

April 2012

A Theory of Negligence and Products Liability

John Cirace

Follow this and additional works at: <https://scholarship.law.stjohns.edu/lawreview>

Recommended Citation

Cirace, John (1992) "A Theory of Negligence and Products Liability," *St. John's Law Review*. Vol. 66 : No. 1 , Article 1.

Available at: <https://scholarship.law.stjohns.edu/lawreview/vol66/iss1/1>

This Article is brought to you for free and open access by the Journals at St. John's Law Scholarship Repository. It has been accepted for inclusion in St. John's Law Review by an authorized editor of St. John's Law Scholarship Repository. For more information, please contact selbyc@stjohns.edu.

ST. JOHN'S LAW REVIEW

VOLUME 66

WINTER 1992

NUMBER 1

ARTICLES

A THEORY OF NEGLIGENCE AND PRODUCTS LIABILITY

JOHN CIRACE*

INTRODUCTION	2
I. LEGAL CERTAINTY AND SIMULTANEOUS ACTION: STANDARD ECONOMIC MODEL OF NEGLIGENCE	6
A. <i>Unilateral Care</i>	8
B. <i>Alternative Care</i>	14
1. Alternative Care Where Plaintiff Is the Least Cost-Avoider	14
2. Alternative Care Where Defendant Is the Least Cost-Avoider	17
C. <i>Joint Care</i>	20
D. <i>Legal Certainty and Principles of Causation</i> ...	24
1. Negligence	25
2. Cause-In-Fact	26
3. Proximate Cause	28
II. LEGAL CERTAINTY AND SEQUENTIAL ACTION: LAST CLEAR CHANCE MODEL	29

* Professor of Economics, The City University of New York; Adjunct Professor of Law, Brooklyn Law School; Visiting Professor of Law, Hastings Law School, Spring 1992. B.A. 1962, Harvard University; J.D. 1967, Stanford University; Ph.D. 1975, Columbia University.

A.	<i>Alternative Care and Sequential Decisions</i>	30
B.	<i>Joint Care and Sequential Action</i>	37
III.	UNCERTAINTY AND SIMULTANEOUS ACTION: DEFENSIVE CARE MODEL	39
A.	<i>Unitary Care and Uncertainty</i>	39
1.	Difficulty in Quantifying the Hand Formula Variables B, P, and L	39
2.	Uncertainty, Unitary Care, and Causation . .	42
B.	<i>Uncertainty and Simultaneous Action: The Defensive Care Model</i>	45
1.	Model IIIa: Only the Least Cost-Avoider Is Uncertain	47
2.	Model IIIb: Both Parties Are Uncertain Who the Least Cost-Avoider Is	47
IV.	UNCERTAINTY AND SEQUENTIAL ACTION: FORESEEABLE NEGLIGENCE MODEL	50
A.	<i>Foreseeable Negligence Model</i>	52
B.	<i>Foreseeable Negligence Model and Cost-Benefit Quantification</i>	58
V.	LIABILITY FOR MISMANUFACTURED PRODUCTS DISTINGUISHED FROM LIABILITY FOR DESIGN DEFECTS AND DEFECTIVE WARNINGS	61
A.	<i>Mismanufactured Products Distinguished from Design Defects and Defective Warnings</i>	62
B.	<i>Asymmetric Information and the Burden of Proof</i>	63
C.	<i>Strict Liability and Insurance</i>	65
1.	Mismanufactured Products and Insurance . .	65
2.	Design Defects and Defective Warnings: From Negligence to Strict Liability to Absolute Liability	66
D.	<i>Strict Liability and the Activity Effect</i>	67
1.	Mismanufactured Products and the Activity Effect	68
2.	Design Defects, Defective Warnings, and the Activity Effect	69
	CONCLUSION	70

INTRODUCTION

In the law of torts, two related disputes between lawyers and economists require resolution. One dispute concerns the definition

of due care—whereas economists contend that the reasonably prudent person is justified in assuming that all other persons use due care,¹ lawyers posit that the reasonably prudent person knows or should know that others act negligently in some circumstances.² A second dispute concerns whether the several negligence rules are equally efficient—economists contend that the common-law defense of contributory negligence, which bars tort recovery from a negligent defendant by a plaintiff who was also causally negligent, is just as efficient as comparative negligence, in which losses are shared according to relative fault;³ lawyers, however, assert that

¹ “A person cannot be deemed negligent for failing to take precautions against an accident that potential victims could avoid by the exercise of elementary care; negligence is failing to take the care necessary and proper to prevent injury to reasonably careful persons.” *Pomer v. Schoolman*, 875 F.2d 1262, 1268 (7th Cir. 1989) (Posner, J.). “It is a bedrock principle of negligence law that due care is that care which is optimal given that the potential victim is himself reasonably careful; a careless person cannot by his carelessness raise the standard of care of those he encounters.” *McCarty v. Pheasant Run, Inc.*, 826 F.2d 1554, 1557-58 (7th Cir. 1987) (Posner, J.). “[T]he law defines due care . . . as the care that is optimal if the other party is exercising due care.” RICHARD A. POSNER, *ECONOMIC ANALYSIS OF LAW* 155 (3d ed. 1986).

[A] rationally self-interested decisionmaker will assume that other potential parties to an accident, victims or injurers, have chosen to take efficient precaution as required by the legal standard of care and, that being so, it makes sense for the rational decisionmaker also to take efficient precaution. We conclude that both parties—potential victims and potential injurers—will take precaution at the efficient level.

ROBERT COOTER & THOMAS ULEN, *LAW AND ECONOMICS* 359-60 (1988).

² “We stress again the obvious truth of fact and law that it is not due care to depend upon the exercise of care by another when such dependence is itself accompanied by obvious danger.” *Haeg v. Sprague, Warner & Co.*, 281 N.W. 261, 262 (Minn. 1938) (citations omitted). “[T]he ordinary reasonable person . . . is required to realize that there will be a certain amount of negligence in the world. . . . It is not due care to depend on the exercise of care by another when such reliance is accompanied by obvious danger.” *Levi v. Southwest Louisiana Elec. Membership Coop.*, 542 So.2d 1081, 1086 (La. 1989) (citations omitted). “[W]e do not believe that the legal standard is set at the efficient level of precaution in all states.” DAVID W. BARNES & LYNN A. STOUT, *CASES AND MATERIALS ON LAW AND ECONOMICS* (unpublished, 1990), Teacher’s Manual, ch. 3, at 9. See generally RESTATEMENT (SECOND) OF TORTS § 302A (1965) (“An act or an omission may be negligent if the actor realizes or should realize that it involves an unreasonable risk of harm to another through the negligent or reckless conduct of the other or a third person.”). “The plaintiff’s contributory negligence may be . . . an intentional and unreasonable exposure of himself to danger created by the defendant’s negligence, of which danger the plaintiff knows or has reason to know” *Id.* § 466.

³ See POSNER, *supra* note 1, at 156. “Comparative negligence has the same effects on safety as contributory negligence.” *Id.*

[W]hen the legal standard is set at the efficient level of precaution, every one of the negligence rules creates incentives for efficient precaution by potential victims and potential injurers. The reason for this is that rationally self-interested decisionmakers are led by considerations of self-interest to choose the legal standard of care under any of the negligence rules.

comparative negligence is the preferred legal standard.⁴

If the economic model of negligence is restated in the context of a simple information theory, it is easy to demonstrate that the lawyers' position in both disputes is, in general, correct. As in the Watergate investigation, the key to both disputes is to ask, what did the actors know and when did they know it? Two simple concepts from game theory,⁵ which concern the state of a person's knowledge and the temporal order of action, will be utilized as a framework for an economic analysis of negligence. We ask whether all persons and courts have certain knowledge of all relevant facts and legal standards, that is, is there legal certainty or uncertainty,⁶ and whether all persons act simultaneously or sequentially.⁷ Because each of these two variables has two choices, four models result. Assuming legal certainty and simultaneous action by all persons results in the *standard economic model of negligence*,⁸ which is presented in Section I. In the standard economic model of negligence, all persons are justified in assuming that all other persons

COOTER & ULEN, *supra* note 1, at 357-58 (emphasis omitted); see also John P. Brown, *Toward An Economic Theory Of Liability*, 2 J. LEGAL STUD. 323, 343 (1973).

⁴ "[W]e hope to address a misunderstanding of tort law by some law and economics scholars and to reopen what apparently has become a closed question, that is, Is contributory negligence efficient? Our answer is a very lawyerly, 'It depends.'" BARNES & STOUT, *supra* note 2, Teacher's Manual, ch. 3, at 9. "The hardship of the doctrine of contributory negligence upon the plaintiff is readily apparent. It places upon one party the entire burden of a loss for which two are, by hypothesis responsible. . . . As of 1982, some 40 states had adopted some general form of comparative negligence." W. PAGE KEETON ET AL., PROSSER AND KEETON ON THE LAW OF TORTS § 67, at 468-71 (5th ed. 1984). As of 1990, forty-four states had adopted some form of comparative negligence. Carol A. Mutter, *Moving to Comparative Negligence in an Era of Tort Reform: Decisions for Tennessee*, 57 TENN. L. REV. 199, 200 (1990). See generally Gary T. Schwartz, *Contributory and Comparative Negligence: A Reappraisal*, 87 YALE L.J. 697 (1978) (reassessing contributory and comparative negligence and concluding that comparative negligence is best rule for economic and fairness reasons).

⁵ See ERIC RASMUSEN, GAMES AND INFORMATION: AN INTRODUCTION TO GAME THEORY (1989) (basic reference); see also MARTIN SHUBIK, GAME THEORY IN THE SOCIAL SCIENCES: CONCEPTS AND SOLUTIONS (1987).

⁶ See *infra* notes 19-21 and accompanying text (defining legal certainty).

⁷ HAL VARIAN, INTERMEDIATE MICROECONOMICS: A MODERN APPROACH, ch. 27.7, at 474-76 (1987); RASMUSEN, *supra* note 5, at 43-56.

⁸ Technically, the legal certainty and simultaneous action assumptions of the standard economic model of negligence result in what economists call a "Nash" equilibrium. STEVEN SHAVELL, ECONOMIC ANALYSIS OF ACCIDENT LAW 33 n.48 (1987). "In a Nash equilibrium the players take their opponents' strategies as given and therefore do not consider the possibility of influencing them." JEAN TIROLE, THE THEORY OF INDUSTRIAL ORGANIZATION 428-29 (1990). Formally, "a pair of strategies is a Nash equilibrium if A's choice is optimal, given B's choice, and B's choice is optimal given A's choice." VARIAN, *supra* note 7, at 468 (emphasis omitted).

use due care. In Section II, assuming legal certainty and sequential action results in the *last clear chance model*, in which the second mover knows that the first mover has not used due care; the first mover has a significant advantage in this model.⁹ Assuming uncertainty and simultaneous action results in the “defensive driving”¹⁰ or more generally the *defensive care model*, discussed in Section III. In the defensive care model, a level of care higher than due care is efficient when significant uncertainty exists as to which person should take care and when the cost of accident prevention is small. Finally, in Section IV, assuming uncertainty and sequential action results in the “foreseeable misuse”¹¹ or more generally the *foreseeable negligence model*, in which the first mover reasonably foresees that the second mover may not use due care; the first mover has a significant *disadvantage* in this model. With the exception of the standard economic model, it is shown that comparative negligence, which shares losses according to relative fault, is more efficient than the contributory negligence defense, which operates as a bar to tort recovery by negligent plaintiffs.

These models are not only relevant to negligence suits, they also explain product liability suits based upon defective warning¹² or defective product design¹³ claims because these claims are de

⁹ VARIAN, *supra* note 7, ch. 27.7.

[T]he concept of Nash equilibrium is appropriate only when all decisions are made *simultaneously* (once and for all); it is generally too weak when sequential decisions are involved. . . . In games in which a player chooses some actions after observing some of his opponents' actions . . . this conjecture [that players take their opponents' strategies as given and therefore do not consider the possibility of influencing them] is naive and leads to some absurd Nash equilibria. . . .

TIOLE, *supra* note 8, at 428-29 (emphasis added).

¹⁰ William Vickrey, *Automobile Accidents, Tort Law, Externalities, and Insurance: An Economist's Critique*, 33 LAW & CONTEMP. PROBS. 464, 467 (1968).

¹¹ DeSantis v. Parker Feeders, Inc., 547 F.2d 357 (7th Cir. 1976); Larsen v. General Motors Corp., 391 F.2d 495 (8th Cir. 1968); Decorative Precast Stone Erectors, Inc. v. Bucyrus-Erie Co., 493 F. Supp. 555 (W.D. Pa. 1980), *aff'd*, 642 F.2d 441 (3d Cir. 1981); Rivera v. Westinghouse Elevator Co., 526 A.2d 705 (N.J. 1987); Soler v. Castmaster, 484 A.2d 1225 (N.J. 1984); Brown v. United States Stove Co., 484 A.2d 1234 (N.J. 1984); *see also infra* notes 191, 192 and accompanying text.

¹² The manufacturer's duty is to give a reasonable warning, not the best possible one. Nolan v. Dillon, 276 A.2d 36 (Md. 1971); *see also* Freund v. Cellofilm Properties, Inc., 432 A.2d 925 (N.J. 1981); KEETON ET AL., *supra* note 4, § 99, at 697; Aaron D. Twerski et al., *The Use and Abuse of Warnings in Products Liability—Design Defect Litigation Comes of Age*, 61 CORNELL L. REV. 495 (1976).

¹³ *See* MacPherson v. Buick Motor Co., 111 N.E. 1050 (N.Y. 1916) (Cardozo, J.); Greenman v. Yuba Power Prods., Inc., 377 P.2d 897 (Cal. 1963) (Traynor, J.); *see also* James A. Henderson, Jr., *Judicial Review of Manufacturers' Conscious Design Choices; The Limits*

facto negligence suits.¹⁴ In Section V, it is shown that manufacturers should be strictly liable for mismanufactured products, but that in design defect and defective warning cases, courts should, in general, be wary of extending liability much beyond a negligence standard.

I. LEGAL CERTAINTY AND SIMULTANEOUS ACTION: STANDARD ECONOMIC MODEL OF NEGLIGENCE

Major contributions to the standard economic model of negligence were made by Judge Hand,¹⁵ J.P. Brown,¹⁶ Dean Calabresi,¹⁷ and Judge Posner.¹⁸ The standard economic model of negligence posits two key assumptions that figure prominently in its exposi-

of Adjudication, 73 COLUM. L. REV. 1531 (1973); James A. Henderson, Jr., *Design Defect Litigation Revisited*, 61 CORNELL L. REV. 541 (1976); James A. Henderson, Jr., *The Boundary Problems of Enterprise Liability*, 41 MD. L. REV. 659 (1982) [hereinafter Henderson, *Enterprise Liability*].

¹⁴ See *Prentis v. Yale Mfg. Co.*, 365 N.W.2d 176, 184 (Mich. 1984) ("Although many courts have insisted that the risk-utility tests they are applying are not negligence tests because their focus is on the *product* rather than the manufacturer's *conduct*, the distinction on closer examination appears to be nothing more than semantic.") (citation omitted); see also *Barker v. Lull Eng'g Co.*, 573 P.2d 443 (Cal. 1978) (applying traditional risk-utility balancing test in design defect case); KEETON ET AL., *supra* note 4, § 99, at 698-700 (discussing consumer-contemplation and danger-utility tests used in design defect cases); Sheila L. Birnbaum, *Unmasking the Test for Design Defect: From Negligence [to Warranty] to Strict Liability to Negligence*, 33 VAND. L. REV. 593 (1980) (analyzing risk-utility model).

"[W]hen liability turns on the adequacy of a warning, the issue is one of reasonable care, regardless of whether the theory pled is negligence, implied warranty, or strict liability in tort." *Smith v. E.R. Squibb & Sons, Inc.*, 273 N.W.2d 476, 480 (Mich. 1979) (citations omitted); see also *Basko v. Sterling Drug, Inc.*, 416 F.2d 417, 427 (2d Cir. 1969) (strict liability turns on whether defendant "adequately warned of known or reasonably foreseeable idiosyncratic reactions"); *Phillips v. Kimwood Mach. Co.*, 525 P.2d 1033, 1036 (Or. 1974) ("The test therefore, is whether the seller would be negligent if he sold the article *knowing of the risk involved.*") (emphasis added).

It is commonly said that a product can be defective in the kind of way that makes it unreasonably dangerous by failing to warn or failing adequately to warn about a risk or hazard related to the way a product is designed. But notwithstanding what a few courts have said, a claimant who seeks recovery on this basis must, according to the generally accepted view, prove that the manufacturer-designer was negligent.

KEETON ET AL., *supra* note 4, § 99, at 697.

¹⁵ See *United States v. Carroll Towing Co.*, 159 F.2d 169, 173 (2d Cir. 1947) (Hand, J.).

¹⁶ See Brown, *supra* note 3.

¹⁷ Guido Calabresi & Von T. Hirschoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055 (1972).

¹⁸ See Richard A. Posner, *A Theory of Negligence*, 1 J. LEGAL STUD. 29 (1972); see also Peter A. Diamond, *Accident Law and Resource Allocation*, 5 BELL J. ECON. & MGMT. SCI. 366 (1974); Peter A. Diamond, *Single Activity Accidents*, 3 J. LEGAL STUD. 107 (1974). See generally SHAVELL, *supra* note 8 (elegant presentation of standard economic model).

tion and conclusions: First, every person knows the legal standard of precaution and knows the costs of satisfying the legal standard, both the costs incurred by her or himself and the costs incurred by all other persons; moreover, the courts are always able to determine accurately whether any person has satisfied the legal standard.¹⁹ Neither persons nor courts ever make mistakes with such calculations.²⁰ This is the *legal certainty* assumption.²¹ Second, all persons choose the levels of precaution they take at one point in time; that is, if more than one person takes action, all of these persons act simultaneously. This is the *simultaneous action* assumption.²² Given these two key assumptions of the standard model, law and economics scholars derive two controversial conclusions: (1) individuals have no duty to foresee or protect themselves from the

¹⁹ Cooter and Ulen distinguish between conditions of certainty and conditions of evidentiary uncertainty in which courts may make mistakes because they may incorrectly perceive the true relationship between the injurer's level of precaution and the legal standard. See COOTER & ULEN, *supra* note 1, at 400-01.

²⁰ See Brown, *supra* note 3, at 323-24.

For our purposes the only function of the legal system is the impeccable administration of whatever liability rule is in force. In order to concentrate on what is our major concern, the parties' behavior, we ignore the distinction between judge and jury, the problems of proof and burden of proof, the uncertainty of outcome, the mistakes that the court can make, and the expense of operating the legal system.

Id. at 327.

²¹ Mark F. Grady, *A New Positive Theory of Negligence*, 92 YALE L.J. 799, 806 (1983) [hereinafter Grady, *Positive Theory*]. "My critique of the conventional theory stems from the examination of the effects of the assumption that injurers can always identify with perfect certainty the precaution level that courts will determine to be [efficient]." *Id.*; see also Mark F. Grady, *Untaken Precautions*, 18 J. LEGAL STUD. 139, 142-43 (1989) [hereinafter Grady, *Untaken Precautions*]. In game theory, certain information is different from perfect information. See TIROLE, *supra* note 8, at 429 ("Roughly, in . . . games [of perfect information] the player whose turn it is to play knows (has perfect information about) all the actions that have been chosen before this play. There is no element of simultaneity at all."). Rasmusen makes technical distinctions among several categories of information; he gives definitions of perfect, certain, symmetric, and complete information as well as common knowledge. See RASMUSEN, *supra* note 5, at 51-54. For example, "[t]he strongest information requirements are met by a game of perfect information, because in such a game each player always knows exactly where he is in the game tree [like chess]. No moves are simultaneous, and all players observe Nature's moves." *Id.* at 51. Information is certain if "Nature does not move after any player moves." *Id.*

²² The standard economic model is an example of what economists call a "Nash equilibrium." See SHAVELL, *supra* note 8, at 33 n.48. "[T]he concept of Nash equilibrium is appropriate only when all decisions are made *simultaneously* (once and for all); it is generally too weak when sequential decisions are involved." TIROLE, *supra* note 8, at 428 (emphasis added). The simultaneous action assumption is usually implicit rather than explicit in the standard economic model. See POSNER, *supra* note 1, at 154; Brown, *supra* note 3, at 335 (using definition, but not name, of Nash equilibrium).

negligent conduct of others;²³ (2) the contributory negligence defense, which bars tort recovery by a negligent plaintiff, is as efficient as comparative negligence, in which losses are shared according to relative fault.²⁴

Judge Posner expounds that standard model in terms of four cases: unilateral care, alternative care in which plaintiff is the least cost-avoider, alternative care in which defendant is the least cost-avoider, and joint care in which the efficient solution requires that both parties take care.²⁵ As will be shown, however, the legal certainty and simultaneous action assumptions make impossible the existence of analytically significant differences among these cases with respect to the issues of whether the reasonably prudent person should foresee the negligence of others or whether the several negligence standards are equally efficient.²⁶ Only when these two assumptions are relaxed do analytically significant differences occur.

A. Unilateral Care

The unilateral care case is illustrated by *Blyth v. Proprietors of Birmingham Waterworks Co.*²⁷ In *Blyth*, water damage occurred when a connection between a fire plug and water main opposite plaintiff's house burst. The apparatus had been installed and maintained for twenty-five years without incident by the defendant waterworks. The main pipe opposite plaintiff's house was buried more than the eighteen inches below the surface, as required by statute.²⁸ A severe frost caused a connection between a water main and a pipe to spring a leak when frozen water expanded. The issue was whether the defendant was negligent. The Court of Exchequer held that even if defendant's precautions proved insufficient against the effects of the extreme severity of the frost of 1855, which penetrated to a greater depth than any which ordinarily occurs south of polar regions, defendant was not negligent be-

²³ See *supra* note 1 (economists' position) and note 2 (lawyers' position).

²⁴ See *supra* note 3 (economists' position) and note 4 (lawyers' position). The lawyers' position also can be inferred from the fact that as of 1987, forty-four states had adopted some form of comparative negligence. See Mutter, *supra* note 4, at 200 n.2.

²⁵ POSNER, *supra* note 1, at 154-56.

²⁶ From the meta-view of game theory, the legal certainty and simultaneous action assumptions guarantee that the four models are distinctions without a difference. See *supra* notes 21-22.

²⁷ 156 Eng. Rep. 1047 (1856).

²⁸ *Id.* at 1048.

cause by providing for the average circumstances of temperature in ordinary years, it had protected against such frosts as experience would have led a prudent person to do.²⁹

The standard economic model of unilateral care explains *Blyth*. Under conditions of legal certainty, the standard economic model of negligence asserts that a person who fails to adopt the level of precaution that will minimize social costs is negligent.³⁰ Moreover, the criterion of social cost minimization is equivalent to the famous Learned Hand test, $B < PL$, which courts use to determine whether a person is negligent.³¹

Two relevant social costs must be considered: the cost of damage that results from accidents and the cost of preventing accidents. In Figure 1 (p. 10), any point on the curve labeled *Cost of Accident Damage* represents the marginal change in expected monetary damage,³² as measured on the vertical axis, when one additional unit of care is taken to prevent accidents, as measured on the horizontal axis. In terms of the Hand test, the *Cost of Accident Damage* curve equals PL , the expected damage, which is the probability of an accident occurring (P) multiplied (discounted) by the loss from such accident (L). The *Cost of Accident Damage* curve is downward sloping because additional precaution yields

²⁹ The Court reversed a jury verdict in favor of the plaintiff homeowner, holding that there was no evidence to leave to the jury. *Id.* at 1049.

³⁰ See COOTER & ULEN, *supra* note 1, at 349-50; SHAVELL, *supra* note 8, at 34; Brown, *supra* note 3, at 340; see also GUIDO CALABRESI, *THE COSTS OF ACCIDENTS: A LEGAL AND ECONOMIC ANALYSIS* 26 (1970) ("I take it as axiomatic that the principal function of accident law is to reduce the sum of the costs of accidents and the costs of avoiding accidents.").

³¹ See *United States v. Carroll Towing Co.*, 159 F.2d 169, 173 (2d Cir. 1947) (Hand, J.). B represents the "burden of adequate precautions," P is the probability of an accident, and L represents the loss from an accident. *Id.* at 173. For a further explanation of the Hand formula, see POSNER, *supra* note 1, at 148-49; Brown, *supra* note 3, at 332. For a contemporary application of the formula, see *United States Fidelity & Guar. Co. v. Jadranska Slobodna Plovidba*, 583 F.2d 1022 (7th Cir. 1982).

³² Expected cost is what economists call the loss discounted by the probability of an accident occurring. The term is formally defined as follows: Expected monetary value of all possible outcomes is determined by taking each possible outcome, L , and multiplying it by its respective probability, P , and summing the results; $P_1L_1 + P_2L_2 + \dots + P_nL_n$, where n is the n th or last possibility. COOTER & ULEN, *supra* note 1, at 55-56; see also EDWIN MANSFIELD, *MICROECONOMICS: THEORY AND APPLICATIONS* 571-72 (6th ed. 1988); A. MITCHELL POLINSKY, *AN INTRODUCTION TO LAW AND ECONOMICS* 51-56 (2d ed. 1989); VARIAN, *supra* note 7, at 216, 219. The area under the *Cost of Accident Damage* curve, expected damage (which in Figure 1 is represented by area ODNB), is a summation of every reasonably foreseeable harm (L) multiplied by its respective probability (P). See SHAVELL, *supra* note 8, at 33-34; *infra* notes 88-90 and accompanying text (discussing proximate cause).

only diminishing returns;³³ that is, increasing the level of precaution initially prevents major accidents, then less serious accidents, and so forth. The trapezoid-like area (ODNC) under the *Cost of Accident Damage* curve represents the total expected damage from all reasonably foreseeable accidents that will be avoided if level of precaution C is taken. The area under the *Cost of Accident Damage* curve between one precaution level and another, say from E to M, represented by the trapezoid-like area EFGM, equals the total decrease in expected accident damage that results from an increase in precaution over that interval.

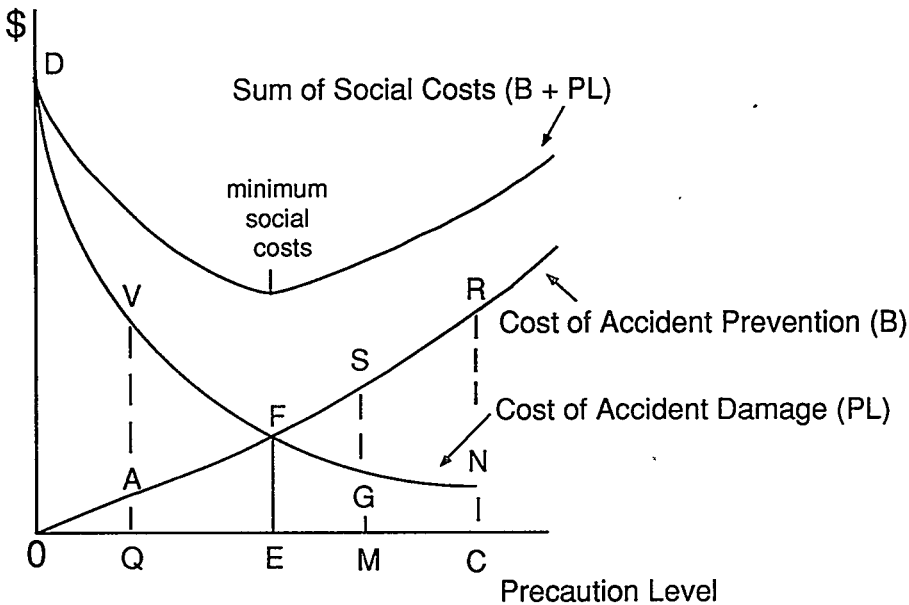


Figure 1. Calculation of social costs in the standard economic model of negligence³⁴

Any point on the curve labeled *Cost of Accident Prevention* represents the marginal change in cost of accident prevention, as measured on the vertical axis, when one additional unit of precaution is taken to avoid accidents, as measured on the horizontal axis; in terms of the Learned Hand test, $B < PL$, this curve equals B , the burden of increased precaution measured in dollar cost. The

³³ Brown, *supra* note 3, at 324; Grady, *Positive Theory*, *supra* note 21, at 801 n.10.

³⁴ See COOTER & ULEN, *supra* note 1, at 364 fig.8.8; SHAVELL, *supra* note 8, at 35 fig.2.1.

Cost of Accident Prevention curve is upward sloping because it is assumed that persons increase precaution by employing the least expensive method of care first, the next least expensive method second, and so forth. For example, a driver of an automobile can increase the level of precaution, in order of ascending cost, by paying closer attention to the road, by driving more slowly, or by buying a heavier and more expensive automobile. The area under the *Cost of Accident Prevention* curve from zero (0) care to a given level of precaution, say M, represented by triangle-like area OSM, equals the total cost of accident prevention up to that level of precaution. The area under the *Cost of Accident Prevention* curve between one precaution level and another, say between Q and M, represented by trapezoid-like area QASM, equals the increase in the total cost of accident prevention that results from the increase in precaution over that interval.

In terms of the Hand test, the efficient level of precaution is that level at which the *Cost of Accident Damage* curve intersects the *Cost of Accident Prevention* curve, level E in Figure 1 (where $B = PL$). A level of precaution equal to M is inefficiently high because the *Cost of Accident Prevention* (MS) exceeds the *Cost of Accident Damage* (MG), that is, ($B > PL$); a level of precaution equal to Q is inefficiently low because the *Cost of Accident Prevention* (QA) is less than *Cost of Accident Damage* (QV), that is, ($B < PL$).³⁵ Another way of establishing that level E is the efficient level of precaution is to look at the curve labeled *Sum of Social Costs*; any point on this curve represents the sum of the *Cost of Accident Damage* curve plus the *Cost of Accident Prevention* curve. In terms of the Hand formula, this curve represents $B + PL$. The minimum point on the *Sum of Social Costs* curve represents the level of precaution at which *minimum social costs* is achieved. The level of precaution that minimizes social costs is the efficient level, E.³⁶ In the unilateral care case, where there is only one active party, the issues of whether individuals have a duty to foresee or to protect themselves from the negligence of others and whether the contributory negligence defense is as efficient as the loss-sharing comparative negligence standard are not relevant.³⁷

Two important generalizations are implicit in the economic

³⁵ See SHAVELL, *supra* note 8, at 37; Brown, *supra* note 3, at 343.

³⁶ See COOTER & ULEN, *supra* note 1, at 364 fig.8.8.

³⁷ For a discussion of these issues, see *infra* notes 121-25, 130-31, 174-75, 200-02 and accompanying text.

model of negligence. First, it is not socially desirable to eliminate all accidents because it would be too costly to do so.³⁸ Put starkly, not only are some deaths from accidents acceptable, it is efficient that some accidental deaths occur. For example, although it is probably desirable to reduce the annual death rate from automobile accidents in the United States, which was approximately 47,000 fatalities in 1986,³⁹ few individuals would agree to accept the costs that would be necessary to eliminate all automobile fatalities. Reducing the annual death rate from automobile accidents to zero would require very low speed limits, long travel time, high transportation costs for goods and persons, larger and heavier cars, and high fuel costs. Most individuals probably would not be willing to accept such costs in the sense that they would prefer to accept a slightly increased risk of death from an automobile accident rather than the greatly increased cost and inconvenience required for absolute safety in transportation.⁴⁰ In terms of Figure 1 (p. 10), not taking precaution to avoid the damage represented by trapezoid-like area EFNC is efficient, since in order to eliminate such damage, it would be necessary to spend an amount represented by trapezoid-like area EFRC, a sum much larger than EFNC.

A second generalization is implicit in the standard model. Even if a court were erroneously to hold a person to a standard of care higher than the efficient level, E, a rational person would not subsequently adopt a level of precaution greater than the efficient level.⁴¹ Since the *Cost of Accident Prevention* curve is higher than the *Cost of Accident Damage* curve at all levels of precaution

³⁸ See W. Kip Viscusi, *Product and Occupational Liability*, 5 J. ECON. PERSP. 71, 89-90 (1991).

³⁹ STATISTICAL ABSTRACT OF THE UNITED STATES 84 tbl. 124 (1989) (46,867 motor vehicle accident deaths reported in 1986).

⁴⁰ Studies of the wage premiums demanded by workers in risky occupations indicate that a trade-off exists between income and the acceptance of some risk of death. See *infra* notes 216-17 (method of calculation and conclusions of these studies). Of course, this trade-off is not linear; the amount of income that a person requires in order to accept a larger risk rises much faster than the risk (exponentially). See MICHAEL J. MOORE & W. KIP VISCUSI, *COMPENSATION MECHANISMS FOR JOB RISKS: WAGES, WORKERS' COMPENSATION, AND PRODUCT LIABILITY* (1990); POSNER, *supra* note 1, at 184-85; Rachel Dardis, *The Value of Life: New Evidence From the Marketplace*, 70 AM. ECON. REV. 1077 (1980); Craig A. Olsen, *An Analysis of Wage Differentials Received by Workers on Dangerous Jobs*, 16 J. HUM. RESOURCES 167 (1981).

⁴¹ See POSNER, *supra* note 1, at 160-61. This ignores the "insurance" and "activity" effects consequent upon a shift from a negligence standard to one of strict liability. These effects are discussed in Section V. See *infra* notes 224-51 and accompanying text (discussing strict liability for mismanufactured products).

greater than the efficient level, a rational person would not adopt a level of precaution greater than the efficient level because paying for any additional damage that occurs to the right of the efficient level of precaution would be less expensive than paying for the cost of taking precaution to prevent such damage. If held to a standard of care greater than the efficient level, a rational person would correctly believe that she or he was being held strictly liable without regard to fault, but, as indicated, would not take precaution beyond the efficient level.⁴²

Let us now use the standard economic model to explain *Blyth*. The Court of Exchequer held that the defendant acted as a reasonably prudent person by providing against such frosts as experience would have led a such person to do.⁴³ Applying the standard economic model of negligence, the court found that the defendant waterworks adopted the efficient level of care, level E in Figure 1 (p. 10). Providing for the effects of an unusual and extreme frost would require a level of precaution greater than the efficient level E. In order to achieve a level of precaution that would prevent damage from a severe frost with a low probability of occurring, much thicker pipes, water mains, and connections would be required, as well as the deeper entrenchment of water pipes; such a level of precaution would be inefficient because the *Cost of Accident Prevention* curve exceeds the *Cost of Accident Damage* curve everywhere to the right of E, the efficient level of precaution. Moreover, as implied by the standard economic model of negligence, even if the court had found the defendant waterworks liable, a rational defendant would not incur the cost of providing for thicker pipes, nor would it bury the pipes deeper, to prevent dam-

⁴² This conclusion, which concerns the level of precaution, ignores the effect of strict liability on the level of activity, which is discussed in Section V, *infra* notes 224-47 and accompanying text. See Steven Shavell, *Strict Liability versus Negligence*, 9 J. LEGAL STUD. 1 (1980). The economic model of mismanufactured product liability, which is based on strict liability principles, also is discussed in Section V, *infra* notes 224-47 and accompanying text.

⁴³ The pipes were 18 inches underground, as required by statute. *Blyth*, 156 Eng. Rep. at 1048. "While compliance with a statutory standard is evidence of due care, it is not conclusive on the issue. Such a standard is no more than a minimum, and it does not necessarily preclude a finding that the actor was negligent in failing to take additional precautions." KEETON ET AL., *supra* note 4, § 36, at 233; see also *Christou v. Arlington Park-Washington Park Race Tracks Corp.*, 432 N.E.2d 920 (Ill. App. Ct. 1982) (industry customs are relevant but not determinative of proper standard of care); *Hill v. Husky Briquetting, Inc.*, 220 N.W.2d 137 (Mich. Ct. App.) (compliance with statutes and safety regulations not conclusive on question of negligence), *aff'd*, 223 N.W.2d 290 (Mich. 1974), *appeal after remand*, 260 N.W.2d 131 (Mich. Ct. App. 1977).

age from an extremely severe frost that occurs once in twenty-five years; rather, it would realize that its least expensive course of action would be to pay for the infrequent damage when it occurs.⁴⁴ The waterworks would conclude that it was being held strictly liable without regard to fault.

B. *Alternative Care*

An alternative care accident is one in which damage could be avoided if either of two persons takes care. In the context of the standard economic model, it is not efficient for both parties to take care; only the least cost-avoider should take care to prevent damage.⁴⁵ In this section, two cases involving alternative care are analyzed: one in which the plaintiff-victim is the least cost-avoider of damage, the other in which the defendant-injurer is the least cost-avoider.

1. Alternative Care Where Plaintiff Is the Least Cost-Avoider

*Tennessee Trailways, Inc. v. Ervin*⁴⁶ illustrates a model involving alternative care in which the plaintiff is the least cost-avoider. In *Ervin*, a motorcyclist who "spurred" out from a private road that intersected a highway was struck by the defendant's bus and died.⁴⁷ The Supreme Court of Tennessee upheld the trial court's directed verdict in favor of the defendant⁴⁸ even though there was evidence that the defendant's bus was being driven at 73.5 miles per hour, in violation of a state statute setting the speed

⁴⁴ In anticipation of the discussion in Section V, *infra* notes 224-47 and accompanying text, a shift from negligence to strict liability would have an "insurance effect." Under a negligence standard, homeowners would either have to buy insurance or accept the risk of the cost-justified damage represented by area EFNC in Figure 1 (p. 10). A shift to strict liability would mean that the waterworks would have to buy insurance or be a self-insurer for the damage represented by area EFNC. Under negligence, homeowners would pay a slightly lower water bill but would have a choice whether to buy insurance for the cost-justified damage. Under strict liability, water bills would be slightly higher because homeowners would be paying for water plus compulsory insurance. In terms of Section V's discussion of the activity effect, a shift from a negligence standard to one of strict liability would not change the quantity of water sold because water is a necessity; that is, water has a greatly inelastic demand within the relevant price range. See *infra* notes 240-47 and accompanying text.

⁴⁵ "[A]lternative care, that is . . . the efficient solution . . . [is] for either party, but not both, to take care." POSNER, *supra* note 1, at 155.

⁴⁶ 438 S.W.2d 733 (Tenn. 1969).

⁴⁷ *Id.* at 734-35.

⁴⁸ *Id.* at 736.

limit at 65 miles per hour.⁴⁹

Next, we consider an alternative care model in which the plaintiff is the least cost-avoider in the context of legal certainty and simultaneous action assumptions, and then apply the conclusions from the model to *Ervin*. Assume that expected accident damage is \$1000 (PL), that the plaintiff-victim, who is the least cost-avoider, can avoid the damage by spending \$50 (B), and that the defendant-injurer, who is the high cost-avoider, must spend \$100 (B) to avoid the damage.⁵⁰ In the context of the standard economic model's assumption of legal certainty, both parties know that plaintiff is the least cost-avoider, and that the plaintiff has a duty to avoid the damage at a cost of \$50. Given that the defendant reasonably assumes the plaintiff will take care, that care by both parties would be redundant and therefore inefficient, and that both parties must choose whether to take care simultaneously, the defendant will reasonably choose not to take care.⁵¹ Thus, the two key assumptions of legal certainty and simultaneous action cause all persons to expect that all other persons will act in a reasonably prudent manner.

Assume that for some reason, say because of negligence, the plaintiff, who is the least cost-avoider, does not take care, and the expected accident damage of \$1000 occurs. The plaintiff-victim sues the defendant, demanding compensation. Will the legal standard employed by courts create incentives for the avoidance of damage in the future? Efficiency requires that the entire burden of avoiding the damage rests on the plaintiff, who is the least cost-avoider, so that in the future the plaintiff will realize that incurring cost of accident prevention is less expensive than bearing cost of accident damage. Because the plaintiff has breached a duty to take care and is negligent, the plaintiff will be liable for the entire loss if its conduct is evaluated by the contributory negligence defense; if comparative negligence is applied, however, the plaintiff will also bear the entire loss because the defendant has no duty of care and is not negligent.⁵² In the context of this model, both standards

⁴⁹ *Id.* at 734.

⁵⁰ See POSNER, *supra* note 1, at 154.

⁵¹ "The efficient solution is to make the plaintiff 'liable' by refusing to allow him to recover damages from the defendant." *Id.*

⁵² A number of comparative negligence standards exist. Probably the simplest method of allocating damages is what is commonly called "pure" comparative negligence. In this form, a plaintiff's contributory negligence does not operate to bar his recovery altogether, but serves to reduce his damages in proportion to his fault. See, e.g., *Li v. Yellow Cab Co.*,

yield identical results and therefore are equally efficient.

Let us interpret *Ervin* in terms of the standard economic model. *Ervin* is an alternative care case because the accident could have been avoided if either the motorcyclist or the bus driver had taken care. The motorcyclist was the least cost-avoider; it is clearly less expensive for a motorcyclist to take care before crossing a highway on which traffic is speeding than it is for a bus to travel slowly enough to stop in time to avoid colliding with vehicles crossing the highway recklessly. In the context of the standard economic model of negligence, defendant bus driver had no duty of care with respect to the motorcyclist because the bus driver was entitled to assume that the motorcyclist, as least cost-avoider, would exercise due care.⁵³ This strong conclusion, that in an alternative care case, the high cost-avoider has no duty of care, depends upon the legal certainty and simultaneous action assumptions of the standard model, which cause all persons to expect that all other persons will act in a reasonably prudent manner.

532 P.2d 1226 (Cal. 1975). Several states have codified the doctrine of comparative negligence. *E.g.*, N.Y. CIV. PRAC. L. & R. 1411 (McKinney 1976); WASH. REV. CODE ANN. § 4.22.005 (West 1988). The most common legislative approach for apportioning fault is the modified, or "50%," system, under which a plaintiff's contributory negligence does not bar recovery so long as it remains below a specified proportion of the total fault. KEETON ET AL., *supra* note 4, § 67, at 471-73. Two varieties of the 50% comparative negligence approach are the 50% and the 51% standards. Under the "equal fault bar," or 50% approach, the plaintiff cannot recover anything if his fault is *equal to* or greater than that of the defendant; in other words, the plaintiff is allowed to recover only if *less* negligent than the defendant. *See, e.g.*, COLO. REV. STAT. § 13-21-111(1)-(3) (1989); KAN. STAT. ANN. § 60-258a (Supp. 1990); ME. REV. STAT. ANN. tit. 14, § 156 (West 1980). Under the "greater fault bar" system, or 51%, the plaintiff is prevented from recovering damages only if the plaintiff's fault exceeds that of the defendant; the plaintiff is therefore allowed to recover if equal to or less negligent than defendant. *See, e.g.*, MASS. GEN. LAWS ANN. ch. 231, § 85 (West 1985); MINN. STAT. ANN. § 604.01 (West Supp. 1992); N.J. STAT. ANN. § 2A: 15-5.1 (West 1987). Under both the 50% and 51% approaches, plaintiff's contributory negligence is a complete bar if its fault exceeds the threshold. Juries tend to apportion fault equally in close cases, and the plaintiff in such cases will recover half the loss under the 51% approach and nothing under the 50% approach. *See* KEETON ET AL., *supra* note 4, § 67, at 473. This result has led to criticism of the 51% approach. *See, e.g.*, Richard V. Campbell, *Recent Developments of the Law of Negligence in Wisconsin—Part II*, 1956 WIS. L. REV. 4, 21; Robert E. Keeton, *Comment on Maki v. Frelk—Comparative v. Contributory Negligence: Should the Court or Legislature Decide?*, 21 VAND. L. REV. 906, 911 (1968).

⁵³ It is clearly less expensive for the motorcyclist, who is on the verge of crossing a highway, to take care to avoid a collision with vehicles traveling at high speed on a limited access highway than it is for those vehicles to travel slowly enough to be able to stop in the event that a vehicle recklessly enters the highway from an unlikely access point.

2. Alternative Care Where Defendant Is the Least Cost-Avoider

*Jackson v. Leach*⁵⁴ illustrates an alternative care case in which the defendant is the least cost-avoider. *Jackson* involved an automobile accident at an intersection of two streets. The plaintiff's vehicle, which was traveling north, collided with the defendant's vehicle, which was traveling west. The plaintiff testified that when he was within a distance of sixty feet from the intersection, traveling at a speed between fifteen and twenty miles per hour, he had a clear view to the west for a distance of 180 feet, and that there was no vehicle in sight. The plaintiff thus argued that for the collision to have occurred, the defendant's vehicle must have greatly exceeded the legal speed limit. The defendant alleged that the plaintiff was contributorily negligent because he failed to look to his right when he reached the intersection; had he done so, he would have seen the defendant's vehicle in time to have avoided the collision.⁵⁵

The Maryland Court of Appeals, which upheld the jury verdict for the plaintiff, held that the plaintiff was not required to look a second time when he reached the intersection.⁵⁶ Although it was incumbent upon the plaintiff to respect the rule giving the right of way at street intersections to vehicles approaching from the right, if, at the time he looked on approaching, and within a short distance of the intersection, the way for a safe distance was clear of traffic coming from that direction, the plaintiff should not be judicially declared negligent for not taking precautions against the possibility of a collision with a car that could not come into dangerous proximity of his own unless it were unlawfully operated.

Next, we present an alternative care model in which the defendant is the least cost-avoider, and then apply the conclusions from the model to *Jackson*. Assume that expected accident damage is still \$1000 (PL) but that the costs of accident prevention are reversed so that the plaintiff-victim is the high cost-avoider at

⁵⁴ 152 A. 313 (Md. 1931).

⁵⁵ *Id.* at 315.

⁵⁶ *Id.* According to a trial judge experienced in collision cases,

In one collision case after another, I have found the factor that had conclusive weight with the jury was the bare rule of right of way, unaffected by any and all evidence of surrounding circumstances, untouched by the qualifications and limitations that the judges have said should be imposed upon the application of the rule.

JOSEPH N. ULMAN, A JUDGE TAKES A STAND 30 (1933).

\$100 (B), and the defendant-injurer is the least cost-avoider at \$50 (B).

Assume that for some reason, say because of negligence, the defendant, who is now the least cost-avoider, does not take care and the \$1000 damage occurs. The plaintiff-victim sues the defendant, demanding compensation. Will the legal standard employed by courts create incentives for the avoidance of damage in the future? Efficiency requires that the entire burden to avoid the damage rest on the defendant, who is the least cost-avoider, so that in the future it will realize that incurring the cost of accident prevention is less expensive than bearing the cost of accident damage. If, however, the Hand test is applied to plaintiff and defendant individually, without regard to the level of precaution that each party can reasonably foresee that the other will take—that is, if the court evaluates each party's level of precaution as if it were a unitary care case—both plaintiff and defendant will be found negligent.⁵⁷ The defendant, primarily negligent because it could have prevented the \$1000 damage if it had spent \$50 ($B(\$50) < PL(\$1000)$); the plaintiff, contributorily negligent because it could have prevented the \$1000 damage if it had spent \$100 ($B(\$100) < PL(\$1000)$). Thus, if each party's level of precaution is evaluated independent of information concerning the level of precaution that each party reasonably foresees the other will adopt, both will be judged negligent, so the defendant will not bear the total loss under any of the several negligence standards. As a result, the defendant will have a reduced incentive to take care in the future. How is this inefficient result to be avoided?

The two key assumptions of the standard economic model of negligence dictate how a court will determine the appropriate foresight of each of the parties. Where the defendant is the least cost-avoider, the desired result is for the plaintiff to be found not negligent under the Hand test, even when it does not take care. The standard economic model's assumption of legal certainty means that the courts and both parties know that the efficient result is for the defendant to spend \$50 to avoid the damage and for the plaintiff to take no precaution. The simultaneous action assumption means that both plaintiff and defendant must choose whether or not to take care at the same time. A reasonably prudent plaintiff

⁵⁷ Guido Calabresi & Jon T. Hirschoff, *Toward a Test for Strict Liability in Torts*, 81 YALE L.J. 1055, 1057-58 (1972).

will not take care because it will assume (foresee) that the defendant will take care and will thus foresee accident damage of zero. Given legal certainty and simultaneous action, the appropriate value for expected accident damage that is to be used in the Hand formula as applied to the plaintiff is zero; therefore, the plaintiff is not negligent, $B(\$100) > PL(\$0)$.⁵⁸ Since the defendant is negligent and plaintiff is not negligent, the several negligence standards yield identical results and are therefore equally efficient.

In the context of the standard economic model of negligence, a reasonably prudent person is always justified in expecting other persons to act in a reasonably prudent manner. As Judge Posner expressed it, due care is "the care that is optimal if the other party is exercising due care."⁵⁹ As will be shown below, once the standard model's key assumptions of legal certainty and simultaneous action are relaxed, Posner's definition of due care, with its implicit assumption that the reasonably prudent person never has a duty to foresee the negligent conduct of others, is false.

Applying the model to *Jackson*, the speeding defendant clearly was the least cost-avoider in terms of all relevant social costs that speeders inflict on others; much less social cost is incurred if one speeder slows down than if all other drivers must take extra care to avoid the speeder.⁶⁰ In terms of the standard economic model, *Jackson* is an alternative care case, in which the plaintiff was entitled to assume that all other persons use due care and so was not required to look a second time upon reaching the intersection; plaintiff was not contributorily negligent because he had no duty of care. In the context of Section III's defensive care model, however, it will be shown that *Jackson* would be reversed because the plaintiff would have a duty to look a second time upon reaching the intersection.

⁵⁸ POSNER, *supra* note 1, at 155.

⁵⁹ *Id.* Posner's definition of due care is a "Nash equilibrium" definition. *See supra* notes 8-9. As pointed out in those notes, the Nash equilibrium concept is appropriate only when all parties act simultaneously.

⁶⁰ It is clearly less expensive for the defendant to reduce speed than it is for all drivers with whom he comes in close proximity to alter their behavior to accommodate the speeder. Technically, speeders, like the defendant, impose external costs on not just the plaintiff but on all other drivers. An externality is "a cost that the voluntary actions of one person impose on others without their consent." COOTER & ULEN, *supra* note 1, at 343; *see also* MANSFIELD, *supra* note 32, at 484 ("An external diseconomy occurs when an action taken by an economic unit results in uncompensated costs to others . . ."); John Cirace, *An Economic Analysis of the "State-Municipal Action" Antitrust Cases*, 61 TEX. L. REV. 481, 493-94 (1982) (externality exists when activity of A imposes cost on B for which A is not charged).

C. Joint Care

*LeRoy Fibre Co. v. Chicago, Milwaukee & St. Paul Ry.*⁶¹ illustrates the joint care case in which both parties must adopt a cooperative level of care if the least cost solution is to be achieved. In *LeRoy Fibre*, the plaintiff-manufacturer stored flax straw on a tract of ground located between its factory and the railroad tracks. The flax was arranged in three-ton stacks in two rows parallel with the railroad. The distance from the railroad tracks to the first row of stacks of flax was about seventy-five feet; the second row was about eighty-five feet from the tracks. When large quantities of sparks and live cinders were emitted from the defendant's locomotive, one of the stacks in the second row ignited, as a result of which all of the stacks were consumed.⁶² Despite substantial evidence that the locomotive was operated negligently, defendant contended that plaintiff was contributorily negligent because of the flammable character of the flax and its proximity to the railroad.⁶³ Speaking for the United States Supreme Court, Justice McKenna held that "[t]he doctrine of contributory negligence is entirely out of place. Depart from the simple requirement of the law, that every one must use his property so as not to injure others, and you pass to refinements and confusing considerations."⁶⁴ Justice Holmes, concurring in part, was not prepared to decide the issue of contributory negligence because the jury should decide "whether the plaintiff's flax was so near to the track as to be in danger from even a prudently managed engine."⁶⁵

The Court's decision in *LeRoy Fibre* can be analyzed through conclusion derived from a model of joint care in which efficiency requires that both persons take care (Table 1). Assume that the expected accident damage (PL) is \$1000. Such damage can be avoided in any of three ways: (1) alternative care in which only the

⁶¹ 232 U.S. 340 (1914).

⁶² *Id.* at 342.

⁶³ *Id.* at 342-43.

⁶⁴ *Id.* at 350 (McKenna, J.). Justice McKenna clarified that the property surrounding the railroad may be subject to risks and may suffer inconvenience from the legitimate operation of the railroad, but distinguished this permissible risk and interference from risk due to the wrongful operation of the railroad, which is impermissible. *Id.* This idea resembles today's recognized cause of action in private nuisance. See KEETON ET AL., *supra* note 4, § 87, at 619-26. To recover on a private nuisance theory, the plaintiff must show that the defendant intentionally, substantially, and unreasonably interfered with plaintiff's use and enjoyment of land. *Id.* at 620-23.

⁶⁵ *LeRoy Fibre*, 232 U.S. at 353 (Holmes, J., concurring in part).

railroad takes care, avoiding damage by installing a super spark arrester that prevents all sparks from escaping but so constricts the engine's smoke stack opening as to increase the total cost of operating the engine by \$110; (2) alternative care in which only the LeRoy Fibre Company takes care, avoiding damage by keeping its flax stacks at least 200 feet from the railroad tracks at a cost of \$100, which it incurs because flax cannot be stored on a large portion of its property;⁶⁶ or, (3) joint care, in which damage is avoided by having the Leroy Fibre Company keep its flax stacks at least 100 feet from the railroad tracks at a cost of \$50 and by having the railroad install a regular spark arrester that is not as effective as the super model but is less expensive to operate at \$25 because it does not constrict the smoke stack as much as the super spark arrester.

Table 1. Model of Joint Care Where Efficiency Requires Both Parties to Take Care⁶⁷

	(1) Super Spark Arrester (0 ft.)	(2) Regular Spark Arrester (100 ft.)	(3) No Spark Arrester (200 ft.)
Cost of Accident Prevention to RR	\$110	\$25	\$ 0
Cost of Accident Prevention to Fibre Co.	\$ 0	\$50	\$100
Total Cost of Accident Prevention	\$110	\$75	\$100

These figures may be changed so that one or the other alternative care solutions becomes the least cost solution; e.g., if in column 3, \$100 was \$70, alternative care by the LeRoy Fibre Company would be the least cost solution; if in column 1, \$110 was \$60, alternative care by the railroad would be the least cost solution.⁶⁸ Adapted, with permission, from Richard A. Posner, *Economic Analysis of Law* (3d ed. 1986).

⁶⁶ Cf. *Vaughan v. Taff Vale Ry.*, 3 H. and N. 743 (Ex. 1858) and 5 H. and N. 679 (Ex. 1860), cited by R. H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 30-31 (1960) (no liability for fires caused by sparks because railway had statutory authority to run steam engines).

⁶⁷ POSNER, *supra* note 1, at 155 tbl. 6.1.

⁶⁸ RICHARD POSNER, *TORT LAW: CASES AND ECONOMIC ANALYSIS* 328 (1982).

It is easy to see from Table 1 that the least cost of \$75 is achieved when the railroad installs a regular spark arrester at a cost of \$25 and the LeRoy Fibre Company keeps its flax stacks 100 feet from the railroad tracks at a cost of \$50, for a total social cost of \$75. Assume that for some reason, say because of negligence, either the railroad or the LeRoy Fibre Company does not take the efficient level of precaution dictated by column 2 of Table 1, so that the expected damage of \$1000 occurs. To be specific, assume that the LeRoy Fibre Company keeps its flax stacks at least 100 feet from the railroad tracks but that the railroad does not install a spark arrester.

As in the models above, we ask whether the legal standards employed by courts create efficient incentives for the avoidance of damage in the future? Efficiency requires that both the railroad and the LeRoy Fibre Company take the appropriate level of precaution, not just the LeRoy Fibre Company.⁶⁹ For the same reasons as in the alternative care cases discussed above, if the Hand test is applied to the railroad and LeRoy Fibre Company individually, without regard to the level of precaution that one party can reasonably foresee that the other will take, that is, if the court evaluates each party's level of precaution as it would in a unitary care case, both will be found negligent.⁷⁰

If the standard economic model is employed, however, only the railroad will be found negligent. The model assumes that all parties know each other's costs and that the efficient legal standard is certain and known to all; therefore, both the railroad and

⁶⁹ See John Cirace, *A Synthesis of Law and Economics*, 44 Sw. L.J. 1139, 1167-86 (1990) (joint care economic analysis of *Boomer v. Atlantic Cement Co.*, 257 N.E.2d 870 (N.Y. 1970), calling for most economically efficient coordination of parties' conduct in determining remedy). "[E]fficient coordination of the activities balances the detrimental effect of each activity on the other by minimizing such effects in the cheapest manner . . . [resulting] in a combined income from the two activities that is greater than the combined income from uncoordinated activities . . ." *Id.* at 1179. Some theorists believe that efficient coordination results naturally from perfect competition, in which the parties themselves recognize the benefits of cooperation and are best able to distribute risk efficiently. See Coase, *supra* note 66, at 1. Those theorists embracing less optimistic views of the competitive process recognize no reason why rational self-interested parties should agree about how to divide the stakes, thus posing an insurmountable obstacle to the creation of noncompetitive bargains absent a rule for dividing the surplus. See Robert Cooler, *The Cost of Coase*, 11 J. LEGAL STUD. 1, 17 (1982).

⁷⁰ Because the railroad could have prevented the \$1000 harm had it spent \$25, it is negligent ($B(\$25) < PL(\$1000)$); similarly, because the LeRoy Fibre Company could have prevented the \$1000 had it spent \$100 rather than \$50, it is negligent as well ($B(\$100) < PL(\$1000)$).

the LeRoy Fibre Company know the information contained in Table 1 and know that their choice of care will be evaluated by reference to it. Since the standard model also employs the simultaneous action assumption, which means that both the railroad and LeRoy Fibre Company have to choose their levels of precaution before each knows what level of precaution the other will choose, it is reasonable for each to foresee that the other will choose the efficient or least cost care level shown in the second column of Table 1; the LeRoy Fibre Company can reasonably assume that the railroad will install a regular spark arrester, and the railroad can reasonably assume that the LeRoy Fibre Company will keep its flax stacks 100 feet from the tracks. Thus, because LeRoy Fibre Company's care level is consistent with expectations of a reasonably prudent person, whereas the railroad's care level is not,⁷¹ a court will determine that the railroad is negligent for not installing a regular spark arrester and that the LeRoy Fibre Company is not negligent if it keeps its flax stacks 100 feet from the railroad tracks.⁷² Moreover the conclusion dictated by the legal certainty and simultaneous action assumptions—that only the railroad is negligent—means that the several negligence standards yield identical results and are therefore equally efficient.

Justice McKenna's opinion in *LeRoy Fibre*, that the railroad must use its property so as not to injure others under any circumstances, is not consistent with the efficient solution. In terms of Table 1, the opinion of Justice McKenna would endorse the first column, which is not the least cost solution because it would require the railroad to install a super spark arrester if the LeRoy Fibre Company put its flax stacks next to the railroad tracks. Justice Holmes's concurring opinion, that the jury should decide whether the plaintiff's flax was so near to the track as to be in danger from even a prudently managed engine, is consistent with the cost-efficient joint care solution depicted in the second column.

In conclusion, the legal certainty and simultaneous action as-

⁷¹ Cf. *McKain v. Haynes*, 203 S.W.2d 970 (Tex. Civ. App. 1947). The plaintiff's filling station was destroyed by a fire that spread from the adjoining lot where defendants were negligently burning trash. The jury found that plaintiff was contributorily negligent in failing to cut the dry grass that surrounded the wooden buildings of the filling station, which were saturated with gasoline and oil. *Id.* at 970.

⁷² The LeRoy Fibre Company's level of precaution is consistent with expectations of a reasonably prudent person. The reasonably prudent person reasonably expects $PL = 0$ because it assumes that the railroad will act as a reasonably prudent person and therefore install a regular spark arrester.

sumptions of the standard economic model dictate that in all four cases discussed above (unilateral care, two alternative care cases, and joint care), the reasonably prudent person always assumes others will use due care. Moreover, the contributory negligence defense, which bars recovery by a plaintiff who was negligent, is as efficient as comparative negligence, which apportions liability according to relative fault.

D. *Legal Certainty and Principles of Causation*

This section will discuss the relevance of the legal certainty assumption made in the standard economic model with regard to the two elements of causation in negligence: cause-in-fact and proximate cause. Major contributions to the theory of causation in economic models were made by Mark Grady⁷³ and Dean Calabresi.⁷⁴ *Ervin*,⁷⁵ the motorcycle-bus collision case, illustrates these principles. The Supreme Court of Tennessee in *Ervin* could have upheld the trial court's directed verdict for the defendant bus company in any of at least three doctrinal ways. The court could have employed the standard economic model of negligence and held that the defendant bus company was entitled to assume that the motorcyclist, as least cost-avoider, would exercise due care in this alternative care situation; therefore, defendant was not negligent because it had no duty to take care. As previously shown, this bold conclusion, that the high cost-avoider has no duty of care in an alternative care situation, is derived from the legal certainty and simultaneous action assumptions of the standard economic model, which allow all parties to assume that all other persons will act in a reasonably prudent manner. Second, the court could have held that the plaintiff's contributory negligence was a complete bar to compensation regardless of whether the defendant was negligent.⁷⁶

⁷³ See Grady, *Positive Theory*, *supra* note 21; Grady, *Untaken Precautions*, *supra* note 21.

⁷⁴ See Guido Calabresi, *Concerning Cause and the Law of Torts: An Essay for Harry Kalvan, Jr.*, 43 U. CHI. L. REV. 69 (1975); see also William M. Landes & Richard A. Posner, *Causation in Tort Law: An Economic Approach*, 12 J. LEGAL STUD. 109 (1983); Steven Shavell, *An Analysis of Causation and the Scope of Liability in the Law of Torts*, 9 J. LEGAL STUD. 463 (1980). *But see* Richard W. Wright, *Actual Causation vs. Probabilistic Linkage; The Bane of Economic Analysis*, 14 J. LEGAL STUD. 435 (1985) (critique of economic analysts' views on causation in tort law).

⁷⁵ See *supra* notes 46-49 and accompanying text (discussing *Ervin*).

⁷⁶ Tennessee is one of the remaining six states that have retained the contributory negligence defense, which bars recovery by a plaintiff who was causally negligent. See *Arnold v.*

Finally, as the court actually held, even if the defendant was driving negligently by exceeding a speed limit set by state statute,⁷⁷ the speed of the bus was not an immediate cause of the accident.⁷⁸ Let us use the standard economic model of negligence as depicted in Figure 1 (p. 10) to explain *Ervin* in terms of the concepts of negligence, cause-in-fact, and proximate cause when all parties and courts are assumed to have certain knowledge of all relevant facts and legal standards.

1. Negligence

A negligence suit comprises two basic elements: (1) a breach of a duty to use due care and (2) causation.⁷⁹ In terms of Figure 1, a party is negligent when it adopts a level of precaution less than the efficient level, E. In *Ervin*, both the motorcyclist and bus driver used less than due care. By "spurting out" onto a high speed highway from a private road, the motorcyclist was negligent in choosing a level of precaution less than E in Figure 1 (p. 10). Since the legislatively mandated speed limit is at least presumptively the maximum speed at which one can travel and still use due care, the evidence that the defendant's bus was being driven in excess of that speed limit makes a strong case that defendant's level of precau-

Hayslett, 655 S.W.2d 941 (Tenn. 1983); KEETON ET AL., *supra* note 4, § 65, at 451-53; Mutter, *supra* note 4, at 201.

⁷⁷ Standards of conduct may be set by legislative enactment, from which it is negligent to deviate. RESTATEMENT (SECOND) OF TORTS §§ 285-286 (1979). A probable majority of courts would hold that the breach of a duty established by applicable statute conclusively would determine the negligence of the breaching party absent sufficient excuse. KEETON ET AL., *supra* note 4, § 36, at 229-30; *see also* *Martin v. Herzog*, 126 N.E. 814 (N.Y. 1920) (Cardozo, J.) (unexcused violation of statute is negligence). Nevertheless, many courts have held that statutory violations may be only prima facie evidence of negligence, which may be accepted or rejected upon the weighing of all evidence presented. KEETON ET AL., *supra* note 4, § 36, at 230.

⁷⁸ *Ervin*, 438 S.W.2d at 735.

⁷⁹ *See* KEETON ET AL., *supra* note 4, § 30, at 164. Defining the scope of an elusive term such as "duty" has proved to be difficult. *See generally* Leon Green, *The Duty Problem in Negligence Cases*, 28 COLUM. L. REV. 1014 (1928). One argument defines duty, and thus negligence, as a matter of relation between the parties, which must be founded upon the foreseeability of harm to the person in fact injured. *See Palsgraf v. Long Island R.R.*, 162 N.E. 99 (N.Y. 1928). Others champion the idea that everyone owes a duty to the world at large, regardless of whether the victim in fact injured was reasonably expected to suffer injury as a result of the conduct at issue. *See id.* at 102 (Andrews, J., dissenting). But "[n]o better statement can be made than that the court will find a duty where, in general, reasonable persons would recognize it and agree that it exists." KEETON ET AL., *supra* note 4, § 54, at 359.

tion was less than E in Figure 1 (p. 10).⁸⁰

2. Cause-In-Fact

The second basic element that a plaintiff has the burden of proving in a negligence suit is that defendant's negligence was the legal cause of plaintiff's damage.⁸¹ Courts often employ but-for, or *sine qua non*, causation to determine whether the cause-in-fact element of the legal causation requirement has been satisfied.⁸² To determine whether the but-for causation requirement is satisfied, courts ask whether the accident that occurred would have been prevented if the party in question had exercised due care. If the answer to this counter-factual inquiry is affirmative, a court will hold that the party's negligence is a cause-in-fact of the accident;⁸³ if the accident would not have been prevented even if due care had been exercised, a party's negligence is not a cause-in-fact of the accident. Let us translate this inquiry into the standard economic model as represented in Figure 1.

The area under the *Cost of Accident Damage* curve, triangular area ODC, includes every reasonably foreseeable damage (L)⁸⁴

⁸⁰ *Ervin*, 438 S.W.2d at 733-34; see also *supra* note 77.

⁸¹ Legal cause includes both cause-in-fact and proximate cause determinations. KEETON ET AL., *supra* note 4, § 41, at 265; see also H.L.A. HART & A.M. HONORÉ, CAUSATION IN THE LAW chs. V-VI (2d ed. 1959); Leon Green, *The Causal Relation Issue in Negligence Law*, 60 MICH. L. REV. 543, 548-49 (1962) (cause-in-fact inquiry "limited to the fact of the defendant's contribution to the injury," whereas proximate cause requires determination of "whether the defendant's conduct should be condemned and he be made to compensate for his victim's injury").

⁸² See Grady, *Untaken Precautions*, *supra* note 21, at 147.

The most common test of cause in fact is whether the harm would have occurred but for the defendant's failure to have taken the untaken precaution that constituted the breach of duty. In other words, viewed ex post, would the untaken precaution have prevented the accident? Indeed, in all situations except concurrent sufficient causation (for example, two converging negligently started fires), whether the untaken precaution would have prevented this harm is the test of cause in fact. Where the precaution identified would not have prevented the harm, the plaintiff can never recover.

Id. (footnotes omitted); see also KEETON ET AL., *supra* note 4, § 41, at 265-69; Wex S. Malone, *Ruminations on Cause-In-Fact*, 9 STAN. L. REV. 60 (1956).

⁸³ See *infra* text accompanying notes 99-104 (discussing *Butterfield v. Forrester*).

⁸⁴ See *Davis v. Consolidated Rail Corp.*, 788 F.2d 1260, 1264 (7th Cir. 1986) (Posner, J.).

For in determining the benefits of a precaution—and PL, the expected accident costs that the precaution would avert, is a measure of the benefits of the precaution—the trier of fact must consider not only the expected cost of this accident but also the expected cost of any other, similar accidents that the precaution would have prevented.

multiplied by its respective probability (P).⁸⁵ In terms of Figure 1 (p. 10), but-for causation is depicted by the area under the *Cost of Accident Damage* curve to the left of the efficient level of care, E (trapezoid-like area ODFE), which includes all damage that would have been prevented had the party used due care. In terms of but-for causation, the specific PL combination that occurred must be within area ODFE. But-for causation excludes the expected damage in trapezoid-like area EFNC to the right of the efficient level E, which depicts damage that would not be prevented even if a person used due care.⁸⁶ The high cost of preventing such damage is indicated by that portion of the *Cost of Accident Prevention* curve above trapezoid-like area EFNC.⁸⁷

With respect to the motorcyclist, the type of damage that occurred would not have occurred but-for his negligence. In other words, the damage that occurred because of the negligence of the motorcyclist was in trapezoidal area ODFE. With respect to the defendant's negligence, the PL combination, which represents the risk of death of the motorcyclist, is not within trapezoid ODFE. The motorcyclist's death could not have been prevented even if the bus driver had respected the 65 mile per hour speed limit because the bus driver, at that speed, would still not have been able to stop in time to avoid hitting the motorcyclist who darted out onto the highway. The only way a bus could stop quickly enough in this situation would be to drive at an extremely slow speed, probably

Id.; see also *infra* note 150.

⁸⁵ See Grady, *Untaken Precautions*, *supra* note 21, at 146 ("The orthodox economic theory assumes that a precaution is required or not, based on its potential to reduce the type of accident that actually occurred. Nothing could be farther from the truth."). In *re* *Polemis & Furness, Withy & Co.*, 3 K.B. 560 (C.A. 1921) is a well-known case that Grady cites as being contrary to the orthodox theory. In *Polemis*, the defendants negligently dropped a heavy plank into the hold of a ship in which petrol was stowed. A spark caused an explosion, which destroyed the ship. The defendants were held liable even though it is not reasonably foreseeable that dropping a plank would cause an explosion. That is, economic theory assumes $P_i L_i$, not $P_i L_e$, where i is not equal to e , as in the *Polemis* case. Grady cites *Polemis* as an example of judicial recognition of what he calls the "risk-adding principle." Grady, *Untaken Precautions*, *supra* note 21, at 146. Under this principle, which is ignored by orthodox economic theory, courts add risks that were not foreseeable to their determination of whether an untaken precaution was negligent. *Id.* Economic theory, which determines the required precaution based on its ability to reduce the probability of the type of accident that *actually* occurred, fails to account for the practice of adding unforeseeable risks by the courts.

⁸⁶ See Grady, *Positive Theory*, *supra* note 21, at 803-06.

⁸⁷ To prevent the damage represented by area EFNC, it would be necessary to spend the much larger amount represented by area EFRC.

30 miles per hour or less. Such slow travel would be extremely costly to the bus company in terms of lost revenue from passengers. With respect to the operation of defendant's bus, the PL combination that occurred is within trapezoid-like area EFNC and therefore does not pass the but-for test. Thus, the bus driver's negligence was not a cause-in-fact of the accident.

3. Proximate Cause

The *Cost of Accident Damage* curve is the upper bound of all reasonably foreseeable damage.⁸⁸ The position and height of any individual's *Cost of Accident Damage* curve depends upon the information courts consider in determining the reasonable foresight that is used to bound expected damage.⁸⁹ Since the standard economic model's legal certainty and simultaneous action assumptions allow individuals to assume that other persons always use reasonable care, this model results in the lowest conceivable *Cost of Accident Damage* curve and correspondingly the most restrictive notion of proximate cause. However, as will be shown, once the legal certainty and simultaneous action assumptions are relaxed, a rea-

⁸⁸ Some damages that pass the but-for test of causation are ruled out of foreseeable expected damage (PL) on public policy grounds; that is, but-for causation is necessary but not sufficient for legal causation. For example, a train breaks down (as a result of the railroad's negligence), and a passenger staying in a hotel is injured when the hotel burns down. But for the train's breaking down, the passenger would have slept in a different hotel that did not burn down that night. Negligence and causation exist, but no liability. The economic reason is that the risk of a hotel fire is not a part of PL, the expected accident damage that the railroad could have prevented by taking precautions at a cost of B. The risk of damage by hotel fire is probably too remote from the railroad's negligence even to be included within the "risk-adding principle" applied by courts according to the critics of economic theories of causation. See *supra* note 85. Another group of cases involving economic damage is also discussed under the rubric of cause in law, even though they seem to rest on the same policy considerations as the first group. See *infra* note 89.

⁸⁹ In *Rickards v. Sun Oil Co.*, 41 A.2d 267 (N.J. 1945), the defendant's negligence put the only bridge between an island and the mainland out of commission. Merchants on the island who saw their business dry up as a result of the collision sued the defendant but lost; there was causation but no liability. Most of the loss experienced by the island merchants was offset by gains to mainland merchants, so the only social cost was the loss of the bridge. POSNER, *supra* note 1, at 168-69. In *In re Kinsman Transit Co.* ("Kinsman No. 2"), 388 F.2d 821 (2d Cir. 1968) a shipper who was put to considerable added expense for extra transportation and storage costs due to defendant's negligence in destroying a bridge was not allowed to recover damages because the connection was too remote to permit recovery. *Id.*; see also *Palsgraf v. Long Island R.R.*, 162 N.E. 99 (N.Y. 1928) (Cardozo, J.) (causation existed but no liability due to unforeseeable plaintiff); *Overseas Tankship (U.K.) Ltd. v. Morts Dock & Eng'g Co.* ("Wagon Mound No. 1"), P.C. 1961 App. Cas. 388 (causation, but no liability because of unforeseeable harm).

sonably prudent person knows or should know that other persons may be negligent, and such knowledge must be considered when determining the reasonable foresight a party will be deemed to have; this consequently affects the reasonable level of care. If courts assume that a reasonably prudent person has a duty to foresee negligent acts of others, the position of the *Cost of Accident Damage* curve will be higher than if courts assume that a reasonably prudent person foresees that all persons act with due care.⁹⁰ As the *Cost of Accident Damage* curve in Figure 1 (p. 10) shifts upward, it will intersect the *Cost of Accident Prevention* curve farther to the right, implying that due care requires a higher level of precaution.

II. LEGAL CERTAINTY AND SEQUENTIAL ACTION: LAST CLEAR CHANCE MODEL

In this section, we retain the standard model's legal certainty assumption but alter the simultaneous action assumption so that the model now assumes legal certainty and sequential action. Contributors to the economic model of negligence under sequential decision making are Thomas Schelling,⁹¹ Steven Shavell,⁹² and Donald Whitman.⁹³ When legal certainty and action regarding the level of precaution are taken sequentially, the person who acts first has

⁹⁰ The *Cost of Accident Damage* curve is plotted on the basis of some amount of information, the possession of which determines the extent of harm to be expected by use of reasonable foresight.

This level of information is assumed to be given (or exogenous) when the . . . [Cost of Accident Damage] curve is drawn. The amount of information that courts use in estimating expected harm is "reasonable foresight." The . . . [Cost of Accident Damage] curve is thus assumed to be drawn on reasonable foresight. . . . The area superscribed by the . . . [Cost of Accident Damage] curve can be called the "reasonably foreseeable risk."

Grady, *Positive Theory*, *supra* note 21, at 802 n.11. The area superscribed by the *Cost of Accident Damage* curve can thus be called the "reasonably foreseeable risk." *Id.* Although each individual's *Cost of Accident Damage* curve is "a function of the precaution taken by the other individuals," this interdependency is irrelevant under the standard economic model's assumptions of legal certainty and simultaneous action. *See id.* at 805 n.24.

⁹¹ THOMAS SCHELLING, *THE STRATEGY OF CONFLICT* 24, 32, 37 (1980).

⁹² Steven Shavell, *Torts in Which Victim and Injurer Act Sequentially*, 26 J.L. & ECON. 589 (1983).

⁹³ Donald Whitman, *Optimal Pricing of Sequential Inputs: Last Clear Chance, Mitigation of Damages, and Related Doctrines in the Law*, 10 J. LEGAL STUD. 65 (1981). Much of the writing on the economic model of negligence under sequential decision making has a schizophrenic character because the authors are attempting to discuss sequential issues in models employing Nash equilibrium concepts that are valid only when parties make decisions simultaneously. *See supra* notes 8-9.

a significant advantage over the person who acts second. In negligence law, the second mover's disadvantage is enshrined in the last clear chance doctrine. The existence of the last clear chance doctrine was an anomaly in the contributory negligence era, and its disappearance in the comparative negligence era is strong evidence that the contributory negligence defense is not as efficient as comparative negligence in cases involving sequential action.⁹⁴

We begin by considering two alternative care cases involving sequential decisions: *Butterfield v. Forrester*,⁹⁵ which most scholars agree established the contributory negligence defense in 1809;⁹⁶ and *Davies v. Mann*,⁹⁷ which established the last clear chance exception to the contributory negligence defense in 1842.⁹⁸ Next, the economic model that assumes legal certainty and sequential action is discussed and applied to the two cases and a joint care case.

A. *Alternative Care and Sequential Decisions*

In *Butterfield*, the defendant, while repairing his house, which was close by the road side, put up a pole across part of the road, leaving some free passage in the same direction.⁹⁹ The plaintiff left a public house at eight in the evening while it was still light enough to discern the obstruction.¹⁰⁰ He rode "as fast as his horse could go," did not observe the obstruction, rode into it, fell with his horse, and was injured.¹⁰¹ The jury verdict for the defendant was affirmed on appeal.¹⁰² Judge Bayley asserted that the plaintiff was the cause-in-fact of the accident: "[T]he accident appeared to

⁹⁴ Last clear chance has been called a transitional doctrine, "a way station on the road to apportionment of damages." KEETON ET AL., *supra* note 4, § 66, at 464; *see also* Fleming James, *Last Clear Chance: A Transitional Doctrine*, 47 YALE L.J. 704, 722 (1938) (calling for statutory adoption of proportional fault). Last clear chance is to contributory negligence as epicycles are to the Ptolemaic system. At least forty-four states have shifted from evaluating plaintiff's conduct by the all-or-none contributory negligence standard to some form of comparative negligence. *See* Mutter, *supra* note 4, at 200.

⁹⁵ 103 Eng. Rep. 926 (K.B. 1809).

⁹⁶ KEETON ET AL., *supra* note 4, § 65, at 451 n.1.

⁹⁷ 152 Eng. Rep. 588 (Ex. 1842).

⁹⁸ KEETON ET AL., *supra* note 4, § 66, at 462-63.

⁹⁹ 103 Eng. Rep. at 926.

¹⁰⁰ *Id.* at 926-27.

¹⁰¹ *Id.* at 927.

¹⁰² *Id.* The report states that there was no evidence of plaintiff being intoxicated at the time. *Id.* Given that the plaintiff had just left a public house at closing time and was riding his horse "violently," *id.*, it is hard to believe plaintiff was not intoxicated.

happen entirely from his own fault."¹⁰³ Lord Ellenborough's opinion contains the classic definition of the contributory negligence defense, which bars recovery by a plaintiff who was negligent: "Two things must concur to support this action, an obstruction in the road by the fault of the defendant, and no want of ordinary care to avoid it on the part of the plaintiff."¹⁰⁴

In *Davies*, the plaintiff fettered the forefeet of an ass belonging to him and turned it onto a public highway to graze off the side of the road.¹⁰⁵ Defendant's wagon, drawn by a team of three horses, came down a slight descent at a "smartish pace," struck and ran over the ass, killing it.¹⁰⁶ The jury verdict for the plaintiff was affirmed on appeal.¹⁰⁷ Notwithstanding Lord Ellenborough's holding in *Butterfield* that the plaintiff must be free from negligence,¹⁰⁸ Baron Parke's opinion established the last clear chance exception to the contributory negligence defense:

although the ass may have been wrongfully there, still the defendant was bound to go along the road at such a pace as would be likely to prevent mischief. Were this not so, a man might justify the driving over goods left on a public highway, or even over a man lying asleep there, or the *purposely* running against a carriage going on the wrong side of the road.¹⁰⁹

Thus, as Baron Parke's opinion makes clear, the second mover is at a disadvantage in a last clear chance situation because a reasonably prudent person, who knows or should know of the first mover's negligence, has a duty to avoid the harm.¹¹⁰

¹⁰³ *Id.* (Bayley, J.). See *supra* notes 81-87 (discussing cause in fact).

¹⁰⁴ *Butterfield*, 103 Eng. Rep. at 927 (Ellenborough, J.); see also KEETON ET AL., *supra* note 4, § 65. The *Restatement (Second) of Torts* states that "the plaintiff's contributory negligence may be . . . an intentional and unreasonable exposure of himself to danger created by defendant's negligence, of which danger the plaintiff knows or has reason to know." RESTATEMENT (SECOND) OF TORTS § 466 (1965).

¹⁰⁵ *Davies*, 152 Eng. Rep. at 588.

¹⁰⁶ *Id.*

¹⁰⁷ *Id.*

¹⁰⁸ *Id.* at 589; see also *supra* text accompanying note 104.

¹⁰⁹ *Davies*, 152 Eng. Rep. at 589 (emphasis added). Lord Abinger was of the opinion that it made no difference whether or not the ass was lawfully on the highway, "for as the defendant might, by proper care, have avoided the animal, and did not, he is liable for the consequences . . ." *Id.*

¹¹⁰ Baron Parke was of the opinion that "the negligence which is to preclude a plaintiff from recovering in an action of this nature must be such as that he could, by ordinary care, have avoided the consequences of the defendant's negligence." *Id.*; see also *infra* note 122 (discussing *Haeg v. Sprague, Warner & Co.*, 281 N.W. 261 (Minn. 1938)). The *Restatement (Second) of Torts* states that "[a]n act or an omission may be negligent if the actor realizes

Thomas Schelling gave the first clear verbal statement of how the first mover may gain an advantage in strategic situations involving sequential action, as, for example, in situations where ambiguity exists as to right of way, where two vehicles meet on a narrow road or approach an intersection, or where one vehicle on the entrance ramp of a highway is trying to break into a stream of traffic.¹¹¹ Schelling showed that there is a rational strategy for resolving such conflicts to one's advantage. If driver one can make an *irrevocable commitment* in a way that is unambiguously visible to driver two, say by speeding up so as to enter an intersection first,¹¹² driver one can squeeze the range of indeterminacy down to the point most favorable to her or him.¹¹³ The commitment problem is nicely illustrated by the legal doctrine of last clear chance,¹¹⁴ which recognizes that, in the events leading up to an accident, at

or should realize that it involves an unreasonable risk of harm to another through the negligent or reckless conduct of the other or a third person." RESTATEMENT (SECOND) OF TORTS § 302A (1965).

¹¹¹ SCHELLING, *supra* note 91, at 24, 32, 37.

¹¹² *But see* Satterlee v. Orange Glenn School Dist., 177 P.2d 279, 285 (Cal. 1947) (discussed *infra* note 115).

¹¹³ George Vecsey, *King Richard [Petty, Champion Car Racer], in Heavy Traffic in New York*, N.Y. TIMES, Aug. 17, 1988, at B12.

Philosophical question: Should one drive aggressively or defensively in city traffic? Petty replied: "it depends what your goal is. With taxi drivers, they have to be aggressive because it's their living. I'm not in any hurry, so I should be defensive." He said he relates to drivers of commercial vehicles because "they got to make a living, so you don't holler at them too much when they cut you off." . . . After Petty signaled for a right into the garage, a bicyclist tried to cut him off. Petty turned anyway, and the bicyclist swerved into the curb losing his own game of chicken. Petty chuckled about it all the way back to the Waldorf Astoria.

Id.

¹¹⁴ *See, e.g.,* Perin v. Nelson & Sloan, 259 P.2d 959, 960-61 (Cal. Ct. App. 1953). In *Perin*, the plaintiff sustained personal injuries when a truck operated by one of the defendant's employees was backed onto plaintiff's foot. *Id.* at 960. The court upheld a jury verdict for the plaintiff and denied the defendant's contention that the trial court committed prejudicial error in instructing the jury on the doctrine of last clear chance. *Id.* at 961.

An instruction stating the doctrine is proper when there is evidence showing: "(1) That plaintiff has been negligent and, as a result thereof, is in a position of danger from which he cannot escape by the exercise of ordinary care; and this includes not only where it is physically impossible for him to escape, but also in cases where he is totally unaware of his danger, and for that reason unable to escape; (2) that defendant has knowledge that the plaintiff is in such a situation, and knows, or in the exercise of ordinary care should know, that plaintiff cannot escape from such situation, and (3) has the last clear chance to avoid the accident by exercising ordinary care, and fails to exercise the same, and the accident results thereby, and plaintiff is injured as the proximate result of such failure."

Id. at 960-61 (quoting Daniels v. City & County of San Francisco, 255 P.2d 785, 788 (Cal. 1953)).

some point the accident became inevitable as a result of prior actions, and that the abilities of the two parties to prevent it may not have expired at the same time. The irrevocable commitment is a device that leaves the last clear chance to decide the outcome with the other person, in a manner that that person fully appreciates; it is to relinquish further initiative, having rigged the incentives so that the other person must choose in one's favor. If driver one speeds up so that she or he cannot stop and driver two realizes it, the latter has to yield or an accident will occur.¹¹⁵ As is clear from the examples used to illustrate Schelling's analysis, automobile cases involving sequential decisions occur frequently and are a fertile source of litigation.¹¹⁶

Consider a simple but formal statement of a model that demonstrates that the least cost-avoider may gain an advantage by moving first in strategic situations involving certain knowledge and sequential action, so that the least cost-avoider can shift the burden of avoiding harm to the higher cost-avoider, the second mover. Assume that the expected damage from an accident is \$1000 (PL) and that it can be avoided by either the least cost-avoider at a cost of \$50 (B) or the high cost-avoider at a cost of \$100 (B). If this were a model in which each person had certain knowledge of each other's costs and both persons acted *simultaneously*, the least cost-avoider would be liable because, as shown in Section I, the high cost-avoider would be justified in assuming that the least cost-avoider would act with due care. Now, however, assume that the least cost-avoider is the first mover. This model is depicted in Figure 2 (next page).

¹¹⁵ See, e.g., *Satterlee*, 177 P.2d at 285.

If as stated by . . . [plaintiff], when he observed the bus it was about twice as far from the intersection and traveling at approximately the same speed as his own vehicle, then he reasonably was justified, the jury could have concluded, in assuming that the bus would not dangerously increase its speed in order to enter the intersection first. Certainly by his own act of increasing speed or "racing for the intersection" an automobile driver should not be allowed to charge the operator of the other vehicle in the collision with negligence per se without the right to prove justification for the statutory violation.

Id.

¹¹⁶ There are dozens, if not hundreds of reported decisions involving automobile accidents at street intersections. See *Morris v. Bloomgren*, 187 N.E. 2 (Ohio 1933); *Caines v. Wofsey*, 167 A. 733 (Conn. 1933); BARNES & STOUT, *supra* note 2, ch. 3A, at 30; see also Annotation, 175 A.L.R. 1013 (1948), 136 A.L.R. 1497 (1942), 89 A.L.R. 838 (1934) (collecting decisions involving automobile accidents at street intersections).

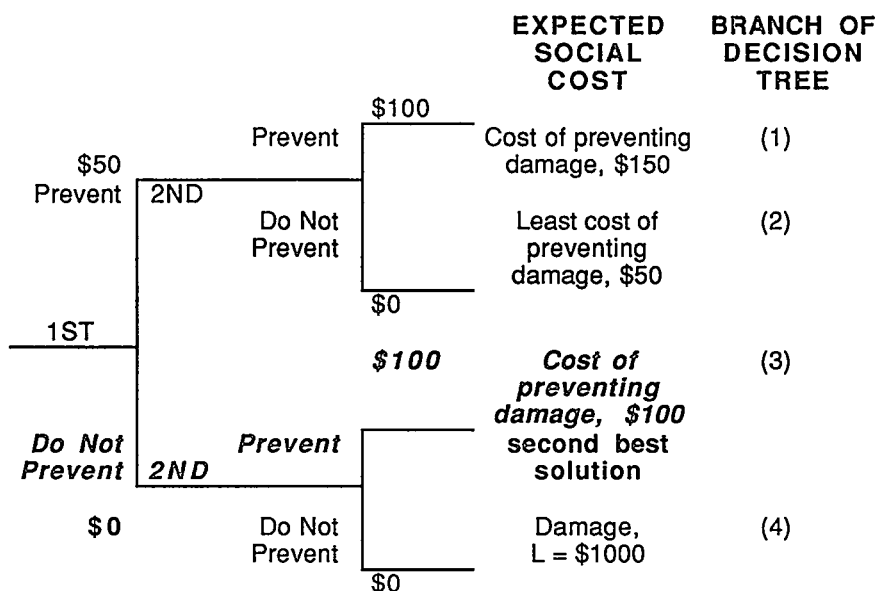


Figure 2. *Certain Knowledge and Sequential Decisions*

The first mover has a choice of either preventing the accident by spending \$50 or not preventing the accident and spending \$0. If the first mover chooses a *Do Not Prevent* strategy, the least cost method of preventing the accident cannot occur because the branch (2) of the decision tree which contains that outcome is no longer relevant. Given the condition that the first mover chooses a *Do Not Prevent* strategy, the second mover confronts a choice between a *Prevent* strategy, in which it must spend \$100 to prevent the expected damage, branch (3), or a *Do Not Prevent* strategy, in which it spends \$0 and allows the expected damage of \$1000 to occur, branch (4). Given the first mover's failure to prevent the damage, the second mover has been put into a position where the second mover has the last clear chance to avoid the harm. The last clear chance represents the "second best" solution.¹¹⁷ Thus, in the context of a model that assumes legal certainty and sequential ac-

¹¹⁷ In Figure 2, branch (2) of the decision tree, where the first mover chooses a *Prevent Strategy* and the second mover chooses a *Do Not Prevent* strategy, has the lowest total social cost of \$50. Branch (3) of the decision tree, where the first mover chooses a *Do Not Prevent Strategy* and the second mover chooses a *Prevent* strategy, has the second lowest total cost; therefore it is the "second best" choice. The other two branches of the decision tree, (1) and (4), have still higher social costs of \$150 and \$1000. See MANSFIELD, *supra* note 32, at 493-94; R.G. Lipsey & Kevin Lancaster, *The General Theory of Second Best*, 24 *REV. ECON. STUD.* 11 (1956-57).

tion, the first mover has a decided advantage.¹¹⁸

It is difficult to conceive of a second mover advantage in this model because the nearly insurmountable problem for the second mover is to find a way to make a commitment in advance not to use care that will be creditable to the first mover.¹¹⁹ In other words, a second mover can claim that it will not take care when it moves, but if the first mover refuses to believe this threat and does not take care, the first mover advantage is reinstated.¹²⁰

Assume that both parties, because of intention or negligence, choose a *Do Not Prevent* strategy, and the expected harm occurs. What legal standards will give the first mover an incentive to take care in the future and will also give the second mover an incentive to take care if faced with the last clear chance in the future? It is easily shown that the all-or-none contributory negligence defense, which gives total victory to one party or the other, cannot accomplish these *dual* objectives. Consider which legal standards give the second mover an incentive to choose a *Prevent* strategy when confronted with last clear chance in the future. The second mover can be either the plaintiff-victim as in *Butterfield* or the defendant-injurer as in *Davies*. If the second mover is the *Butterfield*-like plaintiff-victim, it does not matter whether the plaintiff's conduct is evaluated by the contributory negligence defense or comparative negligence because the plaintiff, who effectively has the last clear chance, will receive no compensation under the former or substantially reduced or no compensation under the latter standard.¹²¹ If, however, the second mover is the *Davies*-like defendant-injurer, comparative negligence is efficient but the contributory negligence defense is not: under comparative negligence, the defendant-wagoner, who rejected the last clear chance, will be required to pay substantial compensation to the plaintiff-donkey-owner; but, under the contributory negligence defense without a last clear chance exception, a defendant, who rejected the last clear chance, will not be required to compensate the plaintiff whose contributory negligence bars it from compensation; that is, under the contributory negligence defense, the defendant will have little incentive to take the

¹¹⁸ VARIAN, *supra* note 7, at 474-76.

¹¹⁹ *Id.* at 476.

¹²⁰ See SCHELLING, *supra* note 91, at 38.

¹²¹ Plaintiff would receive no compensation under comparative negligence with a 50% or 51% threshold and substantially reduced compensation under pure comparative negligence. See *supra* note 52.

last clear chance.¹²²

Next, consider which legal standards give the first mover an incentive to choose a *Prevent* strategy initially, when it makes the first move. If the first mover is the defendant-injurer as in *Butterfield*, comparative negligence is in general efficient,¹²³ but the contributory negligence defense is not efficient because of the possibility that the intentional or negligent actions of the first mover will be immunized by the negligence of the second mover, as in fact happened in *Butterfield*.¹²⁴ If the first mover is the plaintiff-victim as in *Davies*, both the contributory negligence defense and comparative negligence will give it efficient incentives not to use its first mover's advantage.¹²⁵

To appreciate the effect of sequential action in *Butterfield* and *Davies*, assume that the facts are the same in each case except that the accidents occurred in the unlit dark of night. Is it not clear that the decision would be reversed in both cases? In *Butterfield*, the plaintiff-horseman had the last clear chance because, as second mover, he should have seen the obstruction. If, however, the accident had occurred on an unlit night, the plaintiff could not be expected to see and would have no reason to know of the obstruction. Is it not clear that the plaintiff-horseman and not the defendant-

¹²² See *supra* text accompanying note 109 (quoting Baron Parke); *Haeg v. Sprague, Warner & Co.*, 281 N.W. 261 (Minn. 1938). *Haeg* involved a motor vehicle collision at an intersection of a gravel road and a highway. The plaintiff, who entered the intersection from the gravel road and was crossing the highway from left to right, said: "I entered the intersection first, and I expected him to slack up and let me through." *Id.* at 261. Plaintiff stressed his supposed right to assume that defendant would exercise ordinary care to avoid a collision. The defendant, who entered the intersection from the highway, had the statutory right-of-way because he was on the plaintiff's right. Nevertheless, the jury ruled for the plaintiff, possibly because it believed that the defendant had the last clear chance and rejected it. The supreme court reversed the trial court's order denying defendant's motion for judgment n.o.v., stating that "it is not due care to depend upon the exercise of care by another when such dependence is itself accompanied by obvious danger." *Id.* at 262. In dicta, the court said: "It would be hard to imagine a case more illustrative of the truth that in operation the rule of comparative negligence would serve justice more faithfully than that of contributory negligence." *Id.* at 263.

¹²³ If the first mover is the defendant-injurer, comparative negligence standards are in general efficient, because defendant will not totally escape liability to the plaintiff even though plaintiff had the last clear chance.

¹²⁴ See *supra* note 115 (discussing *Satterlee v. Orange Glenn School Dist.* 177 P.2d 279 (Cal. 1947)).

¹²⁵ Because the first mover, the plaintiff-victim, is negligent, it will receive nothing under the all-or-none contributory negligence standard or under a comparative negligence standard with a 50% or 51% threshold and will receive substantially reduced compensation under a pure comparative negligence standard.

homeowner would win this hypothetical case because the plaintiff can reasonably expect that the defendant, who at night is surely the least cost-avoider, will use due care and remove the obstruction.¹²⁶ This hypothetical case is much more like the standard economic model, since darkness tends to remove the sequential aspect; if the plaintiff cannot see the obstruction, it is as if the parties are acting simultaneously. If *Davies* happened at night, its outcome would also be reversed because in darkness, the defendant-wagoner could not be expected to see the ass on the road; in darkness, the hypothetical would be less like a sequential decision case, and more like a simultaneous action case in which the plaintiff-donkey driver was the least cost-avoider.

B. Joint Care and Sequential Action

In *LeRoy Fibre*,¹²⁷ the railroad line was actually constructed some years before the flax factory was built,¹²⁸ that is, the flax factory "came to" the railroad.¹²⁹ Assume that when the LeRoy Fibre Company makes its decision as to how far from the railroad tracks it should place its flax stacks, it knows with certainty that Railroad has not installed a spark arrester and refuses to do so. The new assumption changes the model of negligence from the standard one in which action occurs simultaneously to a model in which action occurs sequentially and in which the railroad is the first mover.

The effect of the sequential assumption on the model is illustrated in Table 1 (p. 21). Given that the LeRoy Fibre Company knows that the Railroad has not installed spark arresters, would a decision by the LeRoy Fibre Company to place its flax stacks 100 feet from the railroad tracks, which decision was efficient when levels of precaution were chosen simultaneously, be efficient in the

¹²⁶ During the daylight hours, absent the sequential element, it is difficult to say which of the two parties in *Butterfield* is the least cost-avoider, particularly since it depends on the structural necessity of having the pole sticking out into the street. It can be argued that removing the pole would remove the threat not only to this but to other riders whereas the alternative is that each rider independently takes measures to avoid the pole. That would make the defendant the least cost-avoider of accidents. BARNES & STOUT, *supra* note 2, Teacher's Manual, ch. 3, at 10.

¹²⁷ See *supra* text accompanying notes 61-72.

¹²⁸ *LeRoy Fibre*, 232 U.S. at 341-42.

¹²⁹ Cf. *Dill v. Excel Packing Co.*, 331 P.2d. 539 (Kan. 1958) (cattle feed lot). See generally KEETON ET AL., *supra* note 4, § 88B, at 634-36 (discussing doctrine of "coming to a nuisance"); *Staton v. Atlantic Coast Line R.R.*, 61 S.E. 455 (N.C. 1908) (denying injunction, but awarding damages, against railroad because of heavy investment and plaintiff's moving to it).

case where levels of precaution are chosen sequentially? The answer is no. The combination of no spark arresters and flax stacks 100 feet from the railroad tracks is not one of the care combinations that would avoid the \$1000 loss. Given that the LeRoy Fibre Company knows that the Railroad has not installed spark arresters, the LeRoy Fibre Company, as second mover, should *temporarily* place its flax stacks at a distance of 200 feet rather than 100 feet from the tracks so as to avoid the harm. It should spend \$100 (an increase of \$50) to avoid a \$1000 loss; in terms of the Hand formula, $B(\$100) < PL(\$1000)$. The LeRoy Fibre Company should begin a nuisance action against the railroad, requesting that the railroad be enjoined from operating engines without spark arresters. Once the railroad is so enjoined, the LeRoy Fibre Company can then place its stacks 100 feet from the tracks.¹³⁰ What legal standard will give the LeRoy Fibre Company, as second mover, an efficient incentive to avoid the damage and effect the efficient result through litigation?

As shown in Section I, under the standard economic model of negligence with its legal certainty and simultaneous action assumptions, both the contributory negligence defense and comparative negligence standard provide equally efficient incentives for plaintiffs. Given a model with legal certainty and sequential action, however, only a comparative negligence standard will give the plaintiff an efficient incentive to avoid a wasteful loss when the plaintiff is the second mover. If the plaintiff's conduct is evaluated with the all-or-none contributory negligence defense, a dilemma results: either the plaintiff is held not to be contributorily negligent, even though it had the last clear chance to avoid a \$1000 loss by placing its flax stacks 200 feet rather than 100 feet from the tracks at a cost of \$100 (a mere increase in cost of \$50), or the plaintiff is held to be contributorily negligent and receives no compensation even though its level of precaution, placing its flax stacks 100 feet from the tracks, would have been optimal had the railroad taken due care. The first possibility allows the plaintiff full compensation even though it knowingly "caused" a \$1000 harm that it could have avoided for a mere \$100; the second possibility causes plaintiff to bear the entire loss even though the defendant's conduct is comparatively more negligent. In either case, the contributory negligence defense does not create efficient incentives. Similar reason-

¹³⁰ The least cost solution in the second column of Table 1 (p. 21) would be reinstated.

ing applies to the railroad if it came to an already densely populated area.

III. UNCERTAINTY AND SIMULTANEOUS ACTION: DEFENSIVE CARE MODEL

We now alter the legal certainty assumption of the standard economic model and assume that the parties and courts act under conditions of uncertainty. Contributions to the economic model of negligence under conditions of uncertainty were made by Mark Grady¹³¹ and by Robert Cooter and Thomas Ulen.¹³² Initially, four problems, which occur when there is uncertain knowledge in unitary care cases, are discussed. Specifically, the difficulty in quantifying the Hand variables—B, P, and L—is illustrated by *Helling v. Carey*.¹³³ Next, we consider three problems of causation due to uncertainty: (1) uncertainty about the injurer's identity, (2) uncertainty about the victim's identity, and (3) uncertainty about the efficient level of precaution. Finally, an alternative care model based upon the assumptions of uncertainty and simultaneous action is constructed. The conclusions that in defensive care models redundant care is often efficient and that a comparative negligence standard is more efficient than a contributory negligence defense are illustrated by *Kerr v. Hayes*.¹³⁴

A. Unitary Care and Uncertainty

1. Difficulty in Quantifying the Hand Formula Variables B, P, and L

The assumption of legal certainty employed in the standard economic model means that all persons and courts know the efficient level of precaution (level E in Figure 1, p. 10) and can employ the Hand test with exactness. But in the real world of uncertain knowledge, it is difficult to quantify the Hand test. Judge Posner has written that he knows of no case in which a court attached

¹³¹ See Grady, *Positive Theory*, *supra* note 21; Grady, *Untaken Precautions*, *supra* note 21.

¹³² Robert Cooter & Thomas Ulen, *An Economic Case for Comparative Negligence*, 61 N.Y.U. L. REV. 1067 (1986). When the legal standard is set at the efficient level, evidentiary uncertainty will cause overprecaution relative to the efficient level. Under certain conditions this overprecaution is less under comparative negligence than under any other form of the negligence rule. COOTER & ULEN, *supra* note 1, at 401.

¹³³ 519 P.2d 981 (Wash. 1974).

¹³⁴ 229 N.W. 430 (Mich. 1930).

numbers to all of the formula's three terms—B, P, and L.¹³⁵ As a result, the Hand test usually is used as a *qualitative* framework to analyze whether the defendant was negligent in not having undertaken a particular precaution.¹³⁶

Consider the well known case of *Helling v. Carey*,¹³⁷ which is generally cited as one of the few cases in which it was possible to make a quantitative estimate of P, the probability of the harm occurring.¹³⁸ The plaintiff first consulted the defendant ophthalmologists for myopia (nearsightedness) in 1959. At that time she was fitted with contact lenses. She consulted the defendants several times over the next nine years for problems the defendants considered to be related solely to complications associated with contact lenses. In October 1968, a defendant tested plaintiff's eye pressure and field of vision for glaucoma for the first time and found that she had it.¹³⁹ The plaintiff was thirty-two years old.¹⁴⁰ The issue was whether the defendant ophthalmologists' compliance with the standard of their profession, which did not require the giving of a routine pressure test to persons under 40 years of age, should insulate them from liability where the plaintiff lost a substantial amount of her vision because of the untimely failure to test the plaintiff.¹⁴¹ The court held that the defendants were negligent as a matter of law.¹⁴²

Using medical evidence, the court found that for persons under the age of forty, the probability of having glaucoma is one in 25,000.¹⁴³ Thus, the probability of harm, P, is 0.00004. The court did not attempt to quantify the Hand test's other two variables, but discussed them qualitatively: "The test [with respect to B, the burden (cost of accident prevention)] is a simple pressure test, relatively inexpensive," and the result of the disease [L, the damage],

¹³⁵ POSNER, *supra* note 68, at 224.

¹³⁶ Grady, *Untaken Precautions*, *supra* note 21, at 140. "For practicing lawyers, the critical choice is properly identifying *which* untaken precaution will be the gist of the plaintiff's case." *Id.*

¹³⁷ 519 P.2d 981 (Wash. 1974).

¹³⁸ WERNER Z. HIRSCH, *LAW AND ECONOMICS* 209 (2d ed.1988).

¹³⁹ *Helling*, 519 P.2d at 981.

¹⁴⁰ *Id.* at 982.

¹⁴¹ *Id.*

¹⁴² *Id.* at 983. In 1975, a year after the Washington Supreme Court's ruling in *Helling*, the Washington legislature enacted a statute requiring health care standards to be established only by health care professionals and not by courts in judicial proceedings. WASH. REV. CODE ANN. § 4.24.290 (West 1975).

¹⁴³ *Helling*, 519 P.2d at 983.

which causes loss of vision and ends in blindness if untreated, is "grave and devastating."¹⁴⁴ The inherent difficulty in quantifying the other two Hand variables in this case is apparent when one considers that economists who have attempted such quantification have reached different conclusions regarding the defendants' negligence. Hirsch estimated B to represent "about 10 minutes of a doctor's time, let us say \$30."¹⁴⁵ Cooter and Ulen "[s]uppose that a tonometry test, which will detect glaucoma, costs \$5."¹⁴⁶ These economists agreed that the average jury verdict for total or legal blindness in the period 1973-1977, which was \$678,000, should be used as an estimate of L.¹⁴⁷ Given these estimates, Hirsch concluded that defendants were not negligent: $B(\$30) > PL(0.00004)(\$678,000)$, or simplified, $B(\$30) > PL(\$27)$,¹⁴⁸ whereas Cooter and Ulen concluded that defendants were negligent, $B(\$5) < PL(0.00004)(\$678,000)$, or simplified, $B(\$5) < PL(\$27)$.¹⁴⁹

In determining the expected damage (PL) from not taking a precaution, the trier of fact must consider not only the expected damage from the accident that occurred, but also the expected damage of any other similar, reasonably foreseeable accidents that the precaution would have prevented. For example, when a railroad engineer fails to blow the train's horn as a warning that it is about to move, which cost of care is small (small B), there is not only a probability (P_1) that hearing the horn would save the life of an inspector who had crawled under a car (L_1), but also a probability (P_2) that hearing the horn would save an inspector leaning on a car (L_2) and a probability (P_3) that hearing the horn would save railroad employee doing repairs on the top of a car (L_3), a brakeman straddling two cars (P_4L_4), or a person who might have business in or on (as well as under) a car (P_5L_5).¹⁵⁰ To be rigorously accurate, the Hand test should be written as $B < \Sigma$

¹⁴⁴ *Id.*

¹⁴⁵ HIRSCH, *supra* note 138, at 209.

¹⁴⁶ COOTER & ULEN, *supra* note 1, at 379.

¹⁴⁷ *Id.*; HIRSCH, *supra* note 138, at 210.

¹⁴⁸ HIRSCH, *supra* note 138, at 210.

¹⁴⁹ COOTER & ULEN, *supra* note 1, at 620.

¹⁵⁰ *Davis v. Consolidated Rail Corp.*, 788 F.2d 1260, 1264 (7th Cir. 1986) (Posner, J.); see also Leon Green, *Foreseeability in Negligence Law*, 61 COLUM. L. REV. 1401, 1403 (1961) (discussing controversy between those who argue for "liability for all the consequences of negligent conduct whether reasonably foreseeable or not" versus "liability only for the consequences of negligent conduct that should have been reasonably foreseen.").

PL.¹⁵¹ Moreover, when the defendant could have taken more than one precaution, plaintiff's lawyer must identify which untaken precaution(s) will pass the Hand test.¹⁵²

2. Uncertainty, Unitary Care, and Causation

We now consider three problems of causation due to uncertainty: (1) uncertainty about the injurer's identity, (2) uncertainty

¹⁵¹ The Σ symbol represents "summation" and $\Sigma PL = P_1L_1 + P_2L_2 + P_3L_3 + \dots P_nL_n$ (where n stands for the nth or last reasonably foreseeable harm that will be avoided by blowing the horn). In terms of Figure 1 (p. 10), if blowing the train's horn is the level of precaution indicated by level E, then ΣPL is measured by the height of the *Cost of Accident Damage* curve at E.

¹⁵² See, e.g., *Davis*, 788 F.2d at 1262-68 (Posner, J.). In *Davis*, an inspector of railroad cars, whose job required him to crawl underneath the cars to look for cracks, lost a leg and a foot when the train moved without blowing its horn as a warning. *Id.* at 1262. The jury found for the plaintiff. *Id.* On the question of the railroad's negligence, the plaintiff alleged three untaken precautions. First, the railroad employee who saw the plaintiff in an unmarked truck should have notified the train crew of his presence. *Id.* at 1263. Speaking for the court, Judge Posner said derisively that if the employee had done so, the train crew would have replied, so what? *Id.* Second, the plaintiff suggested that before the train moved, a member of the crew should have walked the entire length of the train, looking under each car, and back to the engine, a distance of a mile and a half, which might have taken an hour to complete. *Id.* at 1264. Judge Posner opined that this second alleged untaken precaution was even more fantastic than the first. *Id.* Finally, the plaintiff asserted that the train crew was negligent in not blowing the horn before moving the train. *Id.* Judge Posner regarded this untaken precaution as more plausible; a reasonable jury could find that it was imprudent to move the train without signaling in advance. *Id.* Moreover, Judge Posner stated that the defendant's assertion that the horn would not have been heard at the other end of the train, three-quarters of a mile away, was implausible and unsubstantiated. *Id.* As to the defendant's claim that blowing a horn every time a train moved would cause a cacophony that would deprive the horn of its efficacy as a warning, Judge Posner said that the defendant had put in no evidence on how busy the marshalling yard was at that time or at any other time. *Id.* at 1264-65.

In *McCarty v. Pheasant Run, Inc.*, 826 F.2d 1554 (7th Cir. 1987) (Posner, J.), the plaintiff was attacked in a second-floor hotel room by a man who had gained entrance through a sliding glass door that had been closed, but not locked. *Id.* at 1555. The intruder had pried it open from the outside, breaking the security chain. *Id.* The jury found for the defendant. *Id.* On appeal, Judge Posner said that the plaintiff made little effort to show that there were untaken precautions of reasonable cost and efficacy that would have prevented the mishap. *Id.* at 1557.

No effort was made to inform the jury what it would have cost to equip every room [in the hotel] with a new lock, and whether the lock would have been jimmy-proof. . . . And since the door to [plaintiff's] room was unlocked, what good would a better lock have done? No effort was made, either, to specify an optimal security force for a resort [of this size]. No one considered the fire or other hazards that a second-floor walkway not accessible from ground level would create.

Id. Judge Posner also noted that a notice telling guests to lock their doors would be inexpensive, but because this is common knowledge, especially with respect to sliding doors on a walkway, not a balcony, the benefits from such warning would be slight. *Id.*

about the victim's identity, and (3) uncertainty about the efficient level of precaution. *Sindell v. Abbott Laboratories*,¹⁵³ is a leading case that involves uncertainty about an injurer's identity.¹⁵⁴ The plaintiff, who was injured as the result of a drug her mother took during pregnancy, knew the name of the generic drug, DES, but did not know the manufacturer of the precise product.¹⁵⁵ On the issue of causation, the court held defendants liable upon a probabilistic basis: each defendant was liable for the percentage of the total product market for which it accounted.¹⁵⁶

Uncertainty about the victim's identity can occur when an injurer increases the risk of a disease above the "background" level, for example, by negligent discharge into the atmosphere of a cancer-causing chemical. The issue is whether a particular discharge was "the" cause of a particular person's cancer. A probabilistic solution has been suggested: the injury could be defined as the increased risk of cancer to the whole population so exposed, which population could be allowed to use the class action device for recovery of the percentage of damages accounted for by the increased risk.¹⁵⁷

When the efficient level of precaution is uncertain, uncertainty exists about whether the Hand test can be applied correctly, that is, over small increments of care (marginally). The following hypothetical will explain why, because of uncertain knowledge, the Hand test may be applied incorrectly and thereby obscure cause-in-fact problems. Suppose that an automobile accident occurs, and all that is known is that the expected damage, $PL = \$10$, could have been eliminated if the defendant driver had been driving 30 miles per hour slower because of the shorter stopping distance required at a lower speed; assume the cost of driving slower is \$9 (B).¹⁵⁸ Given this limited information, the defendant would be negligent under the Hand test because $B(\$9) < PL(\$10)$.

But, an omniscient court, one in which legal certainty was assumed, familiar with the cost-benefit functions depicted in Figure 3 (next page), would know that most of the reduction in expected

¹⁵³ 607 P.2d 924 (Cal.), cert. denied, 449 U.S. 912 (1980).

¹⁵⁴ See POSNER, *supra* note 1, at 168.

¹⁵⁵ *Sindell*, 607 P.2d at 926. DES is an acronym for diethylstilbestrol.

¹⁵⁶ *Id.* at 937; see also David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 849 (1984).

¹⁵⁷ POSNER, *supra* note 1, at 168.

¹⁵⁸ *Id.* at 148.

damage, from PL (\$10) to PL (\$1), occurs because of a reduction in speed by 10 miles per hour and that such reduction in speed costs only B (\$2). This implies that elimination of the last dollar in expected harm, from PL (\$1) to PL (\$0), requires an additional reduction in speed of 20 miles per hour and costs B (\$7). Figure 3 shows that the efficient level of precaution (driving 62 m.p.h. rather than 70 m.p.h.) requires a reduction in speed of approximately 8 miles per hour. In other words, an omniscient court would be able to apply the Hand test correctly, in small increments (marginally).¹⁶⁹ An omniscient court would find the defendant not guilty; even if the defendant were driving 8 miles per hour too fast, the defendant's negligence was not the cause-in-fact of the injury because such injury would have occurred even if defendant had driven 8 miles per hour slower, since by hypothesis, the accident could only have been avoided by a reduction of 30 miles per hour.

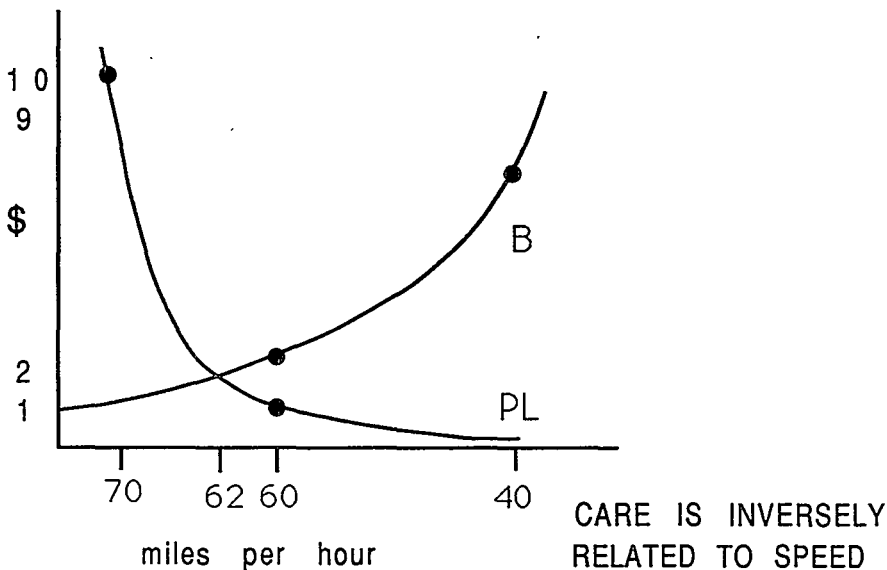


Figure 3. *The Marginal Hand Test (The correct application of the Hand test requires that the cost of accident damage be compared to the cost of accident prevention over small increments).*

Thus, when knowledge of the cost-benefit functions and efficient level of precaution are uncertain, the level of untaken precaution that can be used to show a breach of duty is not fixed, but

¹⁶⁹ See *id.* at 148-49; Brown, *supra* note 3, at 331-35.

depends on the width of the increment to which the Hand test is applied and the injurer's actual level of precaution. By reducing the level of precaution taken, the injurer creates more opportunities for the victim to use a broader increment to show a breach of duty, even though such breach may not be a cause-in-fact of the injury.¹⁶⁰

B. *Uncertainty and Simultaneous Action: The Defensive Care Model*

An economist, William Vickrey, has asserted that "it is just as important to provide an adequate incentive for driving defensively rather than merely nonnegligently as it is to provide an incentive for driving nonnegligently rather than recklessly."¹⁶¹ The defensive care model discussed in this section is an alternative care model in which redundant care is often efficient; that is, the model shows that there are situations in which the high cost-avoider, because of uncertainty, should not rely on the least cost-avoider to take care but should act or drive defensively. *Kerr v. Hayes*¹⁶² will illustrate the defensive care model, which model will also be used to analyze *Jackson*, previously discussed in connection with the standard economic model.¹⁶³

Kerr involved an automobile collision at the intersection of two streets, neither of which was a stop street, trunk highway, or superior to the other. The plaintiff was driving south at about 15 miles per hour, and the defendant was driving west at about 35 to 40 miles per hour.¹⁶⁴ Although the plaintiff had a clear view for 85 feet to the east, he did not look to his left, nor did he see the defendant's automobile at any time until an instant before the collision.¹⁶⁵ The sole basis for the plaintiff's claim of freedom from con-

¹⁶⁰ See Grady, *Positive Theory*, *supra* note 21, at 817. "[T]he maximum level of un-taken precaution that can be used to show breach of duty is not fixed, but depends on the injurer's actual level of precaution. . . . Thus, as the injurer takes less precaution, he creates more opportunities for the victim to show a breach of duty." *Id.* at 815-16. In *Reynolds v. Texas & Pac. Ry.*, 37 La. Ann. 694 (1885), plaintiff tripped on steps that were *both* un-lighted and had no hand rail; moreover, passengers were pressured to "hurry up." *Id.* at 697; see also Malone, *supra* note 82, at 74 (1956) (discussing interdependence of policy and factual likelihood in cause-in-fact determination).

¹⁶¹ William Vickrey, *Automobile Accidents, Tort Law, Externalities, and Insurance: An Economist's Critique*, 33 LAW & CONTEMP. PROBS. 464, 467 (1968).

¹⁶² 229 N.W. 430 (Mich. 1930).

¹⁶³ See *supra* notes 54-60 and accompanying text.

¹⁶⁴ *Kerr*, 229 N.W. at 430.

¹⁶⁵ *Id.*

tributory negligence was that by being on the defendant's right, the plaintiff had the right of way at the intersection.¹⁶⁶ In reversing the trial court's judgment for the plaintiff, the Supreme Court of Michigan said that case law indicates that

the statutory right of way is not an assurance of safety, nor an absolute right in all conditions, but that *both drivers must use due care*. A driver cannot continue to assume that the one on the left will accord him right of way when the circumstances would indicate the contrary to a reasonable person.¹⁶⁷

Because the plaintiff did not look to the left, he could not have formed any belief from the conditions. The court stated that the plaintiff was chargeable with having seen what he should have seen, that defendant's car was about twice the distance from the intersection as his own, approaching at about twice his own speed, without ever giving any indication of according plaintiff the right of way, and that a collision was inevitable unless the plaintiff took measures to avoid it.¹⁶⁸

Consider the following model: assume that if an accident occurs the damage will be \$1000, and that the accident can be avoided either by the least cost-avoider at a cost of \$5 or by the high cost-avoider at a cost of \$10. If this model employed the standard economic assumptions of legal certainty and simultaneous action, it is clear that the least cost-avoider should always take care and the high cost-avoider should never take care. However, in this model, which assumes a significant probability that both parties will be uncertain which of them is the least cost-avoider, it will be shown that both should take care as a defensive measure whether or not they believe they are the least cost-avoider; such defensive care will minimize social cost even though it is redundant most of the time.¹⁶⁹

¹⁶⁶ *Id.*

¹⁶⁷ *Id.* at 431 (emphasis added).

¹⁶⁸ *Id.*; see also *Geeck v. Luckenbill*, 183 N.W. 729 (Mich. 1921) (holding plaintiff negligent as matter of law despite defendant's duty to allow plaintiff right of way).

¹⁶⁹ A model that assumes substantial uncertainty and simultaneous action should be an alternative care model rather than a joint care model. The joint care case is superfluous, or, as economists would say, it is a "degenerate" solution. If the probability that a party may not choose the joint care solution because of uncertainty is substantial, the only way to minimize social costs is for the other party to adopt an alternative care solution. This is true even if a least cost, joint care case—which requires both parties to coordinate their actions—exists (recall the least cost solution of the second column in Table 1, p. 21, which was used to illustrate *LeRoy Fibre*). See *supra* text accompanying notes 127-30.

1. Model IIIa: Only the Least Cost-Avoider Is Uncertain

Assume for the moment that some unspecified probability exists that the least cost-avoider will mistakenly believe the other person is the least cost-avoider. If the probability that the least cost-avoider will make a mistake is greater than 0.005, it is easy to show that social cost would be minimized if the high cost-avoider rather than the least cost-avoider takes care. If the high cost-avoider takes care, the cost of care will be \$10, and no damage will result, for a social cost of \$10; alternatively, if the least cost-avoider is relied upon to take care, expected social cost will not be as low as \$10 unless the probability that the least cost-avoider is careless due to uncertainty is less than 0.005.¹⁷⁰ The intuitive reason for this conclusion is that unless the probability of an accident due to the least cost-avoider's uncertainty is extremely small, expected harm will exceed \$10.

2. Model IIIb: Both Parties Are Uncertain Who the Least Cost-Avoider Is

Assume that neither party takes care all the time because of uncertainty. Specifically, assume some unspecified probability ex-

Moreover, the joint care solution in which one party warns the other to take care is not relevant in this model because the assumption that both parties must decide whether or not to take care simultaneously rules out previous interaction. It is a standard assumption in torts models that neither contracts nor interactions exist between the parties prior to tortious activity: "[R]ules of tort law concern relationships between people for whom the ex ante costs of bargaining about the harm are high and who cannot, therefore, enter into a contractual relationship." COOTER & ULEN, *supra* note 1, at 341 (emphasis omitted); *see also* POSNER, *supra* note 1, at 230; SHAVELL, *supra* note 8, at 1. The joint care solution that involves a warning by one party to the other will figure prominently in the foreseeable negligence model discussed in Section IV. *See infra* text accompanying notes 176-223.

Posner contends that "[m]ost collisions are joint care cases." POSNER, *supra* note 1, at 155. However, since the rules of the road usually provide that one car or the other, but not both, has the right of way in almost all situations, most collisions are better described as alternative care cases. If collisions are categorized as examples of joint care, this "jointness" is unlike the joint care solution discussed in *Leroy Fibre* in Section I, *see supra* text accompanying notes 61-73, in which case joint care was less costly than either of the alternative care solutions; in the defensive care models IIIa and IIIb of this section, as well as in most automobile collisions, joint or redundant care is more expensive than the alternative care solutions.

¹⁷⁰ Relying solely on the least cost-avoider to take care, the expected social cost is equal to $(x)(\$1000) + (1 - x)(\$5)$, where the first term, the expected cost of accident damage (the probability that the least cost-avoider will be careless (x) multiplied by the harm (\$1000)), is added to the second term, the expected cost of accident prevention (the probability that the least cost-avoider will take care to prevent an accident ($1 - x$) multiplied by the cost of taking care (\$5)). Thus, the total social cost is less than \$10, if and only if $x < 0.005$.

ists that each party will mistakenly believe that it is the other: there is some likelihood that the least cost-avoider will mistakenly think that it is the high cost-avoider and will not take care; there is an equal likelihood that the high cost-avoider will mistakenly think that it is the least cost-avoider and will take care. This assumption, that the parties may be mistaken as to who is the least cost-avoider, is realistic, given the acknowledged difficulty of quantifying the variables in the Hand formula.¹⁷¹ Unless the probability that each will mistakenly believe it is the other party is less than 0.01 or greater than 0.995, at which probability the parties have almost totally switched identities, it is easy to demonstrate that defensive care (which is often redundant care), where both parties take care regardless of whether they believe they are the least cost-avoider, is more efficient than alternative care where they take care only when they believe themselves to be the least cost-avoider. If both parties take care all the time, the cost of care will be \$5 + \$10, for a social cost of \$15, and no damage will result; alternatively, if parties only take care when they think themselves to be the least cost-avoider, expected social cost will be higher than \$15 unless the probability that the parties will mistake their identities because of uncertainty is less than 0.01 or greater than 0.995.¹⁷²

¹⁷¹ See *supra* text accompanying notes 137-152 (discussing *Helling v. Carey*).

¹⁷² Let x equal the probability that the least cost-avoider will mistakenly believe that it is the high cost-avoider and *not* take care to prevent an accident; the expected social cost of sole reliance on the least cost-avoider, as in model IIIa, is equal to $(x)(\$1000) + (1 - x)(\$5)$. In model IIIb, x is also the probability that the high cost-avoider will mistakenly believe it is the least cost-avoider and *will* take care to prevent an accident; therefore, $(1 - x)$ equals the probability that the high cost avoider will *not* take care to prevent an accident. The expected social cost of sole reliance on the high cost-avoider to prevent accidents is equal to $(1 - x)(\$1000) + (x)(\$10)$, where the first term $((1 - x)(\$1000))$ is equal to the expected cost of accident damage from the high cost-avoider and the second term $((x)(\$10))$ is the expected cost of accident prevention by the high cost-avoider.

Because this is an alternative care model, no accident will occur if either party takes care, the other takes care, or both take care; these account for three of the four possible outcomes. An accident will occur only if both do not take care, the fourth outcome; and, because elementary probability theory dictates that the probability that one will not take care is independent of the probability that the other will not take care, the respective probabilities that each will not take care are multiplied to determine the probability that both do not take care simultaneously. See LAWRENCE LAPIN, *STATISTICS FOR MODERN BUSINESS DECISIONS* 112-13 (3d ed. 1982). Therefore, $(x)(1 - x)$ is the probability that neither the least cost-avoider nor high cost-avoider takes care to prevent an accident. The expected accident damage when neither takes care is $(x)(1 - x)(\$1000)$. Thus, the expected total social cost of alternative care is $(x)(1 - x)(\$1000) + (1 - x)(\$5) + (x)(\$10)$, where the first term is the expected accident damage if neither prevents an accident and the second and third terms are the expected cost of accident prevention by the least cost-avoider and high cost-

The intuitive reason for this conclusion is that unless the probability of an accident due to mistaken beliefs by the parties is extremely small, expected harm from alternative care will exceed \$15. This model may be summarized by saying that where there is a significant probability that the parties will be mistaken as to which one should take care, and the cost of care is small, both parties must take care to minimize expected social cost. Thus, defensive care is efficient in this model that assumes uncertainty and simultaneous action.

It is also clear that as the damage decreases, or the cost of care to the parties rises, the point at which defensive care is no longer efficient is reached quickly. For example, if the probability that each party will mistakenly believe it is the other is 0.01, and, if the cost of care to the least cost- and high cost-avoider is \$50 and \$100, respectively (rather than \$5 and \$10), then defensive care, which would now cost \$150, would no longer be efficient because it would cost more than the expected social cost of reliance on alternative care, which is only \$60.40, where the parties take care only when each believes it is the least cost-avoider.¹⁷³ Thus, defensive care is efficient in preventing accidents that involve great damage that can be avoided at little cost. Since these conditions seem to characterize many automobile collisions, this model is unlikely to be trivial.

If *Kerr*¹⁷⁴ were decided in the context of the standard economic model, the court's decision would be reversed because the plaintiff would not be contributorily negligent: *Kerr* would be an alternative care case in which plaintiff, having the right of way, would have no duty of care because it would be entitled to assume that all other persons act with due care. However, the Supreme Court of Michigan implicitly employed the defensive care model in which both drivers must use due care; therefore, the plaintiff, who

avoider, respectively.

In order for the expected social cost of alternative care to be less than the redundant defensive care, expected social cost must be less than \$15 ($\$10 + \5). Solving $(x)(1 - x)(\$1000) + (1 - x)(\$5) + (x)(\$10) = \15 for x , yields two roots: $x = 0.01$ and $x = 0.995$. In other words, unless the parties are mistaken as to their identities very infrequently or are almost totally mistaken as to their identities, in which case they have nearly exchanged identities, defensive care, which is redundant, is more efficient than alternative care to prevent accidents.

¹⁷³ The expected social cost of reliance on the alternative care to prevent accidents where the parties take care only when each believes it is the least cost-avoider is equal to $(0.01)(0.99)(\$1000) + (0.99)(\$50) + (0.01)(\$100) = \60.40 , which is less than the cost of defensive care, which is \$150 ($\$50 + \100).

¹⁷⁴ 229 N.W. 430 (Mich. 1930); see also text accompanying notes 162-69.

did not use due care, was found contributorily negligent and received no compensation even though he had the right of way and defendant was speeding. It is easy to show that the contributory negligence defense in *Kerr* leads to inefficient incentives.

If negligence is defined as the failure to take action that minimizes expected social costs given the reasonably foreseeable level of precaution or lack thereof taken by other persons, then within the context of the defensive care model, as well as in *Kerr*, a plaintiff who is a high cost-avoider is negligent for not taking cost-minimizing care. However, if the contributory negligence defense operates as a complete bar to negligent plaintiffs, as it did in *Kerr*, the plaintiff receives no compensation even though the defendant, at least cost-avoider, was the more negligent party. Only a comparative negligence standard would hold the least cost-avoider primarily liable for the accident, thus giving the least cost-avoider an incentive to avoid such behavior in the future and at the same time give a high cost-avoider, who is a plaintiff-victim, an incentive to take defensive care.

Recall that in *Jackson*, which was used to illustrate an alternative care case in the context of the standard economic model,¹⁷⁶ the court held that the plaintiff's failure to look a second time when he reached the intersection was not negligent. In the context of the defensive care model, however, *Jackson* would be reversed because the plaintiff would be negligent for not looking a second time upon reaching the intersection.

IV. UNCERTAINTY AND SEQUENTIAL ACTION: FORESEEABLE NEGLIGENCE MODEL

In this section we begin by considering two cases involving uncertain knowledge and sequential action, *Levi v. Southwest Louisiana Electric Membership Coop*,¹⁷⁶ a negligence case, and *Larsen v. General Motors Corp.*,¹⁷⁷ a design defect, products liability case;¹⁷⁸ next, the foreseeable negligence model is discussed and is applied to the two cases. Finally, *Grimshaw v. Ford Motor Co.*¹⁷⁹ is used to

¹⁷⁶ *Jackson v. Leach*, 152 A. 813, 815 (Md. 1931); see also *supra* notes 54-60 and accompanying text.

¹⁷⁸ 542 So. 2d 1081 (La. 1989).

¹⁷⁷ 391 F.2d 495 (8th Cir. 1968).

¹⁷⁸ See *supra* note 14 and accompanying text (design defect cases are de facto negligence cases).

¹⁷⁹ 174 Cal. Rptr. 348 (Cal. Ct. App. 1981).

discuss cost-benefit quantification problems in the context of a foreseeable negligence case.

In *Levi*, the plaintiff oil company employee sustained near fatal, permanently disabling injuries when the erectable mast of a truck that he was operating came in contact with an uninsulated electrical line that serviced a field of oil wells.¹⁸⁰ With the exception of the oil well near the accident site, the power company routed the power line to avoid crossing an oil well driveway or coming close to a well.¹⁸¹ The power company failed to avoid a close encounter between its line and the well near the accident because this well was omitted from the power company's original construction plan, either by oversight or because no electricity was supplied to the oil well.¹⁸² The power company's employees had warned crews of the power line danger when they drove under uninsulated power lines with their rigs partially or fully upright.¹⁸³ The plaintiff had noticed the electrical distribution line at this location on previous occasions but failed to pay attention to it on the day of the accident.¹⁸⁴ The plaintiff parked near the well in order to get off the main road and find a dry place to repair the rig on which he was working. Using control levers on the side of the truck to raise the mast tip up over the truck and back toward the power line, the plaintiff was severely injured when the mast either touched the power line—some twenty-five feet above the ground—or came close enough for electrical arcing to occur.¹⁸⁵

The jury found that the defendant's conduct did not fall below the reasonable standard of care.¹⁸⁶ The Supreme Court of Louisiana reversed on the ground that "the ordinary reasonable person, and even more so the power company, is required to realize that there will be a certain amount of negligence in the world"¹⁸⁷ and held that the power company's negligence was a legal cause of plaintiff's injuries.¹⁸⁸ Several precautions could have avoided the accident: alternative care by the defendant, who could have prevented the electrocution if it had insulated the overhead wire; al-

¹⁸⁰ *Levi*, 542 So. 2d at 1082.

¹⁸¹ *Id.*

¹⁸² *Id.* at 1082-83.

¹⁸³ *Id.* at 1086.

¹⁸⁴ *Id.* at 1083.

¹⁸⁵ *Id.*

¹⁸⁶ *Id.* at 1082.

¹⁸⁷ *Id.* at 1086.

¹⁸⁸ *Id.* at 1089.

ternative care by the plaintiff, who could have avoided the accident by carefully scrutinizing the site and perhaps choosing another location for the repair of the rig; or, joint, cooperative measures, such as a warning sign on the power pole and an orange warning ball on the power line itself combined with greater attentiveness by the plaintiff, which would have been as effective as the more expensive alternative care measures in preventing the accident.

In *Larsen*, the plaintiff was involved in an automobile collision and sustained severe injuries to his head because of the rearward displacement of the steering shaft.¹⁸⁹ The plaintiff did not contend that the automobile design caused the accident, but rather that because of the design he incurred injuries he would not have otherwise sustained or that his injuries would not have been as severe.¹⁹⁰ The Eighth Circuit held that the manufacturer of an automobile is under a duty to use reasonable care in the design of its product to avoid subjecting the user to an unreasonable risk of injury or enhancement of injury in the event of a collision, which, whether with or without the fault of the user, is clearly foreseeable.¹⁹¹

A. *Foreseeable Negligence Model*

The last clear chance model and foreseeable negligence model,

¹⁸⁹ *Larsen*, 391 F.2d at 496-97.

¹⁹⁰ *Id.*

¹⁹¹ *Id.* at 502-04. A strong dispute existed at one time on the issue of whether an automobile should be designed with a view to minimize the consequences of an accident. In *Evans v. General Motors Corp.*, 359 F.2d 822 (7th Cir.), cert. denied, 385 U.S. 836 (1966), a new X-frame design for a car body turned out to be less safe than a conventional rectangular frame when the car was hit from the side. The court held, however, that the company was under no duty to design an accident-proof or crash-proof car, since the intended purpose of automobiles did not include its participation in a collision. *Id.* at 824-25. In *Larsen*, the Eighth Circuit disagreed. *Larsen*, 391 F.2d at 502. A long line of cases supported each side. See *Frericks v. General Motors Corp.*, 317 A.2d 494, 502-04 (Md. Ct. Spec. App. 1974); Jeffrey F. Ghent, Annotation, *Liability of Manufacturer, Seller or Distributor of Motor Vehicle for Defect Which Merely Enhances Injury from Accidents Otherwise Caused*, 42 A.L.R.3d 560 (1972). But the *Larsen* view soon began to predominate, and the Seventh Circuit changed its view, repudiating *Evans*. See *Nanda v. Ford Motor Co.*, 509 F.2d 213 (7th Cir. 1974). Clearly, the *Larsen* view has prevailed. See generally Michael Hoenig & Cecilia H. Goetz, *A Rational Approach to "Crashworthy" Automobiles: The Need for Judicial Responsibility*, 6 Sw. U.L. REV. 1, 41-44 (1974) (suggesting that many courts rejected *Larsen* because of speculative nature of crash design cases); Ralph Nader & Joseph A. Page, *Automobile Design and the Judicial Process*, 55 CAL. L. REV. 645 (1967) (advocating judicial action in defect design cases to command higher standards for greater public safety); Harvey M. Sklaw, *"Second Collision" Liability: The Need for Uniformity*, 4 SETON HALL L. REV. 499 (1973) (arguing need for consistency among jurisdictions in motor vehicle products liability cases).

both of which are sequential models, are opposites: in the last clear chance model, the first mover has an advantage because it can put the second mover in a position where the second mover must take the last clear chance to minimize expected social cost; in the foreseeable negligence model, the first mover is at a disadvantage because it can reasonably foresee misuse or carelessness by the second mover and should take care against foreseeable harm to minimize expected social cost.

The foreseeable negligence model is one which assumes uncertain knowledge and sequential action. These assumptions dictate that the model should contain the possibility of both alternative care and joint care solutions. With respect to the alternative care solutions, the first mover, who is the high cost-avoider, is at a disadvantage in this model because it can reasonably foresee misuse¹⁹² or negligence by the second mover and so has a duty to take care in order to minimize expected social cost.

If the first mover is the least cost-avoider, the model is trivial. For example, if it is foreseeable that a cheap metal guard on a machine will prevent many injuries to many workers over many years, failure to install such a guard would clearly support a finding that such machine was defectively designed; it is well settled that a manufacturer, as first mover *and* least cost-avoider, is liable for

¹⁹² See *Brown v. United States Stove Co.*, 484 A.2d 1234, 1241 (N.J. 1984) (sufficient evidence to demonstrate objective foreseeability of removal of heater's safety control mechanism and misuse of the product).

The concept of a defect-free and properly-designed product extends to one that is suitably safe after it has been either foreseeably altered or *foreseeably misused*. . . .

. . . .

It is plaintiff's burden to demonstrate that it was objectively foreseeable that the subsequent substantial alteration or misuse of the product would create the risk of his injury.

Id. (emphasis added); see also *DeSantis v. Parker Feeders, Inc.*, 547 F.2d 357, 360-63 (1976) (child caught in whirling blades and injured while climbing over trough and auger of cattle feeder; held irrelevant that boy and brothers activated feeder with pitchfork to play games because feeder's blades were not covered by guard); *Decorative Precast Stone Erectors, Inc. v. Bucyrus-Erie Co.*, 493 F. Supp. 555, 557-58 (W.D. Penn. 1980) (buyer could recover even if both defect and misuse found to be proximate causes), *aff'd*, 642 F.2d 441 (3d Cir. 1981); *Rivera v. Westinghouse Elevator Co.*, 526 A.2d 705 (N.J. 1987) (failure to allocate any degree of fault to decedent in elevator accident was against weight of evidence, but availability of defense of contributory negligence did not turn on whether elevator was used for its intended purpose); *Soler v. Castmaster*, 484 A.2d 1225, 233-34 (N.J. 1984) (jury question whether machine was defective and whether alteration of machine "substantially" increased risk of accidental injury); POSNER, *supra* note 1, at 167.

such injuries.¹⁹³ Thus, the interesting cases are those where the first mover, as the high cost-avoider, reasonably foresees that the second mover, as the least cost-avoider, will be negligent.

A joint care solution is also possible in this model if the probability of foreseeable misuse or negligence by the second mover can be significantly reduced by a warning from the first mover. The joint care, or cooperative, solution significantly reduces the first mover disadvantage inherent in the model by allowing the first mover to shift a significant portion of the burden of care forward to the second mover. Whether the least cost solution is an alternative care or a joint care solution depends upon the relative values of the variables, B, P, and L.

Assume damage of \$1000 can be avoided by two alternative care methods or one joint care method: damage can be avoided by the first mover, who is the high cost-avoider, at a cost of \$100, by the second mover, who is the least cost-avoider, at a cost of \$50, and by joint care, which costs the first mover \$30 to warn the second mover to take care, after which the second mover's cost of care is \$40. It is clear that if legal certainty were assumed, the least cost solution would be the alternative care solution in which the second mover takes care at a cost of \$50. Assuming uncertainty and sequential action, the solution that will minimize social cost depends upon the probability that the first mover will reasonably foresee negligence by the second mover. If the probability of reasonably foreseeable misuse or negligence is low, the standard economic model, which places the entire liability on the least cost-avoider (second mover), is the relevant model.¹⁹⁴

In Figure 4 (p. 56), the expected social cost of each possible outcome is given at the right of each branch of the decision tree.¹⁹⁵

¹⁹³ In *Greenman v. Yuba Power Prods., Inc.*, 377 P.2d 897 (Cal. 1963), a power tool that could be used as a saw, drill, or wood lathe was found to be defectively designed. Screws used to hold parts of the machine together were set inadequately so that normal vibration caused the tailstock of the lathe to move away from the piece of wood being turned, permitting it to fly out of the lathe. *Id.* at 899. In *Phillips v. Kimwood Mach. Co.*, 525 P.2d 1033 (Or. 1974), a sanding machine for fiberboard did not hold its grip on a thin piece of fiberboard but suddenly expelled it, injuring the plaintiff. *Id.* at 1034. The sanding machine was found to be defectively designed because it lacked a line of metal teeth that would have prevented the backward motion at relatively small expense. *Id.* at 1035.

¹⁹⁴ See, e.g., *Venezia v. Miller Brewing Co.*, 626 F.2d 188 (1st. Cir. 1980) (neither manufacturer nor brewer liable to 8-year-old injured by shards from bottle he threw against telephone pole).

¹⁹⁵ Branch (1) equals $\$100 + (0.947)(\$50) = \$147.35$; Branch (2) equals $\$100 + \$0 = \$100$; Branch (3) equals $\$30 + (0.947)(\$40) + (0.053)(\$1000) = \120.88 ; Branch (4) equals

If because of uncertainty the first mover foresees that the second mover will be careless with a probability greater than 0.053, whether or not there is a warning, that is, the warning is not effective, then the alternative care solution (branch (2)) in Figure 4, where the first mover takes care, is the least cost solution (\$100).¹⁹⁶ This solution describes *Larsen*.¹⁹⁷ If, however, the probability that the second mover will erroneously believe it is the high cost-avoider is greater than 0.053 before the warning but less than 0.03 after the warning, that is, the warning is effective, the joint care solution (branch (4)), where the first mover warns the second mover, after which the second mover takes care, is the least cost solution (less than \$100). This solution may describe *Levi*.¹⁹⁸ Applying the model to *Levi*, the power company is the first mover and high cost-avoider, and the plaintiff is the second mover and low cost-avoider. In Figure 4, the first mover's alternative care solution, where the power company insulates all overhead wires at considerable expense, is represented by branch (2). The second mover's alternative care solution, where the plaintiff avoids the accident by carefully scrutinizing the site and perhaps choosing another location for the repair of the rig, is represented by branch (6). If the probability that the plaintiff will be careless is significant and foreseeable, this is not the least cost solution. The joint care solution, which corresponds to cooperative measures, such as a warning sign on the power pole and an orange warning ball on the power line itself combined with greater attentiveness on the plaintiff's part, is represented by branch (3) or (4), depending upon whether the warning is effective or not: if the warning is effective, branch (4) is relevant and represents the least cost solution; if the warning is ineffective, branch (3) is relevant, and branch (2), where the power company insulates electric wires, is the least cost solution.

$\$30 + (0.96875)(\$40) + (0.03125)(\$1000) = 100$; Branch (5) equals $\$30 + \$1000 = \$1030$; Branch (6) equals $\$0 + (0.0526315)(\$1000) + (0.9473685)(\$50) = \100 ; Branch (7) $\$0 + \$1000 = \$1000$.

¹⁹⁶ See *supra* note 195 (determining social cost of branch (2)); see also *Colter v. Barber-Greene Co.*, 525 N.E.2d 1305, 1314 (Mass. 1988) (applying unreasonable use doctrine to product liability actions sounding in negligence foreclosed by Massachusetts' comparative negligence statute that provides that plaintiff's contributory negligence, if less than amount attributable to defendant(s), will proportionately reduce recovery, not bar it).

¹⁹⁷ See *supra* notes 189-91 and accompanying text.

¹⁹⁸ See *supra* notes 180-88 and accompanying text.

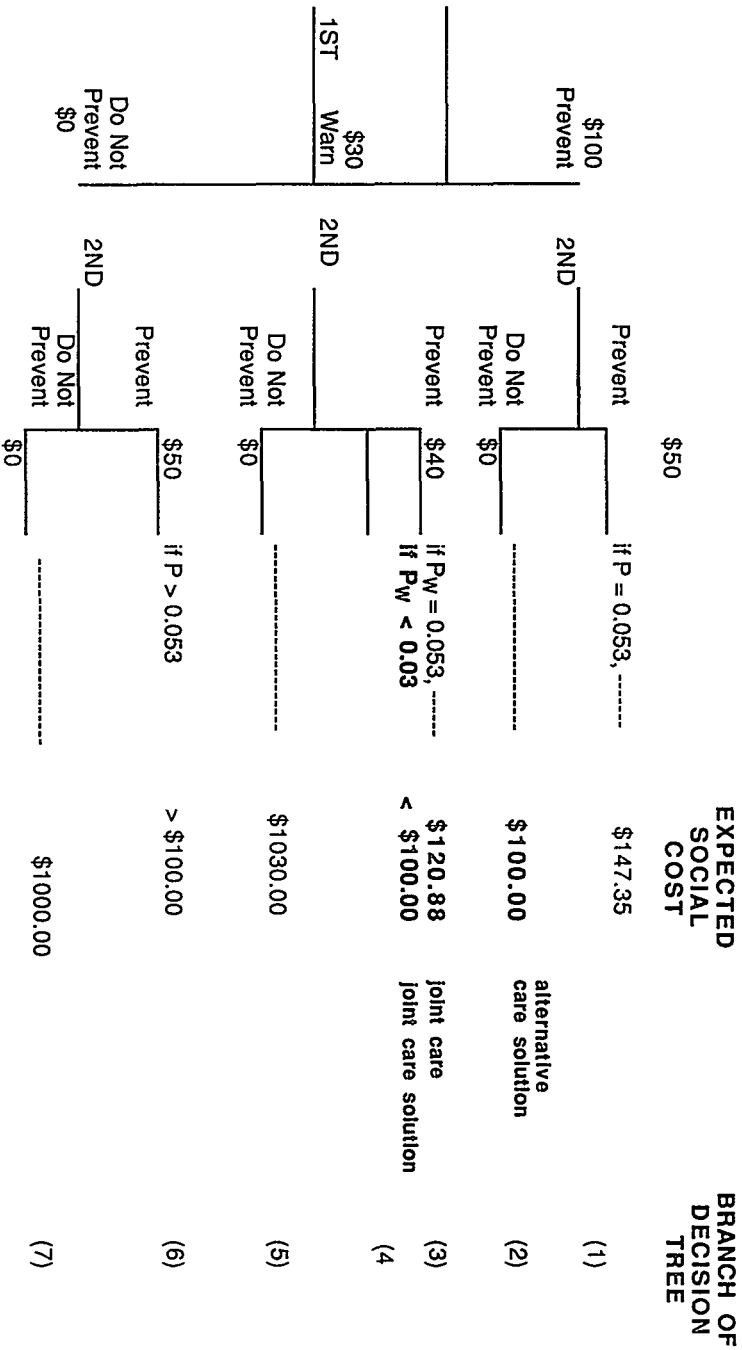


Figure 4. Uncertainty and Sequential Decisions

If the power company had no duty to foresee carelessness by the plaintiff, that is, in a world where everyone is presumed to act with due care, the plaintiff would be the least cost-avoider, and the power company would not be liable for his injuries. However, in a world in which the reasonably prudent person is required to realize that there is some negligence in the world, the power company, to minimize expected social cost, should either have insulated the overhead wire or warned of the danger. The Court in *Levi* held that the power company was negligent because it neither insulated the overhead wire nor warned of the danger.¹⁹⁹

It is easy to see that the contributory negligence defense, in the context of the foreseeable negligence model, is not as efficient as comparative negligence. Under the contributory negligence defense, the plaintiff, who was the least cost-avoider, would be negligent and would bear the entire loss. But, because negligence in the foreseeable negligence model is defined as the failure to take action that minimizes expected social cost, given the reasonably foreseeable level of precaution or lack thereof taken by other persons, the defendant was also negligent for not having at least warned the plaintiff. Only a comparative negligence standard, which shares losses according to relative fault, would provide the defendant with an efficient incentive at least to warn the plaintiff in the future. Since Louisiana is a comparative negligence state, the plaintiff was entitled to some of his damages rather than none.²⁰⁰

In *Larsen*, the manufacturer is the first mover and high cost-avoider and the plaintiff is the second mover and least cost-avoider because it is clearly less expensive for the plaintiff to drive with reasonable care than for the manufacturer to spend several thousand dollars per car in an effort to design automobiles to be crashworthy. However, it is also clear that automobile accidents would not be prevented if manufacturers merely issued a warning that automobiles are not crashworthy because such warning would not be likely to alter driving habits. In a world in which the reasonably prudent person is required to realize that some persons are negligent, an automobile manufacturer, although high cost-avoider, is, because of its first mover status, required to design cars that are crashworthy; that is, branch (2) of the model in Figure 4 is likely to

¹⁹⁹ *Levi*, 542 So. 2d at 1088. The power company also could have routed the line differently, raised it to a safer level, temporarily insulated the line, or installed it underground. *Id.*

²⁰⁰ LA. CIV. CODE ANN. art. 2323 (West 1979 & Supp. 1991).

be the least cost solution. In this case, efficient loss-sharing can be achieved if the manufacturer is "liable for that portion of the damage or injury caused by the defective design over and above the damage or injury that probably would have occurred as a result of the impact or collision absent the defective design."²⁰¹

B. Foreseeable Negligence Model and Cost-Benefit Quantification

In *Grimshaw v. Ford Motor Co.*,²⁰² the plaintiffs were traveling on an interstate freeway in a Pinto hatchback when the carburetor failed, causing the car to stall in the middle lane and to be hit.²⁰³ The colliding car had applied its brakes and was traveling between 28 and 37 miles per hour at the moment of collision.²⁰⁴ The impact of the collision drove the Pinto's gas tank forward, causing it to rupture and spill fuel into the passenger compartment.²⁰⁵ Both the driver and passenger were engulfed in flames and sustained severe burns, from which the driver died.²⁰⁶ The defendant-manufacturer was aware that the preferred placement for the gas tank in Europe and Japan was above rather than behind the rear axle as in the Pinto, that the Pinto had less "crush space" than any other American automobile of the period, that the rear "bumper was little more than a chrome strip, less substantial than the bumper of any other American car produced then or later," and that its rear structure lacked reinforcing members.²⁰⁷ The jury found for the plaintiffs and awarded slightly more than \$3.5 million in compensatory damages and \$125 million in punitive damages; all but \$3.5 million of the punitive damages were remitted.²⁰⁸

Grimshaw has attracted a great deal of comment²⁰⁹ because

²⁰¹ *Larsen*, 391 F.2d at 503.

²⁰² 174 Cal. Rptr. 348 (Cal. Ct. App. 1981).

²⁰³ *Id.* at 359.

²⁰⁴ *Id.* A number of tort actions have been brought against Ford for death or injury resulting from the explosion of the Pinto's fuel tank in low velocity collisions. POSNER, *supra* note 68, at 225-26.

²⁰⁵ *Grimshaw*, 174 Cal. Rptr. at 359.

²⁰⁶ *Id.*

²⁰⁷ *Id.* at 360.

²⁰⁸ *Id.* at 358.

²⁰⁹ See, e.g., COOTER & ULEN, *supra* note 1, at 404-07; POSNER, *supra* note 68, at 225-26; Richard Epstein, *Is Pinto a Criminal?*, REGULATION, Mar.-Apr. 1980, at 15; David G. Owen, *Problems in Assessing Punitive Damages Against Manufacturers of Defective Products*, 49 U. CHI. L. REV. 1, 24-25 (1982); Roy J. Harris, *Why Pinto Jury Felt Ford Deserved \$125 Million Penalty*, WALL ST. J., Feb. 14, 1978, at A1; *Ford Ignored Pinto Fire Peril, Secret*

defendant's in-house cost-benefit studies concluded that it was not cost-efficient to redesign or reposition the gas tank in its Pinto automobile, or to reinforce the Pinto's rear structure to make it more crashworthy.²¹⁰ The defendant did not use the Hand test in its cost-benefit studies, possibly because it may have believed that the probability that an accident would occur, the P variable in the Hand formula, was unquantifiable.²¹¹ The conclusion from one of defendant's cost-benefit studies was that total benefits of \$49.5 million from preventing an estimated 180 serious burn injuries, 180 burn deaths, and 2,100 destroyed vehicles would be significantly less than the total dollar costs of \$137 million required to strengthen or reposition the Pinto's fuel tank on the estimated 11 million cars and 1.5 million trucks that would be sold.²¹²

Three estimates used in the study invite discussion: (1) the estimate of the number of serious burn injuries, deaths, and burned vehicles; (2) the estimate of the value of a life, and (3) the estimate of the cost to redesign or reinforce a gas tank. The estimate of the number of serious burns, deaths, and burned vehicles appears to be reasonable when one considers that 500 to 1000 persons die from traffic accident fires in this nation each year,²¹³ and that the Pinto fire fatality rate was apparently within the norm for subcompacts.²¹⁴ The defendant claimed that the \$200,000 figure as-

Memos Show, CHI. TRIB., Oct. 13, 1979, at 1.

²¹⁰ Ford denied that its decision to neither redesign, reinforce, nor restructure was based on the cost-benefit studies. Ford claimed that it had been required by the National Highway Traffic Safety Administration to make the analysis. POSNER, *supra* note 68, at 226.

²¹¹ Recall Section III's discussion of *Helling v. Carey*, *supra* notes 137-49, concerning the difficulty of quantifying the variables in the Hand test. It was also shown that uncertainty about the variables of the Hand test could mask cause-in-fact problems; in *Grimshaw*, it is possible that a Pinto would have exploded after a rear-end collision even if not defectively designed.

²¹² See POSNER, *supra* note 68, at 225. One of the studies is summarized in the following table:

Benefits

Savings—180 burn deaths, 180 serious burn injuries, 2,100 burned vehicles

Unit Cost— \$200,000 per death, \$67,000 per injury, \$700 per vehicle

Total Benefit— $180 \times (\$200,000) + 180 \times (\$67,000) + 2100 \times (\$700) = \49.5
million

Costs

Sales— 11 million cars, 1.5 million light trucks

Unit Cost— \$11 per car, \$11 per truck

Total Cost— $11,000,000 \times (\$11) + 1,500,000 \times (\$11) = \$137$ million

Id.; COOTER & ULEN, *supra* note 1, at 406.

²¹³ Owen, *supra* note 209, at 30-31 n.138.

²¹⁴ See *id.* (citing defendant's Exhibit EE, in *State v. Ford Motor Co.*, No. 5324 (Super.

signed to the value of a life was supplied by the National Highway Traffic Safety Administration.²¹⁵ In terms of 1978 dollars, estimates of the value of a life varied from \$170,000 to \$3,000,000.²¹⁶ In 1983, W. Kip Viscusi, a leading expert, recommended that for policy purposes a life should be valued at \$2 million.²¹⁷ (Estimates in 1990 dollars are between a low of \$2 million and high of \$6 million per life.²¹⁸) Had the defendants used a life estimate value of \$700,000 or more in its study, total benefits from redesign or repositioning the gas tank would have outweighed the costs;²¹⁹ redesign would have been cost-justified.

A central question is whether the cost of \$11 per vehicle for redesign or reinforcement of the gas tank was the proper amount to use in defendant's cost-benefit analysis (or as the burden, B, in the Hand test). One can argue that many hundreds of design choices are made by engineers in the production of a single complex product—one more cross beam can always be added here, strengthened there, made of another stronger material, and so forth—that each such decision involves a range of trade-offs between cost, weight, appearance, performance capabilities, and safety, and that “although much of this decision making involves the application of proven scientific principles, much is art, and some by its nature can be little more than trial and error.”²²⁰ Therefore, one can conclude that engineering decisions should not

Ct. Elkhart City, Ind., Sept. 13, 1978)). This exhibit set forth National Highway Transportation Safety Administration's Fatal Accident Reporting System data for post-1970 cars in fatal fire accidents, per million cars in operation, for 1975 and 1976: all vehicles—6.8; all compacts—7.3; Pinto—7.0; VW—9.3; Vega—7.0; Datsun—9.7; Toyota—4.9; Gremlin—9.8; Dodge Colt—5.3; Opel—8.8; Honda—11.1. *Id.*

²¹⁵ POSNER, *supra* note 68, at 226.

²¹⁶ See DOUGLAS GREER, *BUSINESS, GOVERNMENT AND SOCIETY* 414-15 (2d ed. 1987). The basic calculation is as follows: If statistical estimates reveal an annual wage premium of \$500 for each added death per annum per thousand workers, then 1,000 workers must be paid \$500 each for accepting the risk of that one death. $1,000 \times \$500 = \$500,000$, the value of that “statistical” life. W. KIP VISCUSI, *REGULATING CONSUMER PRODUCT SAFETY* 26-30 (1984).

²¹⁷ W. KIP VISCUSI, *RISK BY CHOICE: REGULATING HEALTH AND SAFETY IN THE WORKPLACE* 106 (1983). “For the purposes of policy evaluation, . . . estimates of \$500,000 seem most reasonable for workers in high-risk jobs (about 1/1000 annually). For workers facing less severe risks (about 1/10,000 annually), an estimate of \$2,000,000 appears more reasonable.” *Id.*

²¹⁸ Viscusi, *supra* note 38, at 78.

²¹⁹ Savings—180 burn deaths, 180 serious burn injuries, 2,100 burned vehicles;

Unit Cost—\$700,000 per death, \$67,000 per injury, \$700 per vehicle;

Total Benefit— $180 \times (\$700,000) + 180 \times (\$67,000) + 2100 \times (\$700) = \139.5 million, which exceeds \$137 million in costs.

²²⁰ Owen, *supra* note 209, at 24-25.

be judged entirely by hindsight, which is perfect.²²¹ On the other hand, one can argue that if the defendant had designed the Pinto properly in the first place, relying on common knowledge and industry custom, it could have shielded the fuel tank at no extra cost simply by placing the tank above the rear axle or farther forward in the chassis.²²² Moreover, should not the public be entitled to believe that the Pinto's fuel tank was as safe as that of other automobiles of its size and price?²²³ Given the latter position, the benefits of redesign would clearly outweigh the costs, which in a social sense would be zero. If one were to employ the standard economic model of negligence with its assumption of legal certainty, the cost of redesign would be zero, since the defendant would be held to know all relevant costs and legal standards.

V. LIABILITY FOR MISMANUFACTURED PRODUCTS DISTINGUISHED FROM LIABILITY FOR DESIGN DEFECTS AND DEFECTIVE WARNINGS

In this section, we begin by considering *Henningsen v. Bloomfield Motors, Inc.*,²²⁴ a mismanufactured product case. Next, mismanufactured products are distinguished from design defects and defective warnings in three ways: by definition, economic theory, and appropriate liability rules. The effect of a shift from a negligence standard to strict liability is analyzed in terms of three problems of asymmetric information,²²⁵ which concern burden of proof, insurance, and activity effect.²²⁶ A major conclusion is that manufacturers should be strictly liable for mismanufactured products, but that in design defect and defective warning cases, courts should, in general, be wary of extending liability much beyond a negligence standard. Major contributions to the economic analysis of the effect of a shift in the basis of liability from a negligence

²²¹ See James A. Henderson, *Coping with the Time Dimension in Product Liability*, 69 CAL. L. REV. 919, 921-24 (1981).

²²² *Grimshaw*, 174 Cal. Rptr. at 360.

²²³ POSNER, *supra* note 68, at 226.

²²⁴ 161 A.2d 69 (N.J. 1960).

²²⁵ POSNER, *supra* note 1, at 166. "In a game of asymmetric information, player Smith knows something that player Brown does not." RASMUSEN, *supra* note 5, at 133. Rasmusen divides asymmetric information into the categories of moral hazard, adverse selection, signaling, and screening. *Id.*; see also TIROLE, *supra* note 8, at 362-64.

²²⁶ These three effects are sometimes collectively called enterprise liability. See Henderson, *Enterprise Liability*, *supra* note 13, at 659; George L. Priest, *The Invention of Enterprise Liability: A Critical History of the Intellectual Foundations of Modern Tort Law*, 14 J. LEGAL STUD. 461 (1985).

standard to strict liability were made by Dean Calabresi²²⁷ and Steven Shavell.²²⁸

In *Henningsen*, the plaintiff was badly injured when something went wrong with the steering mechanism of the automobile she was driving, causing the car to turn sharply to the right and to crash into a wall.²²⁹ The plaintiff's husband had bought the car as a present for her from a retail dealer who had bought it from the manufacturer; the contract of sale effectively disclaimed all warranties.²³⁰ The Supreme Court of New Jersey held that the disclaimer was contrary to public policy and therefore void.²³¹ Moreover, the court said that a warranty of merchantability is implied by law and is chargeable to either the manufacturer or dealer and extends to anyone operating the car with the owner's consent.²³²

A. *Mismanufactured Products Distinguished from Design Defects and Defective Warnings*

In general, a mismanufactured product is a unit of output which differs from all other units a manufacturer produces by the same process, as, for example, in *Henningsen*, where an automobile's defective steering mechanism caused it to crash, rendering it different from other steering mechanisms produced by the same manufacturing process that did not cause crashes. In a design defect case, however, the issue is whether all products manufactured by the same process subject consumers to unreasonable risks, like the automobiles involved in the *Larsen* and *Grimshaw* cases.²³³

In terms of economic theory, mismanufactured product cases are distinguished from design defect and defective warning cases in terms of their respective *Cost of Accident Damage* curves, which are depicted in Figures 5a and 5b (p. 64). The essential distinction is that in mismanufactured products cases, the total amount of

²²⁷ See Calabresi & Hirschhoff, *supra* note 57, at 1055.

²²⁸ See Shavell, *supra* note 42, at 1. For an analysis of the activity effect elegant in its simplicity, see POSNER, *supra* note 1, at 160-67.

²²⁹ *Henningsen*, 161 A.2d at 73-75.

²³⁰ *Id.* at 73-74, 78-79.

²³¹ *Id.* at 95.

²³² *Id.* at 100.

²³³ See Aaron D. Twerski & Alvin S. Weinstein, *A Critique of the Uniform Product Liability Law—A Rush to Judgment*, 28 *DRAKE L. REV.* 22 (1978-79) (analyzing many problems implicit in distinguishing between manufacturing and design defects for purpose of imposing liability).

damage under the *Cost of Accident Damage* curve is bounded,²³⁴ whereas in design defect and defective warning cases, the total amount of damage under the *Cost of Accident Damage* curve is potentially unbounded. With respect to mismanufactured products, as the level of care employed in a manufacturing process is increased through a quality control program, the cost of accident damage from a mismanufactured product can not only be reduced, it can be reduced arbitrarily close to zero. As is clear from Figure 5a, near perfect quality control is attainable at a level of precaution equal to C. On the other hand, with respect to the safety aspects of product design, the possibility of increased safety is almost limitless. As pointed out in the discussion of *Grimshaw*, the Pinto gas-tank case, a product can always be made safer by using stronger or thicker materials, by being strengthened through the addition of cross beams or through the addition of safety features. Since products can always be designed in a safer manner, it is clear from Figure 5b that the area under the *Cost of Accident Damage* curve is potentially limitless, that is, unbounded.²³⁵ The same reasoning applies to product warnings, which can also be virtually increased to a limitless extent.²³⁶

B. *Asymmetric Information and the Burden of Proof*

If products were governed by a negligence standard where the plaintiff has the burden of proof, manufacturers would have an unfair advantage in litigation because consumers, as plaintiffs, would have the burden of proving that a product was negligently manufactured even though manufacturers have exclusive access to and control over information necessary for such proof.²³⁷ In terms of

²³⁴ Even if the *Cost of Accident Damage* curve is asymptotic, that is, approaches ever closer to but never touches the horizontal axis so that the curve itself is not bounded, the total amount of damage under the curve will be bounded, that is, the total amount of damage will be less than some determinable upper bound.

²³⁵ Figure 5b is Figure 1 minus the *Sum of Social Costs* curve.

²³⁶ Courts have held that manufacturers need not warn against obvious hazards. See, e.g., *Posey v. Clark Equip. Co.*, 409 F.2d 560 (7th Cir.) (seller of a forklift platform that had no guard was not required to warn that large cartons might fall off it), *cert. denied*, 396 U.S. 940 (1969); *Fisher v. Johnson Milk Co.*, 174 N.W.2d 752 (Mich. 1970) (manufacturer of wire mesh milk container does not have to warn that bottles will break if container is dropped on sidewalk).

²³⁷ It is not clear whether costs of administering the judicial system would be more or less after a shift in the basis of liability from negligence to strict liability. The trial of a strict liability case is simpler than a negligence case because there is one less issue, negligence. However, the potential saving in information costs may be offset by a greater number

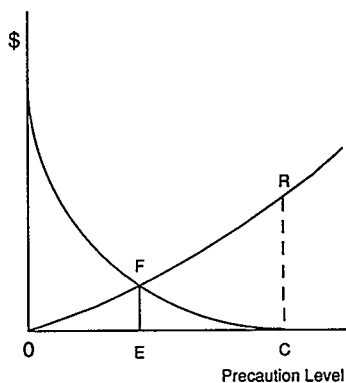


Figure 5a. *Mismanufactured Products*

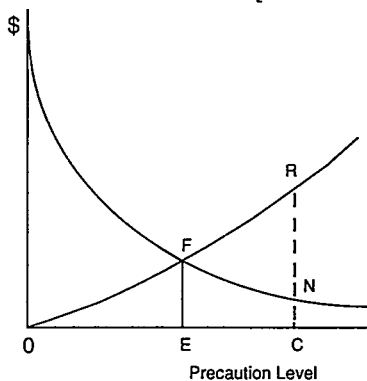


Figure 5b. *Design Defects and Defective Warning*

economic theory, manufacturers are said to have an advantage over consumers because of asymmetric information. Thus, as is well known, one rationale for the shift from a negligence standard to strict liability in products liability cases is to eliminate the burden of proof problem that victims would encounter in a negligence suit by expanding the circumstantial evidence doctrine of *res ipsa loquitur*²³⁸ to encompass all mismanufactured products.²³⁹

If products liability law merely shifted the burden of proof to the defendant on the issue of negligence, then such shift would have no effect on the level of safety. This conclusion is easily demonstrated by looking at Figures 5a and 5b. If products liability were governed by a negligence standard, and a manufacturer adopted the efficient level of care, E, it would not be liable for the cost of accident damage from mismanufactured products represented by the triangle-like area EFC in Figure 5a, nor the cost of accident damage from defectively designed products or defective warnings represented by trapezoid-like area EFCN, which damage could only be eliminated in either case by a level of precaution greater than the efficient level E. If there were a shift from a negli-

of claims, which has a potential for greater total costs. See POSNER, *supra* note 1, at 164.

²³⁸ *Ybarra v. Spangard*, 154 P.2d 687 (Cal. 1944); *Byrne v. Boadle*, 159 Eng. Rep. 299 (Ex. 1863); KEETON ET AL., *supra* note 4, §§ 39-40, at 242-62.

²³⁹ "Strictly speaking, since negligence is not in question, *res ipsa loquitur* has no application to a strict liability case. But the inferences that are the core of the doctrine are not less applicable to strict liability." WILLIAM PROSSER ET AL., *TORTS: CASES AND MATERIALS* 764 (8th ed. 1988); see also *State Farm Mut. Auto. Ins. Co. v. Anderson-Weber, Inc.*, 110 N.W.2d 449 (Iowa 1961); *Kroger Co. v. Bowman*, 411 S.W.2d 339 (Ky. Ct. App. 1967); *Friedman v. General Motors Corp.*, 331 N.E.2d 702 (Ohio 1975).

gence standard to one of strict liability, manufacturers would be liable for the damage represented by area EFC in Figure 5a and the area EFCN in Figure 5b, but they would not increase the level of precaution to eliminate such accident damage because the cost of eliminating such damage as represented in either Figure 5a or 5b by trapezoid-like area EFRC would greatly exceed the damage for which they would be liable. In other words, it would be less expensive for manufacturers to pay for infrequent damage when it occurs than to pay to eliminate such damage, so manufacturers would not take greater care than the efficient level E.

C. *Strict Liability and Insurance*

The kind of product failures against which manufacturers *expressly* warrant their products, mostly due to defects in operation, are frequent and hence familiar to consumers and therefore enter into their buying decisions. However, because consumers generally have little information concerning the probability that they will sustain serious personal injuries because of mismanufactured products, they cannot evaluate accurately the need for insurance against such product failures.²⁴⁰ On the other hand, manufacturers are usually well apprised of the safety record of their products through reports, complaints, demands for replacements, and product liability suits. As a result of this second information, asymmetry that disfavors consumers, manufacturers are, in general, the least cost insurers of mismanufactured and defectively designed products.

1. Mismanufactured Products and Insurance

Consider the effect on insurance markets of a shift from negligence to strict liability in mismanufactured product cases. In terms of Figure 5a, under a negligence standard, consumers would either have to buy first-party insurance to cover damage equal to triangle-like area EFC for which they are not compensated or accept the risk of such damage. Under a negligence standard, accident costs that are unavoidable by due care are borne by consumers and

²⁴⁰ See POSNER, *supra* note 1, at 166. If the injury is common and consumer information better, the defense of assumption of risk will bar the injured consumer from obtaining damages. *Id.*; see also *Green v. American Tobacco Co.*, 409 F.2d 1166 (5th Cir. 1969) (holding cigarettes to be inherently unsafe product), *cert. denied*, 397 U.S. 911 (1970).

other strangers to the industry (hence, external²⁴¹ to the industry). Consumers pay slightly lower prices for products and can decide whether to buy personal insurance for injuries that occur without manufacturer fault or to accept a slightly higher risk of injury without compensation.

Under strict liability, however, manufacturers have to buy insurance or self insure for damage equal to area EFC. Here, the product price includes a small premium for insurance against personal injuries that result from mismanufactured products; consumers pay slightly higher prices for products and a slightly lower price for personal insurance coverage. Thus, under strict liability, consumers must buy both product and insurance even if they would rather pay a slightly lower price for the product and accept a slightly higher risk of injury without compensation. Assuming all consumers would prefer to buy a product plus insurance against accident damage from mismanufacture, to the extent that manufacturers are the least cost insurers against accidents from mismanufactured products because they can use their superior information concerning safety risks, either to self insure or to buy insurance at less cost than consumers can buy such insurance, total insurance costs should be lower under strict liability.

2. Design Defects and Defective Warnings: From Negligence to Strict Liability to Absolute Liability

Consider the effect on insurance markets of a shift from negligence to strict liability in design defect and defective warning cases. In terms of Figure 5b (p. 64), under a negligence standard, consumers would either have to buy first party insurance to cover accident damage equal to the open-ended area EFCN for which they are not compensated or to accept the risk of such damage. Since EFCN is unbounded and therefore potentially limitless, complete insurance for all such accident damage would, if available at all, be extremely costly. It is highly unlikely that consumers would be willing or able to insure completely against all such accident damage. If the standard of liability in products design and products warnings cases is shifted from negligence to strict liability, manufacturers must either buy insurance or self insure for

²⁴¹ See DONALD DEWEY, MICROECONOMICS 221 (1975) ("an externality exists when some activity of party A imposes a cost or confers a benefit on party B for which party A is not charged or compensated by (through) the price system."); POSNER, *supra* note 1, at 162.

damage equal to the open-ended area EFCN. As pointed out, insurance for such potentially limitless damage, even if available, would be extremely expensive.²⁴² Thus, if manufacturers are strictly liable in design defect and defective warning cases, consumers will in effect be compelled to buy more insurance than they would be willing or able to buy.

D. *Strict Liability and the Activity Effect*

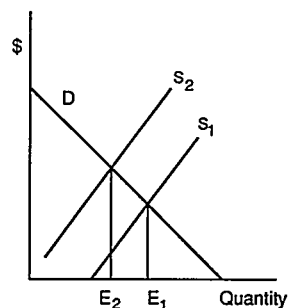
Under a negligence standard, consumers often cannot make informed choices among products and brands because of asymmetric information that favors manufacturers concerning knowledge of injuries from mismanufactured products. If consumers are not well informed, the marketplace may not discipline manufacturers by failing to divert consumers to safer products and brands.²⁴³ However, when the standard is shifted from negligence to strict liability, a higher risk of injury requires a higher insurance premium to cover such risk. Manufacturers consider that such insurance premiums are a cost of doing business, which, like any other cost, must be passed on to consumers if the business is to continue operating without a loss. Strict liability in effect incorporates information about a product's hazards into its price; the price of hazardous products will rise relative to the price of safe products, causing a *substitution* away from hazardous products and brands by consumers, even if they are completely unaware of such hazards. The substitution away from more hazardous products, brands, and activities that is caused by strict liability is known as the activity effect.²⁴⁴ Strict liability will cause products²⁴⁵ and brands²⁴⁶ with

²⁴² See George L. Priest, *The Current Insurance Crisis and Modern Tort Law*, 96 YALE L.J. 1521, 1521-22 (1987) (analyzing relationship between large increase in insurance premiums during middle 1980s and expansion of corporate tort liability); see also Ralph K. Winter, *The Liability Insurance Market*, 5 J. ECON. PERSP. 115, 115-17 (1991).

²⁴³ See POSNER, *supra* note 1, at 162.

²⁴⁴ See Shavell, *supra* note 42, at 24.

²⁴⁵ As a result of the shift in the basis of liability from a negligence standard to strict liability, the cost of insuring against serious injury from mismanufactured products becomes an added cost of doing business at all levels of output for all sellers of the product in an industry; therefore, the industry supply curve is shifted upward and to the left. The equilibrium of industry supply and demand now occurs at a higher price and lower quantity. The reduction in quantity of output that results from shifting to a standard of strict liability from one of negligence is the activity effect.



poorer safety records to have lower output. Thus, strict liability reduces accident costs by inducing changes in activity level.

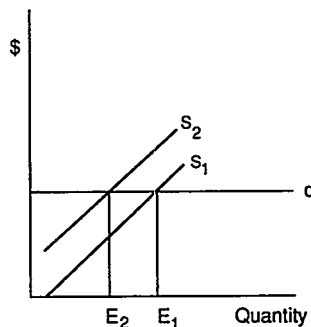
1. Mismanufactured Products and the Activity Effect

If there is a shift from a negligence standard to strict liability, producers of mismanufactured products will be responsible for area EFC in Figure 5a (p. 64), which represents the cost of accident damage from nonnegligently mismanufactured products. Because of the activity effect, a shift from a negligence standard to strict liability will cause a rise in the price of products and a reduction in output below that which would occur under a negligence standard. However, since the area EFC is bounded and probably relatively small in relation to the total cost of production, the activity effect from a shift from negligence to strict liability for mismanufactured products is probably small or negligible.

This analysis tends to explain the law's refusal to enforce disclaimers of liability for personal injuries caused by mismanufactured products like that in *Henningsen*. If the hazard is very small, it will not pay the consumer to be attentive to disclaimers; and, for the same reason, the manufacturer will not reap significant ill-will when it enforces the disclaimer in those very few cases in which someone is injured.²⁴⁷ Moreover, this analysis suggests that the ac-

fect (from E_1 to E_2 above). The strength of the activity effect depends upon the elasticity of demand (the responsiveness of the quantity bought to a change in price and the extent of the vertical shift in the supply curve (from S_1 to S_2)) which in turn depends on the probability the product will be mismanufactured and the damage caused from such mismanufacture. See MANSFIELD, *supra* note 32, at 35-37, 121-26.

²⁴⁶ In a competitive industry, all sellers are "price takers." PAUL A. SAMUELSON & WILLIAM D. NORDHAUS, *ECONOMICS* 541 (13th ed. 1989). They take the competitive price as given (for example, individual farmers have no control over price), therefore the demand curve for a single seller in a competitive industry is horizontal as in the figure below. MANSFIELD, *supra* note 32, at 252-55. If one seller produces a "brand name" product that has a poorer safety record than brands of other manufacturers in the same industry, its supply curve will shift upward and to the left (S_1 to S_2) because of the higher risk premiums it pays for insurance. However, unlike the case in which the costs of insurance rises for all manufacturers in an industry, when one manufacturer has a poorer safety record than other manufacturers in a competitive industry, it cannot pass along any of the higher risk premium to consumers; therefore a substantial activity effect is likely to occur so that quantity sold is reduced (from E_1 to E_2), because of reduced profitability.



²⁴⁷ POSNER, *supra* note 1, at 166. If consumers differ in their ability to cope with prod-

tivity effect, the rise in price and reduction in output consequent upon such liability, is small.

2. Design Defects, Defective Warnings, and the Activity Effect

If there is a shift from a negligence standard to strict liability in design defects and defective warning cases, manufacturers will be responsible for the open-ended area EFCN in Figure 5b, which represents the cost of accident damage from nonnegligently designed products for which additional safety or warnings are not justified by cost-benefit analysis. Since the area EFCN is unbounded and probably relatively large in relation to the total cost of production, the activity effect of a shift from negligence to strict liability in design defect and defective warning cases may be very substantial. In some cases, a shift to strict liability may cause the price of many nonnegligently designed products to rise so much that manufacturers may cease producing them.²⁴⁸ In these cases, the activity effect is such that there may be no price at which manufacturers can profitably produce and sell such products. If manufacturers are strictly liable in design defect and defective warning cases, courts may drive many products off the market. Thus, in design defect and defective warning cases, if liability is extended beyond negligence, there is no logical stopping place; therefore strict liability can easily become absolute liability: unlike mismanufactured products liability, where a shift from negligence to strict liability involves the shifting and spreading of small, known risks, whose costs are bounded, a shift from negligence to strict liability in design defect and defective warnings cases involves potentially unbounded liability and therefore can become limitless absolute liability. Those courts which hold that "strict" liability in design defect and defective warning cases should be circumscribed by risk-utility or cost-benefit tests that sound in negligence²⁴⁹ recognize that strict liability may mean potentially unlimited liability, whereas those courts that adhere to the semantic distinction between negligence, which focuses on a manufacturer's *conduct*, and strict liability, which focuses on the *product*, appear to be unaware

uct hazards a disclaimer of liability could be a good way of sorting consumers according to that ability. *Id.* at 166-67.

²⁴⁸ See Priest, *supra* note 242, at 1522-23; Winter, *supra* note 242, at 115-17.

²⁴⁹ Prentis v. Yale Mfg. Co., 365 N.W.2d 176, 185-86 (Mich. 1984) (design defect case); Smith v. E.R. Squibb & Sons, 273 N.W.2d 476, 480 (Mich. 1979) (defective warning case).

of the problem.²⁵⁰ Thus, in design defect and defective warning cases, courts should, in general, be wary of extending liability much beyond a negligence standard.²⁵¹

CONCLUSION

This Article attempted to resolve two related disputes between lawyers and economists that arise under the law of torts. One dispute concerns the definition of due care: economists contend that the reasonably prudent person is justified in assuming other persons always use due care; lawyers argue that the reasonably prudent person knows or should know that others act negligently sometimes. A second dispute concerns whether the several negligence rules are equally efficient: economists contend that the contributory negligence defense, which bars tort recovery by negligent plaintiffs, is just as efficient as comparative negligence, which shares losses according to relative fault; lawyers argue that comparative negligence is the preferred legal standard.

By restating the economic model of negligence in the context of a simple information theory framework, the general correctness of the lawyers' position in both disputes was easily demonstrated. We asked whether persons and courts have certain knowledge of all relevant facts and legal standards, or, is there legal certainty or uncertainty, and whether all persons act simultaneously or sequentially. Because each of these two variables has two choices, four models result: assuming legal certainty and simultaneous action by all persons yields the standard economic model of negligence; assuming legal certainty and sequential action results in the last clear chance model; assuming uncertainty and simultaneous action gives us the defensive care model; assuming uncertainty and sequential action yields the foreseeable negligence model. With the exception of the first, or standard economic model, it was shown that the reasonably prudent person knows or should know that others act negligently sometimes and that the comparative negligence standard is more efficient than the contributory negligence defense.

²⁵⁰ *Kearl v. Lederle Lab.*, 218 Cal. Rptr. 453, 454-58 (Cal. Ct. App. 1985) (approving this distinction); *Prentis*, 365 N.W.2d at 184 (disapproving this distinction).

²⁵¹ As a rationale for extending liability in a defective warnings case beyond that which would be justified by the cost-benefit standard inherent in a negligence standard, the D.C. Circuit has said that state tort law may have broader compensatory goals. *Ferebee v. Chevron Chem. Co.*, 736 F.2d 1529, 1540 (D.C. Cir.), *cert. denied*, 469 U.S. 1062 (1984).

These models are not only relevant to negligence suits, they also explain products liability suits based upon design defect or defective warning claims because these claims are de facto negligence suits. In terms of economic theory, design defect and defective warning cases are distinguished from mismanufactured product cases by their respective accident damage costs. The essential distinction is that in mismanufactured product cases, the total amount of nonnegligent accident damage is bounded and relatively small in comparison to production costs, whereas in design defect and defective warning cases, the total amount of nonnegligent accident damage is unbounded and potentially limitless. A major conclusion is that manufacturers should be strictly liable for mismanufactured products, but that in design defect and defective warning cases, courts should, in general, be wary of extending liability much beyond a negligence standard.

