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**INCENTIVES TO TAKE CARE UNDER  
CONTRIBUTORY AND COMPARATIVE  
FAULT**

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# Incentives to Take Care Under Contributory and Comparative Fault\*

Benjamin G. Ogden and Keith N. Hylton<sup>†</sup>

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## Abstract

Previous literature on contributory versus comparative negligence has shown that they reach equivalent equilibria. These results, however, depend upon an insufficiently granular model of strategic incentives under the Hand Formula that ignores courts' information constraints. Taking information constraints into account, we identify a set of cases where care by one agent significantly increases the benefits of care by the other. When such cases obtain under bilateral harm, comparative negligence generates greater incentives for care, but this additional care occurs only when it is not socially optimal (i.e. "defensive care"). By contrast, under unilateral harm or asymmetric costs of care, contributory negligence creates socially excessive care. Therefore, it is possible to socially rank negligence regimes depending upon the symmetry of potential harm and costs of care. We discuss optimal choice of rules in light of these results.

*JEL Classifications:* K13, K4

*Keywords:* Comparative Negligence, Contributory Negligence, Fault Regimes, Hand Formula, Negligence, Optimal Care, Strategic Complementarity

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# 1 Introduction

For accidental injuries, tort law requires negligence on the part of the defendant for the plaintiff to recover damages. Relatively early in the common law, courts developed the doctrine of contributory negligence, which provided that a plaintiff who was guilty of negligence could not recover damages against a defendant who was also negligent. This put the emphasis on negligence as a standard for sharing the risks associated with care, intended to induce potential tortfeasors to internalize the costs of their actions and engage in socially efficient behavior.

The harshness of the contributory negligence rule led many legislatures (the majority at present) and some courts (for example, Georgia) to soften its impact by introducing a comparative negligence rule. Under comparative negligence, a negligent plaintiff is permitted to recover some percentage of his damages against a negligent defendant, depending on the court's assessment of the degree to which each party's negligence contributed to the cause of the accident (e.g., *Moffitt v. Carroll*, 640 A.2d 169 (Del. 1994)).

One of the most important questions in the economic analysis of law is the extent to which comparative negligence affects deterrence – specifically, the incentive to take care – in comparison to the older rule of contributory negligence. In an important paper that was the first to analyze the incentive question, Brown (1973) found that the contributory negligence rule generated optimal deterrence incentives. However, he concluded that comparative negligence led to suboptimal incentives. This conclusion stood until Haddock and Curran (1985), Cooter and Ulen (1986), and Rea (1987), using more accurate specifications of the comparative negligence rule, showed that incentives for care are optimal under comparative negligence, just as under contributory negligence, when considering cases of bilateral harm (i.e., both parties can be victims). Indeed, Haddock and Curran actually show that comparative negligence may be superior if courts do not have perfect information and therefore make mistakes in assessing negligence, though Bar-Gill and Ben-Shahar (2003) find less support for this argument. A literature begun by Orr (1991) and Chung (1993) further found that this equivalence held in cases of unilateral harm as well. These equivalence results have been incorporated into the major texts on the incentives of torts (e.g., Landes and Posner (1987); Shavell (1987)).

The equivalence results have relied on two major assumptions: one explicit and one implicit. The earlier papers have all assumed that when courts apply the Hand Formula to determine the negligence of a party, they follow a two-step process: first, they determine the global optimal level of care for both parties, and then they determine whether the parties accused of negligence met that level of care. In short, the negligence test is derived from

conditions specifying optimal care levels for each party.

We depart from this standard framework in two respects, allowing us to examine the operation of the negligence test when courts apply the test as framed by the law instead of determining globally optimal care at the outset. First, recognizing that significant discretion is available to plaintiffs over what particular care decisions will be considered in court, we assume plaintiffs explicitly accuse the alleged tortfeasor of some discrete failure to take a precaution, as in Grady (1989) and Feldman and Frost (1998).<sup>1</sup> Second, and more importantly, instead of determining optimal care *ex ante* for all scenarios, as implicit in a theoretically proper application of the Hand Formula, we assume courts apply the test using the localized algorithm framed by the law; examining whether care, a simultaneous decision, is optimal for the injurer assuming that the victim was also taking care. Under this informationally constrained model, richer strategic incentives emerge (encompassing the equivalence results as special cases), which allow for the possibility that the court may find a party negligent, because taking care is optimal given that the other party takes care, even if a lack of care by *both* parties would be the social optimum. Such “defensive care” equilibria have not been suggested in the previous theoretical literature, though empirical evidence suggests that they may be economically significant (e.g., Kessler and McClellan (1996)).

Assuming an informationally constrained application of the Hand Formula may be appropriate for several reasons. First, the localized algorithm is precisely what the law requires judges to apply; nothing in the formal legal test requires or even instructs judges to find the global optimum. Second, even if a judge were to attempt to determine whether the locally optimal care outcome is also jointly optimal for the parties, he or she may simply lack the information or skills necessary to make such a determination. Third, as decisions on a specific and recurrent negligence charge (e.g., is phone use while driving negligent?) accumulate, courts establish precedent to which they try to adhere in future cases and may therefore forgo an effort to calculate optimal care *ex ante* in alternative scenarios. Fourth, in professional malpractice cases, courts generally consult professional norms to determine negligence rather than attempt to determine globally optimal care.<sup>2</sup> These reasons suggest that it is worthwhile to examine the incentives generated by the contributory negligence standard

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<sup>1</sup>We note that discrete care is not necessary for our results. However, the assumption is consistent with most of the torts cases (Grady, 1989), and offers more plausible conditions for some of our results than the continuous care scenario.

<sup>2</sup>For example, a court conducting a contributory negligence evaluation in a medical malpractice case would ask whether it was negligent for the patient not to take care given that the physician complied with the professional custom (see, e.g., *Canterbury v. Spence*, 464 F.2d 772 (D.C. Cir. 1972)). Obviously, professional customs are likely to reflect the same factors examined in the Hand analysis. But the tendency to focus on custom implies a low likelihood that a court would rigorously evaluate optimality under all of the alternatives in a specific dispute. In one rare case where a court rejected the customary approach, *Helling v. Carey*, 519 P.2d 981 (Wash. 1974), its decision was legislatively overruled.

when it is applied not as economists have theorized but as the law actually specifies.

When we frame the application of the Hand Formula as whether the cost of the care under consideration is less than the reduction in expected harm *given that the other party is taking care* (e.g., *McCarty v. Pheasant Run, Inc.*, 826 F.2d 1554, 1557 (7th Cir 1987); *Davis v. Consolidated Rail Corp.*, 788 F. 2d 1260, 1265 (7th Cir. 1986); *Hession v. Liberty Asphalt Products, Inc.*, 235 N.E.2d 17, 22 (Ill.1968); *LeRoy Fibre Co. v. Chicago, Milwaukee & St. Paul Ry.*, 232 U.S. 340, 352 (1914)), we find that there are substantive differences between the two negligence rules driven by the strategic implications of dual care. With unilateral harm, contributory negligence creates weakly greater incentives for care. It achieves strictly greater care when there is a strong strategic complementarity in care, by creating an incentive for the potential victim to take care even when he expects the injurer will not in order to “foist” the residual liability onto the other party. Expecting this behavior, the injurer will also take care, even when it is not socially optimal for *either* party to do so - i.e., we observe defensive care. Therefore, comparative negligence is weakly socially dominant despite having weaker incentives for care, as it forces both parties to share damages in cases where both fail to take care, reducing incentives for foisting.

With bilateral harm, by contrast, it is possible for comparative negligence to have one party “over-internalizing” the potential harms, and hence taking care even when it is not socially optimal if one expects to bear a majority of the burden. Therefore, contributory negligence is weakly socially dominant despite having weaker incentives for care. In other words, it is always optimal to have both parties share risk when neither takes care. Therefore, whether contributory or comparative negligence dominates will depend on what would occur naturally when neither party takes care (i.e., both sharing risk in the case of bilateral harm, or one bearing all the risk in the case of unilateral harm).

The key changes in our results are driven by the strategic implications of dual care, which have received insufficient attention in law and economics models. Most previous comparisons of contributory and comparative negligence missed the possibility of *strategic complementarity*, which allows one party to de facto “create” negligence on the part of a party not taking care. Our emphasis on the strategic behavior of agents formalizes some of the intuitive arguments of Grady (1990), who first identified the phenomenon of “strategic foisting” of liability. Therefore, choice of negligence regime (or of risk sharing within comparative negligence regimes) can dampen excessive care incentives that such foisting creates. Indeed, when costs of care differ greatly, strategic foisting undermines the cheapest-cost-avoider rationale familiar in the literature since Calabresi (1970).

Our results lead to simple recommendations for courts and legislatures when determining which negligence rule is optimal. When bilateral harm obtains and costs of care are

symmetric (e.g., automobile accidents), contributory negligence leads to socially preferable incentives; by contrast, with either unilateral harm or asymmetric costs of care (e.g., medical malpractice), comparative negligence leads to optimal incentives by “creating” symmetry between the agents. When considering the specific question of *how* generally to divide damages conditional on both sides being found negligent, we show that damages should be split based upon cost of care - i.e., those facing higher costs should pay a greater share if neither takes care. Since some legal tests in contract law and even in criminal law depend on a reasonableness inquiry analogous to the Hand Formula, our model has applications beyond the accident law setting.

We note that this is *not* a model of error in application of the Hand test. Courts apply the test accurately in this model, but the localized procedure framed by the test, accurately applied, generates inefficient care equilibria.

In section 2, we discuss a motivating example. Section 3 discusses the general results under bilateral and unilateral harm, respectively, as well as when the costs of care differ. We conclude with a discussion of the relevant case law.

## 2 Example

### 2.1 Bilateral Harm

Consider the case of two drivers on a road, driving in opposite directions. Both want to stay in touch with associates to coordinate plans (e.g., where to meet, to resolve emergencies, etc.), and therefore both would prefer to use their phones to talk or send text messages while driving. Suppose the cost of not using the phone while driving (i.e., taking care) is the monetary equivalent of \$20 to each driver.

Of course, driving without care makes an accident more likely. If both drive without using their phones, there will never be an accident. By contrast, if they both use their phones while driving an accident will be expected to occur  $\frac{1}{4}$  of the time. If only one uses his phone, but the other remains careful, an accident will occur  $\frac{3}{16}$  of the time. Note that under these assumptions care by only one party generates only a modest reduction in the accident likelihood compared to the case where neither party takes care.

Whether or not the two drivers take care will of course be dependent on the expected cost should they get into an accident, and the expected response of a court should an accident occur. Suppose the cost of an accident (or harm) is \$75 to each driver, and the drivers face a contributory negligence regime.

Note that the Hand Formula is met, as the added benefit of care ( $\frac{3}{16} * \$150 = \$28.125$ ) is

greater than the cost of added care. If a driver expects the other driver on the road to take care, he will do so himself. However, if he expects the other not to take care, he only faces expected damages of \$18.75. Therefore, if the other driver is expected to drive negligently, so will the first driver. There are two realistic outcomes: either both parties will drive without care, or neither will.

Which equilibrium is Pareto dominant? Note that if both take care, the total cost is \$40. By contrast, if neither takes care, the expected cost is only \$37.50. Therefore, a utilitarian social planner would prefer driving without care, since the value to the drivers of using their phones outweighs the expected damage to the vehicles.

How would these stories change if the drivers faced a comparative negligence regime? Consider a case where one driver is driving a foreign-made sedan while the other is driving a domestic sports car. In this case, it is still reasonable that expected damage to the two vehicles from an accident would be symmetric (as importing parts from overseas is more expensive, all else equal, than domestic parts, even if those parts are for a sports car), but it is also reasonable that the driver of the sports car expects that, given both were careless, he would still be held more responsible by a jury.<sup>3</sup> In particular, suppose he expects to have to pay 75% of damages if both did not take care.

Obviously, the sedan driver will not take care if he expects sports cars to not take care, since he now faces even smaller damages than in the previous case. However, the sports car driver now has a dominant strategy of not using his phone. Expecting careful coupes, the sedan will also drive carefully, and we now have a unique outcome: both drivers take care.

Therefore, comparative negligence in this case eliminates the efficient equilibrium and leaves only the inefficient defensive care equilibrium. Comparative negligence with sufficiently asymmetric expected fault can actually lead to *too much care*.

Finally, why doesn't the court simply eliminate the inefficient defensive care equilibrium? To do so would require the judge to step beyond what the legal test requires and rank the full-care and no-care outcomes in terms of efficiency, and a judge would have no clear incentive to take on such extra effort. Having applied the test as framed by the law, the judge would have no reason to expend effort to reexamine his conclusion. In addition, if a judge were (perhaps irrationally) to expend the extra effort, ranking outcomes in terms of efficiency would require the judge to know that the equilibrium in which both parties use their phones is superior to that in which both parties refrain from phone use, and there are several reasons a judge may not have or acquire such knowledge. For example, the court may have established an

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<sup>3</sup>The jury, not present at the time of the accident, infers relative responsibility based on objective features of the litigants. Thus, if one driver is in a sports car and the other in a sedan, the jury may infer that the sports car driver has a greater degree of responsibility - and the same is likely to be true if one driver is male and the other female, or if one driver is the active force while the other passive.



earlier precedent, based on different and more numerous cases, that phone use while driving is negligent, and therefore may not examine de novo the efficiency of the outcome in which both sides take care in this case (or, having examined it, may perceive the cost of deviating from precedent as too high). Alternatively, the court may only know a range for the cost of care (e.g., between \$17 and \$20), and would therefore be able to conduct the negligence test accurately while being unable to accurately determine global optimality. Obviously, one could offer variations on each of these explanations to suggest why a court might forgo the effort to rank the efficiency of full-care versus no-care.

## 2.2 Unilateral Harm

Now consider a case of a doctor and patient. If the doctor fails to take care, only the patient will be hurt. Suppose the cost of taking care for each is still \$20, as the patient still needs to follow proper guidelines for his own safety, and the probabilities remain the same as above. Let the cost in extra medical bills, lost time, etc. to the patient be \$150 (keeping the Hand Formula analysis constant).

Again, let us first consider contributory negligence. It is a dominant strategy for the patient to be careful since the doctor would still be found negligent for not taking care. Therefore, the unique outcome is for both the doctor and patient to be careful. Note here, however, that the cost of both being careful (\$40) is larger than the expected cost of not taking care (\$37.50). Therefore, there is actually an inefficient amount of care being exercised - and the doctor's care could be viewed as defensive medicine. The court may fail to eliminate this possible inefficient equilibrium for many reasons: because the law does not require it, or because of information or doctrinal constraints. For example, if the full care equilibrium is consistent with the general medical custom, even though inefficient in this particular case, the court may neglect to evaluate its overall efficiency.<sup>4</sup>

Now consider comparative negligence analysis. In particular, say that a court will find both parties equally at fault if the doctor and patient both failed to take care to avoid an accident. As before, both parties will take care if they expect the other to do so, and therefore the overly careful equilibrium still exists. Now, however, both parties expect to pay only \$75 with probability  $\frac{1}{4}$  if there is an accident, instead of the patient expecting to pay the full \$150. In this case, the expected damage is only \$18.75, which is less than the

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<sup>4</sup>Indeed, suppose the custom itself is determined using the same localized methodology as the Hand test. Then the court clearly would not eliminate the inefficient outcome. Conversely, even if the custom is consistent with the no-care equilibrium, if the court is unlikely to eliminate it because of legal precedent, the excessive care outcome will again be observed, this time with defensive medicine in excess of the custom. According to some commentators, medical practice has been altered by legal precedent which effectively establishes the standard of care in some settings Anderson (1999).

cost. Therefore, a socially optimal equilibrium in which neither party takes care now exists. The splitting of damages under comparative negligence creates an efficient equilibrium by forcing both sides to internalize the cost in cases of unilateral harm.

### 3 General Results

#### 3.1 Care Under Bilateral Harm

We continue with the assumption of a binary care decision. As discussed above, the assumption of a binary care decision is closer to the actual considerations that will be made by courts: was a particular decision to take or not take a precaution socially optimal conditional on the assumption of care given the other actor?<sup>5</sup> Specifically, we will focus on three probabilities:

- $p$  = probability of injury when neither party takes care,
- $\pi$  = probability of injury when only one party takes care, and
- $q$  = probability of injury when both parties take care

For simplicity, let us assume that  $x$  is the cost of care and  $v$  is the expected loss, which are both symmetric for A and B.

When an accident occurs, both parties suffer  $v$ . An actor is negligent, under the Hand Formula, if he fails to take care and  $x < 2(\pi - q)v$ . When both actors take care, each bears the cost  $x + qv$ , because each incurs the cost of taking care and must suffer his own loss if an accident occurs. When one actor does not take care, and the other does, the careless actor bears the cost of his own injury and that of the other if he is found negligent. Thus, the expected cost for a negligent actor, when the other actor takes care, is  $2\pi v$ .

A party will take care, given that he would be negligent if he failed to take care, if  $x < (2\pi - q)v$ . Since  $(2\pi - q) > 2(\pi - q)$ , it follows that any actor who would be found negligent will also take care whenever he expects the other to care. If he would not be found negligent, by contrast, he would never take care since, by construction, the cost of care is less than the *social* value of extra care, which is greater than the *private* value. In order to focus on cases of strategic interests, from this point forward let us assume that the Hand Formula binds.

This brings us to the distinction between contributory and comparative negligence. These fault regimes differ only in their treatment of a lack of care under negligence: contributory

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<sup>5</sup>See Grady (1989) for relevant discussion.

Table 1: Bilateral Harm	Care	No Care
Care	$-qv - x, -qv - x$	$-x, -2\pi v$
No Care	$-2\pi v, -x$	$-pv (-2spv), -pv (-2(1-s)pv)$

negligence requires that both parties pay their own damages in this case, while comparative negligence requires that party A pay some share of the total damages,  $s$ , with B paying the remainder. There is no reason to assume that this  $s$  should necessarily correspond to the level of expected harm avoided should they have taken care.<sup>6</sup> For example, given the causal language often used by courts (e.g., *Moffit v. Carroll*, 640 A.2d 169 (Del 1994)), a jury might draw a distinction between active and passive force in determining the relative damages of two actors, despite the fact that the passive actor may have been just as able to avoid harm.<sup>7</sup> The strategic incentives can be seen in Table 1.

Let us consider three different cases with relation to the probabilities of harm under different levels of care:  $p$ ,  $\pi$ , and  $q$ :

1. Strategic Substitutes:  $\pi < \frac{p+q}{2}$ ,
2. Weak Strategic Complements:  $\pi \in [\frac{p+q}{2}, \frac{p+q}{2} + \frac{q}{2}]$ , and
3. Strong Strategic Complements:  $\pi > \frac{p+q}{2} + \frac{q}{2}$ .

Let us focus for a moment on the meanings of these three possibilities. Strategic substitutes occur when the majority of the benefit of care comes from the move from no one caring to one actor caring: in other words,  $\pi - q < p - \pi$ . Therefore, one party caring lowers the *marginal* benefit of the other party caring. In this way, care by one acts as a substitute for care by the other. Consider the case of a pedestrian, crossing the street, and a car driven at moderate speed; or a car entering a roundabout as another car circles through. As long as one is paying attention, the probability of an accident vastly diminishes; while it would fall still farther if the other paid heed, such additional care would only be mildly effective.

Strategic complements feature the majority of the benefit of care coming when *both* parties take care. In this case, the care by one party substantially increases the marginal benefit of the other taking care. Consider a surgeon and a patient. The surgeon must decide whether to prepare carefully for a surgery, and the patient must decide whether to follow doctor's orders concerning what to eat and drink, medicines to take, and what not to, in

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<sup>6</sup>See discussion in Rea (1987).

<sup>7</sup>In reality, most states apply a modified comparative negligence standard in which there is a threshold that an injurer must reach before she can be found responsible if the other party did not take care. The results in this paper extend to such a framework, which would only rule out cases in which the two regimes are equivalent, but would still allow for the possibility of strategic foisting in cases where the potential injurer expects to be found sufficiently responsible.

the run-up to the procedure. Failure by either will lead to poor consequences, regardless of what the other does. In this way, the efficacy of care rises with the actions of the other.

The differences between strong and weak complements are in how strong this increase is. With strong complements, the care of one party barely diminishes the probability of harm if the other does not take care. Take the case of oncoming traffic: while driving carefully and paying attention reduces the chance of an accident by a little bit, it does very little to prevent a poor driver from rounding a corner carelessly and smashing into you: preventing that outcome requires care by both parties.

In the intermediate case of weak strategic complementarity, care by one party is neither almost sufficient to eliminate the risk, nor of trivial effect. Take the case of drivers moving relatively fast next to bikers on the shoulder of the road. Care by the biker will significantly reduce the likelihood of an accident, but there will remain a substantial risk unless the driver also takes care.

The case of strong strategic complements will be crucial to the analysis within this paper, as it is the ability of one party's care to shift the marginal incentives for care of others that will lead to the differences between these two negligence regimes. Such cases are of significant economic importance.<sup>8</sup> Indeed, the concept of strong strategic complements maps closely to cases of multiple sufficient causes.<sup>9</sup> In such cases, neither party taking care by themselves would prevent an accident, but only the interaction of the care of both would do so.

### 3.1.1 Equivalence

We start with the case of equivalence in incentives to take care:

*Proposition 1: Under bilateral harm, when care is not a strong strategic complement both comparative and contributory negligence generate full care as the unique outcome.*

Recall that the only difference between the two regimes comes in whether an actor takes care given that the other does not take care. Under contributory negligence, this means that an actor will take care, given he expects the other will not, if and only if  $\frac{x}{v} < p$ ; the damages he avoids by caring must outweigh the cost. Note, however, that  $\pi < \frac{p}{2} + q \Rightarrow p > 2(\pi - q)$ . Therefore, whenever the Hand formula binds under non-strong strategic complementarity,

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<sup>8</sup>One important example is *Mahoney v. Beatman*, 147 A. 762 (Conn. 1929). The plaintiff and defendant were driving in opposite directions on a two-lane highway. The defendant carelessly veered over into the oncoming lane, forcing the plaintiff, who had been exceeding the speed limit, to swerve over to the shoulder of the road, damaging his Rolls Royce. The legal issue concerned the division of damages. For our purposes here, Mahoney is an illustration of the classic strong strategic complements scenario.

<sup>9</sup>*Summers v. Tice*, 199 P.2d 1 (Cal. 1948) (two negligent shooters, one victim); *Kingston v. Chicago & Northwest Railway Co.*, 211 N.W. 913 (Wis. 1927) (two negligently-set fires joining and destroying plaintiff's property).

care is a dominant strategy. Therefore, in these cases there is only a unique equilibrium: both parties take care.

Now consider comparative negligence. In this case, one actor will be careful when  $\frac{x}{v} < 2sp$  and the other when  $\frac{x}{v} < 2(1-s)p$ . Note that for there to exist a no-care equilibrium,  $s \in [1 - \frac{x}{2vp}, \frac{x}{2vp}]$ . This is only possible when  $\frac{x}{v} > p$ , which is impossible given the binding Hand Formula. Therefore, at least one actor will always have care as a dominant strategy, and the unique equilibrium of full care obtains.

### 3.1.2 Non-Equivalence

However, as shown in our examples earlier, there are opportunities for differences between comparative and contributory negligence equilibria:

***Proposition 2: When care is a strong strategic complement and  $\frac{x}{v} \in [p, 2(\pi - q)]$ , both symmetric equilibria (care, care and no care, no care) exist under contributory negligence. However, if, under comparative negligence, damages are sufficiently asymmetrically distributed, full care will be the unique outcome.***

First, consider the case when  $\frac{x}{v} < p$ . In this case, since care is a strong strategic complement, the two parties will be found negligent if they do not take care. By the analysis above, we see that under comparative negligence, taking care is always a dominant strategy for at least one, and in the case of contributory negligence, both, parties. Therefore, the unique equilibrium of both is full care.

Now, consider the interim case - i.e., strong strategic complementarity and  $\frac{x}{v} \in [p, 2(\pi - q)]$ . Note that under contributory negligence, due to the large increase in marginal returns when the other is caring, it only becomes worthwhile to take care if the other does so; otherwise, one would not face negligence in court and would only pay their own potential damages. By construction, these damages are less than the cost of care. Therefore, in this area, contributory negligence leads to multiple equilibria: either both care or neither do.<sup>10</sup> Therefore, beliefs, focal points, repetition, etc. come into play in determining the outcome.<sup>11</sup>

By contrast, consider comparative negligence. As described above, there does exist a range of  $s$  such that there is a no-care equilibrium. Note, however, that if  $s > \frac{x}{2vp}$  or  $s <$

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<sup>10</sup>There also exists a mixed strategy equilibrium where the probability of care for each side is  $\frac{x-pv}{(2\pi-p-q)v}$ .

<sup>11</sup>For example, consider the case of drivers choosing their speed on the highway. Through experience, most have learned that the vast majority of other drivers will be going approximately 5-10 miles per hour over the speed limit. Therefore, others can choose to speed (i.e. in our language, not take care) knowing that if they get in an accident, it will likely be with someone also failing to take care. This may be a focal point because mild speeding is a socially optimal outcome. It is reasonable, however, to consider an alternate state of the world in which enough drivers stay under the speed limit that, through learning, *everyone* is incentivized to drive carefully; if they did not, they would risk being found negligent in court. Therefore, questions of repetition which we have left unmodeled would determine the outcome.

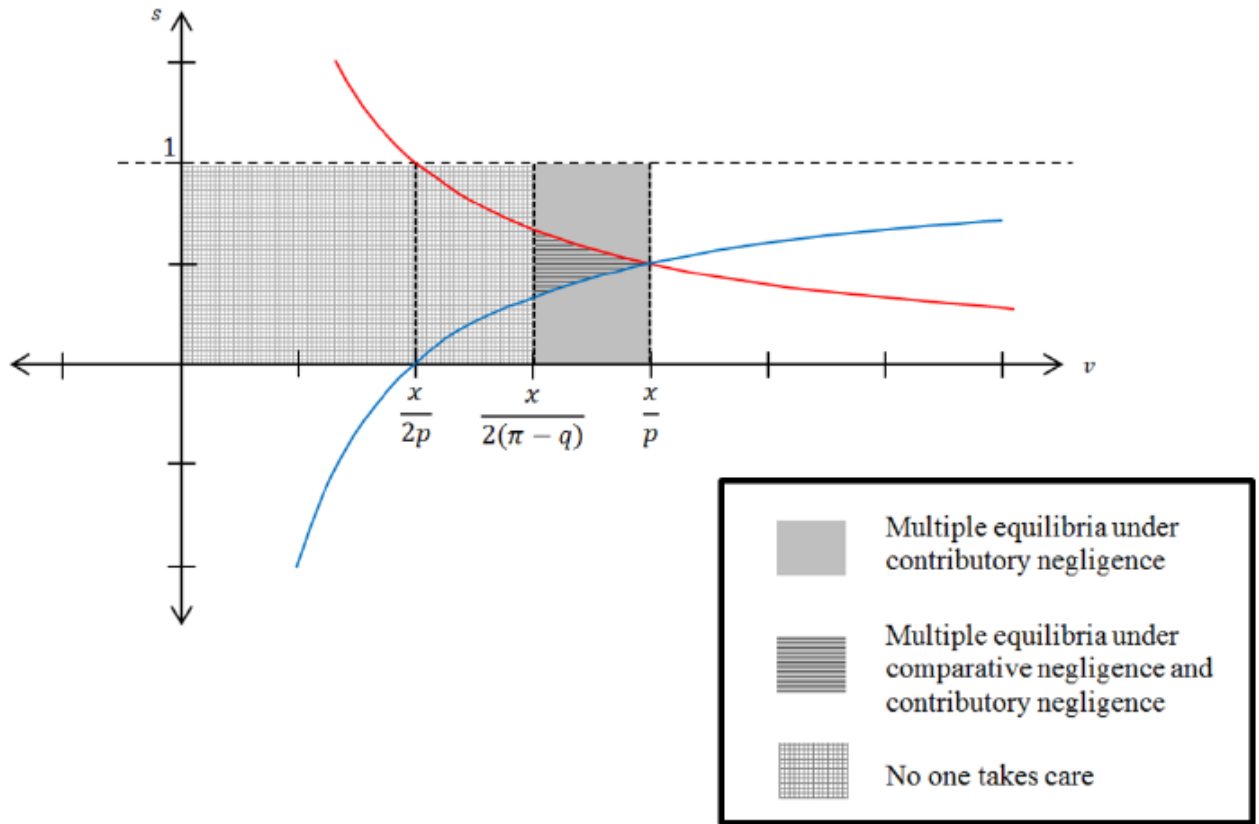


Figure 1: Equilibria under comparative negligence and under contributory negligence for different parameter values.

$1 - \frac{x}{2vp}$ , there will still be one party that prefers to care even when the other is not taking care. This is because he will face more than simply his cost, and therefore will have stronger preferences to avoid paying damages. Note that such a set of  $s$  exists when  $\frac{x}{v} < 2p$ . Since  $2p > 2(\pi - q) > \frac{x}{v}$ , such a set exists. Therefore, if enough of the fault is expected to fall asymmetrically on one party, the unique equilibrium of full care will still obtain, unlike in the contributory negligence case. Figure 1 shows these differences.

Indeed, these two results, taken together, allows us to rank the two forms of negligence in terms of utilitarian efficiency:

***Proposition 3: Under bilateral harm, comparative negligence generates weakly too much care relative to contributory negligence.***

To see this, we simply must look at the only range where the two can derive differing results. Note that, for care to be socially optimal, it must be the case that  $\frac{x}{v} < (p - q)$ . In other words, the cost of care must be less than the expected benefit in terms of reduced harm. However, note that comparative negligence gets different results only if  $\frac{x}{v} > p > p - q$ . Therefore, the two differ only if it is socially optimal for there to be no care. However, recall that the way they differ is that comparative negligence *loses the optimal equilibrium*, instead leading to a unique, full care equilibrium.<sup>12</sup> In other words, while we may still get too much care under contributory negligence, it is at least possible for the optimum to obtain. By contrast, comparative negligence will *always* lead to too much care in this range if too much weight is expected to be placed on one actor, as that agent will take excessive care to avoid any potential lawsuit which would disproportionately place damages on him relative to the victim.<sup>13</sup>

Another way of stating this conclusion is that contributory negligence is socially preferable to comparative negligence under bilateral harm when care exhibits strong strategic complementarity. The reason is that the expected inefficiency due to socially excessive care is greater under comparative negligence.

Intuitively, why should the strategic complementarity or substitutability of care matter? Take the case of strong strategic substitutes. If both agents take care, then, with care being a strategic substitute, one agent's decision to deviate would not dramatically affect the risk. On the other hand, if both agents are not taking care, and then one decides to take care, the effect on risk, and hence liability, is dramatic. It follows that if the Hand Formula (which

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<sup>12</sup>It is worth briefly considering the possibility of differing levels of harm ( $v$ ) where the agent with a smaller  $v$  believes that he is in a case of bilateral harm, while the actor with the larger  $v$  knows that he is more at risk of harm than the other. In other words, information in this setting is asymmetric. For example, one could consider a driver transporting a precious piece of art with near infinite value. For him, care would be a dominant strategy under both contributory and comparative negligence as long as his share of damages is strictly positive. However, since the other actor believes he is playing a different game, he may decide to not take care as per section 3.1 even though care was optimal. In this case, comparative negligence may have done better by ruling out no care as a possibility for the potential tortfeasor. Note, however, that assuming that these cases are vanishingly rare (not many people carry excessively valuable works of art on Sunday drives), we should not design a system around avoiding these outlier cases relative to the more common settings of common knowledge. Indeed, we would expect that drivers would recognize the  $\epsilon$  - possibility of such an event and factor that into the expected harm  $v$  as modeled above.

<sup>13</sup>The possibility has been raised that a court could consider using punitive damages as an alternate means of reaching the social optimum. There are two major reasons we do not consider such proposals here. First, historically, punitive damages have been used by courts in cases of intentional, or very easily preventable, harm. The negligence cases under which the two regimes considered in this case involve unintentional harm that requires a real cost to be prevented. In addition, it is difficult to imagine using punitive damages in these cases since they involve *inefficiently high* levels of care, instead of inefficiently low care. Indeed, to use such a policy here would involve the courts penalizing an injurer for taking care in some circumstances.

Table 2: Unilateral Harm	Care	No Care
Care	$-x, -qv - x$	$-x, -\pi v$
No Care	$-\pi v, -x$	$0 (-spv), -pv \quad -(1-s)pv$

hypothesizes that the other agent takes care) binds, then the agent will surely deviate from the no care outcome under contributory negligence. Conversely, if care is a strong strategic complement, then one agent’s deviation from the full care outcome dramatically affects risk. On the other hand, if both agents are not taking care, one agent’s decision to take care does not affect risk greatly, and so he may not have an incentive to deviate from the full no-care outcome.

We provided a numerical illustration of the strategic complementarity case in Part 2.1, discussing phone use while driving, where  $q = 0$ ,  $p = \frac{1}{4}$ , and  $\pi = \frac{3}{16}$ . Phone use (especially sending text messages) while driving would appear to be a case that often exhibits strategic complementarity, since care by only one party is likely to yield at most a modest reduction in the likelihood of an accident relative to the full no-care scenario. Recall that in that illustration both full care and full no-care are equilibria under contributory negligence. However, under comparative negligence, with damages split 75-25, the full care equilibrium is unique.

### 3.2 Care Under Unilateral Harm

Let us now consider the case of unilateral harm. This has been more central to recent analysis of differing fault regimes, as it encompasses an even wider range of negligence cases where the decision to take care by one individual/group has nothing but an externality effect on the other party (i.e., there is no direct benefit to herself of the individual taking care). In many ways, these are the cases that are of greater interest to researchers, as they entail one party who would *never* take care in the absence of an intervening court regime. In this case, party A has zero probability of being harmed regardless of the care decision. This change is shown in Table 2.

Unilateral harm changes the relationship between contributory and comparative negligence. Under bilateral harm, contributory negligence already had expected damages shared between the two parties if neither (or both) took care; therefore, comparative negligence only has the potential to lead to asymmetries in expected damage amounts paid between the two agents. By contrast, under unilateral harm, contributory negligence behaves as strict liability for the victim if neither takes care. This means that one agent is already bearing the whole burden, while under comparative negligence they are sharing the burden in some way. As expected, this change will drive the differences between the regimes in these two



cases.<sup>14</sup>

**Proposition 4:** *Under unilateral harm, when care is not a strong strategic complement there is no difference in equilibria between comparative and contributory negligence.*

The proof of proposition 4 is simply a corollary of proposition 1 and is left to the reader.

This equivalence changes with strong strategic complements. In contrast to the case with bilateral harm, unilateral harm makes it possible for comparative negligence to actually generate multiple equilibria in comparison to a unique care outcome of contributory negligence. In particular,

**Proposition 5:** *Under unilateral harm, when care exhibits strong strategic complementarity,  $\frac{x}{v} \in [\frac{p}{2}, \pi - q]$ , and  $s \in [1 - \frac{x}{vp}, \frac{x}{vp}]$ , comparative negligence generates both no care and full care equilibria, while contributory negligence generates only the full care equilibrium.*

This comes directly from the discussion above. Contributory negligence only generates full care because the benefit of care is fully internalized into the single potential victim, leading him to always be willing to take care even when the injurer does not. Since the injurer knows that the victim will always take care, he needs to take care in order to avoid being found negligent. By contrast, if courts have the two divide fault evenly when neither takes care, there will no longer be an incentive to care on the part of the victim if he expects the injurer to not take care. He knows that the court will require the injurer to at least partially compensate the damages. Therefore, unlike the above analysis, comparative negligence actually leads to weakly less care.

As above, however, this is a range in which it would be better to receive no care. In particular, full care is preferable to no care if and only if  $\frac{x}{v} < \frac{p-q}{2}$ . Since  $\frac{p-q}{2} < \frac{p}{2}$ , society prefers the no care equilibrium in the range described above.

**Proposition 6:** *Under unilateral harm, contributory negligence gives weakly too much care compared to comparative negligence.*

Again, comparative negligence is socially preferable to contributory negligence under unilateral harm when care exhibits strong strategic complementarity. The expected inefficiency due to socially excessive care (overdeterrence) is greater under contributory negligence.

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<sup>14</sup>A point that has been raised is that we could imagine courts abstracting away from the distinction between comparative and contributory negligence and instead simply think of choosing a split in damages ( $s$ ) in some form of optimal way. For example, our results here show that an  $s$  of close to  $\frac{1}{2}$  is always optimal under the current application of the Hand Formula; later we will (implicitly) show that an  $s$  of close to 1 or 0 is optimal under bilateral harm. Nothing prevents the reader from interpreting our results in this way, but we maintain the language of contributory and comparative negligence in order to both stay in line with the previous literature and make recommendations which will be of clear uses to courts within the current climate.

It is important to note that, by one interpretation, this result is stronger than proposition 3. Note that the preference for contributory negligence when both parties can be harmed comes from the possibility that, under comparative negligence, one party will believe that he will be found more at fault if both similarly behave without care. However, while this is possible, as described in the simple example above, it relies on a form of court preference for punishing one group over the other despite the fact that, based solely on the model, both were equally at fault in terms of harm avoidance.

In contrast, this result relies on the fact that the two parties will be found by the court to be relatively equally at fault. Therefore, when there is one victim and one injurer, it is key to achieving the optimal equilibrium that the victim and injurer will be found roughly equal in fault, which is consistent with the actual fault caused within the model. Indeed, if agents always expect to split damages equally when they are both found at fault under comparative negligence, then the two will be identical with two victims and comparative negligence will be preferable with a single victim.

The difference in these results is driven by the fact that the two parties already share risk equally under contributory negligence with bilateral harm; therefore, comparative negligence can only serve to make risk less equally shared and leads to an over-internalizing of potential harm without taking into consideration the strategic effects of added cost via incentivizing the other party to take care. By contrast, under unilateral harm, the harms are already fully internalized by one party (the victim) who will not take into consideration the potential costs to the injurer of care when she decides to be careful herself, thereby setting up a potential negligence suit. In this case, comparative negligence can serve to more properly divide the risk of harm between the two agents, preventing either from taking too much care.

### 3.3 Differing Costs of Care

The same analysis can be extended to an asymmetry in costs instead of an asymmetry in potential harm. In such a setting, just as with unilateral harm, one party who can take care without much cost may do so under contributory negligence since he receives the benefit of pushing all of the damages onto the other, potentially negligent actor if they believe that the other will not take care. This would lead to potentially excessive care as the other agent now needs to take care to avoid being found negligent and saddled with the joint damages. Although this seems to contradict the old intuition, dating back to Calabresi (1970) that the “cheaper cost avoider” should take care, here the equilibrium expectation of the cheaper avoider’s taking care induces the other agent to take care, leading to inefficiency. In this case, comparative negligence can be used to preclude the inefficient outcome by having the

Table 3: Asymmetric Costs of Care	Care	No Care
Care	$-qv - x_1, -qv - x_2$	$-x_1, -2\pi v$
No Care	$-2\pi v, -x_2$	$-pv (-2spv), -pv (-2(1-s)pv)$

agent who can take care with lower cost pay less than his “share” of damages.

To see this, first note that, as with the standard case, there are no differences unless care is a strong strategic complement and both parties would be found negligent (i.e.,  $\frac{\max\{x_1, x_2\}}{v} < 2(\pi - q)$ ). Therefore, we can focus solely on whether the no care equilibrium exists under this appropriate set. Under contributory negligence, a no care equilibrium will exist in this setting if and only if  $\frac{\min\{x_1, x_2\}}{v} > p$ . By contrast, under comparative negligence a no care equilibrium will exist iff  $\frac{x_1}{v} > 2sp$  and  $\frac{x_2}{v} > 2(1-s)p$ . In other words, it will exist if and only if  $s \in [1 - \frac{x_2}{2vp}, \frac{x_1}{2vp}]$ ; such an  $s$  exists iff  $\frac{x_1+x_2}{2v} > p$ . It’s easy to see that this means that no care is supportable for a greater range of  $\frac{x}{v}$  than under contributory negligence, since only the *average* cost of care needs to be greater than  $pv$ , not the minimum cost. Note that no care is optimal if and only if  $\frac{x_1+x_2}{v} > p-q$ ; therefore, these potential added no care equilibria would be socially optimal.

***Proposition 7: Comparative negligence has stronger incentives for optimal care if the average cost of care exceeds the average expected harm when no one takes care. Contributory negligence has stronger incentives for optimal care otherwise.***

Note that this means that for comparative negligence to be socially optimal, it is sufficient that  $s \in [1 - \frac{x_2}{x_1+x_2}, \frac{x_1}{x_1+x_2}]$ . This means that the party that faces a higher cost of care must face a higher share of damages. This helps to alleviate the incentive for excessive care by allowing the two agents to share risk more efficiently. Under contributory negligence, the actor with the lower cost still faces the same private value of care and will therefore take care and create a potentially negligent situation for the higher cost actor. By having that agent pay a smaller share of the total damages, the two parties will now be taking similar decisions and are less likely to distort the incentives of the other with their private actions. As with unilateral harm, comparative negligence serves a role of aligning incentives between two ex ante asymmetric agents.

Having concluded equilibrium analysis of different scenarios under both negligence regimes, Table 4 provides the recommendations for which regime courts should prefer within each. In Appendix A, we consider a potential modification to the way that the courts apply the Hand Formula which could, in some circumstances, alleviate the concerns raised here.

Table 4: Optimal Negligence Regimes	Preferred Negligence Regime	Optimal Risk Sharing
Unilateral Harm	Comparative Negligence	Equitable ( $s = \frac{1}{2}$ )
Bilateral Harm (w/ Symmetric Costs of Care)	Contributory Negligence	Equitable ( $s = \frac{1}{2}$ )
Bilateral Harm (w/ Asymmetric Costs of Care)	Comparative Negligence	More risk on high cost avoider ( $s \neq \frac{1}{2}$ )

## 4 Discussion

As we noted, one of the features distinguishing this model from the earlier literature is our use of the legal test for contributory negligence as stated by courts and actually implemented in the cases. Much of the previous literature has instead assumed negligence is determined by a finding of care below globally optimal levels, denoted  $x^*$  and  $y^*$  (e.g., Landes and Posner (1987)). This approach, however, incorporates assumptions that are questionable as descriptions of how courts operate. Nothing in the negligence test requires courts to discover globally (as opposed to locally) optimal care, so it unclear why a court would try to do so. The standard approach also ignores the binding role of precedent on questions that reappear before courts, or the binding effect of custom in professional malpractice. Lastly, it assumes that courts have sufficient information to determine globally optimal care.

Although our approach may seem peculiar at first glance, it is actually a relaxation of the approach of the previous literature. Instead of assuming that courts (1) apply the contributory negligence standard and (2) also filter out inefficient equilibria, our model allows us to examine incentives when courts stop at the first step or fail to carry out the second step competently. This additional flexibility generates defensive care outcomes that do not appear in previous models. Indeed, this model provides a positive theory of defensive medicine, a phenomenon that has been demonstrated empirically (e.g., Kessler and McClellan (1996) and DeKay and Asch (1998)) but is otherwise puzzling within the standard model of negligence.

Another feature distinguishing this model is our description of the technology of joint care in terms of strategic complementarity or substitutability. Under strong strategic complementarity, if no one is taking care, one person's decision to take care does not have a dramatic impact on risk of accident; both sides need to take care to substantially affect risk. Outside of the case of strong strategic complementarity, contributory negligence and comparative negligence are indistinguishable in terms of equilibrium care. Differences are observed when care is strongly strategically complementary.

In the bilateral harm case we've shown that comparative negligence can enhance incentives to take care relative to contributory negligence, which is somewhat of a surprise given that Brown (1973) had concluded that comparative negligence reduces care incentives rela-

tive to contributory negligence, and the literature correcting Brown suggested that the two regimes are equivalent in care incentives (with perfect information courts). In this model, care incentives under bilateral harm are equivalent except in the case of strong strategic complementarity. In that special case, comparative negligence generates greater care incentives, when care costs are roughly the same on both sides, as long as the share of fault is assigned sufficiently asymmetrically. However, this additional care is inefficient. The upshot is in that in the absence of some reason extrinsic to the model, contributory negligence is socially preferable under bilateral harm with similar care costs - a situation exemplified by common automobile accidents.

This raises the question whether there are conditions, extrinsic to this model, under which the additional care under comparative negligence could be efficient in the bilateral harm setting. Asymmetry in fault assignment in this model is consistent with a jury basing its fault percentages on observable characteristics of the parties or of the accident - e.g., active versus passive force, male versus female driver, teen versus adult driver. If these status-based determinations correlate positively with the greater-taxed party's irrational tendency not to take care, then comparative negligence could be socially preferable to contributory negligence in the bilateral harm setting, by introducing a form of efficient statistical discrimination into the fault system. Assigning a greater share of fault to young male drivers might offset their tendency to be overly confident in their driving skills.

With bilateral harm and asymmetric costs we find that the familiar "Cheapest Cost Avoider" reasoning no longer provides a useful heuristic. Putting liability on the cheapest cost avoider generates strategic foisting and socially excessive care. This indicates that the traditional result holds only in a scenario which assumes perfect information by the court. Hence, legislatures and courts must consider strategic considerations when determining how to assign liability, which thus far has been absent from those considerations.

The unilateral harm case is illustrated by a doctor and a patient, where strong strategic complementarity implies that both the doctor and patient must take care to avoid a poor outcome; the doctor must prescribe the right dose and the patient must take his medicine under the recommended conditions. Here contributory negligence generates excessive care as the unique equilibrium, and comparative negligence moves us toward optimality by making the no care outcome a potential equilibrium.

It may seem strange at first to suggest that the no care equilibrium might be optimal in the medical care context, but we view defensive medicine as a perfect illustration of such a scenario. Relative to the slight risk of harm, it may be inefficient for both doctor and patient to take some types of precaution, but the liability system may induce them to do so consistently under contributory negligence. Comparative negligence can reduce this

tendency toward excessive precaution.

## 5 Conclusion

We have shown that, under an application of the Hand Formula that maps more closely to the stated behavior of real-world courts, there may be differences between contributory and comparative negligence regimes which have not previously been noted in the literature. In particular one regime is likely to yield inefficiently too much care - a situation we have described as defensive care. When the setting is symmetric (i.e., bilateral harm with identical costs of taking care), contributory negligence provides weakly better incentives by avoiding this excessive care, while asymmetric settings such as unilateral harm and non-identical costs of care lead to comparative negligence potentially yielding superior results by allowing for proper risk sharing.

Therefore, given the information and doctrinal constraints binding courts when determining standards of care, our approach provides simple recommendations for how courts should be asked to determine negligence. Comparative negligence always provides the optimal level of care if risk is shared equally between the two agents. This requires that the two actors pay equal damages in cases of dual negligence when their costs of care were approximately equal, and the potential injurer with the higher cost of care bears a larger share when there is an asymmetry. If the courts cannot commit to such a regime (for example, when juries are instructed to set damage levels in cases of dual negligence), then courts should allow contributory negligence defenses to cases where both parties are potential victims (bilateral harm), and limit comparative negligence to the more common cases of comparative negligence.

Although this paper breaks from earlier models, we see it as consistent with a general progression in economics away from the assumption that players are all-knowing, in the sense of perfectly understanding statistical regularities among relevant economic variables, and instead allowing for the possibility that institutions may not perform optimally according to our models. While it may be obvious that inefficient equilibria arise when courts are not likely to implement or perfectly capable of implementing a full-information optimality rule, the interesting question is precisely how the results play out under plausible deviations from the perfect information ideal. The case of the all-knowing and efficiency-seeking court is actually a special case of this model, where inefficient equilibria are excluded.

In general, it would not be difficult to extend this analysis to other settings where courts consider what the ex ante optimal negligence mechanism is for securing optimal care. This paper implies that such a mechanism should keep relative incentives based on private cost to private value as symmetric as possible. This will be achieved by equal risk sharing when the

care game is already ex ante symmetric, while setting an optimal share of damages otherwise. For example, if one agent faces a lower private cost, he should also perceive relatively less benefit from taking care. Future research into optimal court regimes should focus on keeping strategic incentives symmetric.

In addition, this analysis could also be applied to other potential asymmetries besides cost and damages. For example, it is reasonable to think that the care of some agents would lead to a greater reduction in the probability of harm than the care of others - indeed, much of the “cheapest cost avoider” intuition in accident law economics is based on such reasoning. Our work thus far seems to imply that these agents should potentially pay a different share of damages under comparative negligence than the other party. The framework we have used would be quite useful for examining asymmetries such as this, which may uncover more differences between contributory and comparative negligence regimes.

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