Costly Litigation and Legal Error Under Negligence

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1. INTRODUCTION

In this article, private enforcement under negligence when there is legal error and litigation is costly is examined. Ordover (1978) demonstrated that in a negligence regime in which there is no legal error and litigation is costly, equilibrium requires the presence of actors who refuse to obey the due-care standard. Accordingly, in such a negligence regime, an undercompliance equilibrium must result. Since the existence of litigation costs implies that the socially optimal level of care is greater than that required by the traditional Hand formula, which defines negligence as a failure to take care where the cost of taking care is less than the expected loss if the accident occurs, it is a short step from Ordover's undercompliance result to the conclusion that injurers, under negligence, exercise less than the socially optimal level of precaution (see Hylton).

It is demonstrated that, because of legal error, an undercompliance equilibrium need not result under negligence. In a negligence regime in which courts err and litigation is costly, perfect and overcompliance equilibria are
possible. In such equilibria, the probability of a negligence verdict will simply be the probability that the court erroneously finds the defendant negligent (i.e., the probability of type-2 error). It follows that suits brought in perfect and in overcompliance equilibria may be called “false claims” in the sense that they are brought against nonnegligent defendants. Indeed, the paradox of negligence litigation is that a perfect compliance equilibrium is made possible by the existence of actors who bring suit in the expectation that damages will be awarded because of error.

An implication of this analysis is that legal error may be desirable on second-best grounds in a negligence regime in which litigation is costly. In this model, an equilibrium in which perfect compliance is observed cannot occur unless there is legal error, and, more precisely, unless the probability of type-2 error is positive.

Although a perfect compliance equilibrium is shown to be achievable, it is also shown that underdeterrence results unless the Hand formula is modified to incorporate litigation costs. Whether the equilibrium is one of perfect or overcompliance, negligence, as defined by the traditional due-care standard, fails to provide incentives for all actors to exercise the socially optimal level of care.

In particular, those actors for whom the cost of taking care exceeds the expected losses imposed on others—in other words, those actors who only because of error will be held liable under the traditional due-care standard—never, as a group, have incentives to exercise socially optimal precaution under negligence. The reason is that the traditional due-care standard does not take litigation costs into account. Because of this, there will be some actors among this group for whom taking care is socially desirable, even though the cost of taking care, for such actors, exceeds the expected losses imposed on others. They can be compelled to exercise socially optimal precaution by internalizing society’s costs. But this group bears only the losses of victims who bring suit under negligence, and even then only when type-2 error occurs. Since this is insufficient to align their incentives with the social desirability criterion, negligence fails to compel this type of actor to exercise the socially optimal level of care.

With respect to those actors for whom the cost of taking care falls below the expected losses imposed on others, the optimality of deterrence depends upon the type of compliance equilibrium that is realized under negligence. Negligence compels this type of actor to exercise the optimal level of precau-

3. Generally, the definition of type-2 error depends upon the definition of the null hypothesis. However, this article follows the literature in this area by defining an erroneous decision against the defendant as type-2 error (see, e.g., Polinsky and Shavell).
tion in perfect and in overcompliance equilibria, and less than the optimal level of precaution in an undercompliance equilibrium.

The effects of increases in the probability of error on incentives to sue and to take care are then considered. Because the results depend on the type of equilibrium that occurs under negligence, the effects are shown to be more complicated than is suggested by the recent discussion in Polinsky and Shavell. One result that emerges from this analysis is that in a perfect compliance equilibrium, negligence is robust in its deterrence properties to small changes in the probability of type-1 or type-2 error.

The standard economic analysis of negligence began with John Brown’s model in which litigation was costless and courts never erred. In that model, potential injurers exercised socially optimal precaution because they complied with the due-care standard, which was set at the socially optimal care level.\(^4\)

The standard model was expanded to incorporate costly litigation in Ordover (1978). Generally, taking litigation costs into account introduces several considerations to the analysis of liability rules. First, since litigation costs raise the social costs of accidents, the optimal care level changes when litigation is costly. Second, litigation costs affect the injurer’s incentives to take care, by increasing the losses suffered by an injurer who is sued (assuming such an injurer must bear the cost of bringing suit) and by reducing the incentive of victims to bring suit.\(^5\) Third, because litigation is costly, victims’ incentives to bring suit will depend on their estimate of the probability of winning the suit, as well as on their expected recovery if they win.

The Ordover article examined compliance in a negligence regime in which litigation is costly, and concluded that potential injurers, as a group, undercomplied with the due-care standard. This had to be the result because if all injurers complied or overcomplied, victims would never win a negligence suit. Given that the victim’s rational estimate of the probability of winning should equal the frequency with which injurers are in fact held liable, victims would never have an incentive to bring suit in an equilibrium, such as that in the Brown model, in which injurers complied with the due-care standard. However, if victims never have an incentive to bring suit, injurers will have no incentive to take care.

In this article, the economic model of negligence is expanded further by incorporating costly litigation and legal error.

4. A more general approach is taken in Diamond, which examines a general due-care standard (i.e., one that is not necessarily set at the socially optimal care level). However, if the due-care standard is set at the socially optimal care level, the analysis presented in the Diamond article suggests that an equilibrium in which potential injurers comply with the standard would result.

5. For a discussion of the first two considerations, see Polinsky and Rubinfeld.
2. THE MODEL

2.1. BASIC ASSUMPTIONS

2.1.1. Accident Technology. All actors are assumed to be risk neutral. It is also assumed that victims (plaintiffs) are the only parties who suffer loss from an accident, the risk of loss to victims can be reduced by the exercise of caution by potential injurers (potential defendants), and that it is costly for injurers to take care.\(^6\)

Let \( p \) be the probability of loss if potential injurers do not take care, \( p > 0 \); and \( q \) be the probability of loss if injurers do take care, \( p > q > 0 \). Let \( v \) be the (dollar) loss suffered by an accident victim, \( v > 0 \). The variable \( v \) is assumed to be random, with distribution function \( H(v) \). Specifically, it is assumed that the potential injurer randomly experiences accidents with victims, each of whom is capable of realizing a specific dollar loss, and these losses are distributed over the population in accordance with the distribution function \( H \). Thus, if the potential injurer takes care, the expected loss suffered by victims is \( qE(v) \); and if the injurer does not take care, the expected loss is \( pE(v) \), where

\[
E(v) = \int_0^\infty v \, dH(v).
\]

Let \( x \) be the cost to a potential injurer of taking care, where \( x > 0 \). The variable \( x \) is assumed to be random, with distribution function \( G(x) \). The value of \( x \) is unobservable to potential victims; however, it is observed by the injurer, and is known to him when he chooses whether to take care. The typical injurer will choose not to take care if the expected cost of taking care exceeds the expected cost of not doing so. Thus, unless the injurer is required to pay damages for either committing an offense or failing to take care, precaution will not be exercised.

Victims are assumed to be able to sue for no more than the value of their loss, \( v \). Let \( c_v \) be the litigation cost borne by a victim, \( c_v > 0 \), and \( c_o \) be the litigation cost borne by an injurer in defending himself against a claim, \( c_o > 0 \).

2.1.2. Legal Error. It will be assumed that courts do not have perfect information. Thus, courts are unable to determine accurately in every case whether the defendant, whose behavior gave rise to a lawsuit, acted negligently. With this in mind, let \( \theta_1 \) be the probability of type-1 error (i.e., that the court finds a negligent defendant nonnegligent, \( 0 < \theta_1 < 1 \)); and let \( \theta_2 \)

\(6\) The model is similar to that presented in Hylton, which, in turn, borrows some of its basic features from the model presented in Shavell.
be the probability of type-2 error (i.e., that the court finds a nonnegligent
defendant negligent, 0 < \theta_2 < 1).\footnote{This article treats the probabilities of type-1 and type-2 errors as given, as does Polinsky and Shavell. This assumption is made in order to simplify the model. A more realistic presentation would allow the error probabilities to depend on the level of precaution and the resources invested into altering the probability of error. For a model in which the likelihood of error depends upon the level of precaution, see Craswell and Calfee. The investment of resources into reducing error is discussed in Tullock (1971: 64–75).}

In addition, it will be assumed that courts are sufficiently accurate that 1
- \theta_1 > \theta_2 and, redundantly, 1 - \theta_2 > \theta_1. The former condition requires that
the probability that a negligent defendant will be found negligent exceed the
probability that a nonnegligent defendant will be found negligent; the latter
requires that the probability that a nonnegligent defendant will be found
nonnegligent exceed the probability that a negligent defendant will be found
nonnegligent. The assumption of accuracy is embodied in the following
condition:\footnote{This accuracy condition is assumed in Polinsky and Shavell.}

\[ 1 - \theta_1 - \theta_2 > 0. \] (2)

2.2. STRUCTURE OF NEGLIGENCE REGIME

Suit is brought under negligence when \( wv > c_v \), where \( w \) is the probability
that the jury will find the defendant negligent. Thus, the probability that suit
will be brought after an accident has occurred is \( 1 - H(c_v/w) \).

Under the Hand formula, an actor is negligent if he fails to take care when
\((p - q)E(v) > x\). Any actor for whom \((p - q)E(v) > x\) is potentially negligent,
in the sense that he will be held negligent if his failure to take care leads to
an accident which is followed by a lawsuit which the court decides without
error. It is assumed that victims correctly perceive the probability of a
negligence verdict, and thus are aware of the requirements of the Hand
formula. It is also assumed that victims and injurers know \( \theta_1 \) and \( \theta_2 \).

Each actor will take care when the cost of taking care is less than the cost
of not taking care. Thus, a potentially negligent actor [i.e., an actor for whom
\((p - q)E(v) > x\)] will take care when

\[
x + q[1 - H(c_v/w)][\theta_2E(v|v > c_v/w) + c_o] \\
< p[1 - H(c_v/w)][(1 - \theta_1)E(v|v > c_v/w) + c_o],
\] (3)

where

\[
E(v|v > c_v/w) = \int_{c_v/w}^{\infty} v \, dH(v)/[1 - H(c_v/w)],
\] (4)
is the expected damage award given that the victim brings suit. Condition (3) can be rewritten as follows:

\[ x < [1 - H(c_v/w)][(p(1 - \theta_1) - q\theta_2)E(v|v > c_v/w) + (p - q)c_o], \quad (5) \]

where the left-hand side of (5) is the marginal cost of taking care and the right-hand side is the increase in liability that results from failing to take care. Obviously, when the latter is larger than the former, the potential injurer will take care.9

An actor that is not potentially negligent [i.e., for whom \((p - q)E(v) < x\)] will take care when

\[ x + q[1 - H(c_v/w)][\theta_2E(v|v > c_v/w) + c_o] < p[1 - H(c_v/w)][\theta_2E(v|v > c_v/w) + c_o], \quad (6) \]

or equivalently, when

\[ x < [1 - H(c_v/w)](p - q)[\theta_2E(v|v > c_v/w) + c_o]. \quad (7) \]

Since actors perceive the likelihood of a negligence verdict, \(w\) is

\[ w = s(1 - \theta_1) + (1 - s)\theta_2, \quad (8) \]

where \(s\) is the probability that the injurer is negligent (i.e., potentially negligent and fails to take care), given that an accident has occurred. The first term in (8) is the probability that the defendant is negligent and not found nonnegligent by the court; the second is the probability that the defendant is not negligent but is nevertheless found negligent by the court. Using Bayes’ theorem,10 that probability is expressed as follows:

\[ s = p[g_nq + (1 - g_n)p]^{-1} \times \int_{1-H(c_v/w)\mid[p(1-\theta_1)-q\theta_2]E(v|v > c_v/w)+(p-q)c_o]}^{(p-q)E(v)} dG(x), \quad (9) \]

where \(g_n\) is the probability that a potential injurer will take care under negligence and is given by

9. It should be noted that condition (ii) and the assumption that \(p > q\) guarantee that \(p(1 - \theta_1) - q\theta_2 > 0\).

10. Expression (9) is the probability of a negligence verdict, given that an accident has occurred. If victims are rational, as assumed here, they will update their forecasts of the probability of a negligence verdict using the information that an accident has occurred.
Note that $w$ can be rewritten as

$$w = \theta_2 + (1 - \theta_1 - \theta_2)s. \quad (10)$$

Equilibrium in a negligence regime requires that the probability of a negligence verdict (i.e., $w$) be positive and satisfy (8) or, equivalently, (10). The reason $w$ must be positive is that if it were zero, victims would not bring suit. Of course, if victims refuse to bring suit, injurers would have no incentive to take care, and this could not be an equilibrium (see Ordover, 1978).

2.3. EQUILIBRIUM AND COMPLIANCE WITH DUE-CARE STANDARDS

In this section I examine whether, in an equilibrium under a negligence regime, actors obey the due-care standard. I will describe the results in terms of compliance with the standard. A state of undercompliance exists when there are actors for whom $(p - q)E(v) > x$ and the threat of liability is insufficient to lead them to take care. Overcompliance occurs when the threat of liability causes some actors for whom $(p - q)E(v) < x$ to take care. Perfect compliance is observed when only those actors for whom $(p - q)E(v) > x$ are led by the threat of liability to take care.

A preliminary result should be established at this point.

**Proposition 1.** As long as courts are sufficiently accurate that condition (2) holds, the increase in liability that results from failing to take care is greater for a potentially negligent actor than for one who is not potentially negligent.

To prove this, note that for a potentially negligent actor, the increase in liability that results from failing to take care is given by the right-hand side of (5). For an actor who is not potentially negligent, the increase in liability is given by the right-hand side of (7). It is straightforward to show that the former is larger than the latter if and only if condition (2) holds.

The importance of Proposition 1 will become clear later in the text. However, its basic thrust is that if courts operate with sufficient accuracy, potentially negligent actors have greater incentives to take care than do actors who are not potentially negligent. In this sense, negligence can be said to discriminate between different types of actors. It follows that if courts
are so inaccurate that condition (2) fails to hold, potentially negligent actors may have less incentive to take care than others.\footnote{Specifically, if the inequality in condition (2) is reversed, potentially negligent actors will have less incentive to take care. If the inequality is replaced with an equality, the increase in liability will be the same for both types of actor.}

As noted earlier, an equilibrium value for the probability of a negligence verdict satisfies (8). Plaintiffs will bring suit only if the probability of a negligence verdict is positive. Notice, however, that (8) implies the following compliance equilibrium configurations.

**Proposition 2.** Under negligence, three types of equilibrium are possible: (i) one in which the probability of a negligence verdict exceeds the probability of type-2 error \((w > \theta_2)\) and there is undercompliance; (ii) a second in which the probability of a negligence verdict is equal to the probability of type-2 error \((w = \theta_2)\) and there is perfect compliance; and (iii) a third in which the probability of a negligence verdict is equal to the probability of type-2 error \((w = \theta_2)\) and there is overcompliance.

This is proven by examining (8) and (9). Consider statement (i) of the above proposition first. Note that the probability of a negligence verdict, \(w\), is positive if

\[
(p - q)E(v) > [1 - H(c_o/w)][\{p(1 - \theta_1) - q\theta_2\}E(v|v > c_o/w)] + (p - q)c_o,
\]

\[
(11)
\]

in which case \(s > 0\), and (10) implies that \(w > \theta_2\). But (11) holds if and only if there is undercompliance among potentially negligent actors. Further, given Proposition 1, condition (11) implies that actors who are not potentially negligent will not take care. Thus, the equilibrium is one of undercompliance.

Statement (ii) is true if

\[
(p - q)E(v) \leq [1 - H(c_o/w)][\{p(1 - \theta_1) - q\theta_2\}E(v|v > c_o/w)] + (p - q)c_o,
\]

\[
(12)
\]

and

\[
(p - q)E(v) > [1 - H(c_o/w)](p - q)[\theta_2E(v|v > c_o/w) + c_o].
\]

\[
(13)
\]

Under this set of conditions, only potentially negligent actors will take care. Furthermore, (12) implies that \(w = \theta_2\).
Finally, statement (iii) requires that (12) hold and

\[(p - q)E(v) < [1 - H(c_{o}/w)](p - q)[\theta_{2}E(v|v > c_{o}/w) + c_{o}], \tag{14}\]

where (12) implies \(w = \theta_{2}\). Under this set of conditions all potentially negligent actors will take care and some actors who are not potentially negligent will take care.

This demonstrates that Ordover’s result that a rational expectations equilibrium in a negligence regime requires the existence of actors who refuse to obey the due-care standard does not hold in a regime in which courts err. The reasoning behind Ordover’s proposition is straightforward: if under negligence, all potentially negligent actors [those for whom \((p - q)E(v) > x\)] take care, then no plaintiff will expect to win a lawsuit, so suit will not be brought; however, if suit is not brought, no actor will have an incentive to take care. This argument is no longer valid when it is accepted that courts make mistakes. For in such a negligence regime, plaintiffs will continue to bring suit even when all injurers are obeying the due-care standard. However, because plaintiffs have rational expectations they will in effect know that the probability of a negligence verdict, in a perfect or in an overcompliance equilibrium, is just the probability of type-2 error.

It might be said that all claims brought in perfect and in overcompliance equilibria are “false” or “nuisance” claims. In one sense this must be so because all potentially negligent actors are taking care in such equilibria. However, given that plaintiffs have rational expectations, it seems appropriate to say that, in perfect and in overcompliance equilibria, plaintiffs bring nuisance suits in the sense that their claims are brought in the expectation that damages will be awarded because of error.

This description of suits is not appropriate in an undercompliance equilibrium. For in such an equilibrium, there is a positive probability, from the viewpoint of the plaintiff, that the defendant negligently failed to take care; and since the plaintiff does not observe the injurer’s cost of taking care, it cannot be inferred that plaintiffs are bringing false claims.

It should be noted that Proposition 2 depends on the accuracy condition stated in (2). This implies that perfect compliance is impossible under negligence unless courts achieve a reasonable degree of accuracy. A perfect compliance equilibrium is possible only because the increase in liability that results from failing to take care is greater for potentially negligent actors. Because of this wedge between the marginal liability costs of the two types of injurer, it is possible for an equilibrium to result in which only the potentially negligent have an incentive to take care.

A second implication of Equations (8) and (9) is the following.
Proposition 3. A necessary condition for perfect (or over) compliance is $\theta_2 > 0$.

That is, perfect compliance requires that the probability of type-2 error be nonzero. If the probability of type-2 error is zero, plaintiffs will sue only if the probability that the defendant acted negligently is positive, which cannot happen in a regime of perfect compliance. Thus, complete prevention of type-2 error would eliminate incentives to litigate against defendants who have obeyed the due-care standard, which is the type of litigation that occurs in perfect and in overcompliance equilibria. However, when litigation is costly, prevention of type-2 error would have the less desirable effect of producing a negligence regime in which only an undercompliance equilibrium can result. An additional implication of Proposition 2 is that an overcompliance equilibrium should in principle be distinguishable from an undercompliance equilibrium by comparing the probability of a negligence verdict with the probability of type-2 error.

2.4. Optimality of Care

This section examines whether the care levels of injurers in a negligence regime will be socially optimal.

Given an equilibrium in a negligence regime, taking care is socially desirable if, after the realization of $x$,

12. In theory there are two ways in which type-2 error could be virtually eliminated. One is to make the standard of proof as high as possible: for example, requiring that the evidence prove beyond the slightest doubt that the defendant acted negligently. Negligence verdicts would almost never occur, but the rate of type-2 error would be driven close to zero. A second approach is to make technological improvements in the gathering of evidence: for example, using lie detector tests in court. For discussion of the latter approach, see Tullock (1971: 76–104).

13. I emphasize the presence of litigation costs because the undercompliance result of Ordover depends upon litigation being costly. If litigation were costless, perfect compliance would result. [See, e.g., Ordover (1978, 1981).]

14. Of course, complete prevention of type-2 error is impossible, but continuity implies that the same criticism can be offered for efforts to minimize type-2 error. As $\theta_2$ is driven toward zero, the more likely an undercompliance equilibrium is. Perhaps it should be noted here that instead of treating the probabilities of type-1 and type-2 error as constants, one alternative is to assume that parties attempt to alter these probabilities through investing in litigation. Thus, the plaintiff increases $c_p$ in the hope of maximizing type-2 error, and minimizing type-1 error, and the defendant alters $c_o$ in a manner that maximizes type-1 error and minimizes type-2 error. For the purposes of this article, the interesting implication of such an approach is that under certain conditions the parties can, through investing in litigation, affect the type of compliance equilibrium that emerges under negligence.

15. Craswell and Calfee conclude that overcompliance is likely to be common in "a variety of situations where the uncertainty is relatively small." The results of the model presented in this article may provide a simple way of testing for overcompliance. Tullock (1980: 31–3) estimates that the probability of error is roughly $\frac{1}{2}$. If $\frac{1}{2}$ can be taken to be the probability of type-2 error under a proponderance of the evidence standard, this number might be compared with estimates of the likelihood of a negligence verdict.
\[ pE(v) + p[1 - H(c_v/w)](c_o + c_v) \]
\[ > x + qE(v) + q[1 - H(c_v/w)](c_o + c_v), \]  
(15)  

or, alternatively,

\[ x < (p - q)E(v) + (p - q)[1 - H(c_v/w)](c_o + c_v). \]  
(16)

The right-hand side of (16) is the marginal social cost of failing to take care—or, alternatively, the marginal social benefit of additional care—which is the same whether or not the actor is potentially negligent.

If not all actors for whom taking care is socially desirable have incentives to take care under negligence, it will be said that underdeterrence exists. \textit{Overdeterrence} results when there are actors, for whom taking care is not socially desirable, who are nevertheless led by the threat of liability to take care. \textit{Optimal deterrence} occurs when only those actors for whom taking care is socially desirable take care under negligence.

The following results are implied by Proposition 2 and the preceding comments.

\textit{Proposition 4.} In an undercompliance equilibrium, negligence underdeters.

This is proven by noting that in an undercompliance equilibrium negligence underdeters potentially negligent actors if and only if

\[ (p - q)E(v) + (p - q)[1 - H(c_v/w)](c_o + c_v) \]
\[ > [1 - H(c_v/w)][(p(1 - \theta_2) - q\theta_2]E(v|v > c_v/w) \]
\[ + (p - q)c_o]. \]  
(17)

However, given (11), this condition will obviously hold in an undercompliance equilibrium. In addition, given Proposition 1, actors who are not potentially negligent will also be underdeterred in an undercompliance equilibrium.

\textit{Proposition 5.} In a perfect compliance or in an overcompliance equilibrium, (i) negligence underdeters actors who are not potentially negligent; and (ii) potentially negligent actors take care and, thus, are optimally deterred.

Statement (i) of Proposition 5 is proven by noting that whether the equilibrium is one of perfect or of overcompliance, actors who are not potentially negligent are underdeterred if and only if

\[ (p - q)E(v) + (p - q)[1 - H(c_v/w)](c_o + c_v) \]
\[ > [1 - H(c_v/w)](p - q)\theta_2E(v|v > c_v/w) + c_o]. \]  
(18)
But this reduces to
\[
\int_{c/v}^{\infty} v \, dH(v) \theta_2 < E(v) + (1 - H(c/v, w)) c_v,
\]
which, given the definition of \(E(v)\) in (1), is easily shown to hold.

Statement 2 follows from the definition of perfect and overcompliance equilibria. In both types of equilibrium, actors for whom \(x < (p - q)E(v)\) take care. Since, for such actors, the cost of taking care is less than the social cost of failing to take care, this is efficient.

Note that (17) can be expressed as follows:
\[
\int_{c/v}^{\infty} v \, dH\{[p(1 - \theta_1) - q \theta_2]/(p - q)\} < E(v) + (1 - H(c/v, w)) c_v.
\]

It follows from this that in an undercompliance equilibrium, error can enhance deterrence as long as the difference \(p(1 - \theta_1) - q \theta_2\) is greater than \(p - q\). Since the condition \(p - q < p(1 - \theta_1) - q \theta_2\) is equivalent to \(p \theta_1 < q(1 - \theta_2)\), Proposition 5 implies the following.

**Proposition 6.** If \(p \theta_1 < q(1 - \theta_2)\), then error enhances deterrence in an undercompliance equilibrium.

Thus, if the probability of not being held negligent when one has not taken care \((p \theta_1)\) is less than the probability of not being held negligent when one has taken care \([q(1 - \theta_2)]\), then error enhances deterrence in an undercompliance equilibrium. An alternative way of stating this result is that error cannot enhance deterrence in an undercompliance equilibrium unless the condition of Proposition 6 holds, which places a higher burden of accuracy on courts than does condition (ii).\(^{16}\)

A rather disheartening conclusion follows from Propositions 4 and 5: given the due-care standard defined by the Hand formula, negligence un-

\(^{16}\) The desire to structure rules of criminal procedure in a way that minimizes the risk that an innocent defendant will be convicted has been expressed as an aphorism that it is better that guilty defendants go unconvicted than to convict innocent defendants [see In re Winship, 397 U.S. 358 (1970)]. Although this a model of civil litigation, such a rule could be seen in terms of this model as requiring that \(p \theta_1 < q \theta_2\). This is not inconsistent with the requirement that \(p \theta_1 < q(1 - \theta_2)\). However, there is tension between the two conditions because not all values of \(p \theta_1\) and \(q \theta_2\) that satisfy the former inequality will satisfy the latter. In light of this, deterrence seems to be a questionable argument for sacrificing reductions in the rate at which type-1 error occurs in order to reduce the frequency of type-2 error. See Wittman.
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derdeters. The reason is that actors who are not potentially negligent never have incentives to exercise the socially optimal level of precaution. Now it may be argued that society should not want such actors to take care, since the cost of taking care exceeds the marginal losses imposed on others. However, in a system in which litigation is costly, this understates the social cost of failing to take care; the social cost of failing to take care is the marginal loss imposed on others plus the additional litigation costs imposed on society. Given this, there are actors who are not potentially negligent, under the Hand formula definition of the due-care standard, for whom taking care is still socially desirable. The only way to compel such actors to take care is to internalize the social cost of failing to take care. But this clearly happens at a socially inadequate rate under negligence because the only costs that are internalized to actors who are not potentially negligent are the damages that are awarded because of type-2 error. Since this is far below the level of cost that should be internalized in order to compel such actors to exercise the socially optimal amount of precaution, negligence fails to compel actors who would not be required to take care under the Hand formula to exercise the optimal level of precaution.

The failure of negligence to compel all potential injurers to exercise socially optimal precaution can be corrected by modifying the due-care standard to incorporate litigation costs.\(^\text{17}\) Under such a modified due-care standard, negligence would optimally deter in a perfect compliance equilibrium, and an overcompliance equilibrium would be infeasible. This is demonstrated by observing that because (19) holds, any actor who would not be potentially negligent under the modified due-care standard (i.e., any actor whose precaution cost exceeds the marginal social benefit of additional care) would never take care, whatever the equilibrium. This is a desirable outcome because it is inefficient for such actors to take care. However, potentially negligent actors, given the modified due-care standard, would take care in a perfect compliance equilibrium. This, again, is a desirable result because it is efficient for such actors to take care. Thus, with the due-care standard modified to incorporate litigation costs, optimal deterrence is a feasible outcome under negligence.

It might be asked in light of this discussion whether legal error under negligence really imposes costs on society. The typical discussion assumes that it does,\(^\text{18}\) and assumes that the goal of procedural safeguards should be to minimize legal error subject to relevant constraints. The results of this section suggest that the social desirability of legal error is not so easily

\(^{17}\) In other words, the Hand formula would have to be modified so that it requires a comparison between the cost of taking care (i.e., \(x\)) and the social benefit of additional care, which is \((p - q)E(v) + (p - q)[1 - H(c_0/w)](c_0 + c_i)\).

\(^{18}\) See, for example, Posner (400-1).
determined when litigation costs are taken into account. The social desirability of legal error depends on the desirability of the alternative state in which there is no error. If the state in which there is no legal error is one in which injurers take too little care relative to the social optimum, then legal error may be a desirable feature on second-best grounds.

2.5. Effects on Incentives to Litigate and to Take Care

This section examines the effect of increases in error on incentives to litigate and on deterrence. It should be noted that error can be increased in two ways. One is to alter the technology or process of evidence production or evaluation so that the probability of type-1 or type-2 error increases while the standard of proof is held fixed. The other is to alter the standard of proof. While it is possible to imagine a technological change that alters the probability of only one type of error—for example, subsidizing the defendant's production of evidence—an increase in the standard of proof will reduce type-2 error and increase type-1 error simultaneously. Since the discussion below proceeds as if one type of error can be increased without also altering the other type, it should be understood as implicitly assuming technological change rather than an alteration in the standard of proof. The results, however, can easily be applied to the case in which the standard of proof is altered.

2.5.1. Incentives to Litigate. Recall that under negligence, the probability that suit will be brought is \(1 - H(c_o/w)\). Thus, legal error alters incentives to litigate only through its effect on \(w\).

In light of the foregoing, the effects of error on incentives to litigate depend upon whether the type of equilibrium that results is one of over-, perfect, or undercompliance. In a perfect or an overcompliance equilibrium, \(w = 0_2\); thus,

\[
\frac{\partial w}{\partial \theta_1} = 0,
\]

\[
\frac{\partial w}{\partial \theta_2} = 1.
\]

It follows that in a perfect or an overcompliance equilibrium, an increase in the probability of type-1 error will have no effect on the incentive to litigate, and an increase in the probability of type-2 error will increase the incentive to litigate. The intuition behind this is straightforward. In a perfect or an overcompliance equilibrium the probability of a negligence verdict is the probability of type-2 error. Since this is assumed not to be a function of the
probability of type-1 error, type-1 error is irrelevant insofar as the incentive to bring suit is concerned.

In an undercompliance equilibrium, (9) implies that \( s = s(w, \theta_1, \theta_2) \); where \( \partial s/\partial w < 0 \), because if victims are more likely to sue, potential injurers will, other things equal, take more care; \( \partial s/\partial \theta_2 > 0 \), because if even the innocent will be found guilty, potential injurers will have less incentive to take care; and \( \partial s/\partial \theta_1 > 0 \), because if plaintiffs are less likely to win, because negligent defendants are being found nonnegligent, potential injurers will have less incentive to take care.\(^{19}\)

In an undercompliance equilibrium, the effect of an increase in type-2 error on the probability of a negligence verdict is given by the following expression:

\[
aw = \frac{1 - s + (1 - \theta_1 - \theta_2)\partial s/\partial \theta_2}{1 - (1 - \theta_1 - \theta_2)\partial s/\partial w} > 0.
\]

Thus, in an undercompliance equilibrium an increase in the probability of type-2 error increases the incentive to litigate. An increase in the probability of type-2 error has this effect for two reasons: first, it increases the plaintiff’s likelihood of winning against a given defendant, because some nonnegligent defendants will be found negligent; second, it increases the amount of negligent behavior, thus increasing the probability that a given defendant behaved negligently.

The effect of type-1 error on the probability of a negligence verdict in an undercompliance equilibrium is given by the following expression:

\[
aw = \frac{-s + (1 - \theta_1 - \theta_2)\partial s/\partial \theta_1}{1 - (1 - \theta_1 - \theta_2)\partial s/\partial w},
\]

the sign of which is ambiguous. Thus, in an undercompliance equilibrium, an increase in the probability of type-1 error has an ambiguous impact on the incentive to litigate. Type-1 error has two opposing effects on the incentive to litigate. It lowers the incentive to sue because it increases the probability that the defendant will be found nonnegligent. However, it increases the amount of negligent behavior and, therefore, increases the probability that a given defendant’s behavior was negligent. This increases the incentive to sue. The net effect of type-1 error on the incentive to sue is therefore ambiguous.

The only other study to examine this issue in a theoretical model, Pol-

\(^{19}\) The signs can be proven explicitly using (8) and (9).
insky and Shavell, concluded that type-1 error reduces incentives to litigate, while type-2 error increases incentives to litigate. The reason for this finding was that type-1 errors increase the likelihood that the defendant will prevail, while type-2 errors increase the likelihood that the plaintiff will prevail. The results of the Polinsky and Shavell article are not replicated here because they were derived under the assumption that the probability the defendant acted negligently is unaffected by type-1 and type-2 errors.

2.5.2. Effects on Deterrence. This section examines the effect of an increase in legal error on the probability that a potential injurer will take care under negligence. The conclusion depends on the type of equilibrium that results under negligence.

In an undercompliance equilibrium in a negligence regime, the probability that a potential injurer will be deterred (i.e., led by the threat of liability to take care) is

$$g_n = \int_{0}^{\frac{1}{1-H(c_v/w)[(p_1 - 0) - q_0^2]E(c_v|w > c_v) + (p - q)c_v}} dG(x).$$

(22)

Note that (22) implies $g_n = g_n(w, \theta_1, \theta_2)$; where $\frac{\partial g_n}{\partial \theta_2} < 0$, because an increase in the likelihood that a nonnegligent defendant will be found negligent reduces the incentives of potentially negligent actors to take care; where $\frac{\partial g_n}{\partial \theta_1} < 0$, because an increase in the likelihood that a negligent defendant will be found nonnegligent reduces the incentives of potentially negligent actors to take care; where $\frac{\partial g_n}{\partial w} > 0$, because an increase in the probability of a negligence verdict increases incentives to take care.

In an undercompliance equilibrium, the effect of an increase in type-2 error on the probability that an actor is deterred is given by the following expression:

$$\frac{dg_n}{d\theta_2} = \frac{\partial g_n}{\partial \theta_2} + \frac{\partial g_n}{\partial w} \frac{\partial w}{\partial \theta_2},$$

(23)

the sign of which is ambiguous because the first term in (23) is negative, and the terms multiplied together are both positive. Thus, in an undercompliance equilibrium, the effect of an increase in type-2 error on deterrence is ambiguous because an increase in type-2 error reduces the incentives of potentially negligent actors to take care, but increases the incentives of victims to sue.

The effect of an increase in type-1 error on the probability that an actor is deterred in an undercompliance equilibrium is given by the following expression:
The first term in (24) is negative, the sign of the second term is ambiguous. The reason the sign of the second term is ambiguous is that the sign of $\partial w/\partial \theta_1$ is itself ambiguous, given (21). Thus, in an undercompliance equilibrium, an increase in the frequency of type-1 error has an ambiguous impact on deterrence. The impact of type-1 error is ambiguous because it is unclear whether type-1 error increases or decreases the incentives of victims to sue.

In a perfect compliance equilibrium in a negligence regime, the probability that a potential injurer will be deterred is

$$g_n = \int_0^{(p-q)E(v)} dG(x).$$

(25)

Thus, in a perfect compliance equilibrium, small increases in the probability of type-1 or type-2 error have no effect on deterrence. This is not to say that error is irrelevant insofar as deterrence is concerned. Error is not irrelevant because if the probability of type-2 error were driven to zero, a perfect compliance equilibrium would not be feasible. However, an interesting implication of the divergence (or discontinuity) in marginal liability costs noted in Proposition 1 is that a perfect compliance equilibrium under negligence is fairly robust in its deterrence properties to small changes in the frequency of error.20

In an overcompliance equilibrium in a negligence regime, the probability that a potential injurer will be deterred is

$$g_n = \int_0^{[1-H(c,\beta v)][p-q][\theta_2E(\theta|\alpha>\beta v+c)+\beta]} dG(x).$$

(26)

Note that (26) implies $g_n = g_n(w,\theta_1,\theta_2)$; where $\partial g_n/\partial \theta_1 = 0$, because an increase in the probability of a type-1 error is of no concern to the non-negligent; where $\partial g_n/\partial \theta_2 > 0$, because an increase in the likelihood that a nonnegligent defendant will be found negligent increases the incentives of actors who are not potentially negligent to take care; and where $\partial g_n/\partial w > 0$.

The effect of increases in type-1 and type-2 errors, in an overcompliance equilibrium, are expressed as follows:

20. This is consistent with the analysis of "threshold effects" in Cooter.
Given that $w = \theta_2$ in an overcompliance equilibrium, the sign of (28) is positive. Thus, in an overcompliance equilibrium, an increase in the probability of type-1 error has no effect on deterrence, and an increase in the probability of type-2 error increases deterrence. The reason for this is that the marginal actor (i.e., the one who is almost indifferent as between taking care and not taking care) is, in an overcompliance equilibrium, an actor who is not potentially negligent. For such an actor, type-2 error is the only kind of error that matters, and an increase in type-2 error increases the portion of expected victim losses for which he in effect will be held strictly liable.

The results under the assumption that an undercompliance equilibrium holds are largely in agreement with those of Polinsky and Shavell. However, since their analysis does not reveal that perfect or overcompliance equilibria of the type described here can result, their model does not distinguish the different effects of type-1 error increases in under- and in overcompliance equilibria.

3. CONCLUSION

It has been shown in this article that perfect and overcompliance equilibria can result in a negligence regime in which litigation is costly and courts err. It also has been shown that underdeterrence must result under negligence, unless the Hand formula is modified to incorporate litigation costs.

An implication of this article is that legal error may have desirable second-best properties in a negligence regime in which litigation is costly. Legal

21. Polinsky and Shavell note that type-1 and type-2 errors have an ambiguous effect on incentives to take care because the probability of suit is affected by error. Posner (400-4) and Ehrlich and Posner (262-4) argue that type-1 and type-2 errors reduce incentives to take care. However, the Posner and the Ehrlich and Posner articles fail to take into account the effects of error on the probability of suit.

22. It was noted earlier that an increase in the standard of proof would increase type-1 error and reduce type-2 error simultaneously. The results derived above can be used to examine the effects of an increase in the standard of proof. If $X$ is the standard of proof, then $\theta_1$ and $\theta_2$ are both functions of $X$, where $d\theta_1/dX > 0$ and $d\theta_2/dX < 0$. The effect of an increase in the standard of proof on the probability of negligence verdict is then given by the formula

\[
\frac{dw}{dX} = \frac{\partial w}{\partial \theta_1} \frac{d\theta_1}{dX} + \frac{\partial w}{\partial \theta_2} \frac{d\theta_2}{dX},
\]

which can be used to reach conclusions similar to those derived in the text.
error can offset or counterbalance the tendency of a negligence regime in which litigation is costly to result in undercompliance and undert deterrence (see Ordover, 1978; Hylton). Thus, on deterrence grounds alone (i.e., whether the enforcement regime gives actors incentives to exercise socially optimal precaution), it is unclear whether a negligence regime in which there is no legal error is superior to one in which there is legal error.  

The model developed in this article has also been used to show that the effects of increases in legal error on incentives to sue, and on deterrence, are more complicated than has been suggested in previous analyses. In particular, it is shown that the effects depend on the type of equilibrium that is observed.

REFERENCES


23. Of course, some of this ambiguity can be resolved by assigning social costs to certain types of legal error. For example, one might say that legal error erodes trust in, or respect for, the courts and the rules of civil procedure. Indeed, one of the frequently cited justifications for the rules of criminal procedure is to maintain the appearance of fairness (see, e.g., LaFave and Isreal: 30). As a result of this erosion of respect, people may be led to settle their grievances in ways that generate greater social costs (e.g., investing in protective devices to avoid loss in the first instance, employing less efficient dispute resolution mechanisms, taking revenge).