

A SIGNALING MODEL OF A LAWYER
WITH PRIVATE INFORMATION ABOUT HER TALENT

by

Jean Xiao

Advisors: Jennifer Reinganum and Andrew Daughety



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UNIVERSITY

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DEPARTMENT OF ECONOMICS
VANDERBILT UNIVERSITY
NASHVILLE, TN 37235

www.vanderbilt.edu/econ

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This analysis employs three versions of a two-type (high or low talent) signaling model of a lawyer with private information about her talent. Each version involves a long-run monetary payoff that is a function of effort, type, and believed type. In particular, I examine the incentives and effort levels of lawyers that reflect their anticipation that those perceived as high-talent lawyers will be able to command higher fees in future contracts they are offered by the observers of their effort levels. For each model version, the full information equilibrium, the conditions under which the full information equilibrium provides a separating equilibrium under asymmetric information, and the effort levels that provide a separating equilibrium under asymmetric information are found.

The purpose of my project is to create a signaling model of a lawyer with private information about her talent.¹ This model will examine the incentives and effort levels of lawyers (with different talent levels) that reflect their anticipation that those perceived as high talent lawyers will be able to command higher fees in future contracts they are offered by the observers of their effort levels. The incentives (monetary or implicit) behind lawyers' decisions are worth examining because these incentives affect the costs of litigation and determine the amount of effort lawyers put into cases. The amount of effort affects the probability of success of a case, thereby affecting the payoffs of the plaintiffs and defendants. It is via these channels that incentives determine the alignment of the interests of the client and lawyer as well as the overall costs of the legal system.

In order to obtain robust results, this paper will introduce three versions of a signaling model of a lawyer who may have high talent or low talent. The payoffs in each version will be a function of effort, type, and believed type. Each function will include the potential reward at trial, a cost function, and the expected future payoff based on the believed type. In the first version, the lawyer's talent affects the probability of winning the trial in the courtroom and does

¹ Note that in this paper the lawyer will always be referred to as female.

not affect the lawyer's cost function. In the second version, talent factors into case preparation by reducing the marginal cost of effort. In the third version, talent gives both a boost to the probability of winning the case (by acting as a multiplier to the merits of the case) and reduces the lawyer's marginal cost of effort. For each version of the two-type model, I will solve for the full information equilibrium, find the conditions under which the full information equilibrium provides a separating equilibrium under asymmetric information, and then find the effort levels that will provide a separating equilibrium under asymmetric information (when effort must be distorted away from the full information levels).

I find that all three versions of the model have the same full-information equilibrium effort levels. Although there are some differences between model versions 2 and 3, the full-information equilibrium provides a separating equilibrium under asymmetric information for the same parameter sets. Moreover, when some distortion of effort is required for separation, model versions 2 and 3 yield the same separating equilibrium effort levels. The set of parameters for which the full-information equilibrium provides a separating equilibrium under asymmetric information is larger for model versions 2 and 3 than for model version 1. In all the versions of the model, when some distortion in effort is needed for separation, the high-talent lawyer distorts her effort upward, but she distorts to a greater extent in model version 1 than in model versions 2 and 3.

I shall first review the relevant literature in Section I so that the contribution of this project will be clear. Following this, the solutions under full and asymmetric information will be presented for all three versions in Section II. In Section III, a comparison of the models will be drawn, followed by the concluding remarks in Section IV. In the Appendix, details of all calculations will be shown.

I. Related Literature

Contract theory is an area of economics that studies how individuals and parties construct contractual agreements. Contract theory involves topics such as agency theory, information economics, and organization theory and includes the construction of models based on the ideas of screening (hidden information) and moral hazard (hidden action). There have been several papers that take this approach in the context of lawyers choosing effort.

A. Hidden Action Principal-Agent Model

Previous work on the topic of the incentive effects of various forms of compensation contracts on lawyer performance include the construction of principal-agent models in which the client serves as the principal and the lawyer as the agent. Many times these contracts are drawn up under conditions wherein effort is not verifiable, leading to principal-agent problems where the interests of the principal and agent are not aligned.

In a hidden action (moral hazard) model of the principal-agent problem, the agent's effort is not contractible. Because the client or a third-party cannot verify the effort, there is the danger of the agent putting in less than the (client's) optimal amount of effort. Contracts constructed with different compensation structures are used to influence the lawyer's choice of effort. If a lawyer is paid an hourly fee that is not tied to the outcome of the case, then the lawyer may spend more hours working than the client would want and may take the case to court even when settlement is the better option. However, if compensated under the conventional contingent fee system, the lawyer may spend too little time working on the case and settle when it is not in the client's best interests. Under this conventional contingent fee arrangement, the lawyer is paid a fraction (25-40%) of the trial award or settlement while bearing the entire cost of litigation (Polinsky and Rubinfeld, 2003, p. 166).

Exploring two basic contingent fee structures, Hay (*JLS*, 1997) examines whether unitary fees (the same percentage regardless of settlement or trial outcome) or bifurcated fees (differing percentages for settlement awards and trial judgments) will maximize the plaintiff's welfare, given the choice between going to trial and settling. Hay's goal is to find the optimal fee under each type of structure while noting that the bifurcated structure is preferred to the unitary structure. He finds that under the optimal bifurcated fee, the trial percentage is usually higher than in a trial-only world, and the settlement percentage is comparatively lower.

In Hay's paper, the plaintiff hires a lawyer under a linear contingent fee. The probability the case settles is denoted p with $p > 0$. The settlement amount, which is conditional on settling, is denoted s , and w equals the expected judgment, conditional on the case going to trial. Hay assumes that the settlement is a multiple of the expected judgment: $s = qw$, with q being an exogenously-specified multiplier (which can be less than one). The expected judgment is a function of the lawyer's effort, denoted x_t ; that is $w = w(x_t)$. Higher effort leads to a higher expected judgment, but there is decreasing marginal productivity of effort; thus, $dw(x_t)/dx_t > 0$ and $d^2w(x_t)/dx_t^2 < 0$. The lawyer's fee percentage if the case settles is denoted r_s with $1 \geq r_s \geq 0$, and r_t denotes the lawyer's fee percentage if the case goes to trial, with $1 \geq r_t \geq 0$. The client's objective is to construct a contract to give to the lawyer that will maximize the client's net expected return from the case. The client thus chooses (r_s, r_t) to maximize his payoff function, which is $(1 - r_s)ps + (1 - r_t)(1 - p)w$.

In a bifurcated fee system, the backward induction method is used to find the subgame perfect equilibrium at each step in order to find the fee schedule (r_s, r_t) that maximizes the client's payoff function. First, the lawyer's problem at trial must be solved. The lawyer chooses x_t to maximize his payoff function: $r_t w(x_t) - x_t$. The optimal investment of effort, x_t^* , is

determined by the first-order condition: $r_t[dw(x_t)/dx_t] = 1$. Because the optimal investment of effort in trial preparation is affected by his fee percentage if the case goes to trial, it can be expressed as a function of r_t ; that is $x_t^* = x_t^*(r_t)$. From this, the case's expected judgment with the optimal investment of effort that maximizes the lawyer's payoff is found and denoted $\tilde{w}(r_t) \equiv w(x_t^*(r_t))$. Now, the first-order condition is differentiated with respect to r_t in order to find out what happens to the optimal investment of effort, $x_t^*(r_t)$, as the lawyer's fee percentage (for trial) changes; this gives us:

$$(1) \quad w'(x_t^*(r_t)) + r_t w''(x_t^*(r_t)) \frac{dx_t^*(r_t)}{dr_t} = 0,$$

which yields

$$(2) \quad \frac{dx_t^*(r_t)}{dr_t} = \frac{-w'(x_t^*(r_t))}{r_t w''(x_t^*(r_t))} > 0.$$

Thus, the lawyer will work harder at trial if the contingent fee is higher.

Next, the client's objective is to maximize her payoff function, which is

$(1 - r_s)ps + (1 - r_t)(1 - p)w$. In the client's problem, $\tilde{w}(r_t) \equiv w(x_t^*(r_t))$ accounts for the lawyer's incentive compatibility constraint. The settlement can now be expressed as $s = q\tilde{w}(r_t)$. The cost of the effort for settlement, which is incurred by the lawyer prior to the settlement negotiation, is exogenously determined and denoted x_s . The lawyer will not take the case unless its expected value is nonnegative; thus, the fee schedule must satisfy the lawyer's participation constraint: $[p(r_s q\tilde{w}(r_t) - x_s)] + [(1 - p)(r_t \tilde{w}(r_t) - x_t^*(r_t))] \geq 0$. Solving the participation constraint (at equality) for r_s yields $r_s(r_t)$; the two contingent fees are related through the binding participation constraint. Using $r_s(r_t)$ and $s = q\tilde{w}(r_t)$, the client's payoff can be simplified to

$(1 - r_s(r_t))pq\tilde{w}(r_t) + (1 - p)(1 - r_t)\tilde{w}(r_t)$. Differentiating with respect to r_t gives us the following first order condition:

$$(3) \quad -r'_s(r_t)pq\tilde{w}(r_t) + (1 - r_s(r_t))pq\tilde{w}'(r_t) + \frac{d(1 - p)(1 - r_t)\tilde{w}(r_t)}{dr_t}.$$

In a trial-only world, the client's payoff, $(1 - r_t)\tilde{w}(r_t)$, is maximized at r^* . Using this information to examine the first-order condition (in which there is a chance of settling or going to trial), it is found that r_t^* must be higher than r^* , and r_s^* must be lower than r^* . Under the optimal bifurcated fees, $r_t^* > r^* > r_s^*$. An increase in r_t increases the settlement, s , as well as the investment of effort, x_t , so optimality implies $r_t^* > r^*$. By contrast, r_s is low here because it does not affect the award at trial at all.

Under the unitary fee structure, $r_s = r_t = r^{**}$. The optimal unitary fee is greater than or equal to the optimal fee in a trial-only world; that is $r^{**} \geq r^*$. Even if settlement is certain, the client will want to give the lawyer at least as high a fee percentage as she would give if trial were unavoidable. If settling is costly, the client will want to give the lawyer strictly more than r^* : "this may be necessary to satisfy the lawyer's participation constraint" (Hay, 1997, p. 264). On an additional note, Hay uses λ as an exogenous parameter that indicates where on the settlement range the parties will settle in a more nuanced model of settlement. This term captures the relative bargaining power of the plaintiff and the defendant. A large λ means that the case is expected to settle at the plaintiff's concession limit, and a small λ means that the case is expected to settle at the defendant's concession limit. The results show that the advantages of bifurcated fees are the greatest when the lawyer controls the settlement decision or when the client controls the decision and λ is small.

In an attempt to resolve the potential conflict of interest between lawyers and clients under contingent fees, Polinsky and Rubinfeld (*ALER*, 2003) introduce a third party. This paper proposes a variation of the traditional contingent fee arrangement wherein a third party would compensate the lawyer for a certain fraction of the costs (the complement of the contingent fee percentage). In return, the lawyer pays the third party an up-front fee, and the client does not bear any costs, even if the case is lost. Under this altered system, the lawyer owns his portion of the case, and the lawyer's incentives are identical to those of a knowledgeable client under a flat, hourly compensation scheme. Under this "no-conflict" system, the lawyer will spend the optimal amount of time working on the case and will only settle if the case would not be better off going to trial.

Polinsky and Rubinfeld first set up a benchmark where the filing of a case and lawyer-effort decisions are made with a plaintiff who is knowledgeable about the costs and benefits of litigation and hires a lawyer on an hourly basis to pursue a claim against the defendant. In this model, the fixed costs incurred by the plaintiff's lawyer in bringing a case are denoted k . The number of hours worked by the plaintiff's lawyer is denoted h . The probability that the plaintiff will prevail at trial given h is denoted $p(h)$ with $p'(\cdot) > 0$ and $p''(\cdot) < 0$. The hourly wage of the plaintiff's lawyer is denoted w , and a equals the award at trial if the plaintiff prevails. Here, the plaintiff will choose h to maximize her expected payoff function: $p(h)a - wh$. The optimal value of h is denoted h^* and is determined by the first-order conditions: $p'(h)a = w$. A case will be filed if and only if $p(h^*)a - wh^* - k \geq 0$.

Next, a model is constructed where a lawyer's effort decisions are made when a plaintiff is uninformed about the costs and benefits of litigation, and he hires a lawyer under the usual contingent fee system. In this model, θ equals the fraction of the award given to the plaintiff's

lawyer under the conventional fee system with $0 < \theta < 1$. Here, the lawyer will choose h to maximize her expected payoff function at trial: $p(h)\theta a - wh$. The number of hours worked by the plaintiff's lawyer under the conventional contingent fee system, h_C , is determined by the first-order conditions: $p'(h)\theta a = w$. Because of decreasing marginal productivity and $0 < \theta < 1$, h_C is less than h^* ; thus, from the plaintiff's perspective, the lawyer puts in too little effort. Lawyers compete for clients; thus, θ is determined by $p(h_C)\theta a - k = wh_C$. A lawyer will recommend filing a suit if and only if $p(h_C)\theta a - k - wh_C \geq 0$.

Finally, Polinsky and Rubinfeld propose a model of the no-conflict fee system where the lawyer's fraction of costs incurred equals her fraction of the award obtained if she wins. Here, γ equals the fraction of the award given to the plaintiff's lawyer under the no-conflict fee system with $0 < \gamma < 1$; the third-party administrator compensates the lawyer for $1 - \gamma$ of the costs. The lawyer will choose h to maximize her expected payoff function at trial: $p(h)\gamma a - \gamma wh = \gamma[p(h)a - wh]$. The number of hours worked by the plaintiff's lawyer under the no-conflict fee system, h_N , is determined by the first-order condition, where γ cancels out. The result is that $h_N = h^*$. A lawyer will recommend filing a suit if $\gamma[p(h_N)a - wh_N - k] \geq 0$; this is the same h and same choice to file that the plaintiff would make if he had full information and control. Let the payment by the plaintiff's lawyer to the third-party administrator to obtain the case be denoted t , and if the case has a positive expected value, then

$$(4) \quad t = \gamma[p(h_N)a - wh_N - k].$$

Lawyers compete and bid up "to this amount because any lower t would result in obtaining compensation in excess of lawyers' hourly wage" (Polinsky and Rubinfeld, p. 175).

The distribution of payments to parties under the no-conflict fee system is as follows: the administrator's payout is $(1 - \gamma)(k + wh_N)$; the administrator's net revenue is

$t - (1 - \gamma)(k + wh_N) = \gamma p(h_N)a - wh_N - k$ (using equation (4) above). Under the no-conflict fee system, potential administrators compete for clients by bidding up the portion $(1 - \gamma)$ of the trial award they offer to pay to the client, and so the equilibrium γ is such that the administrator's net revenue is zero. Here, clients receive $(1 - \gamma)a$ if the case is won; if the case is lost, they gain and lose nothing. On the other side, the lawyer receives $\gamma a + (1 - \gamma)(k + wh_N)$ if the case is won; if the case is lost, the third-party administrator pays the plaintiff's lawyer the amount $(1 - \gamma)(k + wh_N)$. Since the lawyer pays the litigation costs $k + wh_N$ and the up-front payment to the administrator, the lawyer just breaks even.

B. Hidden Information Principal-Agent Model

Many times contracts are drawn up under conditions of asymmetric information, leading to another version of the principal-agent problem called the hidden information (adverse selection) model. In this case, where the effort is contractible, the lawyer has private information about his type that influences the client's decision. The client can offer a menu of contracts and allow the lawyer to select among them; this would be an example of monopolistic screening where the menu can screen different types of agents when they choose the different contracts from the menu (Mas-Colell, et al., 1995, p. 488-500). While the choice may reveal the lawyer's type, the client is bound by her offer and this prevents her from being able to utilize the information.

Rubinfeld and Scotchmer (1993) provide a model in which a client designs a menu of contracts to screen lawyers with private information about their ability to win at trial (which may be high or low). They show that if clients can visit lawyers costlessly, then it is optimal to offer a single contract that is acceptable only to a high-ability lawyer, and to search until a lawyer accepts the contract. On the other hand, if it is sufficiently costly for clients to visit lawyers, then

it is optimal to offer a menu of contracts, one of which is selected by low-ability lawyers and the other of which is selected by high-ability lawyers.

Landers, et al. (*AER*, 1996) provide a monopolistic-screening model where the law firm is the principal, and lawyers are the agents whose private information is whether they are high-talent or low-talent lawyers (their type). While conventional theory predicts that individuals work utility-maximizing hours (conditional on their wages), Landers, et al. suggest that if law firms use the willingness to work long hours as “an indicator of some valuable, yet hard to observe, characteristics of its employees [lawyers],” then issues of adverse selection may appear (Landers, et al., 1996, p. 329). In this case, the willingness to work long hours (“long-hour”) may be an indicator of high talent, and a lack of willingness to work long hours (“short-hour”) may be an indicator of low talent. Short-hour lawyers may pretend to be long-hour workers, by working more hours at their current wage, in hopes of being promoted. As a response, firms establish work norms which “may require too many work hours from employees” (p. 329).

Landers, et al. develop a model of adverse selection in work hours for large law firms where the simple internal structure consists of two broad categories: associates (firm’s employees) and partners (who are allowed to purchase an equity stake in the business). Both because there is a degree of revenue sharing among the partners and because moneymaking activities are hard to observe directly, the current partners look for associates with a propensity to work very hard and screen out short-hour associates.

Under complete information, utility for an associate of type t who receives compensation c and works h hours is given by $u_t(c, h) = c - b_t h^2$, where type, t , can be 1 (short-hour) or 2 (long-hour). Let b_t be a weight that represent a lawyer’s disutility toward work with $b_1 > b_2$. Let w_1 denote the hourly wage of an associate; then $c = w_1 h$. The optimal hours of work for type t is

$h_t^* = w_1/(2b_t)$; notice that type 2 works more hours than type 1 for the same wage, since $b_1 > b_2$. The maximized payoff for an associate of type t is $u_t(c^*, h_t^*) = w_1^2/(4b_t)$, where $c^* = w_1 h_t^*$. This is also referred to as the payoff available in the “spot market.” In a competitive market, the wage, w_1 , will be equal to the marginal product of an hour of work by an associate, which is denoted m_1 . The marginal product of an hour of work by a partner is denoted m_2 , where $m_2 > m_1$.

Once in a partnership, the revenues are shared. Thus, since revenue depends on hours worked, partner A will want to maximize $(m_2/2)(h_A + h_B) - b_A h_A^2$, where h_A and h_B represent the hours chosen by the two partners. Let $V_{s,t}$ be the utility a type s individual gets from being in a partnership with a type t individual net of the utility of a job in the spot market; $V_{s,t}$ is equal to $m_2^2[b_s/16 + b_t/8] - w_1^2/(4b_s)$. Since $V_{2,2} > V_{2,1} > V_{1,2} > V_{1,1}$ and $b_1 > b_2$, a partner of either type will always prefer to be paired with a type 2 individual. In the equilibrium with observable types (which we shall label the baseline case), the future value of the firm will be maximized with type 2 lawyers. In this case, the going price for a partnership is $V_{2,2}$; Landers, et al. assume $V_{2,2}$ is strictly greater than zero, and thus, “the existence of partnerships is efficient” (1996, p. 332).

When types are unobservable, they have two different cases. If $V_{1,2} < V_{2,2}$ (“no envy”), a type 1 individual would not be interested in buying into a partnership (at a cost of $V_{2,2}$) because he would only make $V_{1,2}$ once he was a partner. Here the incomplete information equilibrium corresponds to the baseline case. If $V_{1,2} > V_{2,2}$ (“envy”), a type 1 individual may try to pretend to be type 2 and lose utility in the first period, working longer hours than optimal, in order to get to partner status (that is, in order to buy in at the price $V_{2,2}$ and then make $V_{1,2}$). Equilibrium here cannot be characterized (they argue) by partnerships where associates are working the full information utility maximizing hours (conditional on wage). Firms will respond by setting a new level of hours and a wage high enough to induce only type 2 individuals to purchase

partnerships. However, there is a decrease in profits because of their new hours policy. For a sufficiently small increase in hours, the increase in firm value must exceed the loss in extra compensation paid.

Landers, et al. also characterize this separating equilibrium with unobservable types as follows: firms will offer a wage-hours package $(\tilde{w}_2, \tilde{h}_2)$ that will be accepted by type 2 individuals exclusively; type 1 individuals will receive the spot-market equilibrium contract (w_1, h^*) .² This separating equilibrium is inefficient relative to the full information case, and the principal (the firm) is worse off. A maximum-hours law that prohibits more hours than the separating number of hours type 2 would be willing to work makes it impossible for the occurrence of a separating equilibrium. Thus, without such a policy, a single firm will only attract short-hour attorneys if stringent work norms are not kept. In this equilibrium, increases in the number of short-hour attorneys will not lead to shorter associate work hours, and attorneys who are unwilling to work these excessive hours early in their career have reduced access to partnership status.

C. Career Concerns Model

In addition to the hidden action and hidden information principal-agent models, the “career concerns” model is also relevant to our investigation of the incentive effects of compensation on lawyer performance. In the standard version of this model, a manager does not know his type (high or low talent), and his effort is not observable. However, higher effort and higher talent both contribute to the increased chance of the manager performing well, and the observer (future employer, the market) will update his beliefs about the manager’s talent based on the firm’s performance. Note that the timing in this model is different from that of the

² While this hidden information model restricts type 1’s wage to be the spot-market wage, an optimal contract offered by the law firm would push type 1’s wage down further, meaning she would be required to work less, and type 2 would work at her full-information level while being paid more.

principal-agent model wherein the principal moves first and commits to a pay-performance schedule. Here the manager will move first, and the observer subsequently rewards the manager based on the observer's updated beliefs about the manager's type. The idea is that the observer is not in a position to contract with the manager before the manager chooses her effort on this project. The observer is a stand-in for all those agents who may subsequently reward a manager who is inferred to have higher talent based on how successful she was early in her career.

An example of the career concerns model applied in the legal context is found in Ferrer (2009a). Ferrer assesses the effect of career concerns on the efforts provided by two opposing lawyers in a case: the attorney of the defendant (A_D) and the attorney of the plaintiff (A_P). Career concerns influence settlement possibilities and the probability of winning a case (should it go to trial). Each lawyer's career concerns are captured by a term that represents the market's evaluation of the lawyer's talent, which is weighted by a parameter β in the lawyer's payoff function. The market's (observer's) and the lawyer's initial belief about the lawyer's talent is given by the prior distribution over her talent, and if this case goes to court, the market will update its initial beliefs based on the trial outcome, creating the posterior distribution over the lawyer's talent. Ferrer finds that career concerns provide an implicit incentive for lawyers to exert higher levels of effort in court and may lead to the attainment of a more beneficial settlement.

In this model, A_D and A_P can choose how much effort to exert in a case at court. Attorney A_i with $i = P, D$ has talent $t_i \in \{\tau_i^l, \tau_i^h\}$ where $0 < \tau_i^l < \tau_i^h \leq 1$. Neither attorney can observe her own or her rival's talent; the market cannot directly observe this talent either (there is imperfect but symmetric information). There is a common prior, which can vary for A_P and A_D , over the talent of the lawyer. The unconditional probability of A_P or A_D having high talent

is $\rho_i > 0$. Thus, the a priori expected talent for A_i is $\mu_i = \rho_i \tau_i^h + (1 - \rho_i) \tau_i^l$. The outcome of the trial is a function of the lawyer's efforts, e_i , and their talents, t_i : A_p wins at trial with probability $\Phi(e_p, e_D, t_p, t_D)$, and A_p loses at trial with probability $1 - \Phi(e_p, e_D, t_p, t_D)$. After the trial occurs, the market updates beliefs about t based on the trial outcome. Ferrer assumes that $\Phi(e_p, e_D, t_p, t_D) = (1 + e_p t_p - e_D t_D) / 2$ with $e_D, e_p \in [0, 1]$ in equilibrium, and thus, $\Phi \in [0, 1]$. Given this functional form, $E_t(\Phi(e_p, e_D, t_p, t_D)) = (1 + e_p \mu_p - e_D \mu_D) / 2$.

In this model, A_p and A_D are assumed to have the same interests as their respective clients, plaintiff (P) and defendant (D); that is, there is no agency problem present. This simplification is made in order to focus on the effect of career concerns. In what follows, I focus on A_p . The award obtained by the plaintiff's side if they win the trial is denoted W . Here, A_p chooses the effort level in order to

$$\max_{e_p \in [0, 1]} W \cdot E_t(\Phi(e_p, e_D, t_p, t_D)) - \frac{c_p e_p^2}{2} + \beta_p \{ E_t(\Phi(e_p, e_D, t_p, t_D)) \cdot \hat{t}_p(A_p \text{ wins}; e_p^*, e_D^*) + E_t(1 - \Phi(e_p, e_D, t_p, t_D)) \cdot \hat{t}_p(A_p \text{ loses}; e_p^*, e_D^*) \},$$

where c_p is a cost parameter, e_D^* is A_p 's and the market's conjecture about A_D 's effort, and e_p^* is A_D 's and the market's conjecture of A_p 's effort. The first element represents the expected award; the second element represents the costs. The terms $\hat{t}_p(A_p \text{ wins}; e_p^*, e_D^*)$ and $\hat{t}_p(A_p \text{ loses}; e_p^*, e_D^*)$ represent the market's inference about A_p 's talent conditioned on the trial's outcome and on the market's conjecture of effort levels. The payoff is increasing in the expected market's inference of the lawyer's talent modeled in the curly brackets; β_p measures the marginal value of an increase in inferred talent. This implicit incentive is a reduced-form representation of the lawyer's future benefit based on her inferred talent. Implicit incentives need not take this simple linear form, but the linear form enhances tractability.

The first order condition for A_p is:

$$(5) \quad \frac{W\mu_p}{2} - c_p e_p + \frac{\beta_p \mu_p}{2} (\hat{t}_p(A_p \text{ wins}; e_p^*, e_D^*) - \hat{t}_p(A_p \text{ loses}; e_p^*, e_D^*)) = 0.$$

Ferrer shows that the difference between the market's inference about t_p in the cases of A_p winning and losing is:

$$(6) \quad \hat{t}_p(A_p \text{ wins}; e_p^*, e_D^*) - \hat{t}_p(A_p \text{ loses}; e_p^*, e_D^*) = \frac{2e_p^* \sigma_p^2}{1 - (\mu_p e_p^* - \mu_D e_D^*)^2},$$

where σ_p^2 is the variance of the prior over A_p 's talent. In equilibrium, the level of effort that A_p chooses and the market's conjecture of her effort, e_p^* , must be equal. The problem facing A_D is analogous.

If the parameters are the same for A_p and A_D ($\mu = \mu_p = \mu_D$, $\sigma^2 = \sigma_p^2 = \sigma_D^2$, $\beta = \beta_p = \beta_D$, $c = c_p = c_D$), then

$$(7) \quad E_t(\Phi(e_p, e_D, t_p, t_D)) = \frac{1 + \mu(e_p - e_D)}{2};$$

whoever exerts more effort in court has a higher expected probability of winning. A_p 's and A_D 's first-order conditions are symmetric and, when solved, the optimal levels of effort are $e^* = e_p^* = e_D^* = (W\mu/2)/(c - \beta\mu\sigma^2)$. The greater the uncertainty about their talent (σ) and the greater each lawyer's reputational concerns (β), the more incentives they have to exert a higher level of effort. Also, since the equilibrium effort levels are the same, if one lawyer has higher realized talent than the other, the realized probability of winning the case in court is also higher. In this model, both attorneys are trapped into providing higher effort. Ferrer notes that there would not be an equilibrium effort trap if there were no career concerns (i.e., if β were zero or if there were full information) since then the equilibrium effort would be the full information effort equal to $W\mu/(2c) < e^*$.

Ferrer also explores three asymmetries. First, she addresses asymmetric career concerns by starting at the symmetric equilibrium ($\beta = \beta_P = \beta_D$) and holding β_j constant while increasing the other, β_i . It is found that both lawyers increase their effort but attorney A_i increases more than A_j . Second, asymmetric cost functions are explored, also starting at the symmetric equilibrium ($c = c_P = c_D$). Ferrer finds that a decrease in c_i with c_j held constant for $\beta > 0$ would increase both lawyers' efforts, with A_i increasing effort more than A_j . Lastly, Ferrer also explores asymmetric priors, which could (for example) result from differences in the quality of the law school the attorneys attended or differences in their past outcomes in court. She does this by comparing equilibrium effort levels when priors are asymmetric with one specific case where attorneys had the same prior expected talent $\mu_i = \mu_j$ but different prior variance $\sigma_j^2 < \sigma_i^2$. In equilibrium, $e_j^* < e_i^*$, and an increase in σ_i^2 while holding σ_j^2 fixed leads to both attorneys increasing their effort, but A_i increases effort more than A_j does. This results because the market has greater uncertainty (higher variance) over A_i 's talent, which provides A_i with a greater incentive to exert more effort. Ferrer goes on to consider how career concerns affect settlement decisions.

Ferrer (2009b) conducted an empirical study by using survey data from the "After the JD" study to test whether young lawyers representing cases in court have incentives to work more hours. The trial outcome may be an important source of information about the lawyer's skills and may considerably impact their careers by affecting future compensation rates and the likelihood of finding new clients. Ferrer chooses young, inexperienced lawyers (having passed the bar exam two years prior to the survey) because the benefits to their careers (implicit incentives) may be just as strong an incentive to work as explicit monetary rewards and because they are most likely to be unaware of their true talent. She estimates the average treatment effect

between lawyers more frequently involved in court cases (treatment group) and the rest of the lawyers working in the law firms (control group). Ferrer also tried to separate the effect of implicit incentives from a possible selection bias (a selection bias could possibly result from the law firms assigning court cases to lawyers with a lower disutility of work and/or the self-selection of lawyers into becoming trial lawyers). The results indicate that (all else equal) young lawyers, who usually appear in court as first or second chair on a case, work on average about five more hours per week than other young lawyers in law firms.

D. This Paper's Goal

From the aforementioned literature, several significant points are relevant to my project goal. The Hay (1997) and Polinsky and Rubinfeld (2003) papers were both hidden-action principal-agent models, where the principal (client) was uninformed and the agent (lawyer) was informed about the lawyer's effort choice. The Rubinfeld and Scotchmer (1993) and Landers, et al. (1996) papers were examples of the hidden-information principal-agent model, where the principal (client or law firm) was uninformed and the agents (lawyers) were informed about the lawyers' types. Although hidden information and hidden action can occur together in one model, these three papers do not incorporate both. In the Ferrer (2009a) career concerns model, the client, lawyer, and observer do not know what the client's type is, and the lawyer's effort is not observable; only the trial's outcome is observable. Because of the lawyer's career concerns, the lawyer exerts a higher amount of effort to influence the trial outcome, from which the observer updates his beliefs about the lawyer's talent.

The goal of my research is to create a signaling model of lawyer effort-choice. Like the hidden information model, the lawyer (agent) has private information about what type she is, and her type in this case is not directly observable. However, this model differs in the timing of the

movements of the principal and agent(s). For example, in the hidden action models, the client moved first and offered the lawyer a contract, and the lawyer then chose the amount of effort to exert. In Landers, et al. (1996), the law firm moved first and offered a menu of contracts, followed by the lawyers choosing contracts from the menu and then choosing their optimal effort levels. However, in my signaling model, the informed lawyer will move first and choose her effort level. Then, the observer (future client, future employer, market), who is uninformed about the lawyer's type, will try to draw an inference about the lawyer's type from her choice of effort level and will subsequently reward the lawyer based on this inference. As in Ferrer's model, the observer is a stand-in for all those agents who may subsequently reward a lawyer who is inferred to have higher talent based on her effort taken early in her career. Higher perceived talent may lead to increased pay, more clients, a higher likelihood of a partnership, and so on.

Although this is not formally a career concerns model (since the lawyer knows her type), different types of lawyers may have different future payoffs if they can signal their types to the observers. In this signaling model, the basic idea is that higher-talent lawyers have actions they can take to distinguish themselves from other lower-talent lawyers (similar to Spence's original model of signaling; see Mas-Colell, et al., 1995, p. 450 for details). Since effort is observable, the high-talent lawyer's effort choice can serve as a signal of her talent.

II. Model Setup and Equilibrium Under Full and Asymmetric Information

A. Notation

I will consider three versions of a signaling model. Each version involves a long-run monetary payoff that is a function of effort, type, and believed type. Each payoff function takes the general form of $u(e,t,b(e)) = W \cdot p(e,t,m) - c(e,t) - F + \beta \cdot b(e)$ and employs the same notation.

W denotes the award at trial.

e is the lawyer's effort in trial preparation associated with the case at hand; $e \geq 0$.

t denotes the lawyer's type with $t_i \in \{t_L, t_H\}$ (either high or low) where $0 < t_L < t_H \leq 1$.

m denotes the merits or difficulty of the case with $0 < m < 2$. The closer m is to zero, the more difficult the case.

c is a parameter affecting the variable cost of preparing for trial (the cost of doing legal research, procuring and preparing witnesses, and so on).

F denotes the fixed cost of being a lawyer (e.g. acquiring and maintaining certification, showing up at trial, and so on).

$b(e)$ denotes the observer's belief about the lawyer's type, based on the observable effort of the lawyer in the current case. Note that in this two-type model, $b(e)$ will simply be t_L or t_H in a separating equilibrium.

β is the impact that the believed type, $b(e)$, has on the lawyer's future compensation.

$p(e,t,m)$ with $0 \leq p(e,t) \leq 1$ denotes the probability of winning the case that can be affected by the case merits, effort and talent.

$c(e,t)$ denotes the variable cost of trial preparation associated with the case at hand that can be affected by effort, type or both.

$\beta \cdot b(e)$ is the reduced form representation of the lawyer's future payoff as a function of her effort on the current case.

B. Signaling Model Version 1

In version 1, the lawyer's talent affects the probability of winning the trial in the courtroom and does not affect the lawyer's cost function. Similar to Ferrer, I abstract from agency problems in the current case in order to focus on the signaling aspect. The lawyer's long-run payoff function takes the specific form of

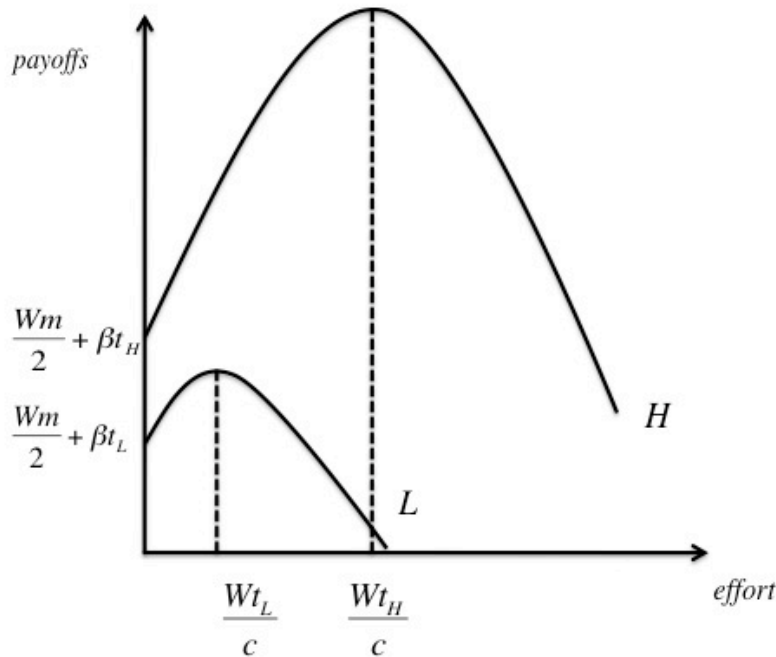
$$(8) \quad u(e, t, b(e)) = W \left(\frac{m + te}{2} \right) - \frac{ce^2}{4} - F + \beta \cdot b(e).$$

Note that when m is close to zero, the lawyer's effort will be very important to the chances of winning. When m is close to 2, then the merits of the case are already so strong that the plaintiff's side is very likely to win even if the lawyer does not engage in much trial preparation.³ The fixed cost F reflects those costs that are not subject to choice by the lawyer; for instance, the lawyer has to maintain her certification and show up for hearings and the trial. On the other hand, she can choose how much effort to put into trial preparation, which is revealed through her performance in the courtroom. Under full information, the observer can observe the lawyer's type directly; the true and perceived type will be the same. Thus, the lawyer will want to exert the effort level that maximizes her payoff, depending on the quadratic variable cost of exerting effort, denoted $ce^2/4$, and depending on whether she has high or low talent. By maximizing $u(e, t_L, t_L)$ with respect to e , we find that the full information equilibrium effort level for a low-talent lawyer, denoted e_L^{FI} , is equal to Wt_L/c . By maximizing $u(e, t_H, t_H)$ with respect to e , we find that the full information equilibrium effort level for a high-talent lawyer, denoted e_H^{FI} , is

³ The parameter space will be restricted so that the probability of winning the case will be less than or equal to one.

equal to Wt_H/c . Therefore, the full information solution is $(e_L^{FI}, e_H^{FI}) = (Wt_L/c, Wt_H/c)$. The diagram below depicts this equilibrium.

Figure 1: Full Information Equilibrium

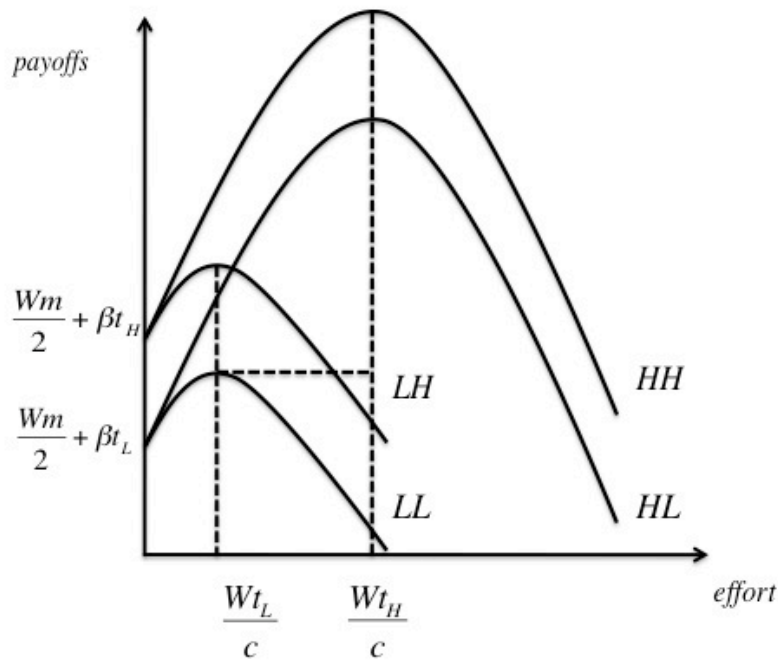


Under asymmetric information, the lawyer's talent is not directly observable. Her effort level is observable, so e may signal information about the lawyer's type to the outside observer. In order for a separating equilibrium to occur, a lawyer must be as well-off choosing the effort level that reveals her true type as she could be by exerting effort that induces the observer to believe that she is the other type. Here, the lawyer can make positive profits regardless of her true or perceived type, so there are no participation concerns. A high-type lawyer does not have the incentive to try to pretend to be a low-type lawyer because the future payoff is higher if one is believed to be of high talent. However, there may be an incentive for a low-type lawyer to

pretend to be a high-type lawyer by exerting more effort if this would lead an observer to believe she was a high-type lawyer.

I now consider what parametric conditions would imply that the full information equilibrium is a separating equilibrium under asymmetric information. First, suppose the observer's beliefs are $b(e) = t_H$ if $e \geq e_H^{FI}$ and $b(e) = t_L$ if $e < e_H^{FI}$. Then (e_L^{FI}, e_H^{FI}) is a separating equilibrium only if the low-type lawyer's payoff at the e_L^{FI} level with $b(e) = t_L$ is not less than her payoff when she is believed to be a high-type lawyer, t_H , at e_H^{FI} ; that is, if $u(e_L^{FI}, t_L, t_L) \geq u(e_H^{FI}, t_L, t_H)$. This condition can be rearranged to obtain $t_H - t_L \geq 4\beta c / W^2$. From this, we can see that the bigger the difference between the talents, the more likely a separating equilibrium will occur at the full information effort levels when the lawyer has private information about her talent level. Under this condition, the observer can take the lawyer's effort level as an accurate signal of her type. The beliefs that support this separating equilibrium are $b(e) = t_H$ if $e \geq e_H^{FI}$ and $b(e) = t_L$ if $e < e_H^{FI}$; here, e_H^{FI} is considered the threshold effort level that is just sufficient to convince the observer that the lawyer's talent is high. In the diagram below depicting the condition when the full information equilibrium is a separating equilibrium, the curves are labeled with the first letter as the actual type and second letter as the believed type.

Figure 2: When the Full Information Equilibrium is a Separating Equilibrium



If the condition derived above is violated (i.e., if $t_H - t_L < 4\beta c/W^2$), then for there to be a separating equilibrium the threshold effort level must be distorted upward to e_H^* so that it will not be profitable for a low-type lawyer to mimic a high-type lawyer. Of course, the high type will also have to be willing to exert e_H^* . I proceed to find the separating equilibrium, (e_L^*, e_H^*) , by utilizing the incentive compatibility constraints for a low-type lawyer and a high-type lawyer:

$$IC_L: u(e_L^*, t_L, t_L) \geq u(e_H^*, t_L, t_H)$$

$$IC_H: u(e_H^*, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L).$$

The low-type lawyer's payoff should be greater when she is exerting the effort e_L^* that corresponds with her type than when she exerts e_H^* and leads the observer to conclude that she is t_H . Since the low type will be identified in a separating equilibrium, there is no reason for her to

deviate from the effort level that maximizes her payoff, which is e_L^{FI} ; thus, $e_L^* = e_L^{FI}$. The solution in a signaling equilibrium must fulfill both incentive compatibility constraints, and so e_H^* must be better for the high type than choosing any other e and possibly allowing the observer to conclude that she is t_L . As can be seen from the objective function, her best alternative in this latter case is her full information effort, e_H^{FI} , resulting in the displayed IC_H constraint above.

The incentive compatibility constraint for the low-type lawyer leads to the inequality

$$(9) \quad \left[\frac{W^2 t_L^2}{4c} - \beta(t_H - t_L) \right] - \frac{W t_L}{2} (e_H^*) - \frac{c(e_H^*)^2}{4} \geq 0.$$

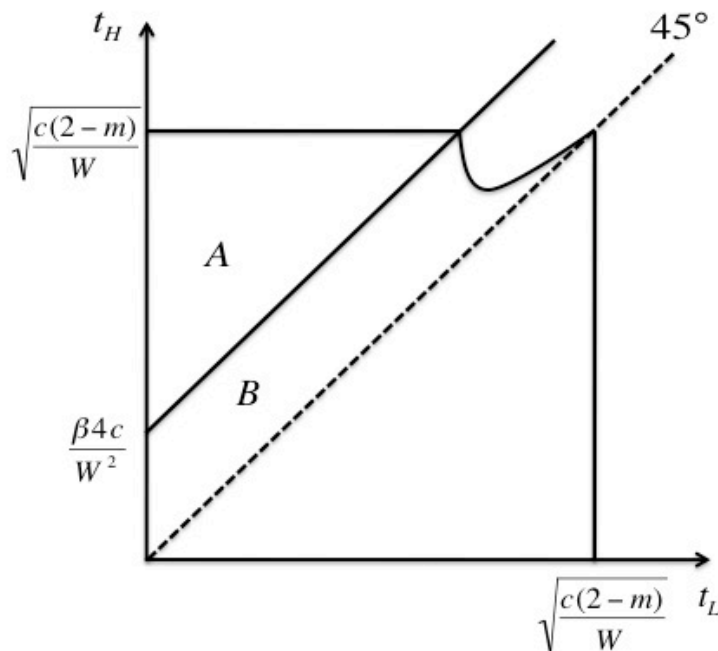
Solving for the roots, we find that $e_H^* \geq e_{LB} \equiv (W t_L + 2\sqrt{\beta c(t_H - t_L)})/c$ and $e_H^* \leq e_{LS} \equiv (W t_L - 2\sqrt{\beta c(t_H - t_L)})/c$ with $e_{LB} > e_{LS}$. Here, B indicates the bigger root, and S indicates the smaller root. The incentive compatibility constraint for the high-type lawyer leads to the quadratic

$$(10) \quad \left[\frac{W^2 t_H^2}{4c} - \beta(t_H - t_L) \right] - \frac{W t_H}{2} (e_H^*) - \frac{c(e_H^*)^2}{4} \leq 0.$$

Solving for the roots, we find that $e_H^* \leq e_{HB} \equiv (W t_H + 2\sqrt{\beta c(t_H - t_L)})/c$ and $e_H^* \geq e_{HS} \equiv (W t_H - 2\sqrt{\beta c(t_H - t_L)})/c$ with $e_{HB} > e_{HS}$. Thus, the value of e_H^* must be inside the interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* must satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Since in this range the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point at which the low-type lawyer is just deterred from mimicry. This is the outcome of using the Intuitive Criterion to refine the set of equilibria (Cho and Kreps, 1987; see Mas-Colell, et al., 1995, p. 470). Thus, the separating equilibrium under asymmetric information is

some simple algebra, we find that in order to keep the probability of winning less than or equal to one for region A , it must be that both t_L and t_H are less than or equal to $\sqrt{c(2-m)/W}$. For region B , a different probability constraint is needed because $e_H^* > e_H^{FI} : (m + t_H e_H^*)/2 \leq 1$. It is shown in the appendix that the curve defined by $(m + t_H e_H^*)/2 = 1$ first decreases and then increases as t_L increases; moreover, it only intersects the 45° line once, where $t_L = t_H = \sqrt{c(2-m)/W}$.

Figure 4: Parametric Regions Supporting Different Separating Equilibrium



C. Signaling Model Version 2

In version 2, the lawyer's talent does not affect the probability of winning the trial in the courtroom, but it does affect the lawyer's cost function. The lawyer's long-run payoff function takes the specific form of

$$(11) \quad u(e, t, b(e)) = W \left(\frac{m+e}{2} \right) - \frac{ce^2}{4t} - F + \beta \cdot b(e).$$

In this version, increasing talent decreases the marginal cost of effort. Using the same logic as for model version 1, we find that the full information equilibrium is $(e_L^{FI}, e_H^{FI}) = (Wt_L/c, Wt_H/c)$, which is a separating equilibrium only if $1 + 4\beta c/W^2 \leq t_H/t_L$. From this, we can see that the bigger the t_H/t_L ratio, the more likely a separating equilibrium will occur at the full information effort levels when the lawyer has private information about her talent level. Under this condition, the observer can take the lawyer's effort level as an accurate signal of her type. The beliefs that support this separating equilibrium are $b(e) = t_H$ if $e \geq e_H^{FI}$ and $b(e) = t_L$ if $e < e_H^{FI}$; here, e_H^{FI} is considered the threshold effort level that is just sufficient to convince the observer that the lawyer's talent is high.

If the condition derived above is violated (i.e., if $1 + 4\beta c/W^2 > t_H/t_L$), then similar to model version 1 we can find the separating equilibrium, (e_L^*, e_H^*) . The incentive compatibility constraint for the low-type lawyer leads to the inequality

$$(12) \quad \left[\frac{W^2 t_L}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_L} \geq 0.$$

Solving for the roots, we find that $e_H^* \geq e_{LB} \equiv (Wt_L + 2\sqrt{t_L \beta c(t_H - t_L)})/c$ and $e_H^* \leq e_{LS} \equiv (Wt_L - 2\sqrt{t_L \beta c(t_H - t_L)})/c$ with $e_{LB} > e_{LS}$. The incentive compatibility constraint for the high-type lawyer leads to the quadratic

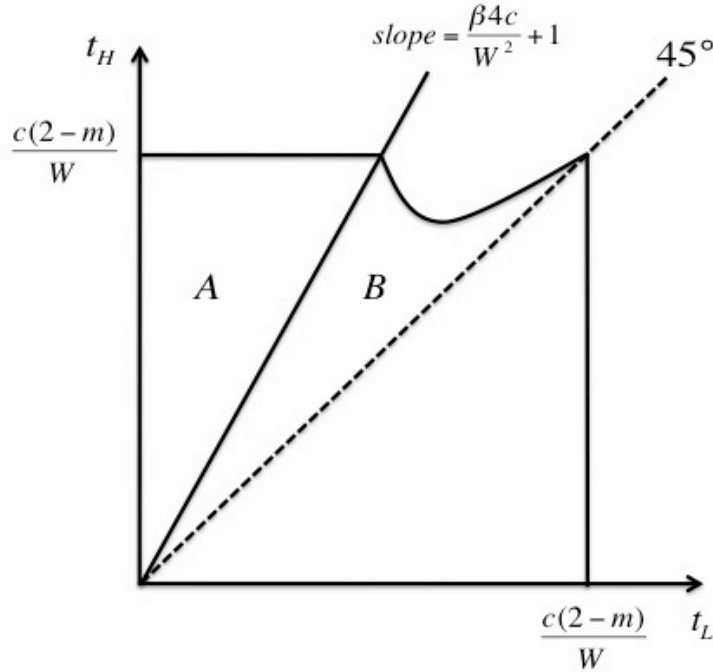
$$(13) \quad \left[\frac{W^2 t_H}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_H} \leq 0.$$

Solving for the roots, we find that $e_H^* \leq e_{HB} \equiv (Wt_H + 2\sqrt{t_H \beta c(t_H - t_L)})/c$ and $e_H^* \geq e_{HS} \equiv (Wt_H - 2\sqrt{t_H \beta c(t_H - t_L)})/c$ with $e_{HB} > e_{HS}$. Thus, the value of e_H^* must be inside the

interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Because in this range, the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point at which the low-type lawyer is just deterred from mimicry; there is upward distortion in the effort level of the high-type lawyer in this separating equilibrium. Thus, the separating equilibrium under asymmetric information is $(e_L^*, e_H^*) = (Wt_L/c, (Wt_L + 2\sqrt{t_L\beta c(t_H - t_L)})/c)$. The beliefs that support the separating equilibrium are $b(e) = t_H$ if $e \geq e_H^*$ and $b(e) = t_L$ if $e < e_H^*$.

Again, the parameter space can be divided into two regions depending on whether the separating equilibrium involves distortion. This is depicted in the diagram below. A represents the parameter region where the full information equilibrium is a separating equilibrium and all constraints are fulfilled. B represents the parameter region where under asymmetric information the separating equilibrium requires distortion ($e_H^* > e_H^{FI}$). With some simple algebra, we find that in order to keep the probability of winning less than or equal to one in region A , it must be that both t_L and t_H are less than or equal to $c(2 - m)/W$. For region B , a different probability constraint is needed because $e_H^* > e_H^{FI}$: $(m + e_H^*)/2 \leq 1$. It is shown in the appendix that the curve defined by $(m + e_H^*)/2 = 1$ first decreases and then increases as t_L increases; moreover, it only intersects the 45° line once, where $t_L = t_H = c(2 - m)/W$.

Figure 5: Parametric Regions Supporting Different Separating Equilibrium



D. Signaling Model Version 3

In version 3, the lawyer’s talent affects the probability of winning the trial in the courtroom and the lawyer’s cost function. The lawyer’s long-run payoff function takes the specific form of

$$(14) \quad u(e, t, b(e)) = W \left(\frac{mt + e}{2} \right) - \frac{ce^2}{4t} - F + \beta \cdot b(e).$$

In this version, not only does increasing talent decrease the marginal cost of effort, but talent also boosts the probability of winning by acting as a multiplier to the merits of the case. Using the same logic for model versions 1 and 2, we find that the full information equilibrium is $(e_L^{FI}, e_H^{FI}) = (Wt_L/c, Wt_H/c)$, which is a separating equilibrium only if $1 + 4\beta c/W^2 \leq t_H/t_L$. This condition is the same as for version 2. Under this condition, the observer can take the lawyer’s

effort level as an accurate signal of her type. The beliefs that support this separating equilibrium are $b(e) = t_H$ if $e \geq e_H^{FI}$ and $b(e) = t_L$ if $e < e_H^{FI}$; here, e_H^{FI} is considered the threshold effort level that is just sufficient to convince the observer that the lawyer's talent is high.

If the condition derived above is violated (i.e., if $1 + 4\beta c/W^2 > t_H/t_L$), then similar to model version 1 we can find the separating equilibrium, (e_L^*, e_H^*) . The incentive compatibility constraint for the low-type lawyer leads to the inequality

$$(15) \quad \left[\frac{W^2 t_L}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_L} \geq 0.$$

Solving for the roots, we find that $e_H^* \geq e_{LB} \equiv (Wt_L + 2\sqrt{t_L\beta c(t_H - t_L)})/c$ and $e_H^* \leq e_{LS} \equiv (Wt_L - 2\sqrt{t_L\beta c(t_H - t_L)})/c$ with $e_{LB} > e_{LS}$. The incentive compatibility constraint for the high-type lawyer leads to the quadratic

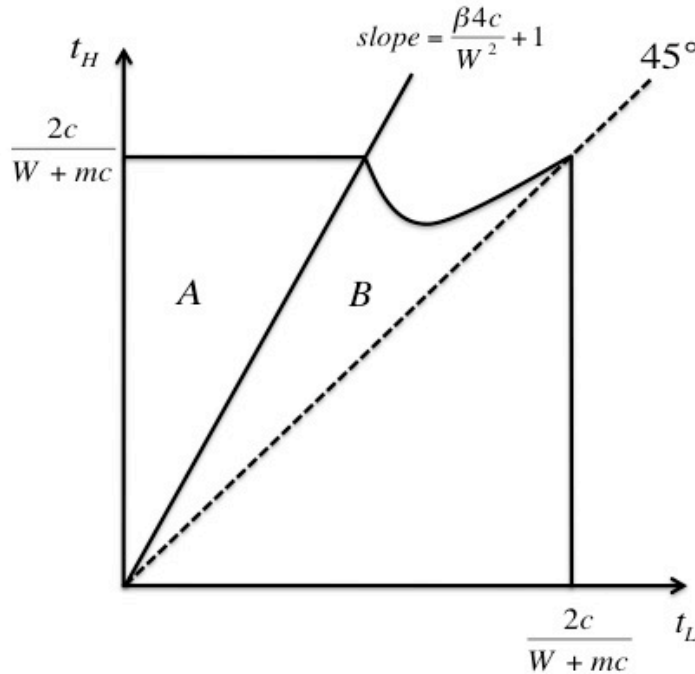
$$(16) \quad \left[\frac{W^2 t_H}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_H} \leq 0.$$

Solving for the roots, we find that $e_H^* \leq e_{HB} \equiv (Wt_H + 2\sqrt{t_H\beta c(t_H - t_L)})/c$ and $e_H^* \geq e_{HS} \equiv (Wt_H - 2\sqrt{t_H\beta c(t_H - t_L)})/c$ with $e_{HB} > e_{HS}$. Thus, the value of e_H^* must be inside the interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Because in this range, the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point to which the low-type lawyer is just deterred from mimicry; there is upward distortion in the effort level of the high-type lawyer in this separating equilibrium. Thus, the separating equilibrium

under asymmetric information is $(e_L^*, e_H^*) = (Wt_L/c, (Wt_L + 2\sqrt{t_L\beta c(t_H - t_L)})/c)$. The beliefs that support the separating equilibrium are $b(e) = t_H$ if $e \geq e_H^*$ and $b(e) = t_L$ if $e < e_H^*$

Again, the parameter space can be divided into two regions depending on whether the separating equilibrium involves distortion. This is depicted in the diagram below. A represents the parameter region where the full information equilibrium is a separating equilibrium and all constraints are fulfilled. B represents the parameter region where under asymmetric information the separating equilibrium requires distortion ($e_H^* > e_H^{FI}$). With some simple algebra, we find that in order to keep the probability of winning less than or greater than one in region A , it must be that both t_L and t_H are less than or equal to $2c/(W + mc)$. For region B , a different probability constraint is needed because $e_H^* > e_H^{FI}$: $(mt_H + e_H^*)/2 \leq 1$. It is shown in the appendix that the curve defined by $(mt_H + e_H^*)/2 = 1$ first decreases and then increases as t_L increases; moreover, it only intersects the 45° line once, where $t_L = t_H = 2c/(W + mc)$.

Figure 6: Parametric Regions Supporting Different Separating Equilibrium



III. Comparisons and Implications

The full information equilibrium for all three versions is $(e_L^{FI}, e_H^{FI}) = (Wt_L/c, Wt_H/c)$. This indicates that regardless of whether talent affects the lawyer's probability of winning the case, the variable cost, or both, the effort level exerted when observers can observe the lawyer's type directly is the same for these functional forms. The equilibrium effort level is increasing in the award at trial, W , and type, t , and decreasing in the effort-cost parameter, c . The high-type lawyer has a higher equilibrium effort level in version 1 because talent is a multiplier of effort, which increases her marginal product of effort. This is true in versions 2 and 3 because talent decreases the marginal cost of effort, which makes it cheaper for the lawyer to put in more effort to win the case. Although the equilibrium is the same for the full information case, the

conditions under which this full information equilibrium occurs are different. For version 1, the condition is $t_H - t_L \geq 4\beta c / W^2$. For versions 2 and 3, the condition is $1 + 4\beta c / W^2 \leq t_H / t_L$, which can be rearranged (using simple algebra) to $t_H - t_L \geq t_L 4\beta c / W^2$. For version 1, the difference is only determined by the sizes of W , β , and c . In versions 2 and 3, the size of t_L affects the required difference for a separating equilibrium; when t_L is higher, the difference has to be larger; it serves as a multiplier to $4\beta c / W^2$, which is the required difference between the effort levels in version 1. As effort choices reveal type in the full information equilibrium, there is no incentive for mimicry when the difference between t_H and t_L in all three versions is large enough to support a separating equilibrium at the full information effort levels.

Under asymmetric information when these constraints are not fulfilled, we can see that a separating equilibrium can only occur with upward distortion of the threshold effort level to e_H^* so that it will not be profitable for a low-type lawyer to mimic a high-type lawyer. A high-type lawyer will input more effort than her full information equilibrium effort level $e_H^* > e_H^{FI}$ in order to distinguish herself from a low-type lawyer and thereby receive the benefits that come from being believed to be a high type. This model indicates that the ability to signal the lawyer's talent level serves as an incentive itself for exerting higher effort. As a consequence, the more important signaling is (e.g., in the earlier portion of a lawyer's career or when competing for partnership status in a firm), the bigger the implied β is, and thus, the stronger the incentive the future payoff is for a high-type lawyer to exert more effort. For version 1, the separating equilibrium under asymmetric information is $(e_L^*, e_H^*) = (Wt_L / c, (Wt_L + 2\sqrt{\beta c(t_H - t_L)}) / c)$, and for versions 2 and 3, it is $(e_L^*, e_H^*) = (Wt_L / c, (Wt_L + 2\sqrt{t_L \beta c(t_H - t_L)}) / c)$. The equilibrium effort level is increasing in the award at trial, W , and in the return to perceived talent, β ; it is decreasing in

the effort-cost parameter, c . Notice that the distortion required for versions 2 and 3 is less than that of version 1 because t_L is strictly less than one.

IV. Conclusion

In this paper, I have examined three different versions of a model in which a lawyer uses effort on trial preparation to signal her talent. I have characterized the full information equilibrium and determined when this provides a separating equilibrium under asymmetric information. I have further characterized the nature and level of the effort distortion required to signal type when the full information equilibrium does not deter mimicry by the low-talent type. Finally, I have characterized the underlying set of parameters for which my model is valid and for which the separating equilibrium does and does not require distortion of effort away from the full information levels.

This signaling model can also be extended in a couple of ways. One direction is going from a two-type model to a continuum of talent levels. The predicted outcome is that regardless of the number of types, different types of lawyers will choose different corresponding effort levels in a signaling equilibrium. If this is true, then the effort level will reveal the lawyer's type, and a revealing or separating equilibrium can be reached. Another direction for extension is going from a one-lawyer model to a two-lawyer model to see how effort levels change when taking account of the other lawyer in the courtroom (similar to Ferrer's two-lawyer career concerns model). I predict that the strategic interaction will increase signaling effort levels, but this may depend on the specific functional form used to represent the probability of winning at trial.

APPENDIX

Model Version 1 Calculations*A. Finding the Full Information Equilibrium*

The lawyer's payoff under full information is: $u(e,t,t) = W\left(\frac{m+te}{2}\right) - \frac{ce^2}{4} - F + \beta \cdot t$.

Differentiating with respect to e yields: $\frac{\partial u(e,t,t)}{\partial e} = \frac{Wt}{2} - \frac{ce}{2} = 0$. Solving for the equilibrium

effort then yields: $e_i^{FI} = \frac{Wt}{c}$. Thus, the full information equilibrium is given by

$$(e_L^{FI}, e_H^{FI}) = \left(\frac{Wt_L}{c}, \frac{Wt_H}{c}\right).$$

B. Finding the Conditions for a Separating Equilibrium with No Effort Distortion

The incentive compatibility constraints are:

IC_H: $u(e_H^{FI}, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L)$ [since e_H^{FI} maximizes $u(e, t_H, t_L)$, this always holds] and

IC_L: $u(e_L^{FI}, t_L, t_L) \geq u(e_H^{FI}, t_L, t_H)$.

The IC_L implies: $\frac{Wm}{2} + \frac{Wt_L}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4} - F + \beta t_L \geq \frac{Wm}{2} + \frac{Wt_L}{2}(e_H^{FI}) - \frac{c(e_H^{FI})^2}{4} - F + \beta t_H$.

This holds if and only if $\frac{Wt_L}{2}(e_L^{FI} - e_H^{FI}) - \frac{c}{4}[(e_L^{FI})^2 - (e_H^{FI})^2] + \beta(t_L - t_H) \geq 0$.

Substituting $\frac{Wt}{c}$ for e_i^{FI} yields $\frac{Wt_L}{2}\left(\frac{Wt_L}{c} - \frac{Wt_H}{c}\right) - \frac{c}{4}\left[\left(\frac{Wt_L}{c}\right)^2 - \left(\frac{Wt_H}{c}\right)^2\right] + \beta(t_L - t_H) \geq 0$.

Upon collecting terms, this holds if and only if $t_H - t_L \geq \frac{\beta 4c}{W^2}$.

C. Finding a Separating Equilibrium When Effort Distortion is Required

Recall that the low-type's incentive compatibility condition is: $u(e_L^{FI}, t_L, t_L) \geq u(e_H^*, t_L, t_H)$.

This implies that $\frac{Wm}{2} + \frac{Wt_L}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4} - F + \beta t_L \geq \frac{Wm}{2} + \frac{Wt_L}{2}(e_H^*) - \frac{c(e_H^*)^2}{4} - F + \beta t_H$.

Substituting $\frac{Wt_L}{c}$ for e_L^{FI} yields $\left[\frac{W^2 t_L^2}{4c} - \beta(t_H - t_L) \right] - \frac{Wt_L}{2}(e_H^*) - \frac{c(e_H^*)^2}{4} \geq 0$.

Using the quadratic formula to solve for e_H^* yields: $e_H^* = \frac{Wt_L \pm 2\sqrt{c\beta(t_H - t_L)}}{c}$.

Thus, to deter mimicry by the low-type, we have $e_H^* \geq e_{LB} \equiv \frac{Wt_L + 2\sqrt{c\beta(t_H - t_L)}}{c}$ and

$$e_H^* \leq e_{LS} \equiv \frac{Wt_L - 2\sqrt{c\beta(t_H - t_L)}}{c}.$$

Of course, it must also be optimal for the high-type to exert e_H^* . The high-type's incentive compatibility constraint is: $u(e_H^*, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L)$.

$$IC_H \text{ implies: } \frac{Wm}{2} + \frac{Wt_H}{2}(e_H^*) - \frac{c(e_H^*)^2}{4} - F + \beta t_H \geq \frac{Wm}{2} + \frac{Wt_H}{2}(e_H^{FI}) - \frac{c(e_H^{FI})^2}{4} - F + \beta t_L.$$

Substituting $\frac{Wt_H}{c}$ for e_H^{FI} yields $\left[\frac{W^2 t_H^2}{4c} - \beta(t_H - t_L) \right] - \frac{Wt_H}{2}(e_H^*) - \frac{c(e_H^*)^2}{4} \leq 0$.

Using the quadratic formula to solve for e_H^* yields: $e_H^* = \frac{Wt_H \pm 2\sqrt{c\beta(t_H - t_L)}}{c}$.

Thus, to deter mimicry by the low-type, we have $e_H^* \leq e_{HB} \equiv \frac{Wt_H + 2\sqrt{c\beta(t_H - t_L)}}{c}$ and

$$e_H^* \geq e_{HS} \equiv \frac{Wt_H - 2\sqrt{c\beta(t_H - t_L)}}{c}.$$

The value of e_H^* must be inside the interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* must satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Since in this range the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point at which the low-type lawyer is just deterred from mimicry. This is the outcome of using the Intuitive Criterion to refine the set of equilibria (see Mas-Colell, et al., 1995 p. 470).

Thus, the separating equilibrium under asymmetric information is

$$(e_L^*, e_H^*) = \left(\frac{Wt_L}{c}, \frac{Wt_L + 2\sqrt{c\beta(t_H - t_L)}}{c} \right).$$

D. Finding the Probability Constraints When there is No Effort Distortion

Since the plaintiff's probability of winning cannot exceed 1, the parameters of the problem must

satisfy the constraint $\frac{m + te_i^{FI}}{2} \leq 1$. That is $t \leq \sqrt{\frac{(2-m)c}{W}}$, for $t = t_L, t_H$.

E. Finding the Probability Constraint for a Separating Equilibrium Involving Distortion

When the separating equilibrium involves distortion, then the constraint $p(t_H, e_H^*, m) \leq 1$ requires

that $\frac{m + t_H e_H^*}{2} \leq 1$, or $t_H \left(\frac{Wt_L + 2\sqrt{c\beta(t_H - t_L)}}{c} \right) \leq 2 - m$. I now characterize the implicit function

$$\{(t_L, t_H) \mid \frac{m + t_H e_H^*}{2} = 1\} \text{ for } t_L \in \left[\sqrt{\frac{c(2-m)}{W}} - \frac{4\beta c}{W^2}, \sqrt{\frac{c(2-m)}{W}} \right].$$

This is the t_L -range over

which the separating equilibrium must involve distortion.

Step 1: First note that the constraint $\frac{m + t_H e_H^*}{2} = 1$ holds at the point

$$(t_L, t_H) = \left(\sqrt{\frac{c(2-m)}{W}} - \frac{4\beta c}{W^2}, \sqrt{\frac{c(2-m)}{W}} \right) \text{ and } (t_L, t_H) = \left(\sqrt{\frac{c(2-m)}{W}}, \sqrt{\frac{c(2-m)}{W}} \right).$$

Moreover, this

latter point is the only intersection with the 45° since $t_H \left(\frac{Wt_L + 2\sqrt{c\beta(t_H - t_L)}}{c} \right) = 2 - m$ implies

$$\text{that } t = \sqrt{\frac{(2-m)c}{W}}.$$

Step 2: To see that the implicit function has a unique minimum on this t_L -range, differentiate

the constraint $t_H e_H^* = 2 - m$ to obtain: $\frac{\partial(t_H e_H^*)}{\partial t_H} dt_H + \frac{\partial(t_H e_H^*)}{\partial t_L} dt_L = 0$; thus,

$$\left. \frac{dt_H}{dt_L} \right|_{t_H e_H^* = 2-m} = \frac{-\partial(t_H e_H^*)/\partial t_L}{\partial(t_H e_H^*)/\partial t_H}. \quad \text{Notice that } \frac{\partial(t_H e_H^*)}{\partial t_H} = \frac{W t_L}{c} + \frac{2}{c} \sqrt{c\beta(t_H - t_L)} + \frac{2t_H \beta}{\sqrt{c\beta(t_H - t_L)}} > 0.$$

On the other hand, $\frac{\partial(t_H e_H^*)}{\partial t_L} = \frac{t_H}{c} (W - \frac{c\beta}{\sqrt{c\beta(t_H - t_L)}})$. This expression is negative when

$$W < \frac{c\beta}{\sqrt{c\beta(t_H - t_L)}} \quad (\text{that is, when } t_H - t_L < \frac{c\beta}{W^2}) \quad \text{and positive when } W > \frac{c\beta}{\sqrt{c\beta(t_H - t_L)}} \quad (\text{that is,}$$

$$\text{when } t_H - t_L > \frac{c\beta}{W^2}). \quad \text{Thus, when } t_H - t_L < \frac{c\beta}{W^2}, \quad \frac{\partial(t_H e_H^*)}{\partial t_L} > 0 \quad \text{and} \quad \left. \frac{dt_H}{dt_L} \right|_{t_H e_H^* = 2-m} = \frac{-\partial(t_H e_H^*)/\partial t_L}{\partial(t_H e_H^*)/\partial t_H}$$

is negative; the curve is decreasing. When $t_H - t_L > \frac{c\beta}{W^2}$, $\frac{\partial(t_H e_H^*)}{\partial t_L} < 0$ and

$$\left. \frac{dt_H}{dt_L} \right|_{t_H e_H^* = 2-m} = \frac{-\partial(t_H e_H^*)/\partial t_L}{\partial(t_H e_H^*)/\partial t_H} \text{ is positive; the curve is increasing. Thus, the minimum occurs on}$$

the line $t_H = t_L + \frac{c\beta}{W^2}$. This justifies the shape of this constraint as illustrated in Figure 4.

Model Version 2 Calculations

A. Finding the Full Information Equilibrium

The lawyer's payoff under full information is: $u(e, t, t) = W \left(\frac{m+e}{2} \right) - \frac{ce^2}{4t} - F + \beta \cdot t$.

Differentiating with respect to e yields: $\frac{\partial u(e, t, t)}{\partial e} = \frac{W}{2} - \frac{ce}{2t} = 0$. Solving for the equilibrium

effort then yields: $e_t^{FI} = \frac{Wt}{c}$. Thus, the full information equilibrium is given by

$$(e_L^{FI}, e_H^{FI}) = \left(\frac{Wt_L}{c}, \frac{Wt_H}{c} \right).$$

B. Finding the Conditions for a Separating Equilibrium with No Effort Distortion

The incentive compatibility constraints are:

IC_H: $u(e_H^{FI}, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L)$ [since e_H^{FI} maximizes $u(e, t_H, t_L)$, this always holds] and

$$\text{IC}_L: u(e_L^{FI}, t_L, t_L) \geq u(e_H^{FI}, t_L, t_H).$$

$$\text{The IC}_L \text{ implies: } \frac{Wm}{2} + \frac{W}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4t_L} - F + \beta t_L \geq \frac{Wm}{2} + \frac{W}{2}(e_H^{FI}) - \frac{c(e_H^{FI})^2}{4t_L} - F + \beta t_H.$$

$$\text{This holds if and only if } \frac{W}{2}(e_L^{FI} - e_H^{FI}) - \frac{c}{4t_L}[(e_L^{FI})^2 - (e_H^{FI})^2] + \beta(t_L - t_H) \geq 0.$$

$$\text{Substituting } \frac{Wt}{c} \text{ for } e_t^{FI} \text{ yields } \frac{W}{2} \left(\frac{Wt_L}{c} - \frac{Wt_H}{c} \right) - \frac{c}{4t_L} \left[\left(\frac{Wt_L}{c} \right)^2 - \left(\frac{Wt_H}{c} \right)^2 \right] + \beta(t_L - t_H) \geq 0.$$

$$\text{Upon collecting terms, this holds if and only if } 1 + \frac{\beta 4c}{W^2} \leq \frac{t_H}{t_L}.$$

C. Finding a Separating Equilibrium When Effort Distortion is Required

Recall that the low-type's incentive compatibility condition is: $u(e_L^{FI}, t_L, t_L) \geq u(e_H^*, t_L, t_H)$.

$$\text{This implies that } \frac{Wm}{2} + \frac{W}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4t_L} - F + \beta t_L \geq \frac{Wm}{2} + \frac{W}{2}(e_H^*) - \frac{c(e_H^*)^2}{4t_L} - F + \beta t_H.$$

$$\text{Substituting } \frac{Wt_L}{c} \text{ for } e_L^{FI} \text{ yields } \left[\frac{W^2 t_L}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_L} \geq 0.$$

$$\text{Using the quadratic formula to solve for } e_H^* \text{ yields: } e_H^* = \frac{Wt_L \pm 2\sqrt{t_L c \beta (t_H - t_L)}}{c}.$$

Thus, to deter mimicry by the low-type, we have $e_H^* \geq e_{LB} \equiv \frac{Wt_L + 2\sqrt{t_L c \beta (t_H - t_L)}}{c}$ and

$$e_H^* \leq e_{LS} \equiv \frac{Wt_L - 2\sqrt{t_L c \beta (t_H - t_L)}}{c}.$$

Of course, it must also be optimal for the high-type to exert e_H^* . The high-type's incentive compatibility constraint is: $u(e_H^*, t_H, t_H) \geq u(e_L^{FI}, t_H, t_L)$.

$$\text{IC}_H \text{ implies: } \frac{Wm}{2} + \frac{W}{2}(e_H^*) - \frac{c(e_H^*)^2}{4t_H} - F + \beta t_H \geq \frac{Wm}{2} + \frac{W}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4t_H} - F + \beta t_L.$$

Substituting $\frac{Wt_H}{c}$ for e_H^{FI} yields $\left[\frac{W^2 t_H}{4c} - \beta(t_H - t_L) \right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_H} \leq 0$.

Using the quadratic formula to solve for e_H^* yields: $e_H^* = \frac{Wt_H \pm 2\sqrt{t_H c \beta(t_H - t_L)}}{c}$.

Thus, to deter mimicry by the low-type, we have $e_H^* \leq e_{HB} \equiv \frac{Wt_H + 2\sqrt{t_H c \beta(t_H - t_L)}}{c}$ and

$$e_H^* \geq e_{HS} \equiv \frac{Wt_H - 2\sqrt{t_H c \beta(t_H - t_L)}}{c}.$$

The value of e_H^* must be inside the interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* must satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Since in this range the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point at which the low-type lawyer is just deterred from mimicry. Thus, the separating equilibrium under asymmetric information is $(e_L^*, e_H^*) = \left(\frac{Wt_L}{c}, \frac{Wt_L - 2\sqrt{t_L c \beta(t_H - t_L)}}{c} \right)$.

D. Finding the Probability Constraints When there is No Effort Distortion

Since the plaintiff's probability of winning cannot exceed 1, the parameters of the problem must satisfy the constraint $\frac{m + e_t^{FI}}{2} \leq 1$. That is $t \leq \frac{(2-m)c}{W}$, for $t = t_L, t_H$.

E. Finding the Probability Constraint for a Separating Equilibrium Involving Distortion

When the separating equilibrium involves distortion, then the constraint $p(t_H, e_H^*, m) \leq 1$ requires

that $\frac{m + e_H^*}{2} \leq 1$, or $t_H = f(t_L) \equiv \frac{(2-m)^2 c}{4t_L \beta} - \frac{W(2-m)}{2\beta} + t_L \left(\frac{W^2}{4c\beta} + 1 \right)$. I now characterize the

function $f(t_L)$ for $t_L \in \left[\frac{Wc(2-m)}{W^2 + 4\beta c}, \frac{c(2-m)}{W} \right]$. This is the t_L -range over which the separating

equilibrium must involve distortion.

Step 1: First note that the constraint $\frac{m + e_H^*}{2} = 1$ holds at the point $(t_L, t_H) = \left(\frac{Wc(2-m)}{W^2 + 4\beta c}, \frac{c(2-m)}{W}\right)$

and $(t_L, t_H) = \left(\frac{c(2-m)}{W}, \frac{c(2-m)}{W}\right)$. Moreover, this latter point is the only intersection with the

45° since $f\left(\frac{c(2-m)}{W}\right) = \frac{c(2-m)}{W}$.

Step 2: It is easy to see that the implicit function has a unique minimum on this t_L -range since

the function of the probability bound $\frac{m + e_H^*}{2} = 1$ is strictly convex, implying that there is only

one minimum between the t_L -range $\left(\frac{Wc(2-m)}{W^2 + 4\beta c}, \frac{c(2-m)}{W}\right)$. This justifies the shape of this

constraint as illustrated in Figure 5.

Model Version 3 Calculations

A. Finding the Full Information Equilibrium

The lawyer's payoff under full information is: $u(e, t, t) = W\left(\frac{mt + e}{2}\right) - \frac{ce^2}{4t} - F + \beta \cdot t$.

Differentiating with respect to e yields: $\frac{\partial u(e, t, t)}{\partial e} = \frac{W}{2} - \frac{ce}{2t} = 0$. Solving for the equilibrium

effort then yields: $e_i^{FI} = \frac{Wt}{c}$. Thus, the full information equilibrium is given by

$$(e_L^{FI}, e_H^{FI}) = \left(\frac{Wt_L}{c}, \frac{Wt_H}{c}\right).$$

B. Finding the Conditions for a Separating Equilibrium with No Effort Distortion

The incentive compatibility constraints are:

IC_H: $u(e_H^{FI}, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L)$ [since e_H^{FI} maximizes $u(e, t_H, t_L)$, this always holds] and

IC_L: $u(e_L^{FI}, t_L, t_L) \geq u(e_H^{FI}, t_L, t_H)$.

The IC_L implies: $\frac{Wmt}{2} + \frac{W}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4t_L} - F + \beta t_L \geq \frac{Wmt}{2} + \frac{W}{2}(e_H^{FI}) - \frac{c(e_H^{FI})^2}{4t_L} - F + \beta t_H$.

This holds if and only if $\frac{W}{2}(e_L^{FI} - e_H^{FI}) - \frac{c}{4t_L}[(e_L^{FI})^2 - (e_H^{FI})^2] + \beta(t_L - t_H) \geq 0$.

Substituting $\frac{Wt}{c}$ for e_i^{FI} yields $\frac{W}{2}\left(\frac{Wt_L}{c} - \frac{Wt_H}{c}\right) - \frac{c}{4t_L}\left[\left(\frac{Wt_L}{c}\right)^2 - \left(\frac{Wt_H}{c}\right)^2\right] + \beta(t_L - t_H) \geq 0$.

Upon collecting terms, this holds if and only if $1 + \frac{\beta 4c}{W^2} \leq \frac{t_H}{t_L}$.

C. Finding a Separating Equilibrium When Effort Distortion is Required

Recall that the low-type's incentive compatibility condition is: $u(e_L^{FI}, t_L, t_L) \geq u(e_H^*, t_L, t_H)$.

This implies that $\frac{Wmt}{2} + \frac{W}{2}(e_L^{FI}) - \frac{c(e_L^{FI})^2}{4t_L} - F + \beta t_L \geq \frac{Wmt}{2} + \frac{W}{2}(e_H^*) - \frac{c(e_H^*)^2}{4t_L} - F + \beta t_H$.

Substituting $\frac{Wt_L}{c}$ for e_L^{FI} yields $\left[\frac{W^2 t_L}{4c} - \beta(t_H - t_L)\right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_L} \geq 0$.

Using the quadratic formula to solve for e_H^* yields: $e_H^* = \frac{Wt_L \pm 2\sqrt{t_L c \beta(t_H - t_L)}}{c}$.

Thus, to deter mimicry by the low-type, we have $e_H^* \geq e_{LB} \equiv \frac{Wt_L + 2\sqrt{t_L c \beta(t_H - t_L)}}{c}$ and

$$e_H^* \leq e_{LS} \equiv \frac{Wt_L - 2\sqrt{t_L c \beta(t_H - t_L)}}{c}.$$

Of course, it must also be optimal for the high-type to exert e_H^* . The high-type's incentive compatibility constraint is: $u(e_H^*, t_H, t_H) \geq u(e_H^{FI}, t_H, t_L)$.

IC_H implies: $\frac{Wmt}{2} + \frac{W}{2}(e_H^*) - \frac{c(e_H^*)^2}{4t_H} - F + \beta t_H \geq \frac{Wmt}{2} + \frac{W}{2}(e_H^{FI}) - \frac{c(e_H^{FI})^2}{4t_H} - F + \beta t_L$.

Substituting $\frac{Wt_H}{c}$ for e_H^{FI} yields $\left[\frac{W^2 t_H}{4c} - \beta(t_H - t_L)\right] - \frac{W}{2}(e_H^*) + \frac{c(e_H^*)^2}{4t_H} \leq 0$.

Using the quadratic formula to solve for e_H^* yields: $e_H^* = \frac{Wt_H \pm 2\sqrt{t_H c \beta (t_H - t_L)}}{c}$.

Thus, to deter mimicry by the low-type, we have $e_H^* \leq e_{HB} \equiv \frac{Wt_H + 2\sqrt{t_H c \beta (t_H - t_L)}}{c}$ and

$$e_H^* \geq e_{HS} \equiv \frac{Wt_H - 2\sqrt{t_H c \beta (t_H - t_L)}}{c}.$$

The value of e_H^* must be inside the interval $[e_{HS}, e_{HB}]$ and outside the interval (e_{LS}, e_{LB}) . Upon comparing the roots, $e_{LS} < e_{HS} < e_{LB} < e_{HB}$, and by examining the inequalities, we find that the feasible values of e_H^* must satisfy $e_{LB} \leq e_H^* \leq e_{HB}$. Since in this range the high-type lawyer's payoff function is decreasing, the lawyer would continue to reduce her effort level until $e_H^* = e_{LB}$, the point at which the low-type lawyer is just deterred from mimicry. Thus, the separating

equilibrium under asymmetric information is $(e_L^*, e_H^*) = (\frac{Wt_L}{c}, \frac{Wt_L - 2\sqrt{t_L c \beta (t_H - t_L)}}{c})$.

D. Finding the Probability Constraints When there is No Effort Distortion

Since the plaintiff's probability of winning cannot exceed 1, the parameters of the problem must

satisfy the constraint $\frac{tm + e_t^{FI}}{2} \leq 1$. That is $t \leq \frac{2c}{W + mc}$, for $t = t_L, t_H$.

E. Finding the Probability Constraint for a Separating Equilibrium Involving Distortion

When the separating equilibrium involves distortion, then the constraint $p(t_H, e_H^*, m) \leq 1$ requires

that $\frac{mt_H + e_H^*}{2} \leq 1$, or $mt_H + (\frac{Wt_L + 2\sqrt{t_L c \beta (t_H - t_L)}}{c}) \leq 2$. I now characterize the implicit

function $\{(t_L, t_H) \mid \frac{mt_H + e_H^*}{2} = 1\}$ for $t_L \in [\frac{W^2 2c}{(W + mc)(W^2 + \beta 4c)}, \frac{2c}{W + mc}]$. This is the t_L -

range over which the separating equilibrium must involve distortion.

Step 1: First note that the constraint $\frac{mt_H + e_H^*}{2} = 1$ holds at the point

$$(t_L, t_H) = \left(\frac{W^2 2c}{(W + mc)(W^2 + \beta 4c)}, \frac{2c}{W + mc} \right) \text{ and } (t_L, t_H) = \left(\frac{2c}{W + mc}, \frac{2c}{W + mc} \right). \text{ Moreover, this}$$

latter point is the only intersection with the 45° since $mt_H + \left(\frac{Wt_L + 2\sqrt{t_L c \beta (t_H - t_L)}}{c} \right) \leq 2$ implies

$$\text{that } t = \frac{2c}{W + mc}.$$

Step 2: To see that the implicit function has a unique minimum on this t_L -range, differentiate

the constraint $mt_H + e_H^* = 2$ to obtain: $\frac{\partial(mt_H + e_H^*)}{\partial t_H} dt_H + \frac{\partial(mt_H + e_H^*)}{\partial t_L} dt_L = 0$; thus,

$$\left. \frac{dt_H}{dt_L} \right|_{mt_H + e_H^* = 2} = \frac{-\partial(mt_H + e_H^*)/\partial t_L}{\partial(mt_H + e_H^*)/\partial t_H}. \text{ Notice that } \frac{\partial(mt_H + e_H^*)}{\partial t_H} = m + \frac{t_L \beta}{\sqrt{t_L c \beta (t_H - t_L)}} > 0. \text{ On the}$$

other hand, $\frac{\partial(mt_H + e_H^*)}{\partial t_L} = \frac{W}{c} + \frac{\beta(t_H - t_L) - \beta t_L}{\sqrt{t_L c \beta (t_H - t_L)}}$. Since $0 < t_L < t_H \leq 1$, $t_H - t_L$ is never bigger

than 1. As $t_H - t_L$ goes to zero (approaching $(\frac{2c}{W + mc}, \frac{2c}{W + mc})$), $\sqrt{t_H - t_L}$ goes to zero slower

than $t_H - t_L$, and since $t_H - t_L$ is getting smaller and smaller, t_L becomes bigger relative to

$t_H - t_L$. Thus, as $t_H - t_L$ goes to zero, $\frac{\beta(t_H - t_L) - \beta t_L}{\sqrt{c \beta t_L (t_H - t_L)}}$ approaches $-\infty$. This means

$$\frac{\partial(mt_H + e_H^*)}{\partial t_L} < 0, \text{ and } \left. \frac{dt_H}{dt_L} \right|_{mt_H + e_H^* = 2} = \frac{-\partial(mt_H + e_H^*)/\partial t_L}{\partial(mt_H + e_H^*)/\partial t_H} \text{ is positive; the curve is increasing. As}$$

$t_H - t_L$ goes to $\frac{t_L 4\beta c}{W^2}$ (approaching $(\frac{W^2 2c}{(W + mc)(W^2 + \beta 4c)}, \frac{2c}{W + mc})$), $\frac{\beta(t_H - t_L) - \beta t_L}{\sqrt{c \beta t_L (t_H - t_L)}}$

approaches $\frac{W}{2c} + \frac{2\beta}{W}$, which is positive. This means, $\frac{\partial(mt_H + e_H^*)}{\partial t_L} > 0$, and

$\left. \frac{dt_H}{dt_L} \right|_{mt_H + e_H^* = 2} = \frac{-\partial(mt_H + e_H^*)/\partial t_L}{\partial(mt_H + e_H^*)/\partial t_H}$ is negative; the curve is decreasing. Since there is only one

intersection of the constraint with $t_H = t_L$, the above is enough evidence to conclude that there is a minimum in the t_L -range. This justifies the shape of this constraint as illustrated in Figure 6.

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