reversal, plaintiff appeals to the supreme court.

Now consider some deviations. (1) Suppose absent an informative signal, appellate court sustains a trial court who ruled against the defendant (rather than reverse the trial court). Plaintiff has no move so this deviation is immaterial here. (2) Suppose a double deviation: the trial court deviated and ruled against plaintiff and there was an uninformative private signal. If the intermediate court also rules against plaintiff (absent an informative public signal), plaintiff's beliefs presumably are its priors, and it will appeal if p_0 is high enough (see module at end of paper). To solve this problem, we can specify that if the double deviation occurred, plaintiff believes defendant is not liable and therefore does not appeal (given high court accuracy). This assures some errors off the equilibrium path and will prevent the appellate court from deviating following a trial court deviation.

Intermediate appellate court: The intermediate appellate court acts according to its beliefs. If, however, the court sees an appeal by a defendant, it must believe the appeal comes from an incorrect loser. So it reverses. An appeal by plaintiff is off the equilibrium path; but if θ is high enough, the court will reverse, putting the onus on defendant (who should separate). So let us specify that, if the trial court deviates and rules against plaintiff absent an informative public signal, and plaintiff appeals, the intermediate court believes defendant is liable and reverses.

Defendant after an adverse trial judgment: If defendant is not liable, then he should appeal as intermediate court will reverse and plaintiff will not appeal. But suppose defendant is actually liable. If he appeals, the intermediate court will reverse. Plaintiff will appeal to supreme court only if there has been an informative public or private signal indicating liability. So a liable defendant will not falsely appeal if $\pi^2(-d) + (1 - \pi^2)(\theta(-d) + (1 - \theta)0) - c < -d$, which will be true iff $\theta \geq 1 - c/[d(1 - \pi^2)]$. In other words, the possibility of facing an informed plaintiff (who will appeal to the supreme court) keeps a correctly losing defendant from making a bogus appeal.

An Informed plaintiff after an adverse trial judgment: This is off the equilibrium path, but it sequentially rational.

An uninformed plaintiff after an adverse judgment: This is off the equilibrium path, so we can specify plaintiff’s beliefs any way we wish. We assume plaintiff believes the trial court was right; hence, he does not appeal (as the appellate court will sustain, or if not the defendant will appeal and prevail). This creates a positive incentive for the trial court not to deviate from its strategy, as errors will occur. Note that if an uninformed plaintiff appeals and appeals court reverses, there will be no errors (since defendants separate after an adverse appellate decision); so in this case, trial court is indifferent between adhering to its strategy and deviating.

Trial court: If the trial judge receives an informative public signal, he follows it. If the trial judge receives an uninformative public signal, he holds the “defendant liable” and exploits the information available to defendant. Q.E.D.

A.4 Proof of Proposition 4

PROPOSITION 4 *If $\pi^3 \geq 1 - c/d$, $\pi^2 \geq 2 - d/c$, and $p_0 > c/d$ the following is an equilibrium with zero errors. Beliefs are determined by Bayes’ rule where ever possible; hard and soft signals are always believed; and other beliefs off the equilibrium path are detailed below.*

(1) *The highest court employs the strategy*

$$\rho_i^3(p_0, x^1, v^1, s^1, x^2, v^2, x^3) = \begin{cases} 1 & \text{if } \mu_i^3(\cdot) \geq 1/2, \\ 0 & \text{otherwise.} \end{cases}$$

(2) *Following adverse judgment by the intermediate court, defendant employs the (separating) strategy*

$$\sigma_D^2(p_0, x^1, y, v^1, s^1, x^2, v^2) = \begin{cases} 1 & \text{if } v^2 \neq \beta, \\ 0 & \text{otherwise.} \end{cases}$$

(3) *Following adverse judgment by intermediate court, informed plaintiffs will separate:*

$$\sigma_P^2(p_0, x^1, y, v^1 = l, s^1, x^2, v^2) = \begin{cases} 1 & \text{if } \mu_P^2 = 1 \text{ and } v^2 \neq l, \\ 0 & \text{otherwise.} \end{cases}$$

(4) *Following an adverse judgment by intermediate court, an uninformed plaintiff plays the strategy*

$$\sigma_P^2(p_0, x^1, y, v^1 = l, s^1, x^2, v^2) = \begin{cases} 1 & \text{if } \mu_P^2 = 1 \text{ and } v^2 \neq l, \\ 0 & \text{otherwise.} \end{cases}$$

(5) *The intermediate inferior court employs the strategy*

$$\rho_i^2(p_0, x^1, v^1, s^1, x^2) = \begin{cases} 1 & \text{if } \mu_i^2(\cdot) > 0, \\ 0 & \text{otherwise.} \end{cases}$$

(6) *Following an adverse judgment by the trial court, defendant employs the strategy*

$$\sigma_D^1(p_0, x^1, y, v^1 = l) = \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{otherwise.} \end{cases}$$

(7) *Following an adverse judgment by the trial court, an informed plaintiff employs the strategy*

$$\sigma_p^1(p_0, x^1, y, v^1 = nl) = \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{otherwise.} \end{cases}$$

(8) *Following an adverse judgment by the trial court, an uncertain plaintiff employs the strategy*

$$\sigma_p^1(p_0, x^1, y, v^1 = nl) = \begin{cases} 1 & \text{if } p_0 \geq c/d, \\ 0 & \text{otherwise.} \end{cases}$$

(9) *The trial court employs the strategy*

$$\rho_i^1(p_0, x^1) = \begin{cases} 1 & \text{if } \mu_i^1(\cdot) \geq 1/2, \\ 0 & \text{otherwise.} \end{cases}$$

PROOF As usual we proceed by backwards induction.

The highest court judge: Following an appeal by a defendant, the supreme court will believe that the defendant was incorrectly held liable, and will reverse (this will happen in equilibrium). An appeal by plaintiff is off the equilibrium path. Assume that the supreme court believes such an appeal indicates defendant is liable (absent a contrary hard signal), and holds for plaintiff.

Defendant after an adverse appellate judgment: The first condition in the proposition assures separation between defendant types: only incorrectly losing defendants have an incentive to appeal.

Informed plaintiffs after an adverse appellate judgment: This event is off the equilibrium path, but is sequentially rational and introduces no errors. Note that if defendant was held liable at trial and separates, plaintiff's beliefs are tied down.

Uninformed plaintiff after an adverse appellate judgment: This case arises if the trial court held against plaintiff, and appellate court sustained. This event is off the equilibrium path, as the appellate court is supposed to rule against defendant. We can accordingly have any beliefs for plaintiff, and we impose "pessimistic" ones: plaintiff believes defendant is not liable. Given the accuracy of the supreme court she does not appeal; and this creates errors; so the appellate court has an incentive not to deviate. Note that if an uninformed plaintiff had "optimistic" beliefs and appealed, the supreme court will reverse; and this creates some errors, too. So in either case, intermediate court has no incentive to deviate.

Intermediate appellate court: If the court has received an informative public signal indicating that defendant is not liable, it holds defendant not liable; otherwise it holds him liable.

Defendant after an adverse trial judgment: Defendant types separate so that only incorrectly losing defendants will appeal. Given the strategy of the intermediate appellate court, a defendant will be held liable by the appellate court under the default rule if that court receives an uninformative public signal. But if this is incorrect, the defendant will appeal (as the supreme court will reverse). So, for defendant to appeal after an incorrect adverse trial judgment, it must be the case that

$\pi^2 0 - c + (1 - \pi^2)(0 - c) > -d$, that is, $\pi^2 \geq 2 - d/c$. This is the second condition in the proposition.

Informed plaintiff after an adverse trial judgment: Informed plaintiffs separate. If plaintiff has lost correctly, he has no incentive to appeal even though the intermediate court will reverse the trial court, because the defendant will surely appeal and the supreme court will reverse the intermediate court. If plaintiff has lost incorrectly, he will definitely appeal because the intermediate court will reverse and defendant will not appeal.

Uninformed plaintiff after an adverse trial judgment: The plaintiff knows that if she appeals, the case will ultimately be adjudicated correctly. So she should appeal only if she is reasonably sure defendant is liable, that is if and only if $p_0 d + (1 - p_0)0 - c > 0$, that is, if and only if $p_0 > c/d$. This condition is the remaining one in the theorem. Otherwise, he will not appeal (and this creates errors).

Trial court: If there is an informative public signal at trial, the court follows it. Otherwise, it rules according to its priors. Q.E.D.

A.5 Proof of Proposition 5

PROPOSITION 5 *If $\pi^3 > 1 - c/d$ and $\pi^2 > 2 - d/c$, the following is an equilibrium in the three-tier hierarchy game:*

$$\begin{aligned} \rho_i^3(p_0, x^1, v^1, s^1, x^2, v^2, s^2, x^3) &= \begin{cases} 1 & \text{if } \mu_i^3(\cdot) \geq 1/2, \\ 0 & \text{otherwise,} \end{cases} \\ \sigma_j^2(p_0, x^1, y, v^1, s^1, x^2, v^2) &= \begin{cases} 1 & \text{if } v^2 \neq \beta, \\ 0 & \text{otherwise,} \end{cases} \\ \rho_i^2(p_0, x^1, y, v^1, s^1, x^2) &= \begin{cases} 1 & \text{if } \mu_i^2(\cdot) \neq 0, \\ 0 & \text{otherwise,} \end{cases} \\ \sigma_j^1(p_0, x^1, y, v^1) &= \begin{cases} 1 & \text{if } v^1 \neq \beta, \\ 0 & \text{otherwise,} \end{cases} \\ \rho_i^1(p_0, x^1) &= \begin{cases} 1 & \text{if } \mu_i^1(\cdot) \neq 0, \\ 0 & \text{otherwise.} \end{cases} \end{aligned}$$

Beliefs are determined wherever possible by Bayes' rule. If a public signal ever reveals defendant's type, the beliefs of subsequently acting judges are fixed accordingly. Following an appeal of the intermediate court's judgment, in the absence of any informative public signals the high court believes an error occurred at the intermediate court.

PROOF The proof proceeds via backward induction.

High court (tier 3) judge: Appeals to the high court are out-of-equilibrium events so Bayes' rule has no bite. However, we require the high court's judge's beliefs to be fixed in the natural way if any $x^t \neq 0$, ($t = 1, 2, 3$). In that case, the indicated judgments follow from the judicial objective of minimizing error. Absent an informative public signal, the most favorable belief to appeals (and difficult for the equilibrium)

is that an appeal of the intermediate court's judgment signals $v^2 \neq \beta$. We assume this belief. But again, given this belief, the indicated judgment follows immediately.

Losing defendant at level 2: If x^1 or $x^2 = \beta$, defendant surely appeals adverse $v^2 = l \neq \beta$ since in this case, following appeal, $\mu_i^3 = 0$ (from the specified out-of-equilibrium beliefs) and defendant prevails. Conversely, if x^1 or $x^2 = \beta$ and $v^2 = l = \beta$, defendant definitely does not appeal, since in this case $\mu_i^3 = 1$ (from the specified out-of-equilibrium beliefs) and defendant loses at additional cost of c . If $x^1 = x^2 = 0$, incorrectly losing defendant surely appeals, as either $x^3 = \beta$ and thus $\mu_i^3 = 0$ and high court reverses, or $x^3 = 0$ and thus $\mu_i^3 = 0$ (from the specified out-of-equilibrium beliefs) and high court again reverses. If $x^1 = x^2 = 0$, correctly losing defendant appeals if and only if the expected value of appealing is greater than or equal to the expected value of not appealing, to wit, $(1 - \pi^3)0 + \pi^3(-d) - c \geq -d \Rightarrow \pi^3 \leq 1 - c/d$. But this contradicts the condition on high court accuracy assumed in the equilibrium.

Losing plaintiff at level 2: Given the strategy of the intermediate appellate court, a plaintiff has only loses if the trial court or the intermediate appellate court has received an informative signal that $\beta = nl$. In these circumstances, the supreme court will uphold the judgment so that plaintiff will not appeal.

Intermediate appellate (tier 2) judge: There are three cases. Case (1): $x^1 = \beta$. An appeal following an informative public signal at trial is an out-of-equilibrium action so Bayes' rule has no bite. We specify that the appellate judge believes the informative public signal (so that $\mu_i^2 = 0$ or 1 , as $x^2 = \bar{l}$ or l , respectively), and the indicated judgments follow immediately from Proposition 1.

Case (2): $x^1 = 0$, $x^2 = \beta$. In this case, $\mu_i^2 = 0$ or 1 , as $x^2 = \bar{l}$ or l , respectively, and the indicated judgment follows from the judicial objective of minimizing errors.

Case (3): $x^1 = 0$, $x^2 = 0$. Given the appellate strategies of the litigants and Bayes' rule, $\mu_i^2 = 0$ if losing defendant appeals. (Given the trial court strategy there are no losing plaintiffs when $x_1 = 0$.)

Litigant losing at trial: There are two cases. Case (1): Incorrectly losing litigant. Given the trial judge's rule of decision, in equilibrium, only defendants may be incorrectly losing litigants. With probability π^2 the intermediate appellate court receives an informative public signal and hence reverses. The losing litigant on appeal (the plaintiff) will not appeal as the informative signal implies that the supreme court will uphold the judgment. With probability $(1 - \pi^2)$ the court receives an uninformative signal and hence upholds the judgment. This judgment will be reversed on appeal to the higher court at an additional cost of c . Thus an incorrectly losing defendant appeals if and only $\pi^2 > 2 - d/c$. Following the reversal, at tier 2 the correctly losing litigant does not appeal so that the correct judgment stands.

Case (2): Correctly losing litigant. If there is a hard signal at trial, an appeal gains nothing and costs c , so is not undertaken. Suppose the public signal at trial is uninformative. If an informative public signal emerges at appeal, the appellant loses again and further appeal is hopeless. If an informative signal does not emerge on appeal at tier 2, the appellant-defendant definitely loses at tier 2. An appeal to the

supreme court will be desirable if and only if (absent a hard signal at trial) if and only if

$$\pi_i^2(-d) + (1 - \pi_i^2)(\pi_i^3(-d) + (1 - \pi_i^3)0) - c \geq -d \Rightarrow \pi_i^3 < 1 - \frac{c}{d(1 - \pi_i^2)}.$$

But this contradicts the condition assumed in the equilibrium (*i.e.*, even if $\pi_i^2 = 0$).

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