AN ECONOMIC CASE FOR COMPARATIVE NEGLIGENCE

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The twentieth century has seen a dramatic shift from negligence with a defense of contributory negligence to comparative negligence as the basic rule of tort liability. Yet scholars who have examined the efficiency aspects of comparative negligence have concluded that it does not produce efficient results and that other liability rules are more efficient. Professors Cooter and Ulen argue that comparative negligence is efficient under some circumstances. Supporting their analysis with mathematical proofs, they show that under full information, all forms of the negligence rule induce efficient behavior by potential victims and tortfeasors. They argue that under the more realistic assumption of evidentiary uncertainty, comparative negligence is the most efficient negligence rule when the parties are symmetrically situated with regard to their ability to take precaution, because it provides moderate incentives for both parties to take precaution, while other negligence rules provide strong incentives for one party and weak for the other. The professors conclude that while efficiency and equity often exert conflicting claims on policymakers, they converge in this instance, because where parties are symmetrically situated and equally likely to be victims or tortfeasors, they will prefer the comparative negligence rule.

INTRODUCTION

In 1900, the basic rule of tort liability in every state was negligence with a defense of contributory negligence. As of 1986, all but six states and the District of Columbia had switched to a comparative negligence standard. The change was effected principally by statute, with a minor-

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2 V. Schwartz, Comparative Negligence § 1.1, at 3 (2d ed. 1986). As of late 1986, the following states remained contributory negligence jurisdictions: Alabama, Golden v. McCurry, 392 So. 2d 815, 817 (1980) (refusing to adopt comparative negligence judicially); Maryland, Harrison v. Montgomery Bd. of Educ., 295 Md. 442, 456 A.2d 894 (1983) (same); North Carolina, Smith v. Fiber Controls Corp., 300 N.C. 669, 268 S.E.2d 504 (1980) (applying contributory negligence rule); South Carolina, Langley v. Boyter, 286 S.C. 85, 332 S.E.2d 100 (1985) (overturning lower court's adoption of comparative negligence); Tennessee, Arnold v. Hayslett, 655 S.W.2d 941 (1983) (neither a true comparative nor contributory negligence rule, distinguishing between "remote" and "proximate" contributory negligence; where plaintiff's negligence is "remote," damages are mitigated, but no recovery if negligence is "proximate");
ity of states adopting the rule by judicial decision. 4

This shift to comparative negligence was not preceded by pervasive support in the scholarly literature on tort liability. 5 Many courts and legal scholars support comparative negligence on the grounds that it is more fair than contributory negligence. 6 However, their arguments have

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3 The following 34 states have passed comparative negligence statutes:


4 The following states have judicially adopted comparative negligence:


been based on intuitive, as opposed to theoretical, conceptions of fairness.\(^7\) Furthermore, these intuitive fairness arguments have not been bolstered by any persuasive efficiency arguments in support of comparative negligence. Indeed, most of the small number of law and economics scholars who have written about the efficiency of comparative negligence have concluded that it does not produce efficient results\(^8\) and that other liability rules, such as negligence with contributory negligence as a defense, are more efficient.\(^9\) Their claim that the shift to comparative negligence is a shift from a more efficient to a less efficient rule is particularly troubling if one accepts the normative claim that the law should be effi-

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\(^7\) These judges and scholars criticize the contributory negligence rule as unjust because it denies the plaintiff any recovery even if he was only slightly negligent and the defendant was grossly negligent. See, e.g., Scott v. Rizzo, 96 N.M. 682, 689, 634 P.2d 1234, 1241 (1981) ("The demise of contributory negligence as a defense can be justified from several points of view. The predominant argument for its abandonment rests, of course, upon the undeniable inequity and injustice in casting an entire accidental loss upon a plaintiff whose negligence combined with another's negligence in causing the loss suffered, no matter how trifling plaintiff's negligence might be."); Bradley v. Appalachian Power Co., 256 S.E.2d 879, 882 (W. Va. 1979) ("There is an almost universal dissatisfaction among leading scholars of tort law with the harshness of the doctrine of contributory negligence. Neither intensive scholarship nor complex legal arguments need be advanced to demonstrate its strictness." (footnote omitted)); 4 F. Harper, F. James & O. Gray, The Law of Torts § 22.3, at 286-90 (2d ed. 1986) [hereinafter Harper, James & Gray]; W. Keeton, D. Dobbs, R. Keeton & D. Owen, Prosser and Keeton on The Law of Torts § 67, at 468-71 (5th ed. 1984) [hereinafter Prosser & Keeton]; Haddock & Curran, supra note 5.

\(^8\) See R. Posner, Economic Analysis of Law § 6.3, at 124 (2d ed. 1977) [hereinafter Posner (2d ed.)] (comparative negligence is inefficient because efficiency requires only one party to take precaution); G. Calabresi, The Costs of Accidents: A Legal and Economic Analysis 158 (1970) (dividing accident costs between two parties may result in inefficient level of care because efficiency requires only one party to take precaution); cf. Haddock & Curran, supra note 5, at 49-50 (finding arguments supporting efficiency of contributory negligence ambiguous). But see R. Posner, Economic Analysis of Law § 6.4, at 156-57 (3d ed. 1986) [hereinafter Posner (3d ed.)] (arguing that under joint precaution, comparative negligence has same effect on safety as contributory negligence; however, comparative negligence entails higher administration costs and may increase rate of litigation); Schwartz, supra note 6, at 704-10 (rejecting efficiency arguments for contributory negligence). See generally text accompanying notes 58-97 infra (discussion of relevant literature).

For an introduction to the basic economic literature on the efficiency of various tort liability standards, see Perspectives on Tort Law 152-236 (R. Rabin 2d ed. 1983); Posner (3d ed.), supra, §§ 6.1-16.

The trend appears to belie the proposition that law evolves toward efficiency. The Article argues that comparative negligence is efficient under a certain set of circumstances. In doing so, it contributes to the existing tort literature in two ways. First, it investigates the incentive effects of tort rules using a more complete and realistic set of assumptions than do previous articles. Specifically, it assumes that courts are not completely certain of findings about fault. This uncertainty, which we call "evidentiary uncertainty," causes potential victims and tortfeasors to exceed the legal standard of care in order to reduce the probability that the court will mistakenly find them at fault. This Article examines the various liability rules and ranks them according to the strength of the incentive for precaution that they provide. We conclude that the doctrine of comparative negligence provides moderate incentives for both parties to take precautions, whereas the other forms of the negligence rule give relatively strong incentives to one party and relatively weak incentives to the other.

Second, the Article investigates the efficiency and equity characteristics of different forms of the negligence rule given the condition of evidentiary uncertainty. The Article argues that the rule of comparative negligence is more efficient than its alternatives when it is desirable to

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11 Even if comparative negligence is inefficient, the shift in rules may not undermine this evolutionary claim as to the common law. In most jurisdictions, it is the legislatures, not the courts, that have effected the change to comparative negligence. J. Dooley, 1 Modern Tort Law § 5.01, at 123 (1982); V. Schwartz, supra note 2, §§ 1.1, 1.5(B); see notes 3-4 supra. The first rigorous demonstration that legislation may fail to achieve efficiency is in K. Arrow, Social Choice and Individual Values (1963). But see Goodman, supra note 10, at 405 (giving several reasons why common law cannot always be expected to outperform legislative law).

12 See authorities cited in notes 8-10 supra.

13 Economists generally study this uncertainty under the broader heading of "limited" or "imperfect information." See Schwartz & Wilde, Imperfect Information in Markets for Contract Terms: The Examples of Warranties and Security Interests, 69 Va. L. Rev. 1387 (1983); Schwartz & Wilde, Intervening in Markets on the Basis of Imperfect Information: A Legal and Economic Analysis, 127 U. Pa. L. Rev. 630 (1979); see also Cooter, Kornhauser & Lane, Liability Rules, Limited Information, and the Role of Precedent, 10 Bell J. Econ. 366 (1979) (judges have enough information to revise legal standards via mechanism of precedent so that standard tends toward efficiency).

14 See text accompanying notes 105-13 infra.
give moderate incentives for precaution to both parties rather than strong incentives to one party and weak incentives to the other. Such a situation occurs when the parties are symmetrically situated with respect to the ability of each to take precaution. In this situation everyone is likely to desire the application of the comparative negligence rules to all future accidents. This Article argues that adopting a liability rule that everyone prefers is fair as well as efficient. It thus concludes that when the parties are symmetrically situated, comparative negligence is both more efficient and more equitable than the alternative forms of the negligence rule.

Part I describes the history of contributory negligence and the reasons for dissatisfaction with the doctrine. It then examines the rise of comparative negligence and describes its variations.

Part II examines the different negligence standards from the perspective of economic efficiency. First, it briefly reviews the existing economic analyses of negligence rules. It then analyzes various forms of negligence rules in situations involving evidentiary uncertainty. Part II demonstrates that, with such uncertainty, potential injurers and victims are induced to exceed the legal standard under any negligence rule. However, when the parties are symmetrically situated with respect to their ability to prevent the accident, the aggregate amount of over-precaution will be less under comparative negligence than under any other negligence rule; furthermore, the overprecaution will be less under pure comparative negligence than under modified forms of comparative negligence. The arguments of Part II are explained mathematically in the appendix.

Part III develops the equity arguments for comparative negligence. First, it examines the intuitive equity argument for comparative negligence. It then formulates a list of conditions under which both injurers and victims prefer comparative negligence over its alternatives. It concludes by developing a rigorous justification for comparative negligence based on the philosophical foundations of ex ante Pareto efficiency.

I

THE ORIGINS OF COMPARATIVE NEGLIGENCE AND ITS VARIATIONS

All negligence rules require individuals to meet a certain legal standard of care. This standard requires individuals to take as much pre-

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15 See text accompanying notes 131-38 infra.
16 Throughout this Article, the terms "individuals" and "persons" refer to both natural persons and corporate entities.
caution as would a reasonable person under the circumstances.\textsuperscript{17} A person who fails to meet the legal standard is said to be at fault in the event of an accident.\textsuperscript{18}

Under all negligence rules, the courts allocate the costs of accidents only to those at fault. The rules differ, however, in the ways in which they distribute accident costs among the negligent parties. For example, contributory negligence bars recovery by negligent plaintiffs and consequently allocates all accident costs to the plaintiff when both plaintiff and defendant are at fault.\textsuperscript{19} Comparative negligence rules, on the other hand, permit negligent plaintiffs to recover partially under certain circumstances.\textsuperscript{20}

\section*{A. The Rise and Fall of Contributory Negligence}

The doctrine of contributory negligence was established in 1809 in the famous case of \textit{Butterfield v. Forrester}.\textsuperscript{21} In \textit{Butterfield}, the plaintiff sued to recover for injuries suffered when he was thrown from his horse one evening after striking a rail that had been placed in the road by the defendant.\textsuperscript{22} The court denied recovery because the plaintiff had contrib-
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uted to the accident by riding too fast and failing to observe the visible obstruction.\footnote{23} Subsequent cases broadened the concept of contributory negligence.\footnote{24} Indeed, the rule came to stand for the proposition that the plaintiff's negligence, however slight, was sufficient to bar his recovery completely.\footnote{25} The rule of contributory negligence was so harsh that, shortly after adopting it, nearly every state had limited its scope.\footnote{26} One of the earliest judicial attempts to restrict the scope of contributory negligence was the "last clear chance" doctrine.\footnote{27} Under this doctrine, negligent plaintiffs could recover if the defendant had the last reasonable opportunity to avoid the accident.\footnote{28} Other jurisdictions placed a more stringent standard of care on defendants than on plaintiffs, on the rationale that a provident individual takes precautions to protect others that he would not necessarily take to protect himself.\footnote{29} Finally, in an effort to minimize the harshness of the contributory negligence rule, Arizona

\footnote{23} Id. at 927.
\footnote{24} See V. Schwartz, supra note 2, § 1.2, at 4; see also Malone, supra note 21 (describing evolution of contributory negligence doctrine).
\footnote{25} See Maki v. Frelk, 85 Ill. App. 2d 439, 445, 229 N.E.2d 284, 288 (1967), rev'd on other grounds, 40 Ill. 2d 193, 239 N.E.2d 445 (1968); see also Restatement (Second) of Torts § 467 (1965) (plaintiff's negligence operates as complete bar).
\footnote{26} See V. Schwartz, supra note 2, § 1.2, at 5-9.
\footnote{27} See Harper, James & Gray, supra note 7, §§ 22.12-.14; V. Schwartz, supra note 2, § 7.1; H. Wood, Comparative Fault §§ 1:6-1:7 (1978); James, Last Clear Chance: A Transitional Doctrine, 47 Yale L.J. 704 (1938). The first case to utilize the doctrine of last clear chance was Davies v. Mann, 152 Eng. Rep. 588 (1842). See Alvis v. Riber, 85 Ill. 2d at 10, 421 N.E.2d at 890.
\footnote{28} See Davies, 152 Eng. Rep. at 589; French v. Mozaila, 433 S.W.2d 122, 125-26 (Ky. 1968); Donohue v. Rolando, 16 Utah 2d 294, 297, 400 P.2d 12, 15 (1965); Harper, James & Gray, supra note 7, § 22.13, at 559; Restatement (Second) of Torts §§ 467, 479-80 (1965).
\footnote{29} See Rossman v. La Grega, 28 N.Y.2d 300, 308, 270 N.Y.2d 313, 317, 321 N.Y.S.2d 588, 595 (1971) (standard applicable to one who negligently harms others not applicable to one who negligently harms himself); V. Schwartz, supra note 2, § 1.2(B); Restatement (Second) of Torts §§ 463 comment b, § 464 comment f (1965) (individuals need not take same precaution to protect themselves as they must to protect others); James, Contributory Negligence, 62 Yale L.J. 691, 706 (1953). Compare Furukawa v. Ogawa, 238 F.2d 272, 273-74 (9th Cir. 1956) (applying California law defining risks of plaintiff's negligence) with Gibson v. Garcia, 96 Cal. App. 2d 681, 687, 216 P.2d 119, 123 (1950) (defining risks of defendant's negligence). See generally Harper, James & Gray, supra note 7, § 22.10 (comparing contributory negligence standard with negligence standard).

Courts have applied a similar line of reasoning to reject attempts to invoke contributory negligence to bar recovery by plaintiffs not wearing seat belts. See, e.g., Britton v. Doehring, 286 Ala. 498, 504-08, 242 So.2d 666, 671-75 (1970); Berger, The Seat Belt Defense—Rejection by the Majority of Courts, A.B.A. L. Notes (July 1969).

The courts also have limited the application of contributory negligence when the defendant is reckless or acts intentionally, see, e.g., Alvis, 85 Ill. 2d at 10, 421 N.E.2d at 890; Victor v. Sell, 301 Minn. 309, 315, 222 N.W.2d 337, 341 (1974); Restatement (Second) of Torts, §§ 482(1), 503(1) (1965); V. Schwartz, supra note 2, §§ 5.1-.3, and when the defendant violates a statute, such as a workplace safety act, designed specifically to protect classes of plaintiffs against their own negligence, see, e.g., Martin v. George Hyman Constr. Co., 395 A.2d 63, 68-
adopted a constitutional provision that requires the jury to decide in all cases whether the plaintiff was contributorily negligent while it does not require the jury to decide the defendant's negligence.\textsuperscript{30}

However, these attempts to mitigate the harshness of the contributory negligence rule are themselves harsh. While they reduce the cost borne by the negligent plaintiff, they do so only by shifting the entire cost of the accident to the defendant. Therefore, one party still bears the entire cost of an accident for which several parties are responsible.\textsuperscript{31}

\textbf{B. The Rise of Comparative Negligence and Its Variations}

Dissatisfaction with contributory negligence eventually led to the adoption of comparative negligence in most of the United States.\textsuperscript{32} Starting in the mid-nineteenth century, a handful of states began to use comparative negligence principles in industrial accident cases.\textsuperscript{33} In the early 1900s, Congress first nationalized the concept of apportionment of damages by introducing provisions for apportionment in several federal safety and employment statutes.\textsuperscript{34} These federal statutes set off a flood of state

\textsuperscript{30} Ariz. Const. art. 18, § 5 ("The defense of contributory negligence or assumption of risk shall, in all cases whatsoever, be a question of fact and shall, at all times . . . be left to the jury."). Even after the statutory adoption of comparative negligence, see note 3 supra, Arizona requires the question of plaintiff's negligence be sent to the jury, Ariz. Rev. Stat. Ann. § 12-2505 (Supp. 1986). Cf. \textit{Rosman}, 28 N.Y.2d at 308, 270 N.E.2d at 317, 321 N.Y.S.2d at 395 (plaintiff's contributory negligence is jury question).

\textsuperscript{31} See generally Harper, James & Gray, supra note 7, §§ 22.13-.14 (criticizing last clear chance doctrine); Prosser & Keeton, supra note 7, supra note 7, § 66, at 468 (same).

\textsuperscript{32} See, e.g., \textit{Bradley v. Appalachian Power Co.}, 256 S.E.2d 879, 882 (W. Va. 1979); \textit{Li v. Yellow Cab Co.}, 13 Cal. 2d 804, 810, 532 P.2d 1226, 1230, 119 Cal. Rptr. 858, 875 (1975); \textit{Maki v. Felk}, 85 Ill. App. 2d 439, 446-47, 229 N.E.2d 284, 288 (1967), rev'd on other grounds, 40 Ill. 2d 193, 239 N.E.2d 445 (1968); Prosser & Keeton, supra note 7, § 67, at 468-71; Prosser, supra note 6, at 469-70.


\textsuperscript{34} The second federal Employers' Liability Act, ch. 149, § 1, 35 Stat. 64 (1908) (codified as amended at 45 U.S.C. §§ 51-60 (1982)) provides that an employee of an interstate railroad carrier who is injured on the job is not completely barred from recovery by his own negligence;
negligence: pure comparative negligence, modified comparative negligence, and the slight-gross rule of comparative negligence.\footnote{See Alvis v. Ribar, 85 Ill. 2d 1, 15, 421 N.E.2d 886, 892 (1981); Prosser & Keeton, supra note 7, § 67, at 471; V. Schwartz, supra note 2, § 3.1, at 45-47.}

Under pure comparative negligence, courts simply apportion damages among parties in the proportion that their negligence contributed to the accident.\footnote{E.g., Alvis, 85 Ill. 2d at 25, 421 N.E.2d at 897; Hoffman v. Jones, 280 So. 2d 431, 438 (Fla. 1973); see Prosser & Keeton, supra note 7, § 67, at 472; V. Schwartz, supra note 2, § 3.2, at 84.} To illustrate, suppose that $A$ and $B$ are involved in an automobile accident in which $A$'s car, worth $200, and $B$'s car, worth $12,000, are both completely destroyed.\footnote{In 1973, the Florida Supreme Court rejected criticisms that such decisions should be left to the legislature and judicially adopted pure comparative negligence. \textit{Hoffman}, 280 So. 2d at 438. Other state courts followed suit. See note 4 supra.} Assume for the sake of simplicity that the cars have no salvage value. Assume also that $A$ sues $B$ for negligence and asks for compensation for the loss of his car; $B$ counterclaims for his losses. The jury, at a consolidated trial, concludes that $A$ was ten percent at fault and $B$ was ninety percent at fault. Under a pure comparative negligence rule, each party recovers only to the extent that he was not at fault. Thus, $A$ recovers $180$ (ninety percent of his $200$ loss) and $B$ recovers $1,200$ (ten percent of his loss of $12,000$).\footnote{The example is drawn from Note, Comparative Negligence, 81 Colum. L. Rev. 1668, 1671-72 (1981).}

Although the net result of the application of the comparative negligence
employers' liability legislation.\textsuperscript{35}

The first state to enact a comparative negligence statute not limited to industrial accidents was Mississippi.\textsuperscript{36} The Mississippi statute, enacted in 1910, was applicable to all personal injury actions\textsuperscript{37} and in 1920 was expanded to cover damages to property.\textsuperscript{38} By 1950, however, only five states had adopted comparative negligence principles for general application.\textsuperscript{39} Indeed, during the 1940s and 1950s, at least twenty-one states considered and rejected comparative negligence legislation.\textsuperscript{40} But thereafter, particularly in the 1970s and early 1980s, most states either enacted comparative negligence statutes or adopted the principle judicially.\textsuperscript{41}

In the United States today, there are three forms of comparative

rather, the employee's recovery is diminished by the proportion of injury attributable to his negligence. 45 U.S.C. § 53. This doctrine was incorporated by reference into the Jones Act, ch. 153, § 20, 38 Stat. 1185 (1915), when the Jones Act was amended by the Merchant Marine Act of 1920, ch. 250, § 33, 41 Stat. 999, 1007 (codified as amended at 46 U.S.C. § 688 (1982)). See Prosser, supra note 6, at 478.


36 See Alvis v. Ribar, 85 Ill. 2d 12, 421 N.E.2d 886, 891 (1981); V. Schwartz, supra note 2, § 1.4, at 12; Prosser, supra note 6, at 480.


In 1863, Georgia adopted the comparative negligence doctrine for limited purposes. See Act of Jan. 1, 1863, Ga. Code § 2979 (1863) (later codified at Ga. Code Ann. § 46-8-291 (1982)) (covering railroad accident cases); Act of Jan. 1, 1863, Ga. Code § 2914 (1863) (codified at Ga. Code Ann. § 51-11-7 (1982)) ("If the plaintiff by ordinary care could have avoided the consequences to himself caused by the defendant's negligence, he is not entitled to recover. In other cases the defendant is not relieved, although the plaintiff may in some way have contributed to the injury sustained."). Subsequent judicial modification expanded the doctrine to cover all types of tort cases and introduced the modified form of comparative negligence. See, e.g., Elk Cotton Mills v. Grant, 140 Ga. 727, 731, 79 S.E. 836, 838 (1913); Smith v. American Oil Co., 77 Ga. App. 463, 501, 49 S.E.2d 90, 114 (1948).

40 V. Schwartz, supra note 2, § 1.4(B), at 12-13.

41 See 3 Comparative Negligence, supra note 2 (state-by-state compilation of comparative negligence statutes and cases); see also notes 3-4 supra (listing comparative negligence jurisdictions).
rule is that A owes B $1,020 and B owes A nothing, A is bearing less of the total accident losses than B. In fact, A’s share of the total accident losses is $1,220 of $12,200, or ten percent. Thus, the burden falls on B to assume the cost of the remaining ninety percent of the total costs or $10,980.

The second form of comparative negligence is modified comparative negligence. This is the most popular form of comparative negligence; it is utilized in twenty-nine of the forty-four states that have adopted some form of comparative negligence. There are two versions of modified comparative negligence. The first version, referred to here as the “fifty percent rule” retains contributory negligence as a complete bar to the plaintiff’s recovery when his negligence is equal to or greater than the defendant’s negligence. When the plaintiff is less than fifty percent responsible, the rule allows recovery with a reduction proportionate to the degree to which he was at fault.

The second version of modified comparative negligence, referred to here as the “fifty percent plus rule,” bars the plaintiff’s recovery if his fault is more than the defendant’s. The plaintiff may recover, with a reduction in damages proportional to his fault, if his fault is equal to or less

46 This $1,220 is made up of the uncompensated portion of the loss of his car ($20) and his obligation to pay B $1,200.

47 Some courts and commentators contend that because both parties to an accident usually have liability insurance, the real beneficiaries of set-off under the pure comparative negligence rule are the insurers. See, e.g., Jess v. Herrmann, 26 Cal. 3d 131, 138-39, 604 P.2d 208, 211-12, 161 Cal. Rptr. 87, 90-91 (1979); Note, supra note 44, at 1672. For example, in a situation without set-off, A’s insurer generally pays for damages suffered by B and B’s insurer pays for damages suffered by A. In the situation described in the text, however, the judgments against A and B are “set off” against each other so that the only payment made is the net payment of $1,020 from A to B. B’s insurer does not have to make any payment while A’s insurer must pay $1,020 to B. Many are dissatisfied with this result, because B’s insurer appears to derive significant benefit from the set-off.


49 See notes 3-4 supra.

than the defendant's.\(^5\) The effect of applying the fifty percent plus rule differs from that of the fifty percent rule only when the fault of the two parties is exactly equal.

Both versions of modified comparative negligence apportion damages differently than pure comparative negligence. Consider the illustration presented above in which \(A\), who was ten percent negligent, suffered losses of $200, and \(B\), who was ninety percent negligent, suffered losses of $12,000. In \(A\)'s action against \(B\), \(A\) will recover $180 under modified comparative negligence, just as he did under pure comparative negligence. But under either modified form of comparative negligence, \(B\) will be unable to recover any of his losses from \(A\), because \(B\)'s percentage of responsibility for the accident is greater than \(A\)'s. Under modified comparative negligence, \(A\)'s share of the total losses is thus reduced to 0.16% and \(B\) bears 99.84% of the total losses.\(^5\) Thus, \(A\) is better off under modified comparative negligence than he would be under pure comparative negligence or contributory negligence. \(B\), however, is worse off under modified comparative negligence than he would be under either pure comparative negligence or contributory negligence.\(^5\)

A third form of comparative negligence is called the "slight-gross" rule.\(^5\) Under this rule, the plaintiff's contributory negligence bars his recovery unless his negligence is slight and the defendant's is gross. In such a case, the plaintiff's recovery is reduced by his relative responsibility for the accident. Thus, the slight-gross rule is similar to modified comparative negligence except that the level of plaintiff's negligence that bars recovery need not be much greater than "slight." Under modified comparative negligence, plaintiff's negligence needs to be at least the same as or more than the defendant's to bar any recovery.

Thus a considerable difference is apparent among the various negligence rules.\(^5\)

\(^5\) This form of modified comparative negligence was first adopted by New Hampshire in 1969. See Act effective May 4, 1970, ch. 225, 1969 N.H. Laws 177 (codified as amended at N.H. Rev. Stat. Ann. § 507:7-a (1983)); see V. Schwartz, supra note 2, § 3.5(B), at 70. For a list of states that currently adhere to the 50% plus rule, see note 3 supra.

\(^5\) A's proportionate share of the total losses is:

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\frac{20}{12,200} = 0.16\%
\]

B's proportionate share is:

\[
\frac{180 + 12,000}{12,200} = 99.84\%
\]

\(^5\) Individual preferences with respect to these rules are examined in greater detail in Part III.

\(^5\) This rule is used in only two states, Nebraska and South Dakota. Nebraska's slight-gross rule is codified at Neb. Rev. Stat. § 25-21,185 (1985). Unlike Nebraska, South Dakota does not require that the defendant's negligence be gross; it merely requires the plaintiff's negligence to be slight in comparison with that of the defendant. See S.D. Codified Laws Ann. § 20-9-2 (1979).
comparative negligence rules with regard to the apportionment of damages. The significance of these differences is analyzed in Part II by examining the relative efficiency of the rules and their effect on injurers' and victims' incentives to take precaution.

II
THE ECONOMIC EFFICIENCY OF COMPARATIVE NEGLIGENCE

Although there is an extensive literature on the economic efficiency of tort law in general, scholars have done relatively little work on the efficiency aspects of comparative negligence. Moreover, at a time when many jurisdictions have shifted to some form of comparative negligence, those scholars who have analyzed comparative negligence on efficiency grounds generally have favored the old rule of contributory negligence. This Part argues that this stand is misguided because it is derived from false or overly simplified models.

A. A Critique of Previous Economic Analyses of Comparative Negligence

The first scholar to compare the efficiency aspects of different rules of tort liability in a formal model was John Prather Brown. His model is rigorous but highly simplified; injurers, victims, and courts are assumed to know both the legal standard and the level of everyone's precaution, and he assumes away the costs of dispute resolution, risk-bearing, and pre-accident information gathering. Prior to Brown's formal model, Guido Calabresi and Richard Posner had offered informal arguments and numerical examples. In spite of differences in technique, all three agreed that comparative negligence provides incentives for inefficient precaution. We will examine how they reached this conclusion and explain why it is wrong.

1. Brown's Formal Model

Brown, in his seminal piece on tort liability, concluded that every form of negligence rule except comparative negligence is efficient.

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55 See, e.g., Perspectives on Tort Law, supra note 8; Posner (2d ed.), supra note 8, at 119-62.
56 See notes 5-9 and accompanying text supra.
57 See authorities cited in note 8 supra.
60 Brown, supra note 58.
61 Brown analyzed simple negligence, comparative negligence, negligence with contribu-
Brown reached this conclusion because his model of comparative negligence was flawed. In Brown's model, the liability rule that he calls comparative negligence allocates accident costs in proportion to the relative effectiveness of each party's additional precaution. Thus, when additional precaution by the injurer is twice as effective as additional precaution by the victim in reducing the probability of the accident, the injurer's share of the total accident costs will be double that of the victim. Therefore, under Brown's model, the parties could be held liable even if both parties satisfied the legal standard of care.

To illustrate, consider an automobile driver who strikes a pedestrian. In Brown's comparative negligence model the driver is liable if further precaution would have reduced the likelihood or the severity of an accident, even if the additional precaution would have been unreasonable or inefficient. Thus, a driver could be partially liable under Brown's rule even if he maintained his car in good repair, kept his eyes on the road, and obeyed the speed limit. His liability would arise from the fact that driving at a speed far below the speed limit would have further reduced the likelihood of an accident.

In contrast, actual comparative negligence laws allocate accident costs according to the relative fault of the parties, based on their shortfall from the legal standard of care. Because of this difference, Brown's model should be called a rule of "comparative precaution," as opposed to a rule of comparative negligence. Thus, although Brown's model representing the hypothetical rule we call comparative precaution may encourage an inefficient amount of precaution, the analysis does not address comparative negligence and should not be used to judge whether comparative negligence rules are efficient.

62 Id. at 346-47. Brown also concluded that strict liability and no liability (i.e., plaintiff's strict liability) are inefficient. Id. at 337-39, 347.

63 Id. at 329-31. When discussing his model of comparative negligence, Brown defines negligence as "the incremental reduction in accident probability per dollar spent," id. at 331, and the liability of the injurer as "his negligence divided by the negligence of both parties," id.

64 See id. at 329. In Brown's notation, x* and y* indicate the legal standards of precaution. Id. at 328. Negligence is a shortfall from these standards. Id. However, Brown's mathematical definition of comparative negligence and relative precaution does not involve the terms x* and y*. See id. at 331. Thus, in analyzing comparative negligence, he failed to take into account whether a party has satisfied the due care standard. See id. at 329-31.

65 See text accompanying notes 43-54 supra.

66 There are reasons to doubt the accuracy of Brown's conclusion that there will be too little precaution under a comparative precaution rule. In fact, the equilibrium precaution may be either too low or too high. The proof was first presented in Cooter, Why Comparative Negligence is Efficient (1982) (unpublished manuscript on file at New York University Law Review). See also Haddock & Curran, supra note 5, at 54, 55 n.16.
2. Informal Economic Models

Calabresi and Posner developed qualitative arguments and numerical examples comparing alternative tort rules. These informal arguments reach the same conclusion as Brown’s formal analysis and found comparative negligence to be inefficient. In _The Costs of Accidents_, Calabresi offers an example in which the division of liability costs can result in inefficient incentives for precaution. He assumes that an accident can be prevented by either party acting alone and that efficiency requires only one of them to take precaution. Calabresi states, without detailed explanation, that dividing accident costs sometimes will prevent either party from taking the adequate precaution. His comments suggest that comparative negligence provides the wrong incentives when efficient precaution is unilateral. He also notes that if the facts were altered so that efficiency required both parties to take some precaution, dividing costs could create efficient incentives. The latter comment suggests that comparative negligence can provide the right incentives when efficient precaution is bilateral.

Regarding the case of unilateral precaution, Posner reached the same conclusion about comparative negligence in the first edition of _Economic Analysis of Law_ and repeated the analysis without change in the book’s second edition. Posner offers an example in which an accident

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67 Calabresi, supra note 8.
68 See id. at 158.
69 This may be referred to as the assumption of “unilateral precaution.” Id.
70 See id.
71 This may be referred to as “bilateral precaution.” Id.
72 Calabresi argued as follows:

Assume that an accident involving two activities costs $80 each time it occurs. Assume also that such an accident could always be avoided by either activity through the installation of a safety device costing $60 per accident prevented. An involvement test would charge each of the activities $40 per accident. At first, neither activity would install the safety device. Either might eventually do so as a result of transactions with the other. But if the cost of entering into such transactions was more than $20 per accident, no transactions would take place and the accidents would not be avoided, even though if either party were originally charged with the full costs of the accident the safety device would be installed, as it should be. Lest this situation seem worse than it is, the exact opposite result would be reached if, instead of the situation posited, we posit the case where the only way to avoid the accident is if both activities modify their behavior somewhat, e.g. by installing a $30 safety device.

74 Posner (2d ed.), supra note 8, § 6.3, at 123-24. Posner argues that contributory negligence also may encourage inefficient results under limited circumstances when the Hand formula, see note 114 infra, is applied literally to the plaintiff and efficiency requires unilateral precaution. Posner (2d ed.), supra note 8, § 6.3, at 124. In the third edition of the book,
can be prevented by either party acting alone, but the defendant can prevent it at less cost than the plaintiff. Given these facts, efficiency requires the defendant alone to take precaution. He suggests, however, that a rule of comparative negligence might not produce this result. Instead, precaution may be taken by neither of them, or, possibly, by both of them. Like Calabresi, Posner suggests that comparative negligence provides the wrong incentives when efficiency requires only one party to take precaution.

Gary Schwartz’s article on contributory negligence and comparative negligence repeated the examples of Calabresi and Posner with slightly different numbers, and concluded with the following generalization:

When the cheapest means of prevention are independent rather than complementary, however, comparative negligence can sometimes be successful, but only on a fortuitous basis.

Thus comparative negligence, although appropriate in situations in which complementary accident prevention is desirable, offers no assurance of the right result in those situations in which independent prevention is required.

All these authors agree that comparative negligence can provide the wrong incentives when efficient precaution is unilateral. These arguments demonstrate the view held by each author that incentives for precaution may be different under the various negligence rules. Thus, any rule that succeeds in one set of circumstances by providing the efficient amount of incentive may fail in other circumstances.

Posner, however, had changed his analysis by 1986 when the third

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77 Schwartz, supra note 6.
78 See id. at 704.
79 Id. at 705, 707.
80 Some of the authors, however, are concerned primarily with considerations other than the incentive effects of comparative negligence. Calabresi, for example, discusses the desirability of comparative negligence as a device for spreading risk.

My conclusion is, therefore, that while comparative negligence is certainly desirable in terms of accepted objectives of fault, and while it might somewhat improve fault’s record as a spreader of losses, it would satisfy our desire for spreading only if it were applied in a way that would place the bulk of liability on the best loss spreader rather than on the party most at fault. Therefore it can save the fault system only if we are willing to accept greater modifications in the system than the adoption of comparative negligence would seem to imply.

Calabresi, supra note 8, at 280-81.
edition of his book appeared. In that edition, he argues that comparative negligence has the same incentive effects on safety as does contributory negligence. In Toward an Economic Theory of Liability, Brown proved that all forms of the negligence rule, except the rule he had mischaracterized as comparative negligence, have equivalent incentive effects. Brown's proof, which we call the 'equivalence theorem,' extends to comparative negligence as well when comparative negligence is characterized correctly. Other formal theorists concurred in Brown's equivalence theorem conclusion. The change in Posner's analysis may have been motivated by this growing appreciation of the equivalence theorem.

3. Haddock and Curran

In one of the most recent works on comparative negligence, Professors Haddock and Curran anticipated several of the conclusions of our work. Their work should be considered as a companion piece to this Article. Because of the close connections, we only sketch their argument and note the ways in which their conclusions differ from ours.

Haddock and Curran's analysis of comparative negligence begins by asking whether it ever makes sense for a rationally self-interested person to choose negligence over compliance with the legal standard of care. They conclude, as do we, that where the parties and the courts are fully informed, so that no one makes mistakes concerning the legal standard of care or the extent of damages from accidents, the legal standard can be set so that all forms of the negligence rule induce efficient precaution.

Haddock and Curran reach a different conclusion, however, when at least one of the parties to the accident or the factfinder has made a mis-

81 See Posner (3d ed.), supra note 8, § 6.4, at 154-58; see also Landes & Posner, Joint and Multiple Tortfeasors: An Economic Analysis, 9 J. Legal Stud. 517, 538 (1980) ("In [bilateral precaution cases] comparative negligence produces the same allocative results as contributory negligence but probably at greater cost."); id. at 539 n.51 (mathematical proof).
83 Brown, supra note 58.
84 Id. at 337-43.
85 See text accompanying notes 98-104 infra.
86 See, e.g., Cooter, Kornhauser & Lane, supra note 13, at 370-71.
87 Haddock & Curran, supra note 5.
88 But see Cooter, supra note 66 (first articulating much of Haddock and Curran's formal analysis).
89 Id. at 60-61.
90 See text accompanying notes 98-104 infra.
91 Haddock & Curran, supra note 5, at 59-63. Haddock and Curran demonstrate this analysis mathematically. Id. at 62.
They consider four possible sources of error: either the injurer or the victim miscalculates the amount of precaution required; the victim and injurer do not know the true relationship between their precaution and the probability of an accident; factfinders make errors in their estimates of precaution taken by the parties; or factfinders do not know the true relation between precaution and the probability of an accident. They conclude that whenever a party or a factfinder makes any of these types of error, the efficiency of an all-or-nothing rule such as contributory negligence is weakened. The loss of efficiency occurs because the parties avoid coming too close to the line that separates efficient care from negligence for fear of making a mistake.

In their conclusion, Haddock and Curran admit that their analysis fails to reach any firm conclusions about the efficiency of comparative negligence compared to other negligence rules. They imply, however, that as errors regarding efficient caretaking costs grow, the scale is tilted toward comparative negligence as the more efficient liability rule. They suggest that a definitive assessment of the comparative negligence rule would include robust efficiency models and a more rigorous treatment of the “fairness” issue. That is precisely the task we undertake in this Article.

B. The Efficiency of Negligence Rules Under Full Information

This Section develops a model of incentives for precaution-taking by potential injurers and victims. We assume that parties facing a fault standard are operating in a “full information” environment. By full information, we mean that the following conditions hold. First, the parties know their technology of precaution; that is, they know the relationship between the amount of precaution they take and the probability and severity of an accident. Second, they know the legal standard of care. Moreover, we assume the court has set the legal standard of care at the social-cost-minimizing or efficient level. The court is also able to assess each party’s precautionary level against that legal standard, so that there

92 See id. at 63-66.
93 See id. at 63.
94 Id. at 63-66.
95 Id. at 64.
96 See id. at 66.
97 See id. at 66-67.
98 If the legal standard is different from the efficient level of care, parties will try to comply with the legal standard in order to escape liability. This will lead to inefficiencies. To minimize these complications, we assume that the legal standard of care and the efficient level of care are the same. The level of care is efficient when the cost to an individual of taking a little more precaution equals the expected reduction in accident costs. See Cooter, Kornhauser & Lane, supra note 13, at 367; H. Kohler, Intermediate Microeconomics: Theory and Applica-
are no errors of fact regarding whether or not a party has complied with the standard. As we will show, under full information, the legal standard can be set so that all negligence rules provide proper incentives for precaution.

The legal standard of care determines whether or not a person is negligent. The standard therefore partitions the universe of action into a permitted zone of adequate precaution and a forbidden zone of insufficient precaution. Only when at least one of the parties is negligent do any of the negligence rules come into play to set the apportionment of damages.

Regardless of the type of negligence rule in effect, the actor's potential costs jump abruptly when he passes from the permitted zone into the forbidden, because once he enters the forbidden zone, he must not only pay for any care he undertakes, but also for any damage he causes. Since rational actors try to minimize their costs, they generally conform to the legal standard in order to avoid this abrupt jump in potential costs. Consequently, if the legal standard of care is set at the efficient level of care, rational actors will be induced to take efficient care. Therefore, under any negligence rule, the actors will take the proper amount of precaution.

The argument can be restated in words corresponding to a mathematical proof. Assume that the legal standard of care is also the efficient level of care. In addition, assume that both parties initially take the efficient amount of precaution so that neither party is negligent. In such a situation, it is possible to show that neither party will want to change the level of care. When neither party is negligent, residual responsibility for the accident's costs falls upon one of them. The party with residual liability benefits from any precaution because he bears the entire accident's costs. Since he internalizes the full benefits of precaution, he

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99 See text accompanying notes 16-18 supra.
100 See Cooter, supra note 98, at 1539.
101 For a rigorous proof of the existence, stability, and efficiency of equilibrium precaution levels under several forms of liability rules, see Cooter, Kornhauser & Lane, supra note 13, at 367-73.
102 The two rules discussed in this paper—negligence with a defense of contributory negligence, and comparative negligence—place residual liability upon the victim. In contrast, the rule of strict liability with a defense of contributory negligence throws residual liability upon the injurer.
can minimize his private costs by taking the level of precaution that is socially efficient. Therefore, the party who has residual liability, assuming he is rational, will persist in taking efficient precaution.

Originally, we assumed that the other party is also taking efficient care and is satisfying the legal standard. If he were to change his behavior and take less care, he would be negligent while the party with residual responsibility would remain nonnegligent. If only one party is negligent, that party bears the entire cost of the accident under any form of the negligence rule. Thus, any reduction in his care will cause his liability to jump abruptly from zero percent to one hundred percent of the accident's cost.

In sum, either party would suffer an increase in costs if he were to depart from the initial situation in which both parties are taking efficient care. The initial situation in which precaution levels were assumed to be efficient is, thus, an equilibrium. Therefore, in a full information model, the legal standard can be set so that all negligence rules—including simple negligence, negligence with contributory negligence, and comparative negligence—provide incentives for efficient care.

C. The Efficiency of Negligence Rules Under Limited Information: Evidentiary Uncertainty

The model in the preceding section is based on the assumption that the parties and the court will have full information regarding both the legal standard of care and the amount of precaution that each person takes. In reality, the level of care that a "reasonable" person would take is a vague standard. Moreover, courts decide cases based upon the preponderance of evidence, which is substantially less than full information. For example, the court may have limited information about the precautionary technology of the parties. Individuals, therefore, cannot predict with complete accuracy whether a court will conclude that a given level of precaution constitutes "due care." Instead, parties operate under conditions of evidentiary uncertainty. Incorporating this form of uncertainty into the model permits the analysis of situations in which reasonable decisionmakers might be found negligent. One consequence

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103 See text accompanying notes 16-20.
104 These proofs ignore the costs of dispute resolution, risk-bearing, and information acquisition. In reality, these costs may be larger than the actual accident and prevention costs.
105 We do not contend that evidentiary uncertainty is the only relevant form of limited information. While it is one of the most important, there are others. For example, courts may make errors in the computation of damages. In addition, potential injurers and victims are often uncertain about their own technology of precaution. See text accompanying note 93 supra.
of this uncertainty is that the parties tend to exceed the legal standard in order to allow courts a margin of error in determining fault.

1. Incentives for Precaution

In order to understand the conditions under which comparative negligence is superior to contributory negligence, it is necessary to understand why evidentiary uncertainty causes excessive precaution relative to the legal standard. Consider the case discussed above, in which legal standards are clear and courts do not make mistakes. Under such circumstances, each party can satisfy the due care standard and ensure that it will not be held liable for any accidents that occur. In the presence of evidentiary uncertainty, however, the parties do not have this option. Both parties know that there is a chance that the court will err and conclude that a party is at fault when, in fact, that party was not negligent. The potential costs to a party arising out of such a mistake can range up to one hundred percent of the accident cost. Thus, given the significant costs associated with an erroneous finding, it is rational to take more precaution than required by the legal standard.

To illustrate, consider Figure One. The horizontal axis indicates the decisionmaker's level of precaution, denoted $x$. The expected cost of accidents, including the harm they do and the cost of precaution against

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106 See text accompanying notes 98-102 supra.

107 This argument applies equally to risk-neutral and risk-averse injurers and results from the discontinuity in costs that is associated with a finding of fault. See text accompanying notes 120-21 infra (discussing attitudes toward risk).
them, is indicated by the curved line. As the level of precaution increases, the expected cost of accidents will decline at first, because precaution costs less than the harm averted by it. When the level of precaution becomes very high, however, the expected cost of accidents will increase, because additional precaution costs more than the harm averted by it. The efficient level of precaution corresponds to the lowest point on the curved line, where the expected cost of accidents is minimized.

In Figure One, the level of precaution that minimizes expected accident costs is the legal standard, denoted by $x^*$. The decisionmaker is legally liable under any negligence rule if his precaution fails to meet the legal standard—if $x < x^*$. He is not liable if $x > x^*$. Therefore, the decisionmaker's total expected cost when $x < x^*$ consists of two elements: expected harm\textsuperscript{108} from the accidents and the cost of precaution against them. The sum of these two cost elements is represented by the curved line labelled “expected cost of accidents.” When $x > x^*$, his total expected cost is simply the cost of precaution represented by the straight line. Thus, the legal standard $x^*$ divides the graph into two zones; the decisionmaker bears both cost elements in the forbidden zone, but in the permitted zone he bears only the cost of his own precaution.

When there is no evidentiary uncertainty, the decisionmaker's expected costs will fall abruptly from the higher value $H$ to the lower value $L$ as his level of precaution crosses the legal standard of care, $x^*$, as depicted in Figure Two. Thus, the decisionmaker's private cost curve consists of two ranges, one high and one low, joined by a vertical line at $x^*$. The decisionmaker's cost-minimizing (or profit-maximizing) point is the lowest point on this cost curve $L$. When there is full information, this point corresponds to the level of precaution exactly equal to the legal standard of care; therefore, $x = x^*$. This is the basis for the conclusion that, under full information, both the contributory negligence rule and the comparative negligence rule cause rational parties to satisfy the legal standard.

In contrast, consider the case of evidentiary uncertainty as depicted in Figure Three, under which both parties know that courts are sometimes mistaken about whether the legal standard of care was satisfied. In this situation, the decisionmaker knows that he may be fortunate and the court may conclude that he was nonnegligent—thus leaving him on the $L$ cost curve. On the other hand, he may be unfortunate and the court may find him negligent even though he has met the legal standard. In such a case, the decisionmaker remains on the $H$ cost curve where he

\textsuperscript{108} The expected cost of harm is the probability of an accident occurring multiplied by the expected harm arising from the accident.
bears the cost of damages in addition to the costs associated with precaution. Therefore, under evidentiary uncertainty, the decisionmaker's expected costs are a weighted average of the higher value $H$ and the lower value $L$, where the weights are based on the probability that his precaution will or will not be deemed by the court to satisfy the legal standard.\textsuperscript{109}

Evidentiary uncertainty is illustrated in Figure Three as a zone around $x^*$ within which the court may make mistakes in assigning liability. When his level of precaution falls within this zone, the decisionmaker faces the risk that a court will find him negligent, even though his actual precaution exceeds the legal standard. The effect of this risk, depicted graphically by the "weighted average" line in Figure Three, is to smooth out the drop in the individual's expected costs that otherwise occurs at the legal standard $x^*$ in Figure Two. Rather than an abrupt drop at $x^*$ from the high value $H$ to the low value $L$, there is a continuous change represented by the weighted average of $H$ and $L$.\textsuperscript{110}

\textsuperscript{109} Let $q(x;x^*)$ indicate the probability that the court finds the decisionmaker to be negligent when his actual precaution is $x$ and the legal standard is $x^*$. His expected liability is $qH + (1-q)L$ where $q = q(x;x^*)$. Expected liability is thus a weighted average of $H$ and $L$ with $q$ and $(1-q)$ as the weights.

This discussion applies to both contributory negligence and comparative negligence. We do not analyze injurer and victim separately here because comparative negligence treats them alike with respect to liability. Thus, we simply refer to the "decisionmaker."

\textsuperscript{110} Another feature of the expected cost curve in Figure 3 warrants attention. The total expected cost curve may bend twice. The two bends appear when the two sharp corners of the discontinuity at $H$ and $L$ are smoothed. This means that there may be two levels of precaution
Economically rational individuals will select the level of care that minimizes their expected costs. The lowest portion on the weighted average line occurs at the level of precaution denoted $x_\sim$. It is clear from Figure Three that under evidentiary uncertainty, individuals will not choose the legal standard of due care, $x^*$, but rather will select a higher level of care, $x_\sim$, in order to minimize their costs.

Therefore, in situations of evidentiary uncertainty, the level of care that minimizes the rational decisionmaker’s expected costs exceeds the legal standard, even if the legal standard is set at the efficient level of care. By exceeding the legal standard, the decisionmaker reduces the probability that a court will make a mistake and find him liable. This shifts the allocation of expected accident costs from the decisionmaker to the other party. The redistribution of expected accident costs provides the decisionmaker with incentives to exceed the legal standard of care. Evidentiary uncertainty therefore explains why decisionmakers opt for a level of care that would be clearly inefficient given full information.

A decisionmaker’s incentive to exceed the legal standard of care will vary, however, depending on which negligence rule is in effect. To explain these differences in terms of incentives, it is useful to introduce the concept of discounting. The term discounting is used here to express the relationship between the total accident costs and the costs that a decisionmaker minimizes their expected costs. The lowest portion on the weighted average line occurs at the level of precaution denoted $x_\sim$. It is clear from Figure Three that under evidentiary uncertainty, individuals will not choose the legal standard of due care, $x^*$, but rather will select a higher level of care, $x_\sim$, in order to minimize their costs.

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sionmaker bears. To illustrate, consider the case where the defendant, \( A \), is forty percent negligent and the victim, \( B \), is sixty percent negligent. Under the rule of negligence with a defense of contributory negligence, \( A \) will not be liable even though he was at fault. Thus, his liability will be discounted under the rule by one hundred percent. By contrast, under comparative negligence, the defendant's liability will be discounted by the victim's relative fault; in this example, the court will discount \( A \)'s damages by sixty percent. Finally, under the rule of simple negligence, a victim's conduct will not be considered at all; the court will discount \( A \)'s liability by zero percent.

This illustration shows that an injurer's potential liability is discounted the most under the rule of negligence with a defense of contributory negligence, somewhat less under comparative negligence, and least under the simple negligence rule. His incentives for taking precaution are inversely related to the discount. Therefore, the greater the discount—for example under the contributory negligence rule—the weaker the potential injurer's incentive to take precaution.

A decisionmaker's incentive also varies with the different forms of the comparative negligence rule. To illustrate, consider our example in which the injurer, \( A \), is forty percent responsible for an accident and the victim, \( B \), is sixty percent at fault. The pure form of comparative negligence allows the damages owed by \( A \) to be reduced by sixty percent. In contrast, the modified form of comparative negligence allows one hundred percent discounting under these circumstances. Consequently, the expected discount of the injurer's liability is greater under the modified form of comparative negligence than under the pure form. Therefore, the injurer's incentives for precaution are greater under the pure form than under the modified form.

In summary, it is possible to rank the different forms of negligence rules according to the strength of the incentives they create for injurer's precaution:

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<thead>
<tr>
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<th>injurer's incentives for precaution</th>
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<tbody>
<tr>
<td></td>
<td>strong</td>
</tr>
<tr>
<td>simple negligence</td>
<td>pure comparative negligence</td>
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<tr>
<td>comparative negligence</td>
<td>modified comparative negligence</td>
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<tr>
<td></td>
<td>slight/gross comparative negligence</td>
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<tr>
<td></td>
<td>contributory negligence</td>
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</tbody>
</table>

Turning to the victim, his incentive to take precaution is strongest when the injurer's incentive to take precaution is smallest, because the victim bears the residual cost of any uncompensated harm. Conversely,
the victim’s incentive is weakest where the defendant’s incentive is greatest. Therefore, his incentive ranking is the mirror image of the injurer’s:

| victim’s incentives for precaution |
|-----------------|-----------------|
| strong           | weak            |
| contributory negligence | slight/gross negligence | comparative negligence |
| comparative negligence | modified negligence | comparative negligence |
| pure negligence | simple negligence |

These variations in the incentive effects determine the conditions under which a particular rule is preferable over its alternatives. Evidentiary uncertainty distorts incentives for precaution and prompts rational decisionmakers to exceed the legal standard of care. Although evidentiary uncertainty distorts incentives for precaution under any form of the negligence rule, the amount of distortion varies under the different forms. The rule of comparative negligence gives moderate incentives for precaution to both injurers and victims, while its alternatives give strong incentives to one party and weak incentives to the other. For this reason, comparative negligence minimizes the total amount of excessive precaution when the parties are “symmetrically situated”—i.e., when efficiency requires both parties to take similar amounts of precaution. Therefore, comparative negligence is the preferable rule in such situations.

Conversely, when the parties are asymmetrically situated, so that it is better to give strong incentives to one party and weak incentives to the other, comparative negligence is inferior to other forms of the negligence rule. For example, if injurers are better situated to take precaution than victims, the simple negligence rule provides better incentives than the rule of comparative negligence or the rule of contributory negligence. But if victims are better situated to take precaution than injurers, the contributory negligence rule provides better incentives than the other two forms of the negligence rule.

2. Anchoring the Legal Standard of Care

Judge Learned Hand’s formula provides the courts with a way to ensure that the legal and efficient standards of care are the same.  

112 See text accompanying notes 109-11 supra.  
113 This definition can be distinguished from that of “bilateral precaution,” which requires both parties to take “some” precaution. See notes 71-72 and accompanying text supra.  
114 See United States v. Carrol Towing Co., 159 F.2d 169, 173 (2d Cir. 1947) (if the probability be called P; the injury, L; and the burden of precautions, B; liability depends upon whether B is less than L multiplied by P—i.e., whether B < L ⋅ P).
When the two standards are the same, meeting the legal standard is best from an economic viewpoint.

While the use of the Hand Rule ensures that the legal standard of care and the efficient level of care are equal, the courts rarely use the Hand Rule explicitly. Instead, they frequently apply the "reasonable care" standard in determining the legal level of care.\(^{115}\) But the Hand Rule and the reasonable care standard are not necessarily the same. The reasonable care standard merely induces individuals to take as much precaution as would a reasonable person under like circumstances,\(^{116}\) whereas the Hand Rule induces individuals to take the efficient amount of precaution.\(^{117}\) The correlation between the Hand Rule and the reasonable care standard exists when the risks that an injurer imposes upon others is given the same weight as the risks that rational person imposes upon himself. It is possible, therefore, that the reasonable care standard may exceed or fall short of the level required by the Hand Rule. The reasonable care standard would require more care than the Hand Rule if injurers were required to give more weight to risks they impose upon others than to their own risks.\(^{118}\) In contrast, the reasonable care standard would require less care than the Hand Rule if injurers were required to give less weight to risks they impose upon others than to their own risks.\(^{119}\) It is only in the latter case, where the reasonable care standard falls short of the Hand Rule—the efficiency rule—that the tendency of evidentiary uncertainty to prompt excessive precaution is counterbalanced by the fact that the efficient standard is at a higher level of care than the legal standard. Therefore, even with the evidentiary uncertainty, parties in this situation are induced to take the efficient amount of precaution.

3. Evidentiary Uncertainty and Attitudes Toward Risk

The analysis in the previous section implicitly assumes that potential

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\(^{115}\) See authorities cited in notes 17-18 supra.

\(^{116}\) See text accompanying note 17 supra.

\(^{117}\) See text accompanying note 111 supra.

\(^{118}\) Cf. note 29 and accompanying text supra (discussing different standards of care for plaintiffs and defendants).

\(^{119}\) The reasonable care standard would also require less care than the Hand Rule when a reasonable person could avoid the accident at a lower cost than a particular injurer. For example, assume that the expected cost of an accident is $50. Suppose that a reasonable person could avoid the accident for $20, whereas a certain particular individual must spend $25 to avoid the accident.

If the particular individual spends less than $20 on precaution, both the Hand Rule and the reasonable care standard would find him liable. However, the Hand Rule would induce that person to take the most efficient level of care because it would also find this particular individual liable if he spent more than $20 but less than $25 on precaution. The reasonable person standard, on the other hand, would require him only to take a suboptimal level of care.
injurers are either risk-neutral or risk-averse. However, the impact of these attitudes on efficiency was not addressed.\textsuperscript{120} This Section briefly distinguishes the responses of risk-neutral and risk-averse persons to comparative negligence.

Since evidentiary uncertainty imposes a risk of liability even upon people who conform to the legal standard, rational decisionmakers take precautions exceeding the legal standard of care in order to allow a margin for court error.\textsuperscript{121} Risk-averse persons will incur greater expense to avoid a given risk than will those who are risk-neutral. Thus, when there is evidentiary uncertainty, there will generally be more overprecaution by risk-averse parties than by risk-neutral parties. This effect will be accentuated by negligence rules that concentrate the risk of liability for all damage costs on a single party. Since comparative negligence spreads the risk of court error between the victim and the injurer, it dampens the impulse of risk-averse decisionmakers to take greater care than the amount taken by risk-neutral decisionmakers. The efficiency argument for comparative negligence is thus even stronger when the parties are risk-averse.

III

POLICY: THE CONVERGENCE OF EQUITY AND EFFICIENCY

Under certain circumstances comparative negligence is more efficient than contributory negligence.\textsuperscript{122} Efficiency, however, is not the only goal of tort law.\textsuperscript{123} Nor is efficiency prominent among the reasons given by judges and legislators for the change to comparative negligence.\textsuperscript{124} Instead, proponents of comparative negligence often claim that

\textsuperscript{120} See generally H. Kohler, supra note 98, at 478-80 (discussing distinctions among risk-neutrality, risk-aversion, and risk-preference).

\textsuperscript{121} See text accompanying notes 105-11 supra.

\textsuperscript{122} See text accompanying notes 55-121 supra.

\textsuperscript{123} See, e.g., Epstein, A Theory of Strict Liability, 2 J. Legal Stud. 151 (1973) (raising questions of “fairness” in context of traditional tort doctrine); Fletcher, Fairness and Utility in Tort Theory, 85 Harv. L. Rev. 537, 543-51 (1972) (discussing victim’s “right” to recover for injuries caused by risk greater in degree and different in order from those he created).

\textsuperscript{124} See notes 6-7 and accompanying text supra.
dividing costs among the parties at fault is more fair and results in a less severe allocation of accident costs than contributory negligence.\textsuperscript{125} This Part will first analyze the fairness justification for comparative negligence as an intuitive claim; then it will bolster the argument for comparative negligence by exploring the relationship between fairness and efficiency.

\textbf{A. Comparative Negligence and Horizontal Equity}

"The person at fault in an accident should compensate the victim." This principle captures widely shared sentiments about fairness.\textsuperscript{126} Suppose that several people are at fault. In that situation, the principle should be: "The people who cause an accident should compensate the victim in proportion to their fault." This is a statement of the rule of pure comparative negligence; that rule seems to satisfy intuitive feelings about fairness.

The basis of the principle's intuitive appeal can be clarified by a reference to a tax concept. A standard of fairness in income taxation is "horizontal equity," which requires that people with the same level of income incur the same tax liability.\textsuperscript{127} Horizontal equity enables the tax system to act in a neutral manner with respect to individuals with differing sources of income. To illustrate, if person \textit{A} has \$50,000 of income from plumbing and person \textit{B} has \$50,000 of income from oil wells, equity requires that they pay the same amount in taxes. The tax system ought not to favor one source of income, such as oil wells, over others, such as plumbing. Departures from horizontal equity, which result in different tax rates for different sources of income, can only be justified in light of special policy goals such as stimulating investments in favored economic sectors.

\textsuperscript{125} See authorities cited in notes 6-7 supra.

\textsuperscript{126} See, e.g., Fletcher, supra note 123, at 543-51. One justification for this principle is that accidents disrupt an initial allocation of resources that is presumptively fair and efficient. Philosophers differ as to which initial allocation of resources the principle should protect. For example, Aristotle argues that every society has an ideal distribution of income that should be protected by law. Aristotle, Nichomachean Ethics, reprinted in 2 The Complete Works of Aristotle 1781, 1785-86 (J. Barnes ed. 1984) [hereinafter Aristotle]. See Gordley, Equality in Exchange, 69 Calif. L. Rev. 1587, 1589-90 (1984). Under this theory, when someone disturbs the ideal income distribution by imposing costs upon others, compensation must be paid in order to restore it. Aristotle, supra, at 1786-87. Thus, the cost principle can be viewed as an instrument for protecting an ideal distribution of income.

In the contractarian tradition of Locke, in contrast, a person is naturally entitled to dispose of his possessions as he thinks fit. See J. Locke, The Second Treatise of Government, in Two Treatises of Government 4 (P. Laslett 2d ed. 1967) (1690); see also R. Nozick, Anarchy, State, and Utopia 57-87 (1974). If someone else destroys or diminishes the value of that possession, the rightful owner is entitled to compensation. J. Locke, supra, at 10. According to this theory, tort liability can be viewed as enforcing the natural right to be free from harm by others. Id. at 16-21.

A similar argument bolsters the case for comparative negligence. Applied to tortious accidents, the principle of horizontal equity holds that two parties who are equally at fault should bear an equal share of the accident's costs. It is inequitable for one to bear a greater share of the accident's cost than the other if their fault is the same. Therefore, if both parties equally cause an accident, allocating costs unequally can be justified only by special excuses.\textsuperscript{128}

The simple negligence rule and the rule of contributory negligence do not satisfy the principle of horizontal equity. In contrast, the rule of comparative negligence in most of its forms satisfies the principle.\textsuperscript{129} The greater intuitive appeal of comparative negligence relative to other forms of the negligence rule is thus partly explained by the fact that it alone achieves horizontal equity.\textsuperscript{130}

\textbf{B. Conditions Under Which Comparative Negligence is Preferred}

The argument above provides an equity rationale that appeals to a simple principle and to widely shared moral sentiment. Some scholars have argued that intuitive ideas and simple principles should command as much respect as would complex theories in providing firm grounding for tort law.\textsuperscript{131} It seems desirable, however, to go beyond intuition in justifying the rule of comparative negligence. This Section bolsters the argument for comparative negligence by showing the relationship between efficiency and fairness.

\textsuperscript{128} For example, an injurer may be excused from liability if he is physically compelled to act. See Fletcher, supra note 123, at 551-56 (discussing role of excuses in torts).

\textsuperscript{129} Only the modified form we call the "50\% plus rule" fails to satisfy the principle of horizontal equity. See text accompanying notes 51-53 supra.

\textsuperscript{130} Negligence rules other than comparative negligence may be invented to achieve horizontal equity. Such rules might divide accident costs equally when both parties are equally at fault, but allocate costs more than proportionally (or less than proportionally) to fault as the levels of fault diverge. This possibility derives from an analogy to taxation. Comparative negligence is analogous to proportional taxation, but the principle of horizontal equity can be satisfied by a progressive tax or a regressive tax, as well as by a proportional tax, provided that the tax schedule has no loopholes or shelters.

\textsuperscript{131} See, e.g., Fletcher, supra note 123, at 572-73.

Metaphors and causal imagery may represent a mode of thought that appears insufficiently rational in an era dominated by technological processes. Yet why should the rhetoric of reasonableness and foreseeability appeal to lawyers as a more scientific or precise way of thinking? The answer might lie in the scientific image associated with passing through several stages of argument before reaching a conclusion. The paradigm of reasonableness requires several stages of analysis: defining the risk, assessing its consequences, balancing costs and benefits. The paradigm of reciprocity requires a single conclusion, based on perceptions of similarities, of excessiveness, and of directness. If an argument requires several steps, it basks in the respectability of precision and rationality. Yet associating rationality with multistaged argumentation may be but a spectacular lawyerly fallacy . . . .

Id. at 573.
When an accident occurs, the parties are unlikely to agree about which liability rule should govern the distribution of costs. The more favorable a given distribution is to one party, the less favorable it will be to the other.\textsuperscript{132} Therefore, assuming that each party wants to bear as few of the costs as possible, there is no basis for the parties to agree after the accident. The injuring party will prefer the rule of contributory negligence over comparative negligence and will prefer comparative negligence over simple negligence. The victim’s ranking of rules will be the mirror image of the injuring party’s.\textsuperscript{133} From the perspective of hindsight, the injuring party and victim will disagree about which liability rule is best.

Although there is no one rule that both parties would prefer after the accident, under certain conditions both parties would consent to be governed by the same rule before the accident. To illustrate, suppose that the parties do not know in advance who will suffer the harm and who will inflict it. The uncertainty of whether the parties will be injuring parties or victims diminishes or dissolves the conflict of interest between the parties. Rather than preferring different tort rules, they will tend to agree upon the preferred rule.

Indeed, consider the behavior of a rational decisionmaker under uncertainty.\textsuperscript{134} One consideration that might affect the decisionmaker’s preferences is the amount of wealth represented by the various prospects. The efficiency arguments of Part II concluded that, when the parties are symmetrically situated, the comparative negligence rule is more efficient than the other negligence rules.\textsuperscript{135} Thus, applying comparative negligence will result in greater wealth than applying one of the alternative rules. If the parties believe that they are equally likely to be victims or injuring parties in future accidents, they have an equal chance of obtaining future wealth, regardless of whether it is distributed in favor of victims or injuring parties. Thus, under conditions of symmetrical precaution and uncertain future identity, the consideration of wealth would encourage a rational decisionmaker to prefer the prospective application of the comparative negligence rule over its alternatives.

Another consideration that might affect rational choice under uncertainty is how evenly wealth would be distributed. Under uncertain prospects, most decisionmakers will prefer a more even distribution of wealth over a less even one. Since the application of comparative negligence results in a more even distribution than does the application of the

\textsuperscript{132} This is the definition of a zero-sum game. See M. Davis, Game Theory: A Nontechnical Introduction 14 (rev. ed. 1983).

\textsuperscript{133} See text accompanying note 112 supra.

\textsuperscript{134} Economics provides a standard framework for making choices under uncertainty. See H. Raiffa, Decision Analysis (1970).

\textsuperscript{135} See text accompanying notes 112-13 supra.
other negligence rules, a rational decisionmaker would prefer comparative negligence.

The preference for comparative negligence is even stronger when the parties are risk-averse. These individuals, by definition, prefer to share risks with others, even at some cost to themselves, in order to avoid the possibility of a dramatic decline in their wealth. Because comparative negligence, especially in its pure form, allocates costs among parties in the proportion that their negligence contributed to the accident, it spreads the risk between the injurer and the victim more than do other negligence rules. Thus, when all the decisionmakers are risk-averse and they believe that the probability of being an injurer equals the probability of being a victim, they will universally prefer pure comparative negligence over other negligence rules.

To recapitulate, every rational decisionmaker will prefer the prospective application of the comparative negligence rule over alternative negligence rules, because the former creates more wealth and distributes it more evenly, under the following conditions:

(1) injurers and victims are symmetrically situated with respect to their ability to take precaution;
(2) the probability of any individual being an injurer approximately equals the probability that he will be a victim;
(3) individuals are averse to the risk represented by the accident; and
(4) the alternative negligence rules are similar to comparative negligence with respect to administrative costs.

C. Ex Ante Pareto Efficiency

A rule that makes some people better off and no one worse off is, by definition, Pareto efficient. We will describe a legal rule as "ex ante

136 See H. Kohler, supra note 98, at 478-79.
137 See text accompanying notes 43-54 supra.
138 This proposition can be stated more precisely in technical terms. Economists often equate risk with the variance in a probability distribution: the larger the variance, the larger the risk. See Rothschild & Stiglitz, Increasing Risk: I. A Definition, 2 J. Econ. Theory 225, 227-31 (1970). Thus, a risk-averse decisionmaker who is given the choice between two gambles, each with the same mean, will prefer the gamble with the smaller variance. When the choice is between legal rules, the mean loss from accidents is held constant by assuming that the legal rules do not influence the precaution levels of the parties. From the perspective of a decisionmaker who is equally likely to be the injurer or the victim, the variance in costs is less under comparative negligence than under simple negligence or negligence with a defense of contributory negligence. Thus, risk-aversion will cause such a decisionmaker to prefer the rule of comparative negligence. Furthermore, the most preferred form of comparative negligence will be the pure form, because it spreads risk the most.
139 Pareto efficiency is the fundamental normative concept in contemporary welfare economics. It is used to determine which allocation of resources would improve total economic

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Pareto efficient” when at least one person prefers its application to the alternatives, and no one prefers the application of an alternative rule. Under the conditions set forth above, rational people prefer the application of the comparative negligence rule rather than its alternatives. Therefore comparative negligence is ex ante Pareto efficient when the conditions are met.

The justification for the ex ante Pareto standard rests on several philosophical foundations. For example, an important strand in political philosophy holds that people should be governed by laws to which they would, at least hypothetically, consent. Consent is fundamental in the contractarian tradition, which attempts to explain the rules of civil society as an implicit social contract. Under the conditions listed above, rational decisionmakers will prefer the application of comparative negligence rather than its alternatives to settle future disputes. This rational preference can be taken as evidence of hypothetical consent.

The ex ante Pareto standard also can be justified by the principle of utility. A change from a law that fails to satisfy the standard of ex ante Pareto efficiency to a law that satisfies it will increase some people’s expected utilities without decreasing anyone’s expected utility. As a consequence, the sum of people’s expected utilities will increase. When legislators apply the principle of utility to an uncertain future, they should adopt laws that maximize the sum of expected utilities. Thus, the principle of utility supports the conclusion that all laws should be ex ante Pareto efficient.

Adding the utilities of individuals to arrive at an aggregate utility, however, is philosophically and functionally problematic. A modern form of utilitarianism tries to solve this problem by identifying the social optimum with the preferences of a decisionmaker who is equally likely to be in the position of any member of society. Thus, the utilities of dif-

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140 See J. Rawls, A Theory of Justice 5-6, 136-50 (1971); Posner, supra note 10, at 488, 492. Others argue that hypothetical consent cannot be employed to justify such laws since the crucial elements of consent are fully informed and uncoerced choice, as distinguished from mere self-interest. Dworkin, supra note 10, at 574-75, 578-79; see also Coleman, supra note 10, at 547 (in absence of a non-efficiency-based theory of rights, it would be irrational to consent to Pareto efficiency as a moral maxim).

141 See notes 126, 140 supra.

different individuals are combined as if they were the utilities of one person. In order to identify the social optimum under this version of utilitarianism, the decisionmaker must proceed as if he were uncertain about his future identity. And as we already have shown, actual uncertainty about identity, whether as victims or injurers, makes everyone prefer the rule of comparative negligence over other forms of the negligence rule. Therefore, this version of utilitarianism identifies the social optimum in a manner similar to the way rational people choose comparative negligence as the most preferable negligence rule.

The ex ante Pareto standard favors rules preferred by a consensus of rational people. Any philosophical tradition that respects such a consensus can provide further justification for the ex ante Pareto standard. That is why it can be justified by such divergent traditions as contractarianism and utilitarianism. The recent history of our courts and legislatures suggests that such a consensus exists in favor of comparative negligence.

**Summary and Conclusion**

Some commentators argue that a comparative negligence rule will induce too much precaution, others argue that it will induce too little, and still others argue that the efficiency aspects are so clouded as to be unfathomable. This Article advances the discussion in several important respects. First, we show that under the assumption of full information, any form of the negligence rule, including comparative negligence, induces efficient behavior by potential victims and tortfeasors. Second, we re-examine all forms of the negligence rule under the assumption that potential victims and injurers are uncertain about how the court will evaluate their precautionary behavior with respect to the legal standard. We find that, under this assumption, comparative negligence is the most efficient rule for parties who are symmetrically situated with respect to their ability to take precaution, and that the pure form of comparative negligence is more efficient than the other forms.

We also examine comparative negligence from a fairness perspective. Borrowing a concept from the area of taxation, we show that the adoption of comparative negligence can be justified on grounds of horizontal equity. Furthermore, for future accidents in which each person is equally likely to inflict harm as well as to suffer it, comparative negligence is the form of negligence rule that every rational person will prefer to apply. A rule everybody prefers is ex ante Pareto efficient and can be justified from the perspective of several different philosophical traditions, including contractarianism and utilitarianism.

In sum, when the parties are symmetrically situated and their future
identity is uncertain, comparative negligence is the best rule from the economic standpoint because, under such circumstance, it is more efficient and more equitable than its alternatives, and is preferred ex ante by everyone.

This endorsement of comparative negligence requires qualification in light of three limitations to our analysis. First, comparative negligence has been found superior to other forms of the negligence rule under the specified conditions, but it was not compared to other alternatives such as no-fault rules. Second, our analysis did not consider administrative costs on the ground that negligence rules do not differ markedly with respect to costs. A broader comparison might reveal that more fundamental changes in tort law are necessary to attain the efficient result. Another limitation is our focus on rational behavior, as opposed to irrational motives or nonrational attitudes that play a significant role in some kinds of accidents. Assessing the relative strength of rational and non-rational motives requires empirical evidence that is woefully lacking.

The business of making public policy, including designing liability rules, is typically more complex than simply choosing a hypothesis on an empirical basis. Other values and interests besides scientific acceptability must be consulted, including equitable considerations. These other values may or may not support the same result as efficiency considerations. When the various values support divergent results, economists have no expertise in deciding among them. Yet, as we show in this Article, when we compare comparative negligence to its alternatives, a dichotomy between efficiency and equity considerations may not emerge. This is because under conditions in which comparative negligence is ex ante Pareto efficient, the equity and efficiency arguments converge to support the same result. Therefore, we believe that under those conditions the performance of further empirical tests—such as analyzing the elasticity of precaution with respect to liability—can help resolve the public policy issues regarding the choice of negligence rules in an equitable manner. That is an important order of business in torts scholarship.


144 Gary Schwartz suggests that irrational motives and nonrational attitudes are so important to tort law that psychological models offer more promise than economic models. See Schwartz, supra note 6, at 726.
MATHEMATICAL APPENDIX

A. Mathematical Description of Rules of Liability

This appendix presents a mathematical proof of the arguments made in Part II. This proof employs the following notation:

- $x$ is the injurer’s expenditure on precaution.
- $y$ is the victim’s expenditure on precaution.
- $p = p(x, y)$ is the probability of avoiding an accident; the probability of having an accident thus equals $(1 - p)$.
- $a = a(x, y)$ is the dollar value of the resulting harm suffered by the victim in the event that an accident occurs.
- $A(x, y)$ is the expected loss from accidents.

Given this notation, the expected loss from accidents is the product of the probability of an accident and the amount of damage caused by the accident:

$$A(x, y) = \left[1 - p(x, y)\right] \cdot a(x, y).$$

Moreover, the total expected cost of accidents, denoted $SC$, is the sum of the cost of precaution and the expected loss from accidents:

$$SC = x + y + A(x, y).$$

A liability rule allocates social costs between the injurer and victim. For example, the injurer bears the cost of his own precaution $x$, and he may or may not be liable for a share of the loss $A(x, y)$. Letting $r$ denote a discount term that assigns a share of the loss to the injurer, the injurer’s liability can be written as the product of the loss and the discount term:

$$\text{injurer's liability} = A(x, y) \cdot r.$$ 

Thus, the injurer is fully liable if $r = 1$; he entirely escapes liability if $r = 0$; and he bears a share of the loss if $1 > r > 0$. Thus, the injurer’s share of expected social costs equals the cost of his precaution plus his discounted share of the expected loss:

$$C_x = x + A(x, y) \cdot r.$$ 

Similarly, assuming there are only two parties, the victim’s share of the expected social costs of accidents is his precaution plus the residual loss after the injurer has paid his share:

$$C_y = y + A(x, y) \cdot (1-r).$$

The various liability rules utilize different functions to determine the value of the discounting term $r$. Liability rules based upon fault determine the discounting term as a function of negligence. This requires an explicit expression for the legal standards of care. Let $x^*$ denote the legal standard of care for the injurer, and let $y^*$ denote the legal standard of care for the victim. The injurer is nonnegligent when he takes precaution

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145 The model explicitly treats precaution and harm, whereas it omits other costs such as dispute resolution, risk-bearing, and information costs.
x such that \( x > x^* \); he is negligent when \( x < x^* \). Similarly, the victim is nonnegligent when he takes precaution \( y \) such that \( y > y^* \); he is negligent if \( y < y^* \).

Having defined negligence, we can state the fault-based liability rules in a compact form by using the discounting term \( r \). A rule of simple negligence makes the injurer liable for 100% of the loss if he is negligent. The injurer, however, is not liable for any loss if he is nonnegligent. Thus, simple negligence can be modeled as:

\[
\begin{align*}
\text{r} &= 1 \text{ if } x < x^*, \\
&= 0 \text{ if } x > x^*.
\end{align*}
\]

Under the rule of negligence with contributory negligence, the injurer is liable for 100% of the loss if he is negligent and the victim is nonnegligent; the injurer's liability is zero otherwise. Thus, negligence with contributory negligence can be expressed as:

\[
\begin{align*}
\text{r} &= 1 \text{ if } x < x^*, \text{ and } y > y^* \\
&= 0 \text{ if either } x > x^* \text{ or } y < y^*.
\end{align*}
\]

To represent comparative negligence, let \( n_x \) denote the legally relevant measure of the injurer's negligence. At this stage, we do not need to explain the measure of negligence \( n_x \) beyond noting that its value is zero if the injurer is nonnegligent (\( x > x^* \)) and positive if he is negligent (\( x < x^* \)). Similarly, let \( n_y \) represent the legally relevant measure of the victim's negligence. Thus, the injurer's relative negligence, as compared to the victim's negligence, is \( \frac{n_x}{n_x + n_y} \). Under comparative negligence, the discounting term \( r \) equals the injurer's relative negligence. Thus, comparative negligence can be modeled as an \( r \) such that

\[
\text{r} = \frac{n_x}{n_x + n_y}.
\]

This definition of comparative negligence must be completed by specifying the legally relevant measures of negligence. The simplest measure of each party's negligence is the shortfall of his or precaution relative to the legal standard:

\[
\begin{align*}
\text{n}_x &= (x^* - x) \text{ if } x < x^* \\
&= 0 \quad \text{ if } x > x^*
\end{align*}
\]

and

\[
\begin{align*}
\text{n}_y &= (y^* - y) \text{ if } y < y^* \\
&= 0 \quad \text{ if } y > y^*.
\end{align*}
\]

This simple measure of negligence is not, however, the best representation of the law. As we explained in this Article, comparative negligence is determined in the law by the amount each party's negligence contributed to the accident. In our model, a good measure of the contribution is the relative increase in expected accident losses due to each party's negligence. The increase in expected accident losses can be measured by the value of each party's incremental precaution, which we shall
denote $A_x$ and $A_y$ for injurer and victim respectively, times the shortfall in precaution relative to the legal standard. Thus, the contribution of the injurer's negligence to the accident can be written $A_x \cdot (x^* - x)$, and the negligent victim's contribution can be written $A_y \cdot (y^* - y)$. According to this improved measure, the legally relevant measure of negligence is written

$$n_x = A_x \cdot (x^* - x) \text{ if } x < x^*$$
$$= 0 \text{ if } x > x^*,$$

and

$$n_y = A_y \cdot (y^* - y) \text{ if } y < y^*$$
$$= 0 \text{ if } y > y^*.$$

Adopting this measure of negligence and substituting terms in the preceding equations, we end up with the following definition of comparative negligence:

$$r = A_x \cdot (x^* - x) / [A_x \cdot (x^* - x) + A_y \cdot (y^* - y)].$$

In the main body of the Article, we mentioned that Brown's model is concerned with comparative precaution rather than comparative negligence. We use the terms $A_x$ and $A_y$ to also model comparative precaution. Under comparative precaution, the discount term $r$, which determines the injurer's share of accident costs, is given by the relative value of his precaution, or:

$$r = A_x / (A_x + A_y).$$

**B. Efficiency and Distribution Under Full Information**

Assuming that the functions representing the technology of precaution and the one expressing the relationship between precaution and accident losses are both convex and continuous, there exist levels of precaution, denoted $x^\sim$ and $y^\sim$, which minimize the social cost of accidents. These levels are, by definition, efficient. Now assume that the legal standards of care equal the efficient levels of care: $x^* = x^\sim$ and $y^* = y^\sim$. Given this assumption, it can be readily shown that all three forms of the fault rule — simple negligence, negligence with contributory

$^{146}$ $A_x$ and $A_y$ are the partial derivatives of $A(x,y)$.

$^{147}$ There is a technical flaw in the text's formulation. For the sake of convenience and also because the flaw does not materially affect the conclusions, we confine our discussion of the flaw to this footnote. The technical problem is that the shortfall of precaution from the legal standard must be restricted so that it cannot become negative, and the discount term must be prevented from becoming a ratio of zeros. For any variable $z$, define a function $m(z,z^*)$ such that

$$m(z,z^*) = (z^* - z) \text{ if } z < z^*$$
$$= 0 \text{ if } z > z^*.$$

Thus, we offer the substitute definition of comparative negligence:

$$r = A_x m(x,x^*) / [A_x m(x,x^*) + A_y m(y,y^*)] \text{ if } m(x,x^*) > 0 \text{ or } m(y,y^*) > 0$$
$$= 0 \text{ otherwise.}$$
negligence, and comparative negligence — provide incentives for efficient behavior. To be more precise, it is easy to prove that the equilibrium levels of precaution by the injurer and victim equal the efficient levels.

Here is a heuristic proof. Assume that the legal standards of care are efficient, i.e., $x^* = x_\sim$ and $y^* = y_\sim$. Now we assume that the victim's precaution is efficient ($y = y_\sim$) and prove that it is cost-minimizing for the injurer to take efficient precaution ($x_\sim$ minimizes $C_x$). Second, we reverse the argument by assuming that the injurer's precaution is efficient and prove that it is cost-minimizing for the victim to take efficient precaution. In notation, we assume that $x = x_\sim$ and prove that $y_\sim$ minimizes $C_y$. The two steps prove that each party will take efficient precaution if the other does, so the efficient levels of precaution constitute an equilibrium.

The first step in the proof assumes that the victim's precaution satisfies the legal standard. Given this assumption, under every form of negligence rule the injurer will be fully liable if negligent and not liable if nonnegligent. Thus, the injurer will minimize his cost by being nonnegligent and escaping liability.

In mathematical notation, we assume that $y = y^* = y_\sim$. Consequently, under each of the three fault rules defining $r$, we have $r = 1$ if $x < x^*$ and $r = 0$ if $x \geq x^*$. The injurer will choose $x$ so as to minimize $[x + A(x,y^*) \cdot r(s,y^*)]$. Thus he will choose $x = x^*$, where $x^* = x_\sim$.

Now we turn to the second step of the proof. The analysis presented above is repeated with $x$ and $y$ terms reversed. Assume that the legal standard of care is efficient and that the injurer is satisfying it: $x = x^* = x_\sim$. Consequently, under each of the three rules defining $r$, $r = 0$ for all $y$. Since the injurer is nonnegligent, the residual responsibility for the accident loss falls upon the victim. The victim's cost function $C_y$ is depicted in figure 2 of Part II under the assumption that $x = x_\sim$. Since the victim bears the full loss, the victim internalizes all the benefit from his precaution. The level of precaution that minimizes $C_y$ or $[y + A(x^*,y) \cdot (1-r(x^*,y))]$ equals the efficient level of precaution $y_\sim$ that minimizes social costs. Thus, the victim would choose $y = y_\sim$ where $r = 0$.

We have shown that the injurer takes efficient care to avoid liability and that the victim takes efficient care because he retains residual responsibility. This argument, which constitutes a proof that the equilibrium levels of precaution are efficient when the legal standards are efficient,

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148 In technical terms, social costs, as defined in the equation on the first page of this appendix, differ from the victim's costs only by the additive constant $x_\sim$, so the minimizing value is the same for each function.
holds regardless of whether the liability rule is simple negligence, negligence with contributory negligence, or comparative negligence.

Working within this same framework, it is easy to prove that the rule of comparative precaution does not generally provide efficient incentives. To be more precise, it is easy to prove that the equilibrium levels of care under a rule of comparative precaution are not generally efficient. As noted, the injurer's cost function is

\[ C_x = x + A(x,y) \cdot r(x,y), \]

where \( r(x,y) \) under comparative precaution equals \( A_x \cdot (x,y) / [A_x \cdot (x,y) + A_y \cdot (x,y)] \). Under this definition of \( r(x,y) \), the value of \( x \) that minimizes \( C_x \) is not generally equal to the efficient value \( x^\sim \).

The explanation for this inefficiency lies in the fact that the injurer fails to internalize the accident losses. Under comparative precaution, when \( r(x,y) \) is a fraction that is greater than zero and less than one, the injurer internalizes only a fraction of the accident loss. The goal of efficiency is served, however, only when he internalizes all of the losses his negligence will produce. Therefore, it appears that, under comparative precaution, the injurer will take too little care. However, this is only part of the story. For, under the rule, the injurer can reduce the fraction \( r \), thereby lowering his expected losses, by taking more care. This feature of comparative precaution will induce the injurer to take too much care. We cannot say in general whether the incentives to take too little care will be stronger or weaker than those to take too much care. We can, however, say that these two inclinations do not generally cancel each other, so the incentives for precaution generally are not efficient.

We now repeat the above explanation in mathematical notations.

The injurer minimizes

\[ C_x = x + A(x,y) \cdot r(x,y) \]

with first order condition

\[ 1 + A_x \cdot r + A \cdot r_x \geq 0. \]

Assuming strict equality, rearranging terms yields

\[ A_x = - \frac{1}{r} \cdot A \cdot r_x / r. \]

By contrast, the efficiency condition obtained from choosing \( x \) to minimize social costs, \( SC \), as defined above, is

\[ 1 + A_x \geq 0. \]

This can be written, after assuming strict equality and rearranging terms,

\[ A_x = -1. \]

For the equilibrium precaution to be efficient, the two preceding expressions must be equal. In other words, \( r \) must equal \( 1 + A \cdot r_x \), where \( A \cdot r_x \) represents the amount of liability costs transferred to the victim when the injurer marginally increases his precaution.

This equality does not generally hold. When \( r \) is less than \( 1 + A \cdot r_x \),
the injurer's precaution will be too low. When \( r \) is greater than \( A \cdot r_s \), the injurer's precaution will be too high.

The same argument can be made with regard to the victim's precaution.\(^{149}\)

C. Efficiency and Distribution Under Evidentiary Uncertainty

First we wish to prove that when the legal standard is the efficient level of care, the parties will take excessive precaution if there is evidentiary uncertainty. Let \( s \) indicate the injurer's precaution as it appears to the court, where \( x \) is the injurer's true precaution. Similarly, let \( t \) indicate the victim's precaution as it appears to the court, where \( y \) is the victim's true precaution. Let \( q(s,t;x,y) \) be the density function — in other words, the probability that the court observes particular values \( s \) and \( t \), conditional upon the true values being \( x \) and \( y \). As before, \( r \) is the discount term as defined by the liability rule, except \( r \) must now be written as a function of the observed precaution, \( r = r(s,t) \) rather than as a function of the true precaution, \( r = r(x,y) \). The expected discount, denoted \( R(x,y) \) is the product of the discount \( r(s,t) \) times the probability \( q(s,t;x,y) \):

\[
R(x,y) = \int \int q(s,t;x,y) \cdot r(s,t) \, ds \, dt.
\]

Thus, the injurer's expected costs can be written

\[
C_x = x + A(x,y) - R(x,y).
\]

It is easy to prove that the value of \( x \) that minimizes \( C_x \) is larger than the efficient level \( x^- \). Consider the effect of an incremental increase in \( x \) when \( x = x^- \). The total effect can be distinguished into the increase in cost of precaution, the fall in expected accidental losses, and the expected redistribution of the losses. Since the level of precaution is assumed to be efficient, the increase in cost of precaution exactly equals the reduction in expected accidental losses, thus cancelling each other. The remaining effect is the expected redistribution of the losses. The expected redistribution caused by more precaution by the injurer must be in favor of the injurer. Consequently, the injurer can gain an advantage by taking a little more precaution, even though he is already taking the efficient amount. This completes the heuristic proof.\(^{150}\)

\(^{149}\) In the demonstration, we implicitly assumed that the injurer chooses his precaution with the belief that his choice will not influence the victim's precaution, and vice versa. This assumption is equivalent to the type of assumption that must be applied to situations in which there are many potential injurers and victims.

\(^{150}\) A more formal proof begins by taking the derivative of \( C_x \) at \( x = x^- \), as follows:

\[
\frac{dC_x(x^-;y^-)}{dx} = 1 + A(x,y^-)R + A(x,y^-)R_x.
\]

The first entry in the right-hand side of the equation represents the marginal cost of additional precautionary expenses. The second term represents the marginal change in accident costs that results from a change in precautionary expenses, and the final term represents the marginal reduction in the injurer's share of accident costs that follows from a change in precautionary expenses. Because \([1 + A(x,y^-)] = 0 \) at the optimal level of care, \([1+
D. Levels of Precaution Under Alternative Liability Rules

The extent of the injurer's liability is different for different liability rules. To express this fact formally, divide the levels of precaution into three zones, so the injurer's costs are written as follows:

\[ C = x + A \int \int qr \cdot x^* y^* \]

- Zone 1: Injurer is nonnegligent.
- Zone 2: Injurer is negligent; victim is nonnegligent.
- Zone 3: Injurer is negligent; victim is negligent.

The three forms of the negligence rule to be considered are the ones defined earlier: simple negligence, comparative negligence, and negligence with a defense of contributory negligence. In zone 1, the injurer is not liable under all three rules. Under the negligence rule, the injurer is liable for the full accident costs \( A \) in zone 2 and zone 3. Under the rule of comparative negligence, the injurer is liable for the full accident costs \( A \) only in zone 2. Finally, under the rule of negligence with a defense of contributory negligence, the injurer is liable for accident costs \( A \) only in zone 3. Thus the extent of injurer's liability is greatest under the negligence rule, intermediate under comparative negligence, and least under negligence with a defense of contributory negligence.

It is not hard to show that the cost-minimizing level of precaution for the injurer increases with the extent of his liability. Consequently, the injurer's precaution will be greatest under the negligence rule, inter-

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151 The injurer chooses \( x \) to minimize his private costs \( C \). Using the facts that expected liability \( qr \) is nonincreasing in precaution \( x \) and \( 1 > r > 0 \), the first order conditions for a minimum under the various forms of the negligence rule can be ordered as follows:

\[ O > 1 + A, [ \int \int q ] + A, [ \int \int qr ] \]

- Negligence & defense of contributory negligence.
mediate under the rule of comparative negligence, and least under the rule of negligence with a defense of contributory negligence.

The extent of the victim's responsibility for accident costs $A$ is the mirror image of the injurer's. Consequently, the victim's precaution will be greatest under the rule of negligence with a defense of contributory negligence, intermediate under the rule of comparative negligence, and least under the rule of negligence.\textsuperscript{152}

In this section we ranked the three liability rules according to the

\[
\begin{align*}
& \geq 1 + A_x \left[ \int \int q \right] + A \left[ \int \int q \right] \\
& \geq 1 + A \left[ \int \int q \right] + A_x \left[ \int \int q \right] \\
& + A \left[ \int \int q \right] + A \left[ \int \int q \right] \\
& x \sim y \sim x \sim t \\
& \text{comparative negligence} \\
& \text{simple negligence} \\
& \text{negligence}
\end{align*}
\]

At the value of $x$ that minimizes private costs under negligence with a defense of contributory negligence, the derivative is still negative for the injurer's private costs under a rule of comparative negligence, so the optimal value of $x$ must be greater under comparative negligence, than under negligence with a defense of contributory negligence. Similarly, at the value of $x$ which minimizes the injurer's private costs under a rule of comparative negligence, the derivative is still negative for the injurer's private costs under a rule of negligence, so the optimal value of $x$ must be greater under the negligence rule than under comparative negligence.

The proof assumes the existence of first and second derivatives in the relevant zone of comparison, which requires the probability density function to smooth out the pieces in the liability function. The proof also implicitly assumes that the victim's precaution is constant, the application of the legal standard is uncertain, the injurer's expected liability is a nonincreasing function of his precaution, and the court's perception of the parties' precaution is independent of the legal rule.

\textsuperscript{152} Divide the levels of precaution into three zones, so the victim's costs are written as follows:

\[
\begin{align*}
C_x = s + A \int \int q &= s + t \\
&+ A \left[ \int \int q(1-r) \right] \\
&= s + t \\
&+ A \left[ \int \int q(1-r) \right]
\end{align*}
\]

Under the rule of negligence with a defense of contributory negligence, the victim is liable for the full accident costs $A$ in both zones 1 and zone 2. Under the rule of comparative negligence, the victim is liable for the full accident costs $A$ in zone 1 and he is liable for part of accident costs in zone 2. Finally, under the rule of negligence, the victim is liable for accident costs $A$ only in zone 1. Thus the extent of the victim's liability is greatest under the rule of
incentives they provide for precaution to the injurer and the victim. We found that the negligence rule provides strong incentives to the injurer and weak incentives to the victim, the comparative negligence rule provides intermediate incentives to both parties, and the rule of negligence with a defense of contributory negligence provides weak incentives to the injurer and strong incentives to the victim. We say that the parties are symmetrically situated when their ability to take precaution is similar. When they are symmetrically situated, it is more efficient to provide intermediate incentives for precaution to both parties than to provide strong incentives to one of them and weak incentives to the other. Thus, we conclude that comparative negligence is more efficient than the alternative rules when the parties are symmetrically situated.

It is possible to extend this result to compare different forms of the comparative negligence rule. The general conclusion of that extension is that the parties are treated more symmetrically with respect to liability under the pure form of comparative negligence than under the modified form, and they are treated more symmetrically under the modified form than under the slight-gross rule. Therefore, under conditions favoring symmetrical treatment, the pure form is preferable.\textsuperscript{153}

\textsuperscript{153} Let \( n_{d} \) as before, represent the defendant's negligence and \( n_{p} \), the plaintiff's negligence. The dollar value of the harm caused by the accident is again represented by \( A \), which is, as usual, a function of \( x \), the defendant's level of precaution, and \( y \), the plaintiff's level of precaution. Under the three forms of comparative negligence, the defendant pays damages equal to:

\[
\text{pure:} \quad A \frac{n_{d}}{(n_{d} + n_{p})} \quad \text{for } n_{d} > 0, \\
0 \quad \text{for } n_{d} = 0;
\]

\[
\text{modified:} \quad A \frac{n_{d}}{(n_{d} + n_{p})} \quad \text{for } n_{d} > 0 \text{ and } \frac{n_{d}}{(n_{d} + n_{p})} > .5, \\
0 \quad \text{for } n_{d} = 0 \text{ or } \frac{n_{d}}{(n_{d} + n_{p})} < .5;
\]

\[
\text{slight-gross:} \quad A \frac{n_{d}}{(n_{d} + n_{p})} \quad \text{for } n_{d} > 0 \text{ and } \frac{n_{d}}{(n_{d} + n_{p})} > g, \\
0 \quad \text{for } n_{d} = 0 \text{ or } \frac{n_{d}}{(n_{d} + n_{p})} < g,
\]

where \( g \) = the lower bound on defendant's precaution for being gross relative to plaintiff's slight fault.

Generalized in this way, comparative negligence is any rule in which plaintiff's liability equals \( A \cdot r \) where \( r \) takes the form:

\[
r = \frac{n_{d}}{(n_{d} + n_{p})} \quad \text{for } n_{d} > 0, \text{ where } r' > 0 \text{ and } r(1) = 1, \\
0 \quad \text{for } n_{d} = 0.
\]

Using these definitions, it is straightforward, although tedious, to prove that the rules can be ranked according to their incentives for precaution as explained in Part II of this Article.