AN ECONOMIC ANALYSIS OF ALTERNATIVE FEE SHIFTING SYSTEMS*

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I

INTRODUCTION

"Fee shifting" refers to the rules for deciding which party to a lawsuit will pay for the attorney fee costs of the suit.[1] The literature on fee shifting is extensive, and virtually every page of it contains statements or predictions concerning the effects of one fee system or another on the economic behavior of litigants or classes of litigants.[2] Most of these statements are based on intuitive reasoning; with few exceptions,[3] the literature does not contain logically rigorous models of the behavioral patterns that underlie the predictions. This is hardly surprising. It is extraordinarily difficult to model the behavior of litigants. Any attempt to do so quickly makes apparent the large number of more or less arbitrary assumptions that must underlie any firm statement about the effect of one method of fee payment versus another.

This paper sets out to answer with rigor some questions about four distinct fee

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1. For discussion, see Goodhart, *Costs,* 38 YALE L.J. 849, 873-74 (1929); Mause, *Winner Takes All: A Re-Examination of the Indemnity System,* 55 IOWA L. REV. 26 (1969); Nussbaum, *Attorney Fees in Public Interest Litigation,* 48 N.Y.U. L. REV. 301, 312-14 (1973); Comment, *Court Awarded Attorney Fees and Equal Access to the Courts,* 122 U. PA. L. REV. 636, 640-44 (1974); Note, *Attorney Fees: Where Shall the Ultimate Burden Lie?,* 20 VAND. L. REV. 1216, 1218-21 (1967).

2. It is the thesis of this article that litigation decisions can be regarded and analyzed as "economic" behavior. *See generally* R. POSNER, ECONOMIC ANALYSIS OF LAW (2d ed. 1977). For a discussion of the general subject of two-person games, including equilibrium concepts, see R. LUCE & H. RAIFFA, GAMES AND DECISIONS (1957).

3. There have been two previous attempts to attack these questions with rigorous analysis. *See* R. POSNER, *supra* note 2, at 434-40; Shavell, *Suit, Settlement, and Trial: A Theoretical Analysis Under Alternative Methods for the Allocation of Legal Costs,* 11 J. LEGAL STUD. 55 (1982). Neither Posner's nor Shavell's model treats the parties' expenditures on legal resources as endogenous continuous variables. The working paper of Marilyn J. Simon, Incentives and the Allocation of Legal Costs: Products Liability (July 1982) (unpublished manuscript), examines some of the same issues as this article, using a model which determines legal expenditures endogenously. The authors were unaware of Simon's work until after this article was drafted; but where the analyses overlap, Simon reaches conclusions similar to the authors'.

shifting systems: the "British" (loser pays all), the "American" (each party pays own costs), one-way favoring plaintiffs (losing defendant pays all), and one-way favoring defendants (losing plaintiff pays all). The reader will observe that these characterizations of the four systems are already somewhat abstract and stylized.[4]

There are two basic questions that motivate this effort. The first is analytical: What is the effect of these systems on litigation behavior—such as the expenditure on lawyers—of the two parties to a lawsuit? The second question is a derivative policy issue: Which if any of these systems should be adopted as a matter of policy? Answers to the first question are a necessary, but not a sufficient basis for addressing the second. Policymaking requires in addition to analysis, the adoption of an objective or policy goal. The number of possible policy goals here is very large, and no particular alternative is actually adopted in this study; however, the hypothesis that the American system tends to reduce the use of attorneys is examined.

There is another type of question that can be addressed by analytical models such as the one presented below. Why does the American legal system depart so radically (in this respect) from the British? To be sure, British courts have long awarded successful plaintiffs their costs, but by 1796 the American courts had firmly rejected the idea of fee shifting.[5] Why? One possibility is the traditional disrepute in which lawyers have been held in the United States. Lawrence Friedman, in his influential history of the American bar, points out that lawyers in colonial America were regarded with suspicion, as disreputable practitioners of an unnecessary trade.[6] If so, and if early policymakers regarded the "American rule" as likely to reduce overall expenditure on lawyers, then adoption of the rule can be explained in terms of its anticipated economic effects. That is, the early American attitude toward lawyers would logically have supported the adoption of the rule if it were thought that the result would be a reduction on the overall social expenditure on lawyers. That there might be an economic basis for the adoption of a legal rule may seem unlikely, but such an explanation is hardly less convincing than the Supreme Court's effort to provide rationales for the rule:

> In support of the American rule, it has been argued that since litigation is at best uncertain one should not be penalized for merely defending or prosecuting a lawsuit, and that the poor might be unjustly discouraged from instituting actions to vindicate their rights if the penalty for losing included the fees of their opponents' counsel. . . . Also, the time, expense, and difficulties of proof inherent in litigating the question of what constitutes reasonable attorney's fees would pose substantial burdens for judicial administration.[7]

Does the American rule, compared to the British, actually reduce the revenues of lawyers? It is hoped that the analysis set forth below sheds some light on this question.

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4. For example, there are many exceptions in the United States to the "American" rule, and the description of the "British" system ignores the distinction between "party and party" costs and "solicitor and client" costs. *See* R. JACKSON, THE MACHINERY OF JUSTICE IN ENGLAND 518 (7th ed. 1977).

5. *See* Arcambel v. Wiseman, 3 U.S. (3 Dall.) 306 (1796). *See also* Fleischmann Distilling Corp. v. Maier Brewing Co., 386 U.S. 714 (1967).

6. L. FRIEDMAN, A HISTORY OF AMERICAN LAW 81-84 (1973).

7. Fleischmann Distilling Corp. v. Maier Brewing Co., 386 U.S. 714, 718 (1967).

II

ANALYSIS

An economic model of certain aspects of the decision process of the parties to a simple civil lawsuit is now presented to provide some answers to the questions set out above. In order to give the reader some flavor of the sorts of assumptions that must be made and the reasoning that must be used to arrive at rigorous answers, a good deal of formal notation is included in the text. The primary results are stated in the text using this notation, with the formal proofs appearing in the Appendix.

A. The Parties

The facts of the case, the law, and the amount of damages claimed (and not in dispute) are assumed to be known in advance.[8] Let the amount of the damages be represented by W. It is assumed that the parties each have expectations as to the outcome of a trial, expressed in terms of the probability that one side or the other will prevail. It is traditional to assume that this probability depends only on the facts and the law, but it is further assumed in this model that each party believes the outcome depends also on the parties' expenditures on legal services. In particular, it is assumed that each party believes that its chances of prevailing will be improved (at least somewhat) by an increase in its own expenditure on legal services, and diminished (at least somewhat) by an increase in its opponent's expenditure. This is noted formally by defining P to be the probability that the plaintiff will prevail. Of course, $1-P$ is the probability that the defendant will prevail. The function P encompasses the mechanics of the legal system itself, including due process and the relationship between fact and law. The two parties are assumed to have the same perceptions about the way that P depends on x_1, x_2, and m:

$$P = P(x_1, x_2, m)$$

where

x_1 = quantity (hours) of legal services purchased by plaintiff
x_2 = quantity (hours) of legal services purchased by defendant
m = the "merits" of the case.

An increase in x_1 or m will increase P; an increase in x_2 will decrease P.

Legal services are assumed to come in units of uniform quality at a price of $\$f$ per unit. Finally, it is assumed that each party is "risk neutral," seeking merely to maximize the expected net dollar value of the outcome of the litigation. Thus, the problem faced by each party is to choose the level of its own purchases of legal services (x_1 or x_2). The model focuses on the effect on this decision of a change from one to another of the fee shifting rules.

The assumptions made produce a somewhat stylized model of the litigation process. Some, such as the assumptions of risk-neutrality, the absence of an explicit model of settlement, the absence of a model of lawyer-client conflict of interest, and neglect of the problem of party solvency, are undertaken without apology in order to simplify the model and get to the point. Others seem more

8. In other words, there is a dispute as to liability but no dispute as to the amount in question.

serious. What justifies the notion that the outcome of a lawsuit should be modeled as a stochastic process? It is, after all, the purpose of the legal system to reduce uncertainty regarding the lawfulness of various acts. Lawyers, if not laymen, are supposed to be able to predict with some precision what a court will do with a given question because of the court's necessary reliance on precedent. But even in such an ideal world, it must be conceded that there exist three sources of uncertainty as to the outcome of litigation. The first is the likelihood that in a changing world facts arise which have no parallel in the decided cases, or at least no exact parallel. Since judgment in such cases cannot be based precisely on precedent, predictions as to the outcome necessarily rely on imperfect analogies, and such predictions cannot be certain. Second, even leaving aside plain errors of fact, there may in some cases be a degree of latitude allowed to the court which leaves the judgment somewhat unpredictable. Finally, and most important for present purposes, the judicial process is by its nature dependent on the imperfect and incomplete information supplied by the parties. American courts are to a substantial extent dependent on the evidence and the arguments presented by the plaintiff and the defendant in each lawsuit. The quality and completeness of the evidence and the argument (and the briefing on the law) will depend partly on what the parties are willing to spend. Therefore, even if it were admitted that in some idealized judicial system a perfectly well-informed court would always reach the same decision on the same facts, in the real world no court has such perfect information. This justifies the assumption that the outcome of the litigation is stochastic and also the assumption that the outcome depends to some extent on the expenditure of the parties. It is this expenditure that informs the court.

At this stage of the analysis no restrictions are imposed on the shape of P. Nevertheless, some possibilities suggest themselves. For example, it might be reasonable to suppose that increasing expenditure by a party has a diminishing marginal effect on P.[9]

B. The Legal Systems

The next task is to characterize formally the four legal systems; the British, the American, and the one-way systems favoring the plaintiff or the defendant. While the primary motive is to compare the pure British and American systems, it is also useful to test whether a one-way system does what it is supposed to do (such as discourage "frivolous" or "nuisance" suits).

Let V^1 and V^2 be the expected values of the dollar outcome of the litigation for plaintiff and defendant respectively. Then

$$V^1 = WP - fx_1\,(1-bP) - fx_2(k+b)\,(1-P) \tag{1}$$

$$V^2 = -WP - fx_1\,(bP) - fx_2[1 - (k+b)\,(1-P)] \tag{2}$$

In words, equation (1) says that the expected value of the lawsuit to the plain-

9. The parties here agree on what P is, given the equilibrium values of x_1, and x_2. If they also agree on the merits, then there will generally be an incentive to settle. We do not model settlement here. The present results apply, therefore, to fully litigated cases. In a more general model, parties might disagree on the merits and therefore on the value of P, and there would not necessarily exist a range of mutually profitable settlement opportunities.

tiff is equal to the amount of the damages (W) times the probability (P) of collecting them, less the expenses of litigation. The expenses of litigation depend on the plaintiff's own consumption of legal services (x_1), the fee per unit of lawyers' services (f), the probability of winning (P), and the legal rules regarding which party pays (represented by k and b). A similar interpretation applies to the defendant's equation (2).

The general system defined by equations (1) and (2) is "general" because certain values for k and b correspond to the four fee shifting systems that are to be investigated. Other values of k and b correspond to various partial or multiple fee shifting systems that are not investigated here. An intuitive interpretation of the variables k and b is as follows: When $k = 0$, b is the proportion of the winner's legal fees that is shifted to the loser. When $b = 0$, k is the proportion of a winning defendant's legal fees paid by the plaintiff.

Consider, for example, the American system. If $k = b = 0$, then the equations (1) and (2) can be rewritten simply as

$$V^1 = WP - fx_1 \tag{3}$$
$$V^2 = -WP - fx_2. \tag{4}$$

Thus, each side always pays (only) its own legal fees. The plaintiff in equation (3) values the lawsuit at its expected outcome (WP) less its certain attorney's bill(fx_1).

In contrast, to model the British system, let $k = 0$ and $b = 1$. Equations (1) and (2) can then be rewritten as

$$V^1 = WP - fx_1(1-P) - fx_2(1-P) \tag{5}$$
$$V^2 = -WP - fx_1P - fx_2P. \tag{6}$$

In other words, for the plaintiff the expected value of the lawsuit is equal to the expected value of the damages (WP), less the expected value of having to pay his own (if he loses) and his opponent's legal costs. The probability of losing is of course $(1-P)$. A similar analysis applies to the defendant. A successful plaintiff wins W and pays no legal fees, while a successful defendant pays nothing at all.

To model one-way fee shifting favoring defendants, let $k = 1$ and $b = 0$. Equations (1) and (2) can then be rewritten as

$$V^1 = WP - fx_1 - fx_2\,(1-P)$$
$$V^2 = -WP - fx_2P.$$

In words again, the plaintiff's expected value is equal to the expected value of the damages (WP), less its own certain legal costs (fx_1), less the expected value of its opponent's legal costs (fx_2), which the plaintiff will have to pay if it fails, which it will with probability $(1-P)$. In this case, the defendant's situation is not symmetrical. The defendant values the lawsuit at its expected payout ($-WP$), less its expected legal costs, which it pays only if the plaintiff prevails. In order to model one-way fee shifting favoring plaintiffs, let $k = -1$ and $b = 1$ so that for the plaintiff and defendant, respectively

$$V^1 = WP - fx_1\,(1-P)$$
$$V^2 = -WP - fx_1P - fx_2.$$

This completes the formal description of the four legal systems. Before an analysis of the model is performed, it should be noted that under all of the fee shifting schemes considered, payments for legal services are not made on a contingency fee basis. More specifically, payments for legal services are based directly on the amount of legal services used, rather than on some percentage of damages awarded. The issue of contingent fees, while interesting, is beyond the scope of the present investigation. It should also be observed that when the parties both agree on the merit of the case, m, then under all four systems the sum of the expected values to the parties is negative and precisely equal to the sum of the legal expenditures. Therefore, the parties would settle if they could. In this analysis, however, it is assumed that for some reason they cannot agree on a settlement.

C. Analyzing the Model

It is assumed that each party seeks to maximize its own expected value (V^1 or V^2) by manipulating its own consumption of legal services (x_1 or x_2) in light of the facts, the law, the rules regarding fee shifting, and the other party's decision about legal services. Therefore, this analysis employs the standard (Nash) equilibrium concept, which has the property that each of the two parties, knowing what the other has chosen to spend, nevertheless is disinclined to alter its own behavior.

An equilibrium thus consists of choices of x_1 and x_2 such that each party simultaneously optimizes the value of the lawsuit to itself. Formally, this requires that

$$V^i_i(x_1,x_2,W,k,b,f,m) = 0 \qquad i = 1,2 \tag{7}$$

where subscripts indicate partial differentiation. This is nothing more than the requirement that each party has optimized its position in the litigation.

Three basic questions could be asked of the model at this point: What is the effect on each party's consumption of legal services of an increase in the "stakes" (W)? Similarly, what would be the effect on litigation expenditure of a change in the hourly rate (f) of lawyers? Finally, what influence is there on the litigation decision from the variable m, representing the "merits" of the plaintiff's case? These questions are ones about which it is possible to have quite strong intuitive opinions, which can be used to test the plausibility of the model. It would be surprising, for example, if the model predicted that a party would spend more to litigate a smaller claim (other things being equal), or that a party would buy more legal services if its lawyer's hourly rate went up. The article will return to these questions below.

There is a second and more interesting set of questions that can be asked of the model at this point: What happens if the rules regarding who pays the lawyers are changed? That is, for given values of W, f, and m, what changes in overall expenditure would result from a switch from the American to the British system?

The way to examine, for example, the effect of moving from the American system to a one-way system favoring defendants is to ask what sign dx_i/dk (for $i = 1$ or 2) or $d(x_1+ x_2)/dk$ takes on when $b = 0$ and $0 < k < 1$. These derivatives correspond to the slopes of the curves that relate the legal system parameter (k) to the expenditures of the parties (x_i) and their aggregate ($x_1+ x_2$). If this slope is negative, then a change from the American to the one-way system will tend to reduce spending on lawyers; if it is positive, the change increases spending. Similarly, the American and British systems can be compared by examining the sign of dx_i/db and $d(x_1 + x_2)/db$ when $k = 0$ and $0 < b < 1$. In each case, of course, the model keeps x_1 and x_2 at their equilibrium values, given the relevant changes in the rules (i.e., changes in k and b).

To examine the litigation decision itself, imagine that (7) is satisfied and that m (the merits) is varied while the other parameters are held constant. There will be some value of m—call it m^*—such that the expected value to the plaintiff of bringing the lawsuit is just equal to zero. Clearly, if the merits were any less favorable to the plaintiff the case would not be brought. It is now possible to ask what the effect is on m^* of alternative legal systems. For example, would a change from the American to the British system raise or lower the minimum merit that a case must have before a plaintiff will go to court?

No matter what policy objective one might wish to pursue, it is useful to know about the parties' level of expenditure and the minimum merit of their cases. But the analysis can also be used to address economic welfare questions. Which system should be adopted in order to achieve a given policy objective? Obviously there are many possible policies that one might wish to pursue.

D. Some More Assumptions

The assumptions made so far have insulated the model from the complications of reality. These assumptions, especially the absence of any restrictions on the form of P, have made the model quite general. Unfortunately, general models are notoriously difficult ones from which to wring specific results. The object here is to employ the modeler's art to find that minimum of additional special assumptions or restrictions necessary to get the model to say something usefully specific. To that end, attention will be restricted to equilibrium values[10] of x_1 and x_2, and stable equilibria at that.[11] Furthermore, rather than examining the conditions under which an increase in the price of lawyers (f) will lead to a decline in demand for their services, this model will simply assume a downward-sloping demand curve, that is, a reduction in quantity of hours demanded as hourly rates increase. As demonstrated in the Appendix, the assumptions which result in such a demand curve imply upper and lower bounds for V_{12}^1. The sign of V_{12}^1 is of very little intrinsic interest. In short, it is the marginal effect of an increase in the defendant's use of lawyers on the marginal value to the plaintiff of an increase in the plaintiff's use of lawyers. This is not easy to think about. But the sign of V_{12}^1 turns out to be of central importance in deciding, for example, whether a change from the British to the American system will increase or decrease the propensity to bring meritorious small claims, a point on which many commentators have strong intuitive views. If these views can be shown to depend on rather special behavioral assumptions, it will be easier to give them proper weight.

10. The assumption that the parties are in equilibrium may seem somewhat curious, since they may "play the game" only once, and thus have little opportunity to find an equilibrium.

11. Stability means that if the parties are at an equilibrium, a small perturbation will not result in a further movement away from the equilibrium. The meaning and realism of this assumption in the present context are of course debatable.

Restrictions placed on the signs and values of partial and cross-partial derivatives of V^i (for $i = 1$ or 2) correspond to the shape of P, the function that relates legal resource inputs by both parties (and the merits) to judicial output. Students and practitioners are likely to have views based on experience and insight that will provide concrete reasons to restrict the generality of V^i. These restrictions will usually produce more determinate results than the ones derived here on the basis of such abstract restrictions as equilibrium and stability.

E. Some Results

One of the first questions asked above, partly as a check on the plausibility of the model itself, is what effect an increase in the stakes (W) will have on the behavior of the parties. The model provides a sensible answer to this question:

> *Proposition 1: Increasing the Stakes.* Under the assumptions stated in Section D, any increase in W, the amount in dispute, will increase the expenditures by both parties to the lawsuit, and it will do so regardless of what rules apply to fee shifting.[12]

There is, however, a much more interesting result. Recall that the American system is characterized by setting $k = b = 0$, while a system with one-way fee shifting favoring defendants is characterized by $k = 1$ and $b = 0$. Knowing what happens to x_1, x_2 and their sum as k moves from 0 to 1 will indicate what a move from the American system to such a one-way system will do to expenditures on lawyers in a given lawsuit. The *a priori* view is that a system designed to discourage nuisance suits should reduce such expenditures.

> *Proposition 2: American to One-Way Defendant.* Under the assumptions made above, a movement from the American system to one favoring successful defendants will indeed encourage defendants to spend more in their own defense, but it cannot generally be said what the effect will be on plaintiffs. Nevertheless, the total expenditures by the two parties combined will *increase.*[13]

This is a surprising result. It runs counter to intuition. Why should *overall* expenditure on lawyers increase as a result of a policy designed to discourage nuisance suits? The answer, apparently, is that the reduction in the budget inhibitions of defendants more than overcomes the increased caution which may be exhibited by the plaintiffs.

The analogous result for a given lawsuit in a system that favors successful plaintiffs (private antitrust or employment discrimination plaintiffs, for example) is:

> *Proposition 3: American to One-Way Plaintiff.* Under the assumptions made above, a movement from the American system to one favoring successful plaintiffs will encourage plaintiffs to spend more on their cases. The effect on defendants is not predictable. Nevertheless, the total expenditures by the two parties combined will *increase.*[14]

This result seems consistent with *a priori* expectations.

Now let us compare the "pure" alternatives: In the American system everyone pays his own lawyer—win, lose, or draw: $k = b = 0$. The British have full two-way fee shifting: $k = 0, b = 1$. What happens when b goes from zero to one?

12. *See* Appendix for proof.
13. *See* Appendix for proof.
14. *See* Appendix for proof.

Proposition 4: American to British. Having made the assumptions already noted, it is not possible to say in general whether either party individually will spend more or less as a result of adopting the British system. However, expenditures by the two parties combined will be higher under the British than the American system.[15]

It seems that the early American legislators and judges knew what they were doing. The adoption of the American system has the unambiguous effect of reducing the revenues derived by the legal profession from a case. Put another way, from the point of view of economic welfare, the American system of prohibiting fee shifting provides justice more efficiently than the British, by reaching judicial decisions at lower overall social cost.

Finally, consider the effects of the different legal systems on the minimum level of merit of cases that plaintiffs will be induced to bring. Recall that m^* is defined as the *minimum* level of merit that a case must have to be brought at all, given equilibrium levels of the variables x_1^* and x_1^*. That is,

$$V^l(x_1^*, x_2^*, W,k,b,f,m^*) = 0. \tag{8}$$

How does m^* vary as the method of paying lawyers moves from the American to other systems? To see the results, for example, of a shift to a one-way system favoring defendants, set $b = 0$, hold W and f constant, and totally differentiate (8) while noting that $V_1^l = 0$. The result is

$$dm^*/dk = -\frac{V_2^l\, dx_2/dk + V_k^l}{V_m^l} \tag{9}$$

It is known from Proposition 2 that $dx_2/dk > 0$; the Appendix shows that $V_2^l < 0$, that $V_k^l = -fx_2\,(1-P) < 0$, and that $V > 0$, all at equilibrium. Thus, $dm^*/dk > 0$. It follows that any case that would be brought under a one-way system favoring defendants would also be brought under the American system. But the converse is not true. Thus, the effect of adopting a system designed to favor successful defendants is indeed to raise the minimum level of merit of cases and hence to reduce the number of cases brought.

It turns out that the effect on m^* of a change from the American to the British system or even to the one-way system favoring plaintiffs is ambiguous. That is, statements about the relative minimum level of merit of cases brought under the systems are either without foundation or are based on even stronger assumptions than those made in this article.

III

AN ASSESSMENT

It only takes a few months of struggling with an intractable mathematical formulation to engender appreciation for the careful analyst's concern about conclusions based solely on intuition. It has been a major aim of this article to illustrate the sorts of assumptions that necessarily lie behind predictions such as the British

15. *See* Appendix for proof.

system will discourage meritless litigation. Indeed, given the assumptions made here (which were not totally unrestrictive) one cannot say whether it does or not.

In a substantive sense, this article provides one of the first rigorous models of the effects of fee shifting in which expenditure on legal resources is determined within the model, and thus provides a real opportunity to test at the conceptual level the link between the historical prejudice against lawyers and the rule against fee shifting. The two are consistent insofar as for any given case brought to trial the American system results in lower legal expenditures.

IV

FURTHER RESEARCH

Aside from filling out the table, so to speak, by carrying out all the comparisons that are possible, there is a good deal of modeling work that remains to be done. It is fascinating, for example, to consider that values for k and b other than those explored here would lower parties' expenditures even below the levels that would obtain under the American system. More precisely, it is possible that some system of *partial* fee shifting could reduce the overall societal expenditure for resolution of a given dispute even further than under the American system. Indeed, it might even be possible to solve for the fee shifting system that optimizes some less simple-minded concept of social welfare.

There are other directions for potential research, identified in a number of places in the text itself. The model could be extended to include risk-averse or risk-loving behavior on the part of the participants. It would also be interesting to generalize the analysis to instances in which the parties disagree on the size of the stakes or the form of the function indicating the probability that the plaintiff will prevail. These extensions will introduce more generality and hence quite possibly more indeterminacy in the analytic results. It may, therefore, be worthwhile to examine the possibility and plausibility of further restrictions on the functional forms in the structure of the analysis.

TABLE 1

SUMMARY OF RESULTS

	Changing from:		
Item	American to British	American to one-way (def.)	American to one-way (pl.)
Plaintiffs' Expenditures	ambiguous	ambiguous	increase
Defendants' Expenditures	ambiguous	increase	ambiguous
Combined Expenditures	increase	increase	increase
Minimum Merit of Cases	ambiguous	increase	ambiguous

APPENDIX

To aid in the development of the general model, (1) and (2) are rewritten as:

$$V^1 = AP - fx_1 - fx_2(k+b)$$
$$V^2 = -AP - fx_2(1-k-b)$$

where $A = W + fx_1b + fx_2(k+b) > 0$. At a regular interior Nash equilibrium, it must be the case that

$$\text{(A1)} \qquad V^1_1 = AP_1 - f(1-bP) = 0$$
$$V^1_{11} = AP_{11} + 2fbP_1 < 0$$
$$\text{(A2)} \qquad V^2_2 = -AP_2 - f(k+b)P - f[1 - (k+b)] = 0$$
$$V^2_{22} = -AP_{22} - 2fP_2(k+b) < 0$$

where subscripts indicate partial differentiation.

Key to the results which follow are various second order cross-partial derivatives, especially

$$V^1_{12} = AP_{12} + fbP_2 + f(k+b)P_1$$
$$V^2_{21} = -AP_{21} - fbP_2 - f(k+b)P_1 = -V^1_{12}.$$

The following also are used:

$$V^1_{1k} = P_1fx_2 > 0$$
$$V^2_{2k} = -P_2fx_2 + f(1-P) > 0$$
$$V^1_{1b} = fP + fP_1(x_1 + x_2) > 0$$
$$V^2_{2b} = f(1-P) - fP_2(x_1 + x_2) > 0$$
$$V^1_{1w} = P_1 > 0$$
$$V^2_{2w} = -P_2 > 0$$
$$V^1_{1f} = P_1[x_1b + x_2(k+b)] - 1 + bP$$
$$V^2_{2f} = -P_2[x_1b + x_2(k+b)] - 1 + (k+b)(1-P).$$

While V^1_{1f} and V^2_{2f} cannot be signed globally, at equilibrium, (A1) and (A2) must hold so that

$$\text{(A3)} \qquad V^1_{1f} = -WP_1/f < 0$$
$$\text{(A4)} \qquad V^2_{2f} = WP_2/f < 0$$

Proposition 1: $dx_i/df < 0$ if $fdx_i/dW > 0$, $i = 1,2$

Proof: Totally differentiating (A1) and (A2) with respect to f and solving via Cramer's Rule yields

$$dx_1/df = (V^2_{2f}V^1_{12} - V^1_{1f}V^2_{22})/r$$
$$dx_2/df = -(V^1_{1f}V^1_{12} + V^2_{2f}V^1_{11})/r$$

where $r = V^1_{11}\,V^2_{22} - V^1_{12}\,V^2_{21} = V^1_{11}\,V^2_{22} + (V^1_{12})^2 > 0$. In view of (A3) and (A4) these become

$$dx_1/df = W(P_1\,V^2_{22} + P_2\,V^1_{12})\,/rf \equiv WT_1/f$$
$$dx_2/df = -W(P_2\,V^1_{11} - P_1\,V^1_{12})\,/rf \equiv WT_2/f$$

Therefore $dx_i/df < 0$ if $fT_i < 0$. Similarly,

$$dx_1/dW = (V^2_{2w}\,V^1_{12} - V^1_{1w}\,V^2_{22})/r$$
$$dx_2/dW = -(V^1_{1w}\,V^1_{12} + V^2_{2w}\,V^1_{11})\,/r.$$

Substituting for V^1_{1w} and V^2_{2w} yields

$$dx_1/dW = -(P_1 V^2_{22} + P_2 V^1_{12})/r = -T_1$$
$$dx_2/dW = (P_2 V^1_{11} - P_1 V^1_{12})/r = -T_2.$$

Clearly dx_i/df and dx_i/dW are of opposite signs.

Stability: The first order condition $V^1_1 = 0$ defines a *reaction function for the plaintiff* $x_1{}^*(x_2)$. The *inverse* of its slope at any point is given by $R_1 \equiv -V^1_{11}/V^1_{12}$. Similarly, the first order condition $V^2_2 = 0$ defines the *defendant's reaction function* $x_2{}^*(x_1)$, whose slope at any point is given by $R_2 = V^1_{12}/V^2_{22}$. Stability of equilibrium requires that $|R_1| > |R_2|$ or $V^1_{11} V^2_{22} - (V^1_{12})^2 > 0$. Combining this with the assumptions that $dx_i/df > 0$ and $T_i < 0$ produces the key expressions

$$\frac{P_2}{P_1} V^1_{11} > V^1_{12} > \frac{-P_2}{P_1} V^1_{11} \tag{A5}$$
$$\frac{P_2}{P_1} V^2_{22} > V^1_{12} > \frac{-P_2}{P_1} V^2_{22} \tag{A6}$$

Proposition 2: Given stability and $dx_i/df < 0$, $(T_i < 0)$, $i = 1,2$, then $dx_2/dk > 0$ and $d(x_1+x_2)/dk > 0$.

Proof: By a now-familiar process,

$$dx_1/dk = (V^2_{2k} V^1_{12} - V^1_{1k} V^2_{22})/r.$$

Upon substitution, this becomes

$$dx_1/dk = f[(1-P) V^1_{12} - x_2 (P_2 V^1_{12} + P_1 V^2_{22}]/r. \tag{A7}$$

While $dx_1/dk > 0$ if $V^1_{12} \geqq 0$, in general its sign is indeterminate; however, the defendant's case proves more tractable:

$$dx_2/dk = -(V^1_{1k} V^1_{12} + V^2_{2k} V^1_{11})/r \tag{A8}$$
$$dx_2/dk = -f[V^1_{11} (1-P) - x_2(V^1_{11} P_2 - V^1_{12} P_1)]/r > 0$$
$$dx_2/dk = -f V^1_{11} (1-P)/r - x_2 f T_2 > 0$$

Adding (A7) and (A8) and rearranging yields the following:

$$d(x_1 + x_2)/dk = f[(1-P)(V^1_{12} - V^1_{11})]r - fx_2(T_1 + T_2). \tag{A9}$$

The last term of (A9) is positive by hypothesis. The first term has the same sign as $V^1_{12} - V^1_{11}$. Using (A5),

$$V^1_{12} - V^1_{11} > -V^1_{11}((P_2/P_1) + 1) = -V^1_{11}(P_1 + P_2)/P_1$$

Now rearrangement of the first order conditions (A1) and (A2) yields, at equilibrium, the general condition

$$P_1 + P_2 = f[(k+b)(1-P) - bP]/A. \tag{A10}$$

When, as in the present case, $b = 0$, $P_1 + P_2 = fk(1-P)/A > 0$.

Therefore $V^1_{12} - V^1_{11} > 0$ and $d(x_1 + x_2)/dk > 0$.

American to One-Way Plaintiff: This comparison can be made by setting $k = -g$ and $b = g$ so that (1) and (2) become

$$V^1 = WP - fx_1(1-gP)$$
$$V^2 = -WP - fx_1 gP - fx_2.$$

Then $g = 0$ represents the American system and $g = 1$ that favoring plaintiffs. The first order equilibrium conditions are then

$$V^1_1 = WP_1 - f(1-gP) + fx_1 gP_1 = 0$$
$$V^2_2 = -WP_2 - fx_1 gP_2 - f = 0$$

Proposition 3: Given stability and $dx_i/df < 0$, $(T_i < 0)$, $i = 1,2$, $dx_1/dg > 0$, and $d(x_1+x_2)/dg > 0$.

Proof: Using the same techniques as before yields

$$\text{(A11)} \qquad dx_1/dg = -f\left((P + x_1P_1)\, V^2_{22} + x_1P_2\, V^1_{12}\right)/r$$

$$dx_1/dg = -f\left[P\, V^2_{22} + x_1(P_1\, V^2_{22} + P_2\, V^1_{12})\right]/r$$

$$dx_1/dg = -fP\, V^2_{22}/r - x_1T_1f > 0.$$

However,

$$\text{(A12)} \qquad dx_2/dg = -f\left(V^1_{11}\, x_1P_2 - V^1_{12}(P + x_1P_1)\right)/r$$

is positive if $V^1_{12} \geq 0$ but is indeterminate in general. Nevertheless, adding (A11) and (A12) and rearranging yields

$$\text{(A13)} \qquad d(x_1 + x_2)/dg = -f\left((P+x_1P_1)\,(V^2_{22} + V^1_{12}) - x_1P_2(V^1_{11} - V^1_{12})\right)/r$$

Now the last term in (A13), $fx_1P_2\,(V^1_{11} - V^1_{12})/r$, is positive by the argument used to prove Proposition 2. Using (A6), $V^2_{22} + V^1_{12} < V^2_{22}\,(P_1 + P_2)/\,P_2$. From (A10), it can be seen that $P_1 + P_2 = -gfP/A \leqq 0$ when $k = -g$ and $b = g$. Thus, $V^2_{22} + V^1_{12} < 0$ and $d(x_1 + x_2)/dg > 0$.

Proposition 4: Given stability, $k = 0$, and $dx_i/df < 0$, $i = 1,2$, then $d(x_1+x_2)/db > 0$.

Proof: By the usual process, it is determined that

$$dx_1/db = (V^2_{2b}\, V^1_{12} - V^1_{1b}\, V^2_{22})/r$$

which is positive if $V^1_{12} \geq 0$, but ambiguous in general. Also,

$$dx_1/db = -(V^1_{11}\, V^2_{2b} + V^1_{12}\, V^1_{1b})/r$$

is ambiguous; however, adding these together gives

$$d(x_1+x_2)/db = -[V^2_{2b}(V^1_{11} - V^1_{12}) + V^1_{1b}(V^2_{22} + V^1_{12})]/r.$$

Since V^1_{1b} and V^2_{2b} are both positive, the arguments in the proofs of Propositions 2 and 3, respectively, demonstrating that the terms in parentheses are negative, suffice for $d(x_1 + x_2)/db > 0$.

Changes in "merit": To examine how changes in merit affect the expected payoff to the plaintiff, it should be noted that

$$V^1_2 = AP_2 - f(k+b)\,(1-P) = -f - V^2_2$$

which is negative at equilibrium. Also, $V^1_m = AP_m > 0$.