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Causal Apportionment in the Law of Torts: An Economic Theory

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Over the past fifteen years, courts have increasingly turned their attention in civil suits to the apportionment of damages. The largely statutory movement toward comparative negligence has been foremost in this development. In at least thirty jurisdictions the liability of defendant can be reduced in proportion to the relative fault of plaintiff.[1] The concept of comparative negligence has also been used to reduce plaintiff's recovery in "strict" products liability cases.[2] Although the prima facie case can be established without reference to negligent behavior, plaintiff's recovery will nevertheless be reduced in proportion to his fault. Similarly, contribution among joint tortfeasors, which indirectly produces an apportioned outcome, has been made possible by statutes in at least forty jurisdictions.[3] Apportionment in this context proceeds either on the administratively simple basis of dividing the total losses by the number of defendants, or by means of more complex relative fault considerations. In either case, a more equitable sharing of the losses has become a reality. Finally, even in the antitrust and securities areas, courts have recently expressed interest in the matter of contribution among jointly and severally liable defendants.[4]

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1. See Landes & Posner, Joint and Multiple Tortfeasors: An Economic Analysis, 9 J. Legal Stud. 517, 551 (1980) (tabulating data originally appearing in V. Schwartz, Comparative Negligence (1974 & Supp. 1978)).

2. See Netzel v. State Sand & Gravel Co., 51 Wis. 2d 1, 186 N.W.2d 258 (1971) (unreasonable assumption of risk treated as contributory negligence for purposes of apportionment under a comparative negligence statute). See also Dippel v. Sciano, 37 Wis. 2d 443, 461, 155 N.W.2d 55, 64 (1967) (dictum). Minnesota and Rhode Island courts have cited *Dippel* favorably. See Haney v. International Harvester Co., 294 Minn. 375, 386, 201 N.W.2d 140, 146 (1972); Ritter v. Narragansett Elec. Co., 109 R.I. 176, 191, 283 A.2d 255, 263 (1971). See generally Feinberg, The Applicability of a Comparative Negligence Defense in a Strict Products Liability Suit Based on Section 402(A) of the Restatement of Torts, 2D (Can Oil and Water Mix?), 42 Ins. Counsel J. 39, 45-58 (1975); Schwartz, Strict Liability and Comparative Negligence, 42 Tenn. L. Rev. 171, 174-76 (1974).

3. See Landes & Posner, supra note 1, at 551.

4. In the antitrust area see Professional Beauty Supply, Inc. v. National Beauty Supply, Inc., 594 F.2d 1179 (8th Cir. 1979), quoted with approval in Heizer Corp. v. Ross, 601 F.2d 330, 333 (7th Cir. 1979) (dictum). See also Note, Contribution in Private Antitrust Actions, 93 Harv. L. Rev. 1540 (1980). In the securities area see, e.g., Globus, Inc. v. Law Research Serv., Inc., 318 F. Supp. 955 (S.D.N.Y. 1970), aff'd, 442 F.2d 1346 (2d Cir. 1971).

This Article develops a technology for the apportionment of tort damages in accordance with the concept of relative causation. The first section establishes the common law roots of apportionment and the importance, in both the strict liability and negligence contexts, of apportionment on the basis of relative causation. Then, in the second section, we proceed to develop a theoretical framework that enables us to use the tools of economic analysis to discuss issues of prima facie liability apportionment.[5] The third section discusses the primary applications of our theory. Cases of simultaneous, superseding, and concurrent causation are analyzed in considerable detail. We then turn our attention to absent or insolvent defendants and the indemnification of those initially held liable. The Article concludes with a discussion of causal defenses and the ramifications of our apportionment scheme for economic efficiency.

I. CAUSAL APPORTIONMENT IN PERSPECTIVE

A. *Apportionment at Common Law*

Although the recent movement toward apportionment has been primarily a statutory development, the seeds of apportioned outcomes were planted at common law. In general, the common law prohibited apportioned judgments. When the wrongful acts of two or more individuals concurred to produce an indivisible harm, the tortfeasors were jointly and severally liable; whether the victim sued one or all of them, the court could not sever damages among them.[6] However, apportioned *outcomes* were possible to the extent that tortfeasors against whom judgments had been recovered could win contribution suits against the other tortfeasors. The degree to which the common law permitted contribution is often underestimated,[7] and hence, so too is the extent to which effective apportionment was possible.

To some extent, contribution was prohibited at common law. However, this prohibition, which is traced to the famous case of *Merryweather v. Nixan*,[8] was, at least in England, restricted "only to cases of wilful and conscious wrongdoing, and [was] not applicable to cases of mere negligence, accident, mistake or other unintentional breaches of the law."[9] In nineteenth-century American case

5. We deal primarily with suits in tort between parties lacking contractual privity. Therefore, we exclude consideration of cases like medical malpractice and products liability. A strict liability emphasis, with its concomitant neglect of due care standards, is not entirely appropriate in such cases. Discussions of negligence in these situations will be based on the shared expectations of plaintiff and defendant. See, e.g., Epstein, Medical Malpractice: The Case for Contract, 1976 Am. Bar Foundation Research J. 87, 96-108; Epstein, Plaintiff's Conduct in Products Liability Actions: Comparative Negligence, Automatic Division and Multiple Parties, 45 J. Air L. & Com. 87, 87-107 (1979) [hereinafter cited as Epstein, Plaintiff's Conduct].

6. G. Williams, Joint Torts and Contributory Negligence, 63-64 (1951).

7. See, e.g., Landes & Posner, supra note 1, at 518-19. But see id. at 519 n.4 (expressing qualifications).

8. 8 T.R. 186, 101 Eng. Rep. 1337 (K.B. 1799).

9. J. Salmond, The Law of Torts 86 (8th ed. 1934). See also W. Prosser, The Law of Torts § 50, at 306 (4th ed. 1971); G. Williams, supra note 6, at 83; Note, Modern Trend of the Law of Contribution Among Joint Tortfeasors, 6 Mont. L. Rev. 34, 34-35 (1945); Note, Contribution and Indemnity Among Joint Wrongdoers, 32 Colum. L. Rev. 94, 94 (1932); Adamson v. Jarvis, 4 Bing. 66, 130 Eng. Rep. 693 (C.P. 1827).

law the no-contribution rule was similarly applied only in cases of intentional concurrent harms.[10] However, in the twentieth century the American common law extended the no-contribution rule to include concurrent negligence.[11] Nonetheless, apportionment through contribution was available in several areas of the law.[12] If, for example, two or more persons were the joint employers or principals of a single wrongdoer and were vicariously liable for his torts, each had a right of contribution against the other.[13] Similarly, if two or more individuals dealt with a chattel in a bona fide and reasonable assertion of a common right, contribution was available in claims arising out of their actions. For instance, if several creditors attached and converted a debtor's automobile, but only one paid the judgment against them in full, he could seek contribution from his co-defendants.[14]

The traditional contribution suit, however, was an imperfect method of effecting apportionment. The rule that "equality is equity"[15] meant that the tortfeasors would ultimately share liability in equal proportion regardless of their relative causal contributions. Furthermore, even in its most liberal formulation, the *Merryweather v. Nixan*[16] rule prohibited contribution among intentional tortfeasors, thereby eliminating any apportionment whatsoever in one important class of cases. Finally, in situations involving wrongful conduct followed by an intervening event, the usual common law approach was to decide whether the event negated the causal connection between the wrongful act and the harm. This did not permit consistent and systematic reduction of defendant's liability in proportion to the *degree* that an intervening event broke the causal link.[17] Hence, "apportionment" between the tortfeasor and the intervening event was

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10. 1 T. Shearman & A. Redfield, A Treastise on The Law of Negligence 44 (6th ed. 1913); 1 Bouvier's Law Dictionary 667 (8th ed. 1914). See also Armstrong County v. Clarion County, 66 Pa. 218 (1870); F. Burdick, Cases on Torts 532 n.1 (3d ed. 1905) (referring to "the generally discarded doctrine of Merriweather v. Nixan"); Hatcher, Battersey's Case (1623), 47 W. Va. L.Q. 123, 125-26 (1941); Reath, Contribution Between Persons Jointly Charged for Negligence—Merryweather v. Nixan, 12 Harv. L. Rev. 176, 182 (1898); Note, Mont. L. Rev., supra note 9, at 34-35.

11. W. Prosser, supra note 9, at 306.

12. It ought to be mentioned in passing that the no-contribution rule among negligent tortfeasors never found approval in the law of admiralty. Leflar, Contribution and Indemnity Between Tortfeasors, 81 U. Pa. L. Rev. 130, 138 (1932).

13. Bohlen, Contribution and Indemnity Between Tortfeasors, 21 Cornell L.Q. 552, 560 (1936).

Landes and Posner argue that a rule of no-contribution among those tortfeasors who have taken less than the economically justified level of care to avoid accidents promotes efficiency. Landes & Posner, supra note 1, passim. To the extent that the doctrine of respondeat superior placed liability on the parties able to avoid the harm more cheaply, see R. Posner, Economic Analysis of Law 140-41 (2d ed. 1977), the right of contribution among those vicariously liable is evidence against the view that the law promotes efficiency in this area.

14. Farwell v. Becker, 129 Ill. 261, 21 N.E. 792 (1889); Selz, Schwab & Co. v. Guthman, 62 Ill. App. 624 (1896); First Nat'l Bank of Pawnee City v. Avery Planter Co., 69 Neb. 329, 95 N.W. 622 (1903); Central Bank & Trust Co. v. Cohn, 150 Tenn. 375, 264 S.W. 641 (1924). See also Bohlen, supra note 13, at 561.

15. W. Prosser, supra note 9, § 50, at 310.

16. 8 T.R. 186, 101 Eng. Rep. 1337 (K.B. 1799).

17. But see H.L.A. Hart & A. Honoré, Causation in the Law 212-13 (1959) (related matters) [hereinafter cited as Hart & Honoré].

not available.[18] Nevertheless, the contribution cases discussed above suggest that at least an indirect form of apportionment was possible at common law.

B. *Relative Causation as an Apportionment Tool*

Recently, the concept of causation has received increased attention from two sources as a basis for establishing liability in tort and for apportioning tort damages. In one development, Richard Epstein has proposed a system of strict liability in which the prima facie case is established solely by showing that defendant was the cause of injury to plaintiff, whether or not defendant intended harm or failed to take reasonable precautions to avoid it.[19] A second development involves the apportionment of damages in strict products liability cases. Here, courts in several jurisdictions have adopted a theory under which the "unforeseeable" misuse of a product by the plaintiff will reduce his recovery in accordance with his comparative causal contribution rather than on the basis of his relative fault.[20] Our theory builds on both developments. It begins with Epstein's use of causation to establish liability and then provides what Epstein[21] and the courts[22] have failed to develop: a systematic method of apportioning damages on the basis of relative causation.

Relative causation is chosen as the tool for apportionment for three reasons. First, relative causation provides a means for equitably allocating the costs of wrongful conduct. We begin with the premise that a party who harms another ought, prima facie, to pay for the damages, regardless of whether he has acted negligently.[23] This principle stands in clear opposition to traditional negligence doctrine, which denies recovery when the defendant could not reasonably have

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18. But see Radburn v. Fir Tree Lumber Co., 83 Wash. 643, 145 P. 632 (1915), discussed at text accompanying notes 91-92 infra, in which the court cleverly avoided this all-or-nothing rule.

19. See generally Epstein, A Theory of Strict Liability, 2 J. Legal Stud. 151 (1973) [hereinafter cited as Epstein, Strict Liability]; Epstein, Defenses and Subsequent Pleas in a System of Strict Liability, 3 J. Legal Stud. 165 (1974) [hereinafter cited as Epstein, Defenses]; Epstein, Intentional Harms, 4 J. Legal Stud. 391 (1975) [hereinafter cited as Epstein, Intentional Harms].

20. See, e.g., Suter v. San Angelo Foundry & Machine Co., 81 N.J. 150, 406 A.2d 140 (1979); General Motors Corp. v. Hopkins, 548 S.W.2d 344 (Tex. 1977); Busch v. Busch Constr. Inc., 262 N.W.2d 377, 393-94 (Minn. 1977); cf. Bielski v. Schulze, 16 Wis. 2d 1, 114 N.W.2d 105 (1962) (causal apportionment in gross negligence setting). See also Note, Comparative Causation, Indemnity, and the Allocation of Losses Between Joint Tortfeasors in Products Liability Cases, 10 St. Mary's L.J. 587 (1979); Twerski, The Many Faces of Misuse: An Inquiry into the Emerging Doctrine of Comparative Causation, 29 Mercer L. Rev. 403 (1978).

21. Although Epstein devotes attention to some issues of concurrent and intervening causation, most of his analysis proceeds in terms of the complete priority of one causal relationship over another. See Epstein, Strict Liability, supra note 19, at 179-89; Epstein, Defenses, supra note 19, at 174-85. To the extent that Epstein does discuss apportionment, it is not really based on causation but rather on ad hoc procedures such as the relative release of kinetic energy in automobile collisions or the equal division of damages among defendants in products liability cases. See Epstein, Defenses, supra note 19, at 180 (automobile collisions); Epstein, Plaintiff's Conduct, supra note 5, at 111-15 (products liability); Borgo, Causal Paradigms in Tort Law, 8 J. Legal Stud. 419, 450 (1979) (criticism of Epstein).

22. The courts have attempted to apply causal ideas to the apportionment of liability, but have not been able to explicate comparative causation systematically. As a consequence, liability tends to be apportioned on the basis of unexplicated, intuitive notions of the relative importance of causes.

23. This premise and the analysis in text following note 24 infra expand on Epstein, Strict Liability, supra note 19, at 168 and Epstein, Defenses, supra note 19, at 167-68.

avoided the harm. Our position, however, is that it is fairer, as a general rule, to impose the burden of an injury on the party who causes it than on the party who suffers it.[24] Thus, assume that *A* has caused injury to *B* but that neither party was negligent. Here, *A*'s and *B*'s adherence to the due care standard initially balances the equities between them. However, the fact that *A* has caused harm to *B*, and not *B* to *A*, tips that balance in *B*'s favor. *B* will recover from *A*. Similarly, when each party has acted negligently, the fault of both initially balances the equities between them. However, that balance is once again tipped in *B*'s favor by the fact that *A* caused him injury. Although the traditional doctrine of contributory negligence would bar recovery,[25] our principle of causation allows recovery. Finally, assume that *A* nonnegligently causes injury to *B*, who has acted unreasonably. To deny recovery in this case would suggest that the victim has a duty to "subsidize" *A*'s activities by taking precautions to make their immediate consequences less harmful or risky. It should not matter that *A* has injured *B* rather than some third party; the Good Samaritan principle should still apply. *A* should pay for the damages he causes despite the presence of another who is capable of shouldering the burden of accident avoidance.[26] Consistent with the premise that causation assigns liability equitably in cases involving a single tortfeasor, our principle of causation provides an equitable division of liability in multitortfeasor cases by allocating damages in accordance with estimates of the degree to which each actor *causally* contributed to the plaintiff's harm.[27]

As an alternative to negligence, relative causation, with its reliance on strict liability, is appealing for a second reason. Negligence theory requires that parties comply with certain standards of care. Although courts[28] must establish these standards when adjudicating liability, the negligence framework often provides them with no basis for choosing between various alternatives. Suppose that two

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24. The word "cause" is being used here in neither the "but-for" nor "proximate" sense. Instead, we view causation in terms of simple commonsense paradigms. See text accompanying notes 44-45 infra.

25. We confine our attention to the traditional common law view of negligence and do not consider comparative negligence.

26. This is not to ignore statutorily imposed duties (e.g., speed limits) and causal defenses. On the latter see text accompanying notes 125-27 infra.

27. Our theory avoids the unfairness of placing the entire responsibility for loss on only one of two or more concurrent tortfeasors. It has recently been argued that this unfairness is only superficial; while *ex post* some defendants may escape liability, *ex ante* they all face the risk of paying. Landes & Posner, supra note 1, at 520. However, where justice or fairness is at issue, and not only deterrence, the *ex post* outcome must receive substantial attention. It is unfair for a single tortfeasor to bear the entire burden, even if *ex ante* the risks of such liability were more evenly distributed. Furthermore, the *ex ante* distribution of risk is unlikely to accord with principles of relative causal contribution, since the ultimate decision in allocating liability will rest with plaintiff and not the court.

The emphasis on the *ex ante* perspective has also given rise to the argument that people would, if given the opportunity, agree *ex ante* to efficient rules even if, *ex post*, they did not like the resulting allocation of liability. If the prohibition against apportionment is efficient, it is claimed, we can *infer* the consent of those governed, and hence there is no unfairness when damages fall on only one party. See generally Posner, The Ethical and Political Basis of the Efficiency Norm in Common Law Adjudication, 8 Hofstra L. Rev. 487 (1980). But see Rizzo, The Mirage of Efficiency, 8 Hofstra L. Rev. 641 (1980) (detailed critique of Posner's view).

28. When we refer to courts here, we include judges sitting as triers of fact as well as juries.

boats are moored alongside each other when one breaks away and begins drifting toward the other. If each of the two ship owners is equally capable of avoiding the collision by providing a lookout, a court allocating liability after the collision will be forced either to impose the duty of supplying a lookout on one of the parties, or to impose it on both. This latter alternative is duplicative and thus inefficient, while the former involves a choice that negligence theory is incapable of rescuing from the arbitrary. The difficulty intensifies if coordinated activity between the parties is necessary to avoid accidents. Proper nighttime precautionary activity may warrant a lookout on one boat only if the other ship has warning lights.[29] If so, the courts have three practical problems: first, what precautions should be taken to avoid accidents and keep costs at a minimum; second, which of the parties should take which precaution;[30] and third, to what extent should each of the parties take a particular precaution, e.g., how many hours should the lookout be on board and how bright should the warning lights be. Solutions to these problems may be simple from a mathematical standpoint when all the relevant information is available,[31] but they are far from easy to arrive at in practice. These problems represent only the first level of difficulties that a court encounters in any attempt to implement the negligence rationale. Others of a more fundamental and far-reaching nature arise.[32] On the other hand, relative causation raises none of these problems. It divides liability in accordance with the parties' causal contributions rather than the degree to which they have deviated from judicially imposed standards of care. Thus, apportionment proceeds without requiring courts to set such standards.

The third reason that we choose relative causation is its capacity for synthesizing the artificial dichotomy in the field of intervening causation between concurrent and superseding causes. This dichotomy requires that intervening causes be characterized as either concurrent or superseding, thereby resulting in joint and several liability with the initial cause or full responsibility; it does not permit causes with relative degrees of responsibility to be accorded relative degrees of liability. Relative causation replaces this dichotomous perspective with a framework that allows assignment of liability in accordance with a continuum of relative degrees of responsibility.

Although the framework advanced here assumes a system of strict liability, the method can also be used in conjunction with a system of negligence: principles of negligence would be employed to identify the wrongful actors, and relative causation would then be used to assign damages among them. Although this

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29. See Epstein, Strict Liability, supra note 19, at 156.

30. If both parties turn on their lights but neither hires a lookout, are they both negligent? If neither party undertakes any precautionary activity and plaintiff is considered contributorily negligent, then defendant will have no incentive to take precautions. If that is the case then plaintiff's hiring of a lookout, for example, is useless because defendant has not undertaken the complementary activity. Thus it is unfair to call plaintiff negligent if, given the circumstances, his lookout or warning lights could not have avoided the accident or reduced its probability. Hence the court is driven to require both parties to each have a lookout and warning lights. Unfortunately, this is not an efficient solution since it involves duplication of resources. Traditional negligence doctrines cannot deal with these problems.

31. See the exercises in Landes & Posner, supra note 1, at 522-26.

32. See note 37 infra.

use of causal analysis may be novel, use of causation to gauge liability in the realm of negligence is not. For example, in *In re Polemis,*[33] a ship was destroyed by fire when longshoremen dropped a plank into the hold and caused a spark, which ignited benzene gas that had collected there. Finding the workers' act to be negligent, the King's Bench held their employer liable for the full extent of the harm that they had *caused,* despite the unforeseeable manner in which the ship was destroyed. Similarly, suppose that due to a driver's negligence his automobile crashes into the stone stoop of a house, loosening a stone on the roof, which later falls to the ground and hits a person twenty feet away.[34] Although this was unforeseeable at the moment defendant was driving carelessly, courts will often use the rhetoric of foreseeability in holding the driver liable for the personal injury. Surely these courts are using causal principles to arrive at that conclusion.[35] Thus, as these cases illustrate, causation is not an unknown feature in the allocation of damages in negligence cases.

II. DEVELOPMENT OF THE THEORY

Our model of causal apportionment applies economics to legal questions in a new fashion. It rejects the usual economic approach to legal questions, which identifies economic considerations with considerations of efficiency,[36] because of

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33. In re Polemis & Furness, Withy & Co., [1921] 3 K.B. 560. The view that *Polemis* has been overruled, see, e.g., Morison, The Victory of Reasonable Foresight, 34 Austl. L.J. 317, 318 (1961); Williams, The Risk Principle, 77 L.Q. Rev. 179, 181 (1961), is an exaggeration. Although the language of Overseas Tankship (U.K.) Ltd. v. Morts Dock & Eng'r Co., [1961] A.C. 388 (P.C. Austl.) (*Wagon Mound I*) clearly states that the "directness test" has been overturned, subsequent cases throw this conclusion into doubt. These cases develop a distinction between the type of harm and its extent, see, e.g., Smith v. Leech Brain & Co., [1962] 2 Q.B. 405. Individuals are held responsible only for foreseeable *types* of harm, but they can be held responsible for harm of an unforeseeable *extent* if it is of a foreseeable type. The application of this distinction, however, has proved exceedingly arbitrary. See *Leech Brain,* id. at 415 (effectively viewing cancer as a subdivision of burn-injury category); Hughes v. Lord Advocate, [1963] 1 All E.R. 705 (burning and explosion treated as the same type of harm). But see Doughty v. Turner Mfg. Co., [1964] 1 Q.B. 518, 529 (distinction between a splash resulting from object falling into vat of sodium cyanide solution and splash resulting from chemical reaction of object with solution, describing the two as "entirely different"). Hence courts inclined to classify unforeseeable injuries into a subcategory of foreseeable types, as in the first two cases, can, in effect, save the *Polemis* test. See, e.g., J. Fleming, The Law of Torts 181, 184-85, 187 (4th ed. 1971); D. Walker, 1 The Law of Delict in Scotland 279, 280, 288 (1966). Defendant will then be held liable for everything that is causally related to his negligence without a showing that the injury was actually foreseeable. This causal connection is demonstrated by showing only that no improbable event intervened between the original wrong and the particular injury, i.e., that the injury was "directly" caused by the wrong.

34. Hart & Honoré, supra note 17, at 241-42.

35. Id. at 259-60.

36. See, e.g., R. Posner, supra note 13, at 140-41 (citing additional sources). See also Posner, Some Uses and Abuses of Economics in Law, 46 U. Chi. L. Rev, 281, 295 (1979) (suggesting that economic analysis in law need not be so linked to efficiency considerations).

The meaning of the efficiency norm in the tort literature is that law ought to encourage accident avoidance, on the part of both defendant and plaintiff, up to the point where the cost of an additional unit of avoidance equals the expected reduction in accident costs. Thus, an efficient tort rule is one that minimizes the sum of expected accident and accident prevention costs.

the theoretical, practical, and moral difficulties inherent in that approach.[37] Instead, our theory employs economic concepts within a framework familiar to the common law, building on the premise that an individual who causes injury should pay for his victim's loss.

The discussion that follows first develops, then applies, the theory of causal apportionment. In the process, the Article does not attempt to solve such problems as the amount of apportionment society deems optimal or the least-cost administrative method of effecting that goal. Rather, the Article presents a *technology* of apportionment in accordance with principles of causation.

Several elementary economic concepts are central to our method of apportionment. First, we adopt and employ Hart and Honoré's distinction between causally relevant factors and mere conditions, in accordance with the production function dichotomy between direct factors and environmental variables.[38] Second, the notion of a probabilistic marginal product[39] is essential to apportioning liability among these causally relevant factors.[40] The value of the probabilistic marginal product is derived through a standard imputation technique.[41] Finally, the concept of foregone opportunity[42] is employed in the calculation of damages.

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37. See, e.g., Rizzo, Uncertainty, Subjectivity and the Economic Analysis of Law, *in* Time, Uncertainty and Disequilibrium 71 (M. Rizzo ed. 1979); Rizzo, Law amid Flux: The Economics of Negligence and Strict Liability in Tort, 9 J. Legal Stud. 291 (1980); Rizzo, The Mirage of Efficiency, supra note 27. For discussion of the moral difficulties, see Dworkin, Is Wealth a Value?, 9 J. Legal Stud. 191 (1980); Kronman, Wealth Maximization as a Normative Principle, 9 J. Legal Stud. 227 (1980). But see Posner, The Value of Wealth: A Comment on Dworkin and Kronman, 9 J. Legal Stud. 243 (1980). Useful mathematical presentations of the theoretical difficulties (or at least complexities) may be found in Diamond, Single Activity Accidents, 3 J. Legal Stud. 107 (1974) and Shavell, Strict Liability Versus Negligence, 9 J. Legal Stud. 1 (1980).

38. Hart and Honoré distinguish, for example, between a cause and mere condition of a fire. The cause may be the person lighting a match, while a condition is the oxygen in the air. See Hart & Honoré, supra note 17, at 32. Analogously, one of the direct factors of production used in making a fire is the labor of the person who lit the match; the presence of oxygen is an environmental variable. For the economics background, see, e.g., R. Michael, The Effect of Education on Efficiency in Consumption 7-11 (1972).

39. In economic theory, the marginal product of a factor is the increase in total output made possible by an additional unit of that factor. Accordingly, a probabilistic marginal product is the increase in the *probability* of a particular event (e.g., output or harm) brought about by either an additional unit of some input or the addition of an event or an act to a given situation.

40. Inasmuch as probabilities are employed to *apportion* liability, they are irrelevant when only one cause is operating. Thus, the probability or improbability of an outcome produced by only one cause is irrelevant to allocating liability; the one cause is fully liable. Thus, we distinguish between improbable outcomes produced by one cause, however remotely, and the intervention of improbable events. See generally McLaughlin, Proximate Cause, 39 Harv. L. Rev. 149, 179-81 (1925); Terry, Proximate Consequences in the Law of Torts, 28 Harv. L. Rev. 10, 21 (1914).

41. In economic theory, the importance of an input is derived or imputed from the value of the output it helps to produce. In particular, the market value of an input tends to equal the value of its marginal product, defined at note 39 supra. Analogously, the importance of a cause is equal to its (probabilistic) marginal product in producing the particular harm in question.

42. The foregone opportunity associated with a given act is the highest-valued alternative sacrificed as a result of performing the act. For example, watching television may be the foregone opportunity associated with reading this Article. Similarly, when someone bears the consequences of another person's act, the foregone opportunity is the most highly valued alternative sacrificed by the victim as a result of the act. Thus, if A shoots B as B is jumping off a cliff to certain death, then the value of the foregone opportunity connected with B's being shot, namely the value of the rest of B's life which is sacrificed by A shooting him, is virtually zero. The former is an example of choice-*influencing* cost, while the latter illustrates choice-*influenced* cost. See J. Buchanan, Cost and Choice 44-45 (1969); text accompanying notes 72-76 infra.

Our theory of causal apportionment is primarily normative in character; it recommends changes in the law by proposing a new method of apportionment based on strict liability. On the other hand, it also has a great deal of descriptive power. Given the present state of the law, with its traditional definitions of wrongful conduct and its reluctance to apportion damages, the theory developed here yields positive implications about the proximity of causal relationships. In particular, it predicts whether an instance of wrongful conduct in the presence of intervening events is a legal cause of the harm. Moreover, in cases of concurrent torts where indemnity (but not contribution) is permitted, the theory predicts the party on whom liability will ultimately lie. The full descriptive power of the theory is revealed in the subsequent sections of this study.

A. *Hypothetical Method*

Causal apportionment, like traditional measures of apportionment, entails two steps. First, wrongful conduct is identified; and, second, its relative importance is appraised.

1. *Wrongful conduct and environmental conditions.* Wrongful conduct is defined as any act or omission that bears a standard causal relationship to a harmful result.[43] Richard Epstein identifies four such relationships or "paradigms":[44] (1) *A* hit *B*; (2) *A* frightened *B*; (3) *A* compelled *B* to hit *C*; and (4) *A* created a dangerous condition that resulted in harm to *B*.[45] When the defendant has engaged in behavior that is subsumed within one of these paradigms, he has engaged in wrongful conduct.

Since other acts, events, and conditions will occur with and follow wrongful conduct, it is important to distinguish between cooperating or "environmental" factors and those that constitute separate causes. For example, though the victim's thin skull may contribute to his injuries, classical tort law imposes damages attributable to this condition on the tortfeasor. The thin skull constitutes a standard environmental factor. Such factors include all conditions inherent in the person or thing affected by the wrongful conduct.[46] Environmental factors also include those events occurring subsequent to the moment (t_0) of the wrong, but prior to the harm, that have an objectively high probability of occurring.[47]

43. Negligence theory classifies wrongful conduct as a breach of a duty of care. However, in a strict liability scheme, which encompasses the instant theory, wrongfulness is not so defined. The feasibility of avoidance plays no part in the prima facie case.

44. See Epstein, Strict Liability, supra note 19, at 166-89.

45. A causal tort theory can have significance only if there is a prior specification of the set of rights that society is prepared to enforce. People are "harmed" by many things, including, for example, the low prices of competitors; yet most of these are not the result of tortious conduct. This is because the harm often does not constitute the violation of some protected interest. These protected interests can be called "ownership rights." Behind every tort there must be either an explicit or implicit violation of such a right. See Terry, supra note 40, at 12; Epstein, Nuisance Law: Corrective Justice and Its Utilitarian Constraints, 8 J. Legal Stud. 49, 50 (1979). But see Posner, Epstein's Tort Theory: A Critique, 8 J. Legal Stud. 457, 465-71 (1979). But see Epstein, Causation and Corrective Justice: A Reply to Two Critics, 8 J. Legal Stud. 477, 499-504 (1979).

46. This definition includes conditions with a low objective relative frequency ("abnormal" conditions) in addition to normal conditions, and is therefore inconsistent with most versions of the foreseeability theory. However, it is not inconsistent with Posner's version, see R. Posner, supra note 13, at 131. See also Rizzo, Law amid Flux, supra note 37, at 304-06.

47. In determining whether an event's measured probability is high, a court may consider whether the level of risk is one that people typically take into account.

This probability is calculated on the basis of facts existing at t_o, in conjunction with the best theories available at the time of the trial.[48] These subsequent events constitute part of the environment at t_o insofar as their high probability means that they are "inherent" in the setup at that time.[49] Viewing attributes of the person or thing affected by a tort as environmental is consistent with orthodox tort law.[50] Defining subsequent events as such is not only consistent with strict liability but is also in general harmony with a negligence framework. Even from the latter perspective, foreseeability of the intervention by the reasonable man at the moment of the initial wrong is irrelevant to the determination of proximate cause. Instead, according to the *Restatement,* the court ought to use all of the knowledge available to it at the time of the trial to ascertain retrospectively the probability of the event.[51]

2. *Appraising relative importance.* Once two or more wrongful causes of a harm are identified on Epsteinian grounds,[52] it is then necessary to determine their relative importance. Where the causes arise simultaneously, this determination is made by hypothesizing a simpler situation in which only one of the causally relevant factors is operative. We appraise the relative importance of the causes by measuring the differential degree of *risk* to which each cause exposes the plaintiff.[53] We employ this probabilistic analysis because a deterministic analysis is incapable of disentangling the relative importance of causes. In those contexts in which each wrongful act is a necessary condition of the harm, the marginal product of each would be the entire damage. If, on the other hand, neither were necessary, then each of their marginal products would be zero. A probabilistic analysis, however, enables us to determine the relative importance of causes by referring to their general harm-producing capacities.[54]

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48. Hence "objective" means society's best estimate. Even the best theories only imperfectly predict or determine the outcome at a future time given the world at some prior period.

49. Subsequent intentional acts are excluded and considered separately. See text accompanying notes 98-103 infra.

50. See Hart & Honoré, supra note 17, at 160-64.

51. See Restatement (Second) of Torts § 435, Comments c and d. See also W. Prosser, supra note 9, § 44, at 272; Seavey, Principles of Torts, 56 Harv. L. Rev. 72, 91 (1942); Bohlen, Book Review, 47 Harv. L. Rev. 556, 557 (1934). For the view that foreseeability is relevant, see McLaughlin, supra note 40, at 182-83.

52. See text accompanying notes 44-45 supra.

53. Ordinarily we measure that risk, or probability of harm, at the moment the wrongful conduct occurs. If, however, an actor creates a dangerous condition that persists over time and with respect to which the probability of harm is shifting, we use the probability at the moment immediately preceding the time that an intervening act concurs with the dangerous condition to create the harm. After all, it is the dangerous condition at this time, and not at another, that produces the harm.

Cases involving omissions rather than commissions raise similar measuring-time questions. If an actor's omission creates a dangerous condition that, when acted on by an intervening event, leads to harm, we measure the riskiness of the omission at the time immediately preceding the intervention of the concurring event. On the other hand, where the omission is the intervening agent that acts upon a dangerous condition, we measure the omission's riskiness either at the time the harm arises or when the two factors have concurred to create a condition that will lead directly to the harm, whichever is earlier.

54. Deterministic analysis portrays a causal chain of events that is inevitable; by the operation of natural laws, a given cause is shown to lead necessarily to its effect. On the other hand, a probabilistic analysis stresses that given causes lead to particular results with only a certain frequency. If we imagine a cause repeating itself a large number of times, that cause might result in a particular consequence only, for example, 50% of the time.

a. *Simultaneous causes.* Let us define A_{to} as the wrongful act of A, and B_{to} as the wrongful act of B, where both occur simultaneously at time t_o and combine to cause a single indivisible harm. Each cause, when considered separately from the other but in conjunction with standard environmental conditions (E_{to}), has some probability greater than zero of producing the harm. We can therefore write the probability of the occurrence of such a harm (H_i) as follows:

$$\alpha = P_{to}(Hi \mid A_{to}, E_{to}) \qquad (1)^{55}$$

$$\beta = P_{to}(H_i \mid B_{to}, E_{to}). \qquad (2)$$

Thus, the conditional probability of H_i given A_{to} alone in the standard environment is equal to α; the analogous probability given only B_{to} is equal to β. Each of these expresses the marginal product of the relevant wrongful conduct in terms of its likelihood of producing the harm actually suffered. The *ratio* of those marginal products (α/β) represents the relative contribution of one cause with respect to the other.[56] When damages (D) are apportioned, A's share will amount to $(\alpha/(\alpha+\beta))D$ and B's will be $(\beta/(\alpha+\beta))D$.[57]

Borgo, supra note 21, at 425 argues that probability analysis does not fit well with causal theory because the former considers relations between classes of events while the latter considers one specific event. Thus, probability statements take the form "in the class of events X a certain percentage give rise to members of the class Y"; causal statements, on the other hand, take the form "this X caused this Y." The difference, however, is overstated. To identify causal relationships it is necessary to know something about the *typical* relations between events. "When we assert that A's blow made B's nose bleed or A's exposure of the wax to the flame caused it to melt, the *general knowledge* used here is knowledge of the familiar 'way' to produce, by manipulating things, certain *types* of change which do not normally occur without our intervention." Hart & Honoré, supra note 17, at 29 (emphasis added).

55. P_{t_o} takes the place of f in the more familiar functional notation of $y=f(x)$. We use P to emphasize that the equations measure probabilities at a particular time (here, t_o represents the time of the wrongful conduct). The vertical line following H_i signifies the word "given."

56. As before, the probabilities are measured on the basis of facts existing at t_o, but evaluated in accordance with the best theories available at the time of the trial. In the examples that follow we assign precise probability measurements to the harmful potential of various activities and events. We do so for illustrative purposes only; precise probabilities are not necessary for the application of our system. Rough estimates of relative likelihoods are all we can or ought to expect from courts. Uncontroversial probability assignment is, of course, easiest in circumstances that are readily subject to seriable or repeatable experiments, such as the number of Coke bottles per 100,000 that will explode upon opening. In other cases, however, it is still possible to use the information on hand to form estimates of probability. Suppose, for example, we want to know the likelihood that a boulder precariously perched atop a hill will fall into a ravine below under the force of a gentle breeze. To make a rough estimate we do not require 100,000 similar cases. We can draw on scientific and everyday knowledge about objects that are positioned precariously and on information about the force that winds of different speeds exert on various objects. Expert testimony and common sense ought to enable a jury to arrive at rough approximations. (Indeed, in situations such as these, a probability statement is more profitably viewed as a rational or informed *degree of belief.*) Numerical estimations of one sort or another are continually being made in comparative negligence cases. To the extent that the concept of negligence employed is that embodied in Judge Learned Hand's formula, which finds an actor liable if the burden of adequate precaution is less than the product of the probability that the harm will occur and the gravity of the resulting loss ($B<PL$), not only probability estimates but also decisions about relative costs of avoidance are being made. See United States v. Carroll Towing Co., 159 F.2d 169 (2d Cir. 1947). By requiring fewer estimates, our system is simpler. See note 129 infra.

57. Our goal is to compute A's and B's damages so that each actor's monetary contribution bears the same relation to the total monetary contribution as the causal contribution of each bears to

Suppose, for example, that two tortfeasors simultaneously shoot a third person who later dies as a consequence of both injuries. If one type of injury is serious, carrying with it a probability of death equal to .90, and the other is less serious, with a .45 probability of death, the relative causal contribution of the former is twice that of the latter.[58] Therefore, the first tortfeasor will pay twice as much in damages as the other. Damages are thus computed in accordance with the degree of causal contribution, which is equal to the *objective relative marginal product of the wrongful act or event at the moment it occurs.*[59]

The analysis of simultaneous causes can be extended to account for and to allocate the effects of synergistic interaction. Suppose that the two tortfeasors above inflict minor injuries that, when taken independently, present only a slight chance of death, but that, when taken together, render death a near certainty. In this case, the actual joint probability of death (γ) is equivalent to the sum of two effects: (1) that of the two causes acting independently but taken together, that is, the definitional joint probability, (δ), defined by the equation

$$\delta=\alpha\beta+(1-\alpha)\beta+(1-\beta)\alpha, \qquad (3)^{60}$$

and (2) the synergistic effect of the two causes acting together. Assuming two wrongful causes (A_{to}, B_{to}) operate simultaneously under standard conditions to produce an indivisible harm, we can write:

$$\alpha=P_{to}(Hi|A_{to},E_{to}) \qquad (4)$$

$$\beta=P_{to}(Hi|B_{to},E_{to}) \qquad (5)$$

$$\gamma=P_{to}(Hi|A_{to},B_{to},E_{to}). \qquad (6)$$

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the total causal contribution. For A this latter ratio can be expressed as the fraction: $\alpha/(\alpha+\beta)$. The numerator is A's causal contribution, the denominator the sum of both parties' causal contributions. To compute A's share of the damages, we multiply total damages (D) by that fraction, as follows: $D_A=(\alpha/(\alpha+\beta))\ D$.

58. Although for illustrative purposes we use absolute probability measurements, the theory requires only an approximate measure of the *relative* likelihood that each cause will produce harm.

It should also be noted that we are estimating the probabilities of death after plaintiff has been shot. We could have estimated them at the beginning of the activity (e.g., hunting) that led to the killing. The former is more consistent with our emphasis on what did happen rather than what could have happened. Ultimately, however, there would be no major sacrifice in principle by using the latter method, because more dangerous or risky hunting will presumably have more serious consequences in the long-run.

59. Our theory bears a certain similarity to the German "adequate cause" approach. See, e.g., Hart & Honoré, supra note 17, at 411-41; Honoré, Causation and Remoteness of Damage, *in* 11 Int'l Ency. Comp. L. ch. 7, at 49-55 (1971). Under the German approach, however, an adequate cause must be a *necessary* condition that significantly raises the probability of the harm. Following Hart & Honoré, we reject the view that all causes must be necessary conditions. Furthermore, the adequacy theory is normally, though not necessarily, developed within a system of negligence, while ours is part of a theory of strict liability. See also notes 72 & 85 infra.

60. As an example, suppose that one flip of a coin has a .50 probability of turning up heads. By definition, if two coins are flipped, the probability of recovering at least one head rises to the sum of: (1) the probability that *both* coins will turn up heads ((.50)(.50)); (2) the probability that only the first coin will turn up heads ((.50)(1-.50)); and (3) the probability that only the second coin will turn up heads ((1-.50)(.50)). This sum is equal to .75.

The synergistic effect is measured by $\gamma-\delta$. Synergism is present when this value is positive and absent when it is zero. When the value of $\gamma-\delta$ falls below zero, "negative synergism" is present.

Causal apportionment allocates responsibility for synergistic effects equally between the two causes. It does so on the assumption that neither cause should be held more responsible than the other for an effect that neither could have produced alone. Thus, the apportionment ratio of A's share to B's will be:

$$\frac{\left(\frac{\alpha}{(\alpha+\beta)}\right)\delta+\left(\frac{(\gamma-\delta)}{2}\right)}{\left(\frac{\beta}{(\alpha+\beta)}\right)\delta+\left(\frac{(\gamma-\delta)}{2}\right)} \qquad (7)^{61}$$

The limiting case of positive synergism is represented by "acts harmless in themselves which together cause damage."[62] Hart and Honoré call this "contributory causation."[63] Assume that A places a few drops of one chemical in C's coffee while B pours in a few drops of some other substance. If each chemical alone is harmless, but together they interact to produce death, then the outcome is truly the joint product of both causes. With $\alpha=0$, $\beta=0$, $\delta=0$, and $\gamma>0$ formula (7) apportions damages equally between A and B.

The absence of synergism may be illustrated by an instance of what Hart and Honoré label "additional causation."[64] In their case, each cause is strictly sufficient to produce a harm: thus, the probability of each alone creating that harm is unity. If α and β are both equal to one, and γ equals δ, then formula (7) reduces to the simpler relationship, α/β, and damages are apportioned in accordance with $\alpha/(\alpha+\beta)$ and $\beta/(\alpha+\beta)$. These apportionment formulae apply to all cases lacking synergistic effects, because in these cases, γ and δ are by definition equal.[65]

In cases of negative synergism, formula (7) apportions the benefit of the synergistic effect equally between the tortfeasors. Suppose that A and B each

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61. Without either a definitional or a synergistic effect, A's and B's relative shares would, as before, be $\alpha/(\alpha+\beta)$ and $\beta/(\alpha+\beta)$, respectively. If we introduce a definitional effect, this must be divided between A and B in proportion to their relative contributions. (Recall that the definitional effect is the result of an algebraic combination of α and β. See note 60 supra.) The synergistic effect, on the other hand, is divided equally between A and B, because neither factor is more responsible than the other for an effect that neither could have produced alone. This then yields formula (7). A's and B's absolute shares can be derived from formula (7); if formula (7) is set equal to X, then A's share is $X/(1+X)$ and B's share is $1/(1+X)$.

62. See W. Prosser, supra note 9, § 52, at 322-23.

63. Hart & Honoré, supra note 17, at 190-216.

64. Id. at 216-25.

65. The absence of synergism is not, of course, restricted to cases in which each cause, taken separately, has a probability of producing the harm equal to one.

administers a poison to C and that each poison reduces the probability that the other will be lethal.[66] The actual joint probability of death (γ) falls below the definitional joint probability (δ), rendering the synergism element in both the numerator and denominator of the apportionment formula negative. The causal contribution of each tortfeasor is reduced accordingly, with a corresponding adjustment in the ratio between them.

b. *Nonsimultaneous causes.* Cases involving nonsimultaneous causes require an adaptation of the analysis. Because the contribution of each cause is measured at the moment it occurs,[67] we can no longer measure the contribution of the second cause in isolation from the first. Instead, we recognize the first cause as part of the environment in which the second cause operates; we measure the relative importance of the second by determining the increase in the risk attributable to it. On the other hand, we continue to measure the first cause independently of the second.

Assume that a car driven by A forces C, a pedestrian, into the middle of a roadway, where he is hit by a car driven by B. We write the degree to which the harm is dependent on the original wrongful act in the following way:

$$\alpha = P_{t_1}(H_i \mid S_{t_1}, E_{t_1}) \tag{8}$$

where H_i is the harm to C, S_{t_1} is the state of C's being on the roadway, and E_{t_1} represents environmental conditions at time t_1. The probability is evaluated at a point after A's intervention but before B's. We then introduce the factor of B's driving the second automobile (B_{t_2}):

$$\beta = P_{t_2}(H_i \mid S_{t_1}, B_{t_2}, E_{t_2}) \tag{9}$$

where β is the risk of harm after B's intervention. Damages are then apportioned in accordance with $(\alpha/\beta)D$ for A and $((\beta-\alpha)/\beta)D$ for B.[68] According to our

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66. For example, suppose that A slips a lethal dose of lithium hydroxide (LiOH) into C's coffee while B fills the sugar bowl with beryllium fluoride (BeF_2), a sweet-tasting poison. If C stirs a proper amount of the beryllium fluoride into his coffee, the poisons will precipitate as beryllium hydroxide ($Be(OH)_2$) and lithium fluoride (LiF), and will settle to the bottom of the cup. When C drinks his coffee, it is less likely that he will consume the poisonous sediment than he would have consumed either of the two poisons, which, had either been administered separately, would have remained dissolved in the coffee. Thus, not only is C less likely to die, but also he will consume a *therapeutic* dose of lithium, which remains in solution.

67. See text accompanying note 59 supra.

68. A's causal contribution to the harm is represented by α, while β represents the combination of A's and B's contributions. Thus, B's causal contribution is equal to $\beta-\alpha$. Employing these values, we apply the analysis presented in note 57 supra to derive the formulae for damage apportionment.

theory, A is responsible for the effects of subsequent causes that have a high probability of occurring.[69] Thus, if B's driving did not exceed the customary degree of dangerousness, A will be liable for the full extent of the harm. On the other hand, to the degree that B drove more dangerously than is customary for the road, β will exceed α and liability for the harm will be apportioned between the two actors.[70] B is liable in damages, therefore, only to the degree that his conduct raises the probability of the harm occurring to C above the customary degree of dangerousness for a person lying on the road.

3. *Two constraints on the theory.* While our method relies on hypothetical fact patterns,[71] it demands adherence to the actual facts of the tortious occurrence in two ways. First, the actual order of events must be maintained to insure an accurate apportionment in cases involving nonsimultaneous causes. Maintaining this temporal order is crucial because we are attempting to measure the objective marginal product of the wrongful act or event *at the moment it occurs*. Second, the method is constrained by the actual harm suffered by the victim. The objective is to apportion liability for what did happen, rather than for what might have occurred; therefore, speculation about other possible results of the tortfeasors' actions is impermissible. Moreover, where the harm is divisible, responsibility for each part should be apportioned separately. Thus, suppose that while operating his automobile, A hits pedestrian C, breaking his arm and throwing him into the path of a car driven by B, which runs over C and breaks his leg. Responsibility for the arm would be allocated solely to A, whereas liability for the leg would be divided between A and B in accordance with their causal contributions.

B. *Causation and Damages*

While causation is employed to apportion responsibility among joint tortfeasors, its impact is not felt until a court measures the extent of the harm. Suppose that A and B are falling off a cliff to certain death, A having jumped and B having been pushed by C, when both are shot dead by D. Although causal theory identifies D as the sole causal agent in each case and therefore imposes responsibility upon him,[72] it does not constrain a court from treating

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69. This responsibility is incorporated into α through the variable E_{t_1}. See text accompanying note 47 supra.

70. A finding that B has driven more dangerously than normal is not equivalent to a finding of negligence in the sense of, say, Judge Learned Hand's formula in United States v. Carroll Towing Co., 159 F.2d 169 (2d Cir. 1947). The cost of B's avoidance of dangerous driving is not relevant. The only issue is the degree to which B makes the final outcome more probable.

71. See text accompanying note 53 supra.

72. Responsibility is imposed on D despite the fact that his acts are not necessary conditions of the deaths. Indeed, for liability to be allocated, D's acts need not even raise the probability of A's or B's death relative to *alternative* conduct or states of the world neutralized by those acts. What is important is that D has caused A's and B's deaths. This is important because we are concerned with events or acts that *did* happen, not those that *might* have happened. Hence we are not defining causes in cases like these in terms of raising the probability of their effects, as has been done by the adequacy theorists, see generally Hart & Honoré, supra note 17, at 415, 417 (citing sources), and by

these cases differently. Because the two deaths differ on the compensability of the cause neutralized by D's intervention, a court may find damages appropriate for B's death but inappropriate for A's. It can achieve this result by reducing the measure of damages, the present value of the victim's life at t_o, by the effect of only noncompensable factors, such as self-imposed or innocently created[73] harms. At t_o, A's suicidal act reduces the present value of his life to nil; therefore, the value of the objective marginal product of D's wrongful conduct is zero. D escapes all liability for A's death. On the other hand, no parallel reduction in the value of B's life would be made, because the losses that would have been occasioned by the neutralized alternative are compensable; hence D would pay full damages for this death.[74] Furthermore, in a probabilistic variation of the first case, suppose that at the moment of the shot, the probability that A would have died was only .50. The expected present value of A's life, the measure of D's liability, would be half its value in the absence of A's actions, rather than zero. Therefore, in contrast to the nonprobabilistic case, here D would not escape all liability.

The analysis extends as well to cases with two operative causes. Suppose that a field is burned by two combining fires, one set wrongfully by A, the other of unknown origin. If the origin of the second fire is innocent, A will pay no damages, because the present value of the property destroyed takes into account the impact of that fire. On the other hand, if the second fire is also of wrongful origin, its occurrence does not reduce compensable value. Thus, the objective marginal value product of each cause is the same as it would have been absent the other cause: the full value of the property destroyed.[75]

It ought to be emphasized that reduction of damages is appropriate only when the "threats" deriving from innocent causes are above the average endured by all people. The average level of risks is implicitly subtracted from the value of life, and to subtract it again would be double counting. In the case of land or chattels, their market price would already incorporate all risks of uncompensated losses to the extent that they are anticipated at the time of an exchange. If there is a .50 probability that a house will be innocently washed out to sea tomorrow, the price that is paid today for that house will reflect the diminution in value.[76]

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others, see, e.g., Calabresi, Concerning Cause and the Law of Torts: An Essay for Harry Kalven, Jr., 43 U. Chi. L. Rev. 69, 71-72 (1975); Shavell, An Analysis of Causation and the Scope of Liability in the Law of Torts, 9 J. Legal Stud. 463, 468 (1980); P. Suppes, A Probabilistic Theory of Causality 12 (1970). Although a cause need not increase the probability of a harm relative to alternative means, it must, of course, have a nonzero probability of producing it.

73. "Innocently created" denotes acts of God and, in a negligence framework, nonnegligent accidents.

74. Imposing damages on D for B's death but not A's reflects the premise that the victim should pay the costs of self-imposed or innocent factors whereas the tortfeasor should pay for all others.

75. See Peaslee, Multiple Causation and Damage, 47 Harv. L. Rev. 1127, 1137 (1934). Steven Shavell argues that *neither* of those responsible for the two (independent) wrongful fires would be liable, because a proximate cause must be at least a necessary condition, Shavell, supra note 72, at 482, 495. This is neither consistent with a commonsense view of causation nor perhaps with economic efficiency. See generally Landes & Posner, supra note 1, at 522-26.

76. This hypothetical is derived from Peaslee, supra note 75, at 1135.

Therefore, if it is *wrongfully* burned down, the damages will equal its market price without any additional reduction. Only when the losses are unanticipated is any adjustment necessary.

III. Applications of the Theory

Causal apportionment is capable of apportioning damages in all cases involving joint causes,[77] whether they arise simultaneously or at different times. This section demonstrates that capacity and reveals one of the method's most appealing attributes: its unification of the analysis of concurrent and superseding causation.

A. *Simultaneous Causation*

Our method of causal apportionment readily allocates liability among causes that arise simultaneously. Assume that two fires, which are set simultaneously but independently by A and B, combine and destroy C's field. Assume further that A sets his fire in a location with vegetation more dense than the vegetation at the spot chosen by B, so that there is a two in ten chance (.2) that A's fire will destroy the entire property, while the comparable figure for B is one in ten (.1). Finally, assume that the combined fire is more powerful than the two fires taken separately, so that there is a five in ten chance (.5) that it will destroy the entire field. Apportioning liability between A and B in accordance with formula (7),[78] we first compute the definitional joint probability (δ) in accordance with equation (3).[79] Since $\alpha=.2$ and $\beta=.1$, equation (3) yields $\delta=.28$. Substituting appropriate values for the variables in formula (7), if the actual joint probability (γ) equals .5, we get

$$\frac{\left(\frac{.2}{.2+.1}\right).28+\left(\frac{.5-.28}{2}\right)}{\left(\frac{.1}{.2+.1}\right).28+\left(\frac{.5-.28}{2}\right)}\approx 1.46 \qquad (7')$$

When damages are judged, of each dollar of recovery, A will pay $(1.46/(1+1.46))\ (\$1.00) \approx \$0.59$, and B will pay $(1/(1+1.46))\ (\$1.00) \approx \$0.41$.[80] For each dollar of damage, A's fire independently caused approximately \$0.37 of damage, B's caused approximately \$0.19, and the synergistic effect, which A and B divide evenly, caused the remaining \$0.44 of damage.[81]

77. The method also "apportions" damages in cases involving direct causation. In these cases, where the harm is produced directly by the actions of only one tortfeasor, all liability flows to him. Beale discusses many such cases. Beale, The Proximate Consequences of an Act, 33 Harv. L. Rev. 633, 644 (1920).

78. See text accompanying note 61 supra.

79. See text accompanying note 60 supra.

80. See note 61 supra.

81. The nonsynergistic share of the total damages caused by both A and B is in the proportion of .28/.50 or 56%. This share is then divided between A and B in the proportion yielded by formula

B. *Intervening Causation*

An intervening event is one of low relative frequency that is both subsequent to and independent of the original wrongful conduct.[82] The requirement of low frequency differentiates the event from an occurrence typical of the ordinary environment. The requirement of independence distinguishes intervening events from subsequent events that are caused, even in part, by the original wrongful conduct. Once the causal status of the intervening event is established, classical tort law employs shifting and semantic bases to classify such an event as either a concurrent[83] or a superseding cause.[84] If the cause is deemed concurrent, it shares joint and several liability for the harm with the initial cause. If found to be superseding, the intervening cause takes full responsibility. The causal apportionment theory eliminates this distinction by assigning liability in accordance with the extent to which the intervening event raises the probability of plaintiff's harm.[85] Concurrent and superseding causes are merely two points along a continuum of causal significance.

1. *The continuum of intervening causation*

a. *Superseding cause.* Suppose that *A* parked his car at the top of a hill in an unsecured manner, so that there was a slight possibility the car would come charging down the hill, through a stand of trees at the bottom, and into *B*'s nearby house. Can we say that *A*'s creation of this dangerous condition was the cause of the harm if a cyclone later picked up the car and dropped it on *B*'s house?[86] Intuitively, the answer appears to be no. Causal apportionment reaches

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(7) if the synergistic effect is zero. That proportion here is .187/.093.

82. See Hart & Honoré, supra note 17, at 151-52. Standard conditions do include abnormal subsequent events when their *cumulative* probability is high. Thus, some acts of God will not be intervening events. For example, if a building is constructed to last 75 years in an earthquake-prone area, the probability that a quake would occur in any given month might be extremely low. However, the probability that it would happen at least once in 75 years could conceivably approach unity. In this case, then, the builder constructs the building under conditions that *include* the likelihood of an earthquake. Hence all causal responsibility deriving from the marginal product of his activity must lie with him. Of course, no account is taken of whether the probability of a quake reasonably could have been known at the time of construction.

83. We employ "concurrent" in its causal rather than temporal sense; thus, concurrent causation is present when two or more causes jointly produce a harm, whether or not the causes are simultaneous. See generally W. Prosser, supra note 9, § 44, at 271 n.85; G. Williams, supra note 6, at 2.

84. See generally W. Prosser, supra note 9, § 44, at 270-89. This dichotomy is used, like the doctrine of proximate cause, to limit the initial tortfeasor's liability after causation-in-fact is established. Id. § 44, at 270-71. In contrast, our theory synthesizes the elements of liability and causation in fact; causation defines the extent of liability rather than playing a prior independent role along the road to recovery.

85. In contrast to the discussion at note 72 supra, it is appropriate here to define a cause in terms of raising the probability of plaintiff's harm. The difference is that now we are not contrasting probabilities relative to some theoretical alternative situation, but rather with respect to a temporally prior event or action. We are attempting to determine what a subsequent additional factor has *added* to what has actually occurred. This is consistent with our actual harm and time order constraints. See text accompanying note 71 supra.

86. This example is adapted from Epstein, Strict Liability, supra note 19, at 184.

the same conclusion. Let A_{to} be the creation of the dangerous condition by A, and H_i the damage to B's house:

$$\alpha = P_{to}(H_i | A_{to}, E_{to}). \tag{10}$$

Now let I_{tl} be the intervening cyclone:

$$\beta = P_{tl}(H_i | A_{to}, I_{tl}, E_{tl}). \tag{11}$$

Upon careful examination of the facts, it is reasonable to say that α is approximately zero, because it was quite improbable that the car would have successfully negotiated the trees and reached the house under standard environmental conditions. If this is indeed the case, then no matter what the value of β, so long as it exceeds zero (as it clearly does), all causal responsibility must be placed on the intervening event. Thus, in general, whenever $\alpha \approx 0$ and $\beta > \alpha$ the intervention amounts to a full superseding cause.

When analyzed in tort rather than contract, many of the shipment delay cases also fall within this category. In *Toledo & Ohio Central Ry. v. Kibler & Bros.*,[87] the T. & O. delayed shipment of goods, which during the delay were destroyed by a flood. The delay was a necessary condition of the destruction, because otherwise the goods would have been elsewhere during the flood. Nevertheless, the Ohio Supreme Court held the shipper to be free from liability. Our theory concurs. If A_{to} is the delay and I_{tl} is the flood, an examination of equations (10) and (11) makes it clear that α is approximately zero and $\beta > \alpha$. Therefore the delay, though a necessary condition, is not causally responsible for the damage.

b. *Concurrent ("partial") cause.* Let us reexamine the precariously parked car of the previous section under different assumptions. Suppose that no trees separate the base of the hill from B's house and that the car was pushed down the hill and into the house, completely destroying it, by the intervention of an unusually strong wind. If a normal wind could have produced the same damage to the house, orthodox tort analysis would consider the unusally strong wind superfluous, and therefore not an intervening cause.[88] Under causal apportionment analysis, we compare the effect of the strong wind on the probability that the harm will occur with the probability in the absence of the unusual wind. Thus, assume that under normal wind conditions, there was a one in ten chance that the car would plunge down the hill into the house, and that the intervention of the stronger wind increased this probability to two in ten. Referring back to equations (10) and (11), $\alpha = .10$ and $\beta = .20$. If we apportion liability in accordance with these prohibitions, the two causes will share the damages equally;

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87. 97 Ohio St. 262, 119 N.E. 733 (1918).

88. See Epstein, Strict Liability, supra note 19, at 184.

This conclusion is, of course, at odds with the law's view of alternative *wrongful* causes. It is immaterial that if A had not hit B, C would have; A still caused harm to B. See Hart & Honoré, supra note 17, at 225-26.

the driver and the homeowner will each pay half.[89] In general, where $\alpha>0$, $\beta>0$, and $\alpha<\beta$, the first cause is assigned a share of the damages equal to α/β, and the second cause, called an "intervening partial cause," is responsible for $(\beta-\alpha)/\beta$.[90]

Although the law has not attempted to apportion damages in cases such as this, in which the harm was indivisible, the Supreme Court of Washington did apportion liability in a case involving a divisible harm. In *Radburn v. Fir Tree Lumber Co.*,[91] Fir Tree constructed a dam that, in the presence of a normal rainfall, would very likely produce flooding. An abnormally heavy rainstorm erupted, leaving extensive flooding. The court held that Fir Tree should be found liable only for the portion of damages that a normal rainfall was likely to produce, and that the remainder of the damages should be attributed to an act of God. Thus, the court's apportionment scheme did not employ causation, but rather rested on the divisibility of the damages.[92]

This analysis would be inappropriate under our regime of causal apportionment, because we are constrained by the harm that actually occurred.[93] For several reasons, we do not speculate about other types or degrees of harm that might have been produced. First, holding an actor liable for the expected losses if environmental conditions had been otherwise involves the concept of foreseeability, a notion that is inconsistent with a system of strict liability.[94] Second, although the actual harm might not have been possible under standard conditions (zero probability), the court's analysis might still hold the actor liable for the expected losses of another type of harm.[95] The possibility that the defendant would have to compensate the plaintiff for damages he could not possibly have caused is inconsistent with our principle of liability based upon causation. Finally, if the expected losses under standard environmental circumstances exceed the actual losses under abnormal circumstances, the court's method must set the

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89. We assume here that the victim will be assigned liability for damages caused by innocent causes, such as the unusually strong wind. See notes 73-74 and accompanying text supra.

90. Although the defendant has engaged in wrongful conduct it would be inappropriate to hold him completely liable for the subsequent damages, because he is not the *sole* cause of those damages. Unfortunately, the other cause is an act of God, and no legal system has yet recognized causes of action against Him. The argument that as between an innocent plaintiff and a tortfeasor the latter should bear the burden is criticized in text accompanying notes 110-12 infra.

91. 83 Wash. 643, 145 P. 632 (1915).

92. Divisibility in this context has a different meaning from its usual one. In the usual sense, it refers to cases in which, for example, *A* hits *B* in the leg, and *C* at the same time hits *B* in the arm. The result may be a single serious hospitalization, but this can be broken up into its component parts (i.e., an injured leg and an injured arm). Here divisibility refers to the amount of harm that *would* have occurred in an alternative state of the world.

93. See text accompanying note 71 supra. See also Landes & Posner, supra note 1, at 521-22 (analysis of similar topics, where the severity of the harm is held constant while only the probability of its occurrence is allowed to vary with respect to different levels of accident avoidance).

94. On the problems of foreseeability see, e.g., Rizzo, Law amid Flux, supra note 37, at 303-06.

95. In *Radburn*, the actual harm and the expected harm were of the same type: flooding. Radburn v. Fir Tree Lumber Co., 83 Wash. 643, 644, 145 P. 632, 633 (1915). Therefore one cannot be certain whether the court's rule that the defendant is liable for expected harm is limited to cases in which that harm is of the same type as the actual harm. If it is not, then the defendant may be held liable for damages that he could not possibly have caused.

harm actually suffered as an exogenous limit on recoverable damages. On the other hand, our system incorporates that limitation directly into the model by adhering to the harm that actually occurred. In our framework, we estimate the probability of the actual harm occurring under standard conditions (α) and the probability of occurrence under abnormal circumstances (β). The defendant then bears α/β of the damages.[96]

A special case of concurrent causation is that of successive torts. Suppose that A, the driver of an automobile, hits a pedestrian, C, fracturing his skull. Knocked unconscious by the accident, C lies on the road where B, another driver, runs over his leg and breaks it.[97] The orthodox law of successive negligence provides that either the original tortfeasor is liable for both injuries or A is liable for the skull and B for the leg. In general, both of these solutions are incorrect on causal grounds, as our analysis will show.

If the initial injury, the skull fracture, was produced under standard environmental conditions, then A is fully liable for it on causal principles. Allocating responsibility for the ulterior harm, however, is not as simple. Here, both A's and B's acts may have had causal significance in producing C's broken leg. We measure that significance by calculating α and β in accordance with equations (8) and (9). Recall that α is the probability that the broken leg would have resulted from A's placing C on the roadway in an unconscious state, in conjunction with standard environmental factors, while β represents the probability that the leg woud have been broken in the presence of both A's and B's actions. Damages (D) for the broken leg are apportioned as $(\alpha/\beta)D$ for A and $(\beta-\alpha/\beta)D$ for B.

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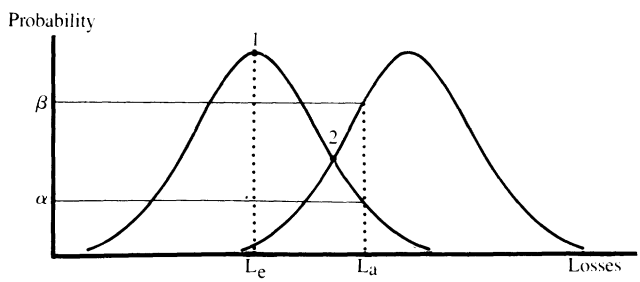
96. In general, it is not possible to say whether our apportionment method or that of the *Radburn* court yields the greater recovery for plaintiff. It is possible to say, however, that for well-behaved probability distributions the proportion of losses recoverable by plaintiff under both methods falls as the actual total losses rise.



The first curve represents the probability distribution of losses given standard environmental conditions; the second is the distribution given abnormal circumstances. If the actual losses are within the interval between points 1 and 2, the court in *Radburn* would impose the expected loss under standard conditions (L_e) on defendant, while our method would assign the full losses. Here the abnormal conditions constitute a partially neutralizing factor. If, on the other hand, actual damages (L_a) lie beyond point 2, we impose liability equal to $(\alpha/\beta)(L_a)$. Although no general statement can be made about the relationship between $(\alpha/\beta)(L_a)$ and L_e, simple inspection of the diagram shows that as L_a rises the proportion of losses recovered by plaintiff in both systems will decline.

97. This example is taken from W. Prosser, supra note 9, at 320.

c. *Noncausal intervening factor.* The third point along the continuum of intervening factors is the intervening factor that lacks causal significance. Assume that a driver parks his car atop a hill, failing to set the parking brake. Assume further that light winds capable of starting the car down the hill and into a house below are normal for the area. If the car damages the house because of the intervention of an unusually strong wind, but would be equally likely to roll down the hill under the influence of a normal wind, then $\alpha=\beta$, and the intervening factor (the strong wind) is noncausal. Under the apportionment formula, α/β, the driver would be liable for the full extent of the harm.

d. *Partially neutralizing intervention.* Suppose that defendant, who lives in an arid region, lights a fire that spreads to and destroys his neighbor's house. If the fire spreads despite a freak rainstorm, the rainstorm is a partially neutralizing force, since under equations (10) and (11), $\alpha>\beta$. Such intervention is not causal because it reduces the probability of the harm. Therefore, despite the occurrence of an intervening event, defendant is liable for the entire loss.

2. *The nature of intervening conduct and placement along the continuum.* It has been suggested that an intentional[98] intervening act "negatives causal connexion,"[99] while a negligent intervening act does not:[100] an intentional act supersedes, while a negligent act, in and of itself, concurs. Although this formulation is overly broad,[101] it captures a fundamental insight. The law treats intentional and reckless or grossly negligent intervention quite differently from that which is merely negligent. In most cases, causal apportionment will parallel this different treatment.

Assume that *A* places a huge boulder precariously close to the edge of a cliff. Subsequently, *B* comes along and, seeing his archenemy *C* below the cliff, pushes the boulder down, killing him.[102] Relative causal significance can be computed in the normal fashion by using equations (10) and (11) to obtain values for α and β. Because *B*'s act was intentional, the value of β is likely to be quite high, if not unity. The likelihood of success is limited only by the accuracy of *B*'s aim. In general, the extent to which intentional intervention raises the probability of harm is substantial, provided, of course, that α itself is not high. Consequently, in many such cases the preponderance of causal responsibility (and hence of liability) will lie with the intentional intervener.[103] In a system constrained not to apportion liability, the rule of thumb that imposes full liability upon the intentional intervener is consistent with his normally greater relative causal significance.

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98. Here, not only the act but also the resulting consequences are intended.

99. Hart & Honoré, supra note 17, at 129.

100. Id. at 143.

101. See Epstein, Strict Liability, supra note 19, at 181-83.

102. This example is taken from id. at 182.

103. Epstein assumes the causal priority of the dangerous condition. Epstein, Strict Liability, supra note 19, at 182. On the other hand, in criticizing Epstein's theory, Borgo, supra note 21, at 446-47, emphasizes the importance of intentional intervention. The argument in the text reconciles these two views by showing the importance of both creating the dangerous condition and deliberately exploiting it.

Suppose that in the example of the precariously perched boulder the intervening conduct had been reckless instead of intentional. Can the law's treatment of such intervention be explained within our framework? Recall that reckless or grossly negligent acts also relieve the first wrongdoer of responsibility (i.e., negate causal connection).[104] In practice, reckless conduct is characterized by a substantial risk of harm.[105] This high degree of risk makes it likely that β will be large relative to α. Accordingly, to the extent that the law refrains from apportionment and imposes the entire liability on B, it parallels the conclusion of causal apportionment as to relative causal significance.[106]

The traditional view that negligent intervening acts do not negative causal connection is also explicable within our framework. Of the three forms of intervening conduct, negligent intervention is least likely to raise substantially the probability of harm; the relative values of α and β are apt to diverge less than they will in cases of intentional and reckless or grossly negligent acts. Thus, it is consistent with causal apportionment not to place the burden on the second actor merely because he has intervened.

The famous case of *Palsgraf v. Long Island R.R.*[107] illustrates some of the principles discussed above. A man, carrying a package, was running after a train. He managed to catch up to it and jumped on board, "but seemed unsteady as if about to fall."[108] While a conductor on the train pulled him up and another on the platform pushed him aboard, the package he had been carrying fell to the ground and exploded. Unbeknownst to the conductors, it had contained fireworks. The force of the explosion caused some scales at the other end of the platform to fall, injuring Mrs. Palsgraf, who sued the railroad in tort. Speaking for the majority, Chief Judge Cardozo emphasized the railroad's negligence and inquired whether the injury to Mrs. Palsgraf was in the scope of that negligence.[109] This inquiry is unnecessary in our framework. The man carrying

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104. See Hart & Honoré, supra note 17, at 143.

105. Recklessness is often defined as "flying in the face of an *apprehended* risk, indifferent as to its outcome." Id. at 197 (emphasis added). In practice, however, the requirement of apprehension is often assumed, see W. Prosser, supra note 9, § 34, at 185, especially when the probability of harm is high. Thus, the important characteristic becomes the degree of risk that reckless conduct entails.

See also Restatement (Second) of Torts § 500, Comment g (1965) (emphasis added) (recklessness "differs . . . from that negligence which consists in intentionally doing an act with knowledge that it contains a risk of harm to others, in that the actor to be reckless must recognize that his conduct involves a risk *substantially* greater in amount than that which is necessary to make his conduct negligent").

106. What we have said applies equally well to grossly negligent intervention. "[T]here is often no clear distinction at all between such conduct [i.e., recklessness] and 'gross' negligence, and the two have tended to merge and take on the same meaning . . . ." W. Prosser, supra note 9, § 34, at 185.

107. 248 N.Y. 339, 162 N.E. 99 (1928).

108. Id. at 340, 162 N.E. at 99.

109. Id. at 341, 162 N.E. at 99; see R. Keeton, Legal Cause in the Law of Torts, 79-80 (1963). Shavell adds a new twist to this argument: in his view, "unforeseeable" events are those the probability of which is systematically underestimated by even the reasonable man. Shavell, supra note 72, at 491. The theoretical underpinnings of this idea, however, are not secure. If, a priori, a particular contingency is thought to be highly unlikely, then rational individuals will not invest much in trying to refine their probability estimates. Consequently, they ought to overestimate that probability as often as they underestimate it.

the package of explosives had created a dangerous condition by running with it. In fact, he may well have fallen from the train if the conductors had not helped him aboard. Had this happened, the package would probably have dislodged and exploded without any assistance from the conductors. Therefore, the analysis within our theory is straightforward. Clearly, β in equation (9) is not much higher than α in equation (8), because the conductors' acts added little risk to the situation already created by the man with the package. The great preponderance of the causal responsibility lies with him and not with the railroad. Accordingly, in an action against the railroad in which apportionment is not possible, Mrs. Palsgraf should fail, as indeed she did. On the other hand, in an action against the creator of the dangerous condition, she ought to prevail.[110]

C. *Special Applications*

1. *Insolvent or missing defendants.* Until now, we have implicitly assumed that all causally relevant defendants are present in the suit and that each is capable of satisfying the apportioned judgment. If, on the other hand, a tortfeasor either is not joined in the action or is judgment-proof, on whom should the burden of his causal contribution fall?

Causal apportionment demands that the burden rest on the plaintiff. If *A* and *B* jointly cause harm to *C*, and *A*'s contribution is 70 per cent while *B*'s is 30 per cent, *C* is entitled to collect only 70 per cent of the damages from *A*. *C*'s inability to gain full redress from *B* is irrelevant to the question of *A*'s responsibility to *C*, because the limit of a tortfeasor's responsibility to his victim is defined by his causal contribution.

This position is supported at common law in certain kinds of nuisance cases.[111] If, for example, plaintiff's property has been damaged by the independent escape of water from many sources, he is entitled to recover from each tortfeasor only the share of the damages for which that defendant is responsible. Although it is no defense to argue that none of the "escapes," taken individually, would have been sufficient, the single, indivisible harm is nevertheless apportioned among those responsible. Plaintiff's recovery is diminished when other causes were operative, even though only one defendant is a party to the action.[112]

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110. This conclusion is consistent with Epstein's analysis of the case; he reaches it, however, by a different route. See Epstein, Defenses, supra note 19, at 176 n.33.

111. It is also supported in England, at least in part, by the Contributory Negligence Act of 1945. Law Reform (Contributory Negligence) Act, 1945, 8 & 9 Geo. 6, c. 28, § 1. Under this statute, plaintiff's recovery is reduced by his *independent* share of responsibility, regardless of how responsible he was relative to the *particular defendant sued*. Suppose, for example, there are two tortfeasors, *A* and *B*, each 40% responsible, and a single plaintiff, *C*, who is 20% responsible. If *C* sues only *B*, his share relative to *B* is one-half, but his independent share is still 20%. Therefore, he recovers only 40% and not 50%. See Honoré, Causation and Remoteness of Damage, *in* 11 Int'l Ency. Comp. L. 125 (1971).

112. See Woodland v. Portneuf-Marsh Valley Irr. Co., 26 Idaho 789, 146 P. 1106 (1915); Sloggy v. Dilworth, 38 Minn. 179, 36 N.W. 451 (1888).

2. *Indemnity*. In certain instances, the law grants a right of indemnity to one concurrent tortfeasor against another.[113] In many of these cases, the party upon whom ultimate liability falls is responsible for the greatest causal contribution. Therefore, in a legal system that does not apportion liability, our theory predicts whether an action for indemnity should lie.

Suppose a driver, C, stopped for a traffic light and was hit from the rear by A and from the left by B. Suppose further that C was killed by the joint impact of the other two cars. If A was negligent while B intentionally drove into C, and plaintiff recovers from A, A would, under current law, succeed in an indemnity suit against B. Because an intentional act generally has a greater causal contribution than a negligent one,[114] if liability cannot be apportioned, our theory would permit indemnity as well. Similarly, if B had been reckless or grossly negligent, the law would also entitle A to indemnity.[115] Under our theory, the difference in causal significance between B's behavior and A's negligence would lead to the same result.[116]

The law regularly permits indemnification by the actual wrongdoer of a tortfeasor held vicariously liable.[117] This again conforms to our theory. For example, when an employer is held liable for his employee's tort under the doctrine of respondeat superior, the greater degree of risk creation most often lies with the employee. A construction worker who drops a tool on the head of a passerby is causally more responsible than the employer who hired him. Consequently, by succeeding in an action for indemnity, the employer can shift ultimate liability to the more culpable employee.

The law has also permitted indemnification in cases of successive negligence. If, for example, the driver of an automobile wrongfully hits plaintiff, whose wounds are then negligently aggravated by a carefully chosen physician, the driver could be held liable for the full extent of damages. If he were so held, the driver would have a right of indemnity over the physician for the portion of damages caused by the latter's negligent treatment.[118] Thus, liability is appor-

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113. See Keeton, Contribution and Indemnity Among Tortfeasors, 27 Insur. Counsel J. 630, 631-32 (1960).

114. See text accompanying notes 98-103 supra. See also Keeton, supra note 113, at 631 ("intentional wrongdoer is obligated to indemnify a negligent tortfeasor who is also liable to the claimant").

115. See Keeton, supra note 113, at 631. See also Hardware Mut. Cas. Co. v. Danberry, 234 Minn. 391, 48 N.W.2d 567 (1951) (contribution).

116. This may raise the question of why the law assigns liability to the less responsible party in the first place. It does so because A, for example, has *some* responsibility; thus between A and C the equities lie with C. There is sometimes a plausible "deep pocket" explanation as well. See also Landes & Posner, supra note 1, at 533-34 (suggesting an interesting explanation).

117. See generally Leflar, supra note 12, at 148; Bohlen, Contribution and Indemnity Between Tortfeasors (pt. 2), 22 Cornell L.Q. 469, 470-72 (1937).

118. See Bohlen, supra note 117, at 480-81; Leflar, supra note 12, at 154. Although termed indemnity, this might more accurately be called contribution. In analyzing successive tort situations, Landes and Posner ignore the common law's reliance on indemnity to apportion liability. If the ultimate location of liability is taken into account, then the common law's handling of such cases is inconsistent with the efficiency implications of their model. See Landes & Posner, supra note 1, at 545.

tioned according to a rough notion of causal contributions.[119] This is consistent with our analysis. We would determine the probability that the driver's act alone could cause the total harm and compare that with the additional risk created by negligent treatment. Only in the special case where the physician's treatment added no risk would the driver be liable for the entire harm.

In *Brown & Root, Inc. v. United States*,[120] plaintiff had created a dangerous condition by negligently failing to have lighted flares around an open culvert. Defendant's employee negligently lost control of the truck he was driving as he approached the hazard. As a consequence of the joint negligence several people in the truck were injured. The victims recovered damages from Brown & Root, which then sued the driver for indemnification. The court denied indemnification, in part because the negligence of plaintiff was more "culpable" than that of defendant's employee.[121] The court found the relative risk creation of the dangerous condition to be much greater than the driver's risk creation: "In this age of good roads and fast cars, permitting an open culvert to remain without lights of any kind and with a flimsy barricade is more fraught with danger than driving even at the maximum estimate of [the driver's] speed."[122] The court was correct to refuse indemnity, because in a system that does not apportion damages, liability ought to lie with the party with greater causal responsibility.[123]

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119. See text accompanying note 97 supra for the difference between this method and our own.

120. 92 F. Supp. 257 (S.D. Tex. 1950), aff'd, 198 F.2d 138 (5th Cir. 1952).

121. Id. at 263.

122. Id.

123. Landes & Posner, supra note 1, at 533, attempt to explain indemnity in part by the effort to shift liability from more expensive to cheaper cost avoiders. In their view, indemnity is allowed only in alternative care situations, i.e., when the most efficient method of accident avoidance is for just one party to do something. When the party for whom avoidance would have been more costly is initially liable, indemnity will shift the entire burden to the cheaper avoider, who will then have an incentive (in the future) to undertake all avoidance activity. Contrary to their view, indemnity *is* allowed in some joint care situations, as, for example, in the case of successive torts. Assume that *A* harms *C* in an automobile collision and *C*'s injuries are aggravated by the negligent care of physician *B*. Landes and Posner would impose joint and several liability with no contribution for the aggravation of the harm, id. at 548-49; the law, however, permits indemnity in favor of *A* against *B* for this addition to the harm.

Furthermore, Landes and Posner's discussion of indemnity reveals an inconsistency in the interpretation they give to the courts' use of the term "negligence" in cases involving two or more tortfeasors. In joint care situations, that is, where it is economically efficient for both parties to engage in accident avoidance activity, Landes and Posner suggest that a judicial finding that both of the parties were negligent constitutes a judgment that each has failed to adhere to an economically efficient standard of care. On the other hand, in alternative care cases, where efficiency requires avoidance activity of only one of the actors, Landes and Posner do not give the same holding of negligence the same meaning. To find that both parties have failed to meet an economically efficient standard of care in an alternative care context would contradict the definition of alternative care. Instead, Landes and Posner find such a dual holding of negligence to be an accommodation to the plaintiff to permit recovery against either of the defendants. Then, only through an indemnity action is it possible to identify the one of the two negligent actors who has failed to adhere. Since courts deviate from an economic conception of negligence in alternative care cases, one must wonder whether they similarly depart from such thinking in joint care cases. Landes and Posner's hypothesis that joint and several liability is efficient collapses if negligence standards are not set in accordance with economic theory. Id. at 525-26.

D. *Causal Defenses*

We have thus far focused attention solely on the prima facie case and have not discussed the possibility of defenses.[124] A theory of causal apportionment, however, enables us not only to divide liability among joint tortfeasors, but also to determine the method by which defendant may reduce or eliminate damages. Just as there can be partial causal responsibility on the part of one tortfeasor, there can be partial causal responsibility on the part of the plaintiff.

The paradigm of compulsion often constitutes a complete defense. For example, although "*A* hit *B*" states a good prima facie case, "*B* compelled *A* to hit *B*" can state a valid and complete defense.[125] Let α represent the probability that *A* would hit *B* under standard environmental conditions and β the probability that *A* would hit *B* under compulsion; if $\alpha \approx 0$ and $\beta > 0$, then compulsion ought to be a complete defense on causal principles. However, if $\alpha > 0$, then compulsion is only a partial defense and, in the limit (where $\alpha = \beta$), it is no defense at all. In fact, in the latter case we may doubt whether there was any compulsion whatsoever.

In our system, plaintiff's creation of a dangerous condition is typically a partial causal defense.[126] The analysis is analogous to that employed when a concurrent tortfeasor created the condition: we compare the probability of the harm stemming solely from the dangerous condition with the probability of the harm given both the condition and the defendant's wrongful conduct. If the latter's wrongful conduct increases the likelihood of the harm, then there ought to be apportionment. If not, the defense is complete. For example, suppose *B* blocks *A*'s right-of-way on a road, and then *A* crashes into *B*. The blockage alone carries with it a certain probability of the harm, because some other car driving with the "typical" degree of care could have run into *B*. If the addition of *A*'s actual driving to the situation does not measurably increase the probability of the harm, then blockage is a complete defense to an action by *B* against *A*.[127] If, on the other hand, *A* had been driving so carelessly that the probability was higher, then apportionment is clearly applicable and the defense is only partial.

Mitigation of damages is the final defense that we shall consider. Suppose that *B* is run over by *A* and that *B* aggravates his injury by failing to seek medical attention for six months. To apportion liability, we first calculate the joint probability of the ultimate harm (H_i) flowing from both the initial condition (S_o) and plaintiff's subsequent conduct (B_{tl}):

$$\beta = P_{tl}\ (H_i | S_o, B_{tl}, E_{tl}). \tag{12}$$

We then calculate the same probability, but assuming that plaintiff's subsequent conduct (B^*_{tl}) included mitigation of damages to the extent that he would miti-

124. Although we discuss only causal defenses, noncausal defenses, such as trespass or assumption of risk by the plaintiff, are possible in a system of strict liability. On these see Epstein, Defenses, supra note 19, at 185-213.

125. See Epstein, Defenses, supra note 19, at 175.

126. But see id. at 176 (considering plaintiff's creation of dangerous condition a complete defense).

127. Epstein views blockage of right-of-way as a complete defense. Id.

gate were he paying for his own losses. Mitigation is thus incorporated subjectively, because we are concerned with what this particular person *would* have done and not with what he *should* have done. Thus, if defendant had the misfortune to injure a careless, incompetent, or unreasonable plaintiff, he must, consistent with the thin skull rule, bear the extra costs. This second calculation gives:

$$\alpha = P_{ti}(H_i | S_o, B^*_{ti}, E_{ti}). \tag{13}$$

If $\beta > \alpha$, then B's conduct contributed causally to the ultimate harm. If, on the other hand, $\beta = \alpha$, then B has not worsened the damages inflicted on him by A and therefore has not contributed causally. Apportionment of Hi *thus involves* allocating α/β to the defendant and $(\beta - \alpha)/\beta$ to the plaintiff.

E. *Efficiency Considerations*

At the beginning of this Article, we expressed our desire to develop an economic theory of apportionment along lines that bypass efficiency considerations.[128] Nevertheless, since most of the economic literature in this field revolves around such considerations, it is useful to explore the efficiency characteristics of our framework. There are three types of costs to consider: administrative costs, costs of reassignment of rights, and the sum of expected accident and avoidance costs.

Causal apportionment produces significantly lower costs of administration than the more traditional efficiency-based apportionment systems. Both undivided assignment and apportionment of liability in efficiency-oriented negligence systems require knowledge of the *absolute* levels of riskiness of the various wrongful causes.[129] In contrast, all that is needed for causal apportionment is an estimate of the *relative* riskiness of the causal agents.[130] While, on this ground alone, the information costs of our system are lower,[131] the cost differential widens when one adds the additional informational requirements of an efficiency-based system, such as knowledge of avoidance technologies, avoidance-input costs, and second-best relationships.[132]

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128. See notes 36-37 and accompanying text supra.

129. This is the case in Judge Learned Hand's classic formulation in United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947). The difficulties in assigning uncontroversial probabilities in Judge Hand's formulation have been discussed elsewhere. See Rizzo, Uncertainty, supra note 37, at 82-84.

130. Knowledge of relative probabilities does not require knowledge of their absolute levels when the individual estimates need not add to one. Thus, there is more than one set of individual probability assignments consistent with cause A being, for example, twice as risky as cause B.

131. The difficulties of applying probability analysis are either reduced or obviated in our model. First, we restrict the use of probability estimates to cases of multiple causation. Judge Learned Hand's formula in United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947), requires such estimates in all cases. Second, we are not concerned with replicating what the "reasonable" man would have estimated under the circumstances. This estimate requires the court to determine not only probabilities but also the "reasonable" degree of ignorance of facts and theories. Third, to the extent one is interested in which party could more cheaply avoid the harm *in the long run*, it is necessary to make probability estimates about the future course of technology. This is a difficult endeavor, which we avoid. See Rizzo, Law amid Flux, supra note 37, at 307-09.

132. See Rizzo, Law amid Flux, supra note 37, at 301-02, 304-06, 307-10. See generally Rizzo, The Mirage of Efficiency, supra note 27.

Second, assuming that initial rights can and ought to be established on the basis of efficiency considerations,[133] rigid judicial adherence to these rights in each case will promote efficiency on the *average* and increase certainty in general. Consider the classic case of a railroad emitting sparks onto crops growing next to the railroad's right-of-way. If the cost of eliminating the sparks *normally* would exceed the value of the opportunity foregone by being unable to grow crops in that locale, then efficiency criteria might be used to determine that the railroad has the right to emit sparks without compensating the farmer. This would transform what would otherwise be characterized by the paradigm "*A* hit *B*" into a case of "*A* hit *A*."[134] In all such instances, the farmer would gain no recovery from the railroad, and efficiency would be promoted on average.[135] This method is preferable to defining rights on a case-by-case basis to the extent that the informational and administrative costs of measuring the relative values for each particular case exceed the potential benefits. Hence, given an allocation of rights, based on cost-benefit comparisons for the typical or normal case, the use of causal theory to identify violations of those rights and to assign liability in each particular instance can be consistent with economic efficiency. Moreover, this approach has the additional advantage of creating certainty in legal relationships by avoiding the tendency of the case-by-case method to redefine rights with each difference in relative prices, income, or wealth.[136]

The final efficiency characteristic is revealed if we assume that we have little or no knowledge of the actors' relative capacities for avoiding accidents. If so, we may assume on Laplacean "indifference" grounds[137] that initially, all parties are equally efficient avoiders.[138] This means that both high and low risk-creators can reduce the probability of an accident by the same absolute amount if they undertake an additional unit of avoidance. Thus, in the short run, efficiency concerns are advanced equally whichever party is induced to engage in more precautionary activity. Nevertheless, in the longer run, imposing liability on higher risk-creators will encourage them to invest relatively more in the discovery of better and cheaper avoidance technologies than would low risk-creators invest if liability were imposed on them. As compared with the latter, high risk-creators have more to gain in expected loss savings through such

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133. See R. Posner, Utilitarianism, Economics and Legal Theory, 8 J. Legal Stud. 103, 125-27 (1979). But see Rizzo, The Mirage of Efficiency, supra note 27, at 648-51.

134. See note 45 supra.

135. This result is possible under our theory because causal apportionment is essentially neutral with respect to the criteria by which initial ownership rights are distributed. Thus, our theory remains unaffected whether the distribution is made on first-possession grounds, on a Lockean mixing-of-labor theory, or even by means of Coase-Demsetz efficiency criteria. On the latter, see generally R. Coase, The Problem of Social Cost, 3 J.L. & Econ. 1 (1960); H. Demsetz, When Does the Rule of Liability Matter?, 1 J. Legal Stud. 13 (1972).

136. On the importance of stable property rights from an efficiency perspective, see, e.g., R. Posner, supra note 13, at 27-34.

137. W. Fellner, Probability and Profit 27 (1965). For the original statement of what is sometimes called the Principle of Insufficient Reason, see P. Simon, Marquis de Laplace, A Philosophical Essay on Probabilities 56 (F. Truscott & F. Emory trans. 1902).

138. We are defining equally cheap avoiders in terms of how efficiently they can use avoidance inputs and not in terms of the cost of those inputs, which in competitive markets would be the same for all individuals.

technologies because, by definition, they will cause injuries more often than relatively low risk-creators. Consequently, their relative avoidance capacity will ultimately be greater. Thus there will be a greater absolute reduction in the probability of causing harm for a given social cost when liability is imposed in accordance with the riskiness of the activity. In a system that does not apportion liability, the imposition of all losses on the agent with the highest probabilistic causal contribution is the most efficient solution, since it minimizes the sum of expected accident and accident prevention costs. If losses can be apportioned, however, then imposing liability in accordance with the activity's riskiness will, in the long run, require the activity to bear the social costs it has generated.[139] Costly conduct will be deterred more than less costly conduct and each will be deterred in proportion to the costs produced.[140]

CONCLUSION

This Article has developed a technology of apportionment consistent with a causally based system of strict liability. Unlike most, if not all, of the previous tort literature, our theory provides a fairly precise method of ascertaining the relative importance of multiple causes. This is done by using some fundamental economic concepts and employing a constrained hypothetical method of analysis. Our theory then apportions liability in accordance with each tortfeasor's relative causal contribution.

Two recent developments in the field of tort law provide the most immediate grounds for applying our theory. First, in many jurisdictions, statutes now mandate apportionment in torts. Although this apportionment is most often made along the lines of comparative negligence, our theory provides courts in these jurisdictions with a more precise measure for allocating damages. Second, in strict products liability cases, some jurisdictions have begun apportioning damages on the basis of relative causation rather than relative fault. With a slight modification,[141] our theory of causal apportionment can be used in this area to supply courts with a more precise technology of apportionment than they presently employ.

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139. Aside from the important incentive role of the causal defenses, this does not provide any incentive for the low-risk creator to take precautions against the activities of the high-risk creator where that is feasible. Nevertheless, such a strict liability rule need not be less efficient than the negligence rule because of this fact. Strict liability has a possibly offsetting gain insofar as it creates an incentive for the defendant to engage in the proper *level* of his activity. This is absent under negligence. For an explanation, see Shavell, supra note 37, at 2-3, 6-7, 11-12, 18-19.

140. Landes and Posner have admitted recently that from an efficiency perspective, joint and several liability with no contribution among negligent tortfeasors is not necessarily superior to apportionment effected directly or by contribution, Landes & Posner, supra note 1, at 531. The main efficiency gain of a no-contribution rule is in eliminating litigation and administrative costs associated with judicial division of liability. Id. at 529. On the other hand, this must be balanced against the advantage of apportionment in occasioning greater sharing of the risk of liability among joint tortfeasors. Landes and Posner express no opinion on whether this insurance-like advantage is worth the extra administrative costs. Id. at 531.

141. This modification involves the definition of wrongful conduct. To the degree that the law recognizes the shared expectations of manufacturers and consumers, wrongful activity must be redefined to include these expectations. See note 5 supra.

Beyond these immediate testing grounds, the entire field of tort law provides a fertile area for the application of causal apportionment. As courts become increasingly aware of the merits of apportioning damages in tort, our theory can supply them with both theoretical and practical bases. By providing a sensible and workable mechanism for the division of damages, the theory may also encourage courts to cast off their traditional reluctance to apportion damages among joint tortfeasors.