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Shapiro, Sidney; Ruttenger, Ruth; and Leigh, Paul (2009) "The Social Costs of Dangerous Products: An Empirical Investigation," *Cornell Journal of Law and Public Policy*: Vol. 18: Iss. 3, Article 4.
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THE SOCIAL COSTS OF DANGEROUS PRODUCTS: AN EMPIRICAL INVESTIGATION

Sidney Shapiro, Ruth Ruttenberg** & Paul Leigh****

Defective consumer products impose significant costs on consumers and third parties when they cause fatalities and injuries. This Article develops a novel approach to measuring the true extent of such costs, which may not be accurately captured under current methods of estimating the cost of dangerous products. Current analysis rests on a narrowly defined set of costs, excluding certain types of costs. The cost-of-injury estimates utilized in this Article address this omission by quantifying and incorporating these costs to provide a more complete picture of the true impact of defective consumer products. The new estimates help to gauge the true value of the civil liability system.

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INTRODUCTION

The tort system benefits society by deterring the sale of consumer products that are defective under the relevant common law product liability standards.¹ We will refer to such products as “dangerous products.” From an economic perspective, dangerous products that remain on the market impose costs on consumers and third parties by causing fatalities and injuries. This study puts the role of the civil justice system in perspective by offering a new methodology to estimate these costs.

Available data either overestimate or underestimate the costs of injuries and fatalities resulting from the use of dangerous products. Our study attempts to improve on existing analytical methods by directly esti-

¹ While this is not the only social benefit of the tort system, it is the one that is the focus of this study. See Marc Galanter, *Real World Torts: An Antidote to Anecdote*, 55 MD. L. REV. 1093, 1142 (1996) (benefits include the vindication of legal rights, deterrence of undesirable behavior, and the inducement of investments in safety); Gary T. Schwartz, *Mixed Theories of Tort Law: Affirming Both Deterrence and Corrective Justice*, 75 TEX. L. REV. 1801, 1831 (1997) (recognizing the humane or progressive benefit of preventing unnecessary deaths and injuries).

mating the cost of injuries and fatalities attributable to three dangerous products: Ford SUV's with Firestone tires, the pharmaceutical drug Baycol, and All Terrain Vehicles (ATVs) with three wheels. In each case study, we identify the adverse consequences caused by the product defect and then estimate the costs associated with each consequence using published data. We arrive at these estimates by employing the cost-of-injury (COI) approach commonly used in the economic literature, but we broaden our cost estimates to include costs traditionally excluded from COI methodology. This extension is necessary to obtain a more comprehensive estimate of the costs to society of dangerous products. Because of limited data, we employ a synthetic cohort technique to generate demographic information on the age of victims and the gender distribution of injuries for COI measurements. For the same reason, we use hypothetical scenarios to illustrate and estimate costs not traditionally considered in COI measurements, which we term "extended costs."

Our methodology offers a different, more complete picture of the value of the tort system than do existing studies. This approach better evaluates the significance of preventing torts as a matter of public policy because it accounts for the society-wide implications of avoidable death and injury. Our results indicate that the three products we studied created nearly \$4.7 billion dollars in external costs, excluding extended costs. These extended costs are potentially greater than costs measured by a COI methodology; and families and taxpayers may end up paying a significant portion of extended costs. Our results also suggest that the compensation awarded under the tort system fails to satisfy the actual costs created by dangerous products, although our evidence for this point is weaker than for the prior conclusions.

This Article proceeds in four parts. Part I discusses the economic significance of measuring the costs of injuries and fatalities resulting from dangerous products and why available information fails to provide a good estimate of these costs. Part II explains the methodology we developed for use in this study. Part III presents three case studies based on available data, and applies the new methodology to present estimates of actual costs. The Article concludes with an analysis of the implication of these results for public policy.

I. SOCIAL COSTS

Economic theory identifies the cost of injuries and fatalities caused by dangerous products as an economic inefficiency. The tort system improves market efficiency by forcing the sellers of dangerous products to pay for costs that would otherwise be borne by other parties. Available information, however, is inadequate to allow measurement of the costs actually caused by dangerous products.

A. *Economic Theory*

Economics recognizes two types of costs associated with the sale and use of a consumer product. “Internal” costs are costs associated with the production and sale of a product that is paid for by the manufacturer of the product.² A manufacturer, for example, will have to pay for the labor and raw materials that are necessary to make its product. These costs are “internal” to the transaction of making and selling the product in the sense that the seller must pay for these expenses in order to be in business. “External” costs are costs associated with the making and use of a product that are paid for by persons other than the seller.³ For example, medical expenses paid by a consumer as the result of an injury by a dangerous product are external costs.

In an efficient market, the seller of a dangerous product would pay for the external costs resulting from use of the product, and include these expenses in the product price.⁴ If the product is sold for a price less than its internal and external costs, there will be greater demand for the product than if it were sold at a higher price reflecting both of these costs, an economically inefficient outcome.⁵ Overproduction also reduces aggregate social wealth by creating costs that would not exist if the product were properly priced.⁶

As we will show, some of the costs of accidents created by dangerous products are borne by the injured person. Less obviously, third parties pay for other costs, such as government programs including Medicaid and food stamps, which means that the public bears at least some of the costs created by the sale of dangerous products.⁷

² See SIDNEY A. SHAPIRO & JOSEPH P. TOMAIN, *REGULATORY LAW AND POLICY: CASES AND MATERIALS* 379 (3rd ed. 2003) (defining “internal cost”).

³ See FRED BOSSELMAN, JIM ROSSI & JACQUELINE LANG WEAVER, *ENERGY, ECONOMICS AND THE ENVIRONMENT* 41 (2000) (defining an externality as “a social cost or benefit that has not been internalized or incurred by the private owner of the resource”); see also SHAPIRO & TOMAIN, *supra* note 2, at 378 (noting that an externality is also described as a “spillover” cost because it is a cost that spills over onto someone other than the seller of the product).

⁴ See Giuseppe Dari Mattacci & Francesco Parisi, *The Economics of Tort Law*, in *THE ELGAR COMPANION OF LAW & ECONOMICS* 88 (Jürgen G. Backhaus ed., 2nd ed. 2005) (explaining that “[t]ort rules should . . . be designed to induce parties to internalize the external costs of the activities”).

⁵ See WILLIAM J. BAUMOL & ALAN S. BLINDER, *ECONOMICS: PRINCIPLES & POLICY* 315 (6th ed. 1994) (noting that “an industry that charges a price above marginal cost will reduce quantity demanded through this high price, and so it will produce an output too small for an efficient allocation of resources. The opposite will be true for an industry whose price is below marginal social cost.”).

⁶ See *id.*

⁷ See *infra* Part I.D.3.

B. Total Injury Costs

A number of studies attempt to estimate the total cost of injuries in the United States or the total cost of specific types of injuries. However, the data are not a reliable estimate of the external costs of dangerous products because the studies fail to apportion the costs due specifically to dangerous product injuries and fatalities. Finkelstein and his colleagues, for example, have estimated that the total lifetime cost of injuries from all sources in the United States in 2000 was \$406 billion (\$80 billion for medical treatment costs and \$326 billion for lost productivity costs).⁸ Lawrence and his colleagues estimated the annual costs of non-fatal consumer product injuries to be “approximately \$500 billion in 1996, accounting for nearly one-third of the total annual injury costs.”⁹ These studies presumably include the cost of injuries and fatalities due to dangerous products, but do not provide a separate estimate of such costs. The lack of reliable data establishing the proportion of accidents caused by legally culpable behavior means that there is no direct method of determining what percentage of Finkelstein’s \$406 billion estimate constitutes social costs from the sale of dangerous products and other types of tortious behavior.

C. Total Insurance Payments

Insurance claims offer another potential measure of the external cost of dangerous products. Towers Perrin, an insurance consulting firm, estimated that insurance companies and firms which self-insure either paid or anticipated paying \$247 billion in 2006 for expenses associated with tort litigation.¹⁰ Although critics of the tort system have misconstrued this point,¹¹ the amount of compensation paid by insurance companies or

⁸ See ERIC A. FINKELSTEIN, PHAEDRA S. CORSO & TED R. MILLER, *INCIDENCE AND ECONOMIC BURDEN OF INJURIES IN THE UNITED STATES* (2006); DOROTHY P. RICE & ELLEN J. MACKENZIE, *COST OF INJURY IN THE UNITED STATES: A REPORT TO CONGRESS* (1989). For additional estimates of the total cost of injuries, see Phaedra Corso et al., *Incidence and Lifetime Costs of Injuries in the United States*, 12 *INJURY PREVENTION* 212, 214–15 (2006); Jeffrey W. Runge, *The Cost of Injury*, 11 *EMERGENCY MED. CLINICS OF N. AM.* 241 (1993).

⁹ Bruce A. Lawrence et al., *Estimating the Costs of Non-Fatal Consumer Product Injuries in the United States*, 7 *INJURY CONTROL & SAFETY PROMOTION* 97, 97 (2000). The methodology of the Finkelstein and Lawrence studies differ; Lawrence includes more categories of costs, e.g., insurance administration as well as, importantly, pain and suffering. For another estimate of the total costs of a specific type of injury, see Ted R. Miller, *Societal Costs of Transportation Crashes*, in *THE FULL SOCIAL COSTS AND BENEFITS OF TRANSPORTATION* 281 (David Greene, Donald Jones & Mark Delucchi eds. 1997).

¹⁰ See TILLINGHAST INSURANCE CONSULTING, TOWERS PERRIN, 2007 UPDATE ON U.S. TORT COST TRENDS, at 5, available at http://www.towersperrin.com/tp/getwebcachedoc?webc=TILL/USA/2007/200712/tort_2007_1242007.pdf [hereinafter 2007 UPDATE].

¹¹ Some commentators describe cost estimates by Towers Perrin as a “tax” on the American consumers. See, e.g., Bruce Bartlett, *The Tort Tax*, *NATIONAL REVIEW*, Mar. 3, 2003, available at http://www.nationalreview.com/nrof_bartlett/bartlett030303.asp (claiming a 2001

self-insurers in tort system adjudications or settlements is a likely proxy for external costs caused by the sale of dangerous products and other types of tortious behavior. The insurance industry for dangerous products is designed to compensate victims in accord with tort law which includes payments for medical costs, lost wages, pain and suffering, and punitive damages. Studies of workers compensation, for example, rely on similar insurance payment data to estimate the external costs attributable to workplace injuries and diseases.¹² Unfortunately, the Towers Perrin estimate is overinclusive because it includes more than payments made through the tort system.¹³ It is possible to infer from the Towers

Towers Perrin estimate of tort costs amounted to “a tax of 2% on everything in the American economy that takes \$721 per year out of the pockets of every citizen”); Lawrence J. McQuillan & Hovannes Abramyan, Op-Ed, *The Tort Tax*, WALL ST. J., Mar. 27, 2007, at A18. The tort tax claim is based on the assumption that the total cost of torts (as estimated by the Towers Perrin studies) will be passed on to consumers by manufacturers and other sellers in the form of higher prices, and that this is an undesirable outcome. However, this argument fails to address the positive effect on society of increased prices, to the extent that tort judgments reflect legitimate costs to society resulting from preventable accidents. As discussed earlier, *see supra* Part I.A, the tort system serves society when it causes manufacturers of dangerous products to internalize external costs. For the same reason, it is economically desirable for the tort system to force entities or persons who violate common law product liability standards to pay for the costs of that behavior. Tort critics seek to obscure the economic efficiency of the outcome by using the word “tax” and by capitalizing on public disapproval of taxes. This rhetorical move, however, stands economic theory on its head.

In contrast, it would be socially undesirable for consumers to pay higher prices that are not the result of manufacturers and others paying for external costs. Tort critics seek to make this claim by associating the Towers Perrin estimates with stories of apparently outrageous results in the tort system. The implication is that some significant amount of the total cost of torts (as estimated by the Towers Perrin studies) reflects erroneous tort settlements and verdicts. This claim is problematic for two reasons. First, by claiming that the entire amount of an estimate by Towers Perrin estimate is a tort “tax,” critics are arguing that the entire amount reflects erroneous tort settlements and verdicts, an improbable conclusion. Second, the implication that some significant amount of Towers Perrin estimate reflects erroneous tort settlements and verdicts is unsubstantiated.

The public may understand the tort tax claim to mean that the Towers Perrin estimate is the amount of money it costs to administer the tort system, but Towers Perrin does not include the governmental costs of administering the tort system. It presumably does, however, include the amount of money that tort victims have or will pay to their lawyers in the form of contingent fees. Published data does not indicate what portion of the Towers Perrin estimate is composed of such fees. Moreover, although the Towers Perrin estimate includes administrative fees (aside from governmental costs), there is also no way of knowing what portion of these expenses are legitimately transaction costs of defending lawsuits, as opposed to the costs of running an insurance company in general.

¹² *See, e.g.*, J. PAUL LEIGH, STEVEN MARKOWITZ, MARIANNE FAHS & PHILIP LANDRIGAN, COSTS OF OCCUPATIONAL INJURIES AND ILLNESSES chs. 5, 8 (2000).

¹³ Towers Perrin includes three cost components in its estimate: the benefits paid or expected to be paid to third parties, defense costs, and administrative expenses. 2007 UPDATE, *supra* note 10, at 7. For insurance companies, the first component, paid benefits, is the estimated total of the money that has been (“paid benefits”) or will be paid to tort victims (“incurred benefits”). The incurred benefits amount is derived from the amount of money that insurance companies reserve for payments to potential tort victims. *Id.* For firms that self-insure, the estimate of payments to third parties (i.e., tort victims) is based on actual payments

Perrin data that the insurance industry and companies that self-insure paid approximately \$190 billion in compensation and for the costs of defending lawsuits.¹⁴ Although the \$190 billion figure overstates external costs by some unknown amount, it is a reasonable assumption that defense costs are only a relatively small portion of that total, and that compensation will total close to \$190 billion. If this assumption is correct, the Towers Perrin estimate suggests that various types of torts impose very large external costs each year and substantially decrease social wealth. Moreover, as we will discuss below,¹⁵ the Towers Perrin estimate does not include the significant external costs that fall on third parties because the tort system does not compensate many of these third parties for those costs.

D. *Jury Verdicts and Settlements*

Jury verdicts and settlements are the final source of information about the external costs of torts, but suffer from two defects. First, the data are incomplete because available data bases do not include many, if not most, product liability trial awards and settlements. In addition, jury verdicts and settlements do not for the most part account for external costs of dangerous products paid by persons or entities other than plaintiffs. Such costs might include costs paid by family members, businesses who employ tort victims and their families, and by the public sector.

1. Jury Verdict and Settlement Information

The debate over far-reaching changes in the common law of torts has produced an “abundance of studies—indeed an entire industry of studies—that have focused on the operation of the tort litigation sys-

by various forms of self-insurance and on the cost of insurance purchased directly from non-insurance companies. *Id.* at 9. This portion of the Towers Perrin estimate—actual or anticipated payments to tort victims—is an approximation of the total external costs paid by insurance companies or firms that self-insure to persons who have been harmed by tortious behavior, as determined in adjudications or settlements. The second and third components of the Towers Perrin estimate are for costs related to the administration and handling of claims. The second component, defense costs, reflects costs “directly incurred in the defense and investigation of a claim, as well as general claim handling costs.” *Id.* at 7. The third component, administrative expenses, reflects “expenses, other than defense costs, incurred by either the insurance company or self-insured entity in the administration of tort claims.” *Id.* Towers Perrin does not indicate what portion of its total cost estimate is comprised of the first component, benefits to be paid or expected to be paid.

¹⁴ Towers Perrin indicates that administrative expenses constituted an average of 23 percent of total tort costs from 2000 to 2006, but it does not indicate how much of the total cost is made up of defense costs. If one assumes that administrative expenses constitute 23 percent of the 2006 total insurance company costs, then the insurance industry and self-insured will pay (or have paid) external costs and defense costs totaling \$190.19 billion. *Id.* at 7.

¹⁵ See *infra* Part I.D.3.

tem.”¹⁶ Analysts have sought to estimate mean and median jury verdicts in both the federal and state court systems. Table 1 offers a representative sampling of studies of product liability verdicts in federal court. Table 2 does the same for studies of product liability awards in state and county courts.

TABLE 1: FEDERAL PRODUCT LIABILITY TRIAL AWARDS

Year(s)	Trial Award		Sample Size
	Mean	Median	
1978-89 ¹⁷	\$1,143,000	\$205,000	4,217
1980-84 ¹⁸	\$858,000	\$197,000	2,284
1979-93 ¹⁹	\$1,547,000	\$318,000	-
1991-92 ²⁰	\$2,332,000	\$668,000	261
1994-95 ²¹	-	\$284,000	527
2000 ²²	-	\$368,000	385

TABLE 2: STATE AND COUNTY PRODUCT LIABILITY TRIAL AWARDS

Year(s)	Source	Trial Award		Sample Size
		Mean	Median	
1983-85 ²³	Five states	\$633,000	\$150,000	136
1991-92 ²⁴	75 largest counties in US	\$727,000	\$260,000	-
1985-96 ²⁵	Franklin County, Ohio	-	\$207,560	44
2001 ²⁶	75 largest counties in US	-	\$450,000	158

¹⁶ Gary T. Schwartz, *Empiricism and Tort Law*, 2002 U. ILL. L. REV. 1067, 1067 (2002).

¹⁷ Theodore Eisenberg & James A. Henderson, Jr., *Inside the Quiet Revolution in Products Liability*, 39 UCLA L. REV. 731, 762-63, 797 (1992).

¹⁸ *Id.* at 767, 797.

¹⁹ Theodore Eisenberg et al., *Litigation Outcomes in State and Federal Courts: A Statistical Portrait*, 19 SEATTLE U. L. REV. 433, 439 (1996).

²⁰ *Id.* at 439, 443.

²¹ ANDREW H. PRESS & CAROL J. DEFANCES, BUREAU OF JUSTICE STATISTICS, FEDERAL TORT TRIALS AND VERDICTS 1994-95 4 tbl.5 (1997), available at <http://www.ojp.usdoj.gov/bjs/pub/pdf/fttv95.pdf>.

²² Theodore Eisenberg & Margo Schlanger, *The Reliability of the Administrative Office of the United States Database: An Initial Theoretical Analysis*, 78 NOTRE DAME L. REV. 1455, 1494-95 (2003). The actual data indicate a median award for product liability of \$486,000 based on 385 verdicts, but the authors question the reliability of this figure because of a problem with the federal data entry system. After correcting for the problem, the authors hypothesize that the true median is closer to \$368,000. *Id.* at 1494. The problem is that the federal data entry system does not permit the entry of verdicts larger than \$999,999.00, which suggests that federal data understates awards of \$1 million dollars or more. *Id.* at 1466.

2. Limitations of Existing Data

A significant problem with relying on federal databases is that most tort cases are litigated in the state courts under state tort law. Researchers estimate that federal litigation constitutes only 2 percent of all of the tort cases that are filed.²⁷ The percentage of product liability cases litigated in the federal courts is higher than in state courts, where other types of torts, such as medical malpractice, are typically litigated; one estimate is that federal trials constitute 25 percent of all product liability trials excluding asbestos cases.²⁸

Data obtained from state courts are also subject to limitations. The National Center for State Courts collects information about lawsuits filed in state courts, but there is no broad, systematic data collection effort by the states for compensation awarded as the result of a trial.²⁹ Researchers have been able to employ public records in some states or counties to obtain information about product liability case awards. The studies included in Table 2 are of this type. There are also reports by private firms such as Jury Verdict Research, but researchers regard these data as unreliable because they are not produced by systematic and representative sampling.³⁰

A further problem with data from state and federal courts is that estimates based on trial awards neglect the fact that most tort cases that result in compensation for plaintiffs are not litigated to the end. Researchers estimate that fewer than 10 percent of lawsuits are resolved through a trial,³¹ and there is little data on how many of the other 90-plus

²³ U.S. GENERAL ACCOUNTING OFFICE, GAO/HRD-89-99, PRODUCT LIABILITY: VERDICTS AND CASE RESOLUTION IN FIVE STATES 102 tbl.V.2 (1989), available at <http://archive.gao.gov/d26t7/140004.pdf>. The study is based on data from five states: Arizona, Massachusetts, Missouri, North Dakota, and South Dakota. *Id.* at 19.

²⁴ CAROL J. DEFRANCES ET AL., BUREAU OF JUSTICE STATISTICS, PUB. NO. NCJ 154346, CIVIL JUSTICE SURVEY OF STATES COURTS 1992: CIVIL JURY CASES AND VERDICTS IN LARGE COUNTIES 5 tbl.6 (1995), available at <http://www.ojp.usdoj.gov/bjs/pub/pdf/cjcavilc.pdf>.

²⁵ Deborah Jones Merritt & Kathryn Ann Barry, *Is The Tort System in Crisis? New Empirical Evidence*, 60 OHIO ST. L. J. 315, 334 (1999).

²⁶ THOMAS H. COHEN & STEVEN K. SMITH, BUREAU OF JUSTICE STATISTICS, PUB. NO. NCJ 202803, CIVIL TRIAL CASES AND VERDICTS IN LARGE COUNTIES 2001 2 tbl.1, 5 tbl.6 (2004), available at <http://www.ojp.usdoj.gov/bjs/pub/pdf/ctcvc01.pdf>.

²⁷ See Michael J. Saks, *Do We Really Know Anything About the Behavior of the Tort Litigation System—and Why Not?*, 140 U. PA. L. REV. 1147, 1155 (1992).

²⁸ See Eisenberg et al., *supra* note 19, 441 (estimating that federal trials account for approximately 25 percent of product liability actions that do not involve asbestos).

²⁹ See, e.g., Thomas A. Eaton & Susette M. Talarico, *A Profile of Tort Litigation in Georgia and Reflections on Tort Reform*, 30 GA. L. REV. 627, 635, 635 n.21 (1996); Saks, *supra* note 27, at 1206.

³⁰ See Saks, *supra* note 27, at 1245–46.

³¹ See William L. Felstiner et al., *The Emergence and Transformation of Disputes: Naming, Blaming, and Claiming*, 15 LAW & SOC'Y REV. 631, 649–52 (1981); Herbert M. Kritzer,

percent of law suits result in cash payment settlements.³² More generally, there is little systematic information available on the total dollar value of tort settlements or the transaction costs of a settlement for plaintiffs or defendants.³³ There is also a dearth of studies that would provide a better quantitative understanding of settlements themselves.³⁴

Another consideration is whether settlement and trial awards adequately compensate plaintiffs for the damages that they have suffered. Empirical work has found that the most seriously injured plaintiffs collect a smaller proportion of their economic losses than do those with less serious injuries.³⁵ Several aspects of the tort system are thought to lead to this result, including the fact that defendants and their insurers have a greater incentive to invest in contesting large claims, as well as the possibility that the full costs of major injuries may be more difficult to assess until well after the injury occurs.³⁶

A related problem is that not all persons who are eligible to sue do so. In a massive national survey of the filing of lawsuits, the RAND Institute for Civil Justice found that claims for compensation were made for only about 10 percent of accidental injuries.³⁷ Another study found that only 5 percent of persons who believe that their injury might have been caused by another person actually file suit in court.³⁸ Based on these studies, scholars suggest that a significant number of potential plaintiffs with valid claims never sue.³⁹ To the extent that these esti-

Adjudication to Settlement: Shading in the Gray, 70 JUDICATURE 161, 161–62 (1986) (estimating one percent to twelve percent of tort trials filed go to the jury).

³² See Saks, *supra* note 27, at 1213.

³³ STEVEN K. SMITH ET AL., BUREAU OF JUSTICE STATISTICS, PUB. NO. NCJ-153177, TORT CASES IN LARGE COUNTIES 1991-92 (1995), available at <http://www.ojp.gov/bjs/pub/ascii/tclic.txt>.

³⁴ BUREAU OF JUSTICE STATISTICS, U.S. DEP'T. OF JUSTICE, SUMMARY: CIVIL JUSTICE ROUNDTABLE 1 (2004), available at <http://www.ojp.gov/bjs/pub/pdf/cjrd.pdf>.

³⁵ See D. DEWEES ET AL., EXPLORING THE DOMAIN OF ACCIDENT LAW 422–23 (1996) (noting how jurors tend to undercompensate for the severest injuries); Galanter, *supra* note 1, at 1116–20 (reviewing the empirical evidence on undercompensation).

³⁶ Galanter, *supra* note 1, at 1120.

³⁷ DEBORAH HENSLEY ET AL., RAND INSTITUTE FOR CIVIL JUSTICE, COMPENSATION FOR ACCIDENTAL INJURIES IN THE UNITED STATES 110 (1991). Claims were made for 44 percent of motor vehicle claims, 7 percent of work injuries, and 3 percent of other injuries. *Id.* at 121.

³⁸ Richard E. Miller & Austin Sarat, *Grievances, Claims & Disputes: Assessing the Adversary Culture*, 15 LAW & SOC'Y REV. 525, 544 (1980–81). This study found that of every one thousand events for which an injury was noticed, 718 became claims in which the victim brought the problem to the alleged harm doer, 103 were brought to the attention of a lawyer, and 50 became filed cases. *Id.*

³⁹ See, e.g., Galanter, *supra* note 1, at 1102–03 (noting Richard Abel's conclusion that "the tort system suffers from a chronic 'crisis of underclaiming'"); Merritt & Barry, *supra* note 25, at 385 ("Researchers repeatedly have shown that the majority of individuals injured by negligent conduct—whether medical malpractice, flawed manufacturing processes, or other actions—never file a legal complaint."); Saks, *supra* note 27, at 1185 ("[T]hese studies suggest that . . . a large number of potential plaintiffs never initiate a claim . . .").

mates accurately reflect behavior in product liability actions, estimates of external costs based on settlement and trial awards will be too low.

3. Third-Party Payments

A final problem with using existing data on pre-trial and trial awards is that persons or entities other than plaintiffs pay for external costs associated with dangerous products. We could not find data indicating the full extent of such third-party payments across the full spectrum of tort cases. The Department of Transportation (DOT), however, has published data (see Table 3) indicating the proportion of costs associated with motor vehicle accidents that are borne by third parties.⁴⁰ The DOT data presumably include the cost of injuries (or fatalities) due to defective automobiles and trucks, but there is no separate estimate of these externalities.

TABLE 3: INJURY COSTS IN 2000, ESTIMATED SOURCE OF PAYMENT BY COST CATEGORY

	(Percent of Total Cost)						
	Federal	State	Total	Insurer	Other	Self	Total
Medical	14.4	9.8	24.2	54.9	6.4	14.6	100
Emergency Services	3.9	75.8	79.6	14.7	1.7	3.9	100
Market Productivity	16.2	3.1	19.3	41.1	1.6	38.1	100
Household Productivity	-	-	0.0	41.1	1.6	57.4	100
Insurance Administration	0.9	0.5	1.4	98.6	-	-	100
Legal/Court	-	-	-	100.0	-	-	100
Travel Delay	-	-	-	-	100.0	-	100
Property Damage	-	-	-	-	65.0	35.0	100

There are four primary sources of third-party payments for the external costs of dangerous products: private insurance, government programs, the business community, and the families of tort victims. The common law collateral source rule and subrogation rights determine the extent to which private insurance and government programs pay for external costs. While studies commonly recognize payments by private in-

⁴⁰ See NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., U.S. DEP'T OF TRANSP., THE ECONOMIC IMPACT OF MOTOR VEHICLE CRASHES 2000 59 tbl.22 (2002), available at <http://lhsc.lsu.edu/OutsideLinks/EconomicImpact-1.pdf>.

surance, government programs, and the business community, studies generally overlook payments by family members. The DOT data, for example, do not include this category, as Table 3 indicates.

a. Private Insurance

A person injured by a dangerous product who has private insurance may receive reimbursement of his or her costs from health insurance and disability insurance. However, nearly 40 million Americans have no health insurance.⁴¹ Another category of insurance is general-purpose life insurance that covers death resulting from accidents.

b. Government Programs

Persons injured by dangerous products may also become eligible for cash or in-kind assistance from a multitude of government programs, including unemployment compensation, food stamps, Medicaid, Medicare, State Children's Health Insurance Program (SCHIP), Temporary Assistance for Needy Families (TANF), Social Security Disability, and Old Age, Survivors and Disability Insurance. There may also be costs to Veterans Affairs for use of military hospitals and clinics.

Less proximate costs might arise when affected families may need more community services such as emergency calls, ambulance services, tutoring programs, job training programs, and rehabilitation services. These families may also require community resources such as special programs for children, special programs for persons with disabilities, counseling services, and local social services and mental health services. Local school systems may experience an increase in their special education expenses, which may significantly increase with the addition of even one special education child.

c. Collateral Source Rule

Relatively often, people injured by dangerous products do not file law suits.⁴² One likely reason is that private insurance reimburses them for their expenses. Similarly, people may not sue because they receive assistance from government safety net programs. When they do file a lawsuit, the collateral source rule and subrogation rights determine the extent to which private insurance companies and some government programs ultimately pay for external costs of dangerous products.

⁴¹ NAT'L CTR. FOR HEALTH STATISTICS, NUMBER AND PERCENT OF PERSONS WITHOUT HEALTH INSURANCE COVERAGE, BY AGE GROUP: UNITED STATES, 1997 — QUARTER ONE 2002 tbl.1.1 (2007), available at http://www.cdc.gov/nchs/about/major/nhis/released200209/table01_1.htm (indicating that 39.7 million persons lacked health insurance as of the first quarter of 2002, the most recent data available).

⁴² See *supra* notes 37-39 and accompanying text.

The common law collateral source rule permits plaintiffs to recover from defendants sums that a third party, such as an insurance company or government program, has already paid to the plaintiff.⁴³ In this circumstance, however, a third party can recover the cost of those payments if the third party has a contractual or statutory right of subrogation.⁴⁴ In cases where an insurer has subrogation rights, a plaintiff may not be able to keep any compensation from a tort award or cash payment settlement if the amount collected from the defendant is less than the amount the person received from his or her insurance company. Subrogation rights may also discourage a plaintiff from filing a lawsuit in the first place, where the recovery is likely to fall short of the plaintiff's expenses.⁴⁵ In the twenty-three states that have abolished or changed the common law collateral source rule,⁴⁶ manufacturers of dangerous products are relieved of the obligation to pay for part or all of the costs that they have created because those costs have been or will be paid by private insurance or government programs.⁴⁷

d. Business Community

The business community also bears some of the external costs of dangerous products. First, there are costs to the manufacturer of a dangerous product other than the payment of compensation through the tort system. Companies lose money from recalls, poor public relations and bad press, and from the need to redesign a product to avoid earlier hazards.⁴⁸ Many corporate annual reports take note of these effects in their financial analysis. Second, there are indirect costs that other firms must bear. For example, a company employing a person injured or killed by a dangerous product loses his or her services for a time or permanently. Less obviously, firms employing the family members of a victim may also lose the services of family members for a time or permanently.

⁴³ See Kenneth S. Abraham & Lance Liebman, *Private Insurance, Social Insurance, and Tort Reform: Toward A New Vision of Compensation for Illness and Injury*, 93 COLUM. L. REV. 75, 95 (1993).

⁴⁴ Private insurers contract for a right of subrogation except for life insurance companies. See *id.* at 96. Congress has likewise established a right of subrogation for Medicaid and Medicare by statute. See 42 U.S.C. §1395y(b)(2)(A)(ii) (2006). The extent to which local and state programs have similar provisions is unknown.

⁴⁵ See *supra* notes 37-39 and accompanying text (noting that many persons injured as a result of a tort do not file a lawsuit).

⁴⁶ See CONG. BUDGET OFFICE, U.S. CONG., *THE EFFECTS OF TORT REFORM: EVIDENCE FROM THE STATES* 6 (2004), available at <http://www.cbo.gov/ftpdocs/55xx/doc5549/Report.pdf>.

⁴⁷ See Abraham & Liebman, *supra* note 43, at 96. In states that have modified the rule, the result will be the same to the extent that third parties ultimately pay for external costs.

⁴⁸ See, e.g., Andrew Martin, *Peanut Corporation of America to Liquidate*, N.Y. TIMES, Feb. 13, 2009, at B2; Natasha Singer, *FDA Finds "Natural" Diet Pills Laced with Drugs*, N.Y. TIMES, Feb. 9, 2009 at B1.

Such firms may incur costs from locating and training replacements, or may experience reduced productivity of those family members due to dislocations at home.

e. Family Members

Families and family members may suffer a wide variety of costs that arise from an injury, illness, or death resulting from the use of a dangerous product. A family member, for example, may become an unpaid caretaker to a seriously injured individual, thus foregoing earned income. Or, because of the financial strain on a family, children may have to cut their education short, resulting in decreased lifetime earnings.

II. METHODOLOGY

The external costs of dangerous products can be estimated from current data sources, but each measure of externalities has its own limitations and defects. In light of these problems, we have developed a new methodology to estimate these costs. This part identifies and explains the basic building blocks of our methodology: case studies, synthetic cohorts, cost of injury measurements, and hypothetical scenarios. Each of the case studies further explains the methodology. Readers who wish to see the details of our calculations can consult the on-line database.⁴⁹

A. Case Studies

We estimate the external costs attributable to three widely sold dangerous products: Ford SUVs with Firestone tires, the pharmaceutical drug Baycol, and All Terrain Vehicles (ATVs) with three wheels. Our choice of these three dangerous products was based on the availability of injury and fatality data; more comprehensive data were available for the three chosen dangerous products in comparison to other such products. The choice of products may have affected the results of the study, but we believe that the selected products produce injuries and fatalities that are representative of the range of consequences and outcomes that those dangerous products might cause in a mass consumer society.

B. Synthetic Cohorts

Producing an estimate of the external costs of dangerous products requires demographic information about the tort victims, such as their age and gender, as well as injury information specifying the part of the body that was injured, the medical classification of that injury, and what treatment, therapy, and drugs the patient required. To obtain the necessary information, we searched legal opinions, public databases, articles

⁴⁹ See "COI Methodology Appendix," available at <http://users.wfu.edu/shapirsa/>.

published in the scholarly and popular legal, economic, and medical literature, and newspaper articles. We also spoke with attorneys familiar with the relevant product defects. These efforts did not produce the detailed demographic information required for our cost studies.

To bridge this gap, we created synthetic cohorts of victims. The synthetic cohort technique is an established method in medicine and economics, which researchers use to estimate effects and outcomes when demographic and other necessary data are not available.⁵⁰ It is heavily relied on as the method of choice for investigating the cost-effectiveness of pharmaceuticals.⁵¹ We generated our cohorts after a thorough review of the existing literature and discussions with lawyers involved in litigation concerning the products we study. These synthetic cohorts represent our best judgments regarding the demographics, injury, and medical characteristics.

C. *Cost-of-Injury Measurements*

The use of the synthetic cohort method in medicine and economics is typically conducted with the use of the cost-of-illness or cost-of-injury (COI) approach,⁵² which we also adopt. This combined methodology divides costs into two categories: direct and indirect costs. In the simplest version, direct costs include only medical expenses and indirect costs include only lost earnings.⁵³ Medical costs include hospital bills, doctor visits, medical tests, rehabilitation, and drug costs. Lost earnings measure the dollar value of the lost work-time that results from injury or illness.⁵⁴ This measurement of lost earnings is sometimes referred to as the “human capital” technique.⁵⁵ More elaborate versions of COI include such additional direct costs as the cost of administering medical insurance, and such indirect costs as the dollar value of lost production in the household and lost fringe benefits.⁵⁶ Household production would

⁵⁰ See, e.g., Pierre-Olivier Gourinchas & Jonathan A. Parker, *Consumption over the Life Cycle*, 70 *ECONOMETRICA* 47, 47 (2002); Anna Peeters et al., *A Cardiovascular Life History – A Life Course Analysis of the Original Framingham Heart Study Cohort*, 23 *EUROPEAN HEALTH J.* 458, 459 (2002).

⁵¹ See, e.g., Brian F. Gage et al., *Cost-effectiveness of Warfarin and Aspirin for Prophylaxis of Stroke in Patients with Nonvalvular Atrial Fibrillation*, 274 *J. AM. MED. ASSOC.* 1839, 1839 (1995); MARTHE R. GOLD ET AL., *COST-EFFECTIVENESS IN HEALTH AND MEDICINE* 18 (1996).

⁵² See PETER MUENNING, *DESIGNING AND CONDUCTING COST-EFFECTIVENESS ANALYSIS IN MEDICINE AND HEALTH CARE* ch. 7 (2002).

⁵³ See *id.* at ch. 1.

⁵⁴ See *id.*

⁵⁵ See *id.*

⁵⁶ See *id.*

include, for example, the costs of preparing meals, childcare, and cleaning; fringe benefits would include medical insurance.⁵⁷

To calculate direct costs, we measured the total medical costs of persons injured or killed as the result of using one of the three products we studied. To calculate indirect costs, we measured the cost of lost wages, lost fringe benefits, and the lost value of home production. All traditional costs are expressed in 2007 dollars.

Although trial awards are a starting point for calculating costs, these awards may or may not fully compensate a tort victim.⁵⁸ In comparison, our calculations include 100 percent of medical costs and lost wages. As noted, we also included estimates of the lost economic value of home production, values which appear to be excluded from tort awards at least some of the time.⁵⁹ Finally, in contrast to the tort system, the traditional COI method typically does not estimate pain and suffering because the difficulty of monetizing its value due to the lack of market evidence of value, and we adhere to this approach.

We also applied COI methodology to develop estimates of costs not normally included by COI methodology, which we term "extended costs." In our approach, "extended" costs include any external cost that results from an injury or fatality caused by a dangerous product other than the direct and indirect costs considered in traditional COI measurements (i.e., the medical costs of persons injured by a dangerous product and that person's lost wages, lost fringe benefits, and the lost value of home production). Such costs may be less proximate in time, but nevertheless are attributable to the dangerous product injury or fatality. For example, the cost of caregiving provided by a spouse for a partner injured by a dangerous product would be an extended cost that we would include.⁶⁰ All extended costs are expressed in 2007 dollars, discounted at 3 percent, with no adjustment for future inflation.

D. *Hypothetical Scenarios*

Although we have sought to measure extended costs, there is little available information about the distribution of extended costs for the three dangerous products that we studied. For example, the cost of caregiving provided by a spouse for a partner rendered a permanent

⁵⁷ See *id.*

⁵⁸ See *supra* note 35 and accompanying text.

⁵⁹ See Ann Laquer Estin, *Love and Obligation, Family Law and the Romance of Economics*, 36 WM. & MARY L. REV. 989, 1023 (1995) (discussing the exclusion of home production in tort awards).

⁶⁰ See *infra* notes 84-85 and accompanying text. When a person was injured and the family chose to hire someone for caregiving, the cost measured the average amount paid. On the other hand, if a family member quit his or her job to undertake the caregiving, we measured the cost as foregone earnings.

quadriplegic in an SUV rollover is an extended cost. However, we do not know how many persons injured as a result of an SUV rollover were injured in this manner and how frequently the care of such persons involved caregiving by a spouse.

To address this limitation, we created three hypothetical scenarios of potential extended costs for each cost study, then estimated the extended costs identified in each scenario using published data. Although we must use hypothetical examples, we still believe our methodology is an improvement over existing efforts to measure external costs. This extension is necessary to develop a more complete picture of external costs due to the likelihood of public agencies, the business community, and family members bearing significant extended costs. In fact, these costs may be greater than the costs measured by the traditional COI methodology, as we will demonstrate.⁶¹

III. FORD/FIRESTONE ROLLOVERS

The first case study determines the social costs associated with the rollover of the Ford Explorer model SUV equipped with Firestone tires. We describe the product defect that made these automobiles a dangerous product. We then detail how we derived our estimates of traditional COI external costs, which total almost \$555 million, and our estimates of extended costs, which total between \$733,000 and \$2.55 million per family. We conclude with a discussion of the results.

A. *Product Defect*

The Ford Explorer model SUV, which Ford first produced in 1991, had suspension problems due to its high center of gravity.⁶² These problems created “significant handling and stability defects” and the “substantial risk of rollovers.”⁶³ To remedy these design flaws, Ford recommended that tires on Explorers be kept at 26 pounds per square inch (psi) in order to decrease the distance between the weight of the car and the ground.⁶⁴ Since the tires had been designed for 30 psi,⁶⁵ Ford essentially was recommending that owners substantially under-inflate their tires.

⁶¹ See *infra* Conclusion, tbl.19 (comparing traditional and extended costs).

⁶² See *In re Ford Motor Co. Securities Litigation*, 184 F.Supp.2d 626, 629 (E.D. Mich. 2001).

⁶³ *In re Bridgestone/Firestone, Inc. Tires Products*, 155 F.Supp.2d 1069, 1077 (S.D. Ind. 2001).

⁶⁴ See *In re Ford*, 184 F.Supp.2d at 629.

⁶⁵ Jamie Butters, *Tire Pressure Alert is Promised for Fall Also On the Horizon: Side Airbags, New Brakes*, DETROIT FREE PRESS, Jan. 10, 2001, at 1E.

The National Highway Traffic Safety Administration (NHTSA) had classified the Firestone ATX tire, which came on the Ford Explorer as standard equipment, as having the lowest heat/temperature rating allowed to be sold under the agency's Uniform Tire Quality Grading System.⁶⁶ Tires with this rating are unable to resist heat-buildup to the same degree as higher quality tires. This flaw proved even worse for consumers, since the NHTSA grades tires under controlled laboratory conditions, which assume that tires are properly inflated.⁶⁷ As a result, Ford's recommendation that owners keep the ATX tires at reduced pressures resulted in significantly higher percentage of tire failure than government tests would have predicted.⁶⁸

Consumers in the United States began filing claims based on problems with Firestone tires on Ford Explorers as early as 1993.⁶⁹ Subsequently, Firestone redesigned the "ATX" tire twice, once in 1995, releasing its "ATX II" model tire, and again in 1996, releasing the "Wilderness AT" tire.⁷⁰ In 1996, Firestone received a growing number of complaints regarding all three models of tires. Most of these complaints alleged problems with tread separation,⁷¹ a problem that increases the likelihood that a driver may lose complete control of an Explorer, particularly during significant braking or steering.⁷² In response, Ford recommended that drivers increase the tire pressure for their vehicles, forcing consumers to choose between the risk of tread separation or of a rollover.⁷³

After a Houston television station aired a special report regarding fatalities and Firestone tires in February 2000, NHTSA launched an in-

⁶⁶ *In re Ford*, 184 F.Supp.2d at 269; see Terril Yue Jones & Ricardo Alonso-Zaldivar, *Low Heat Rating Found in Tires on Ford SUVs*, L.A. TIMES, Sept. 23, 2000, at A1.

⁶⁷ See 49 C.F.R. § 575.104, tbl. 1.

⁶⁸ *In re Ford Motor Co. Securities Litigation*, 184 F.Supp.2d 626, 629 (E.D. Mich. 2001). ATX tires had a failure rate of 60 to 200 per million tires, while the average failure rate of tires from other manufacturers was less than five per million tires. Keith Bradsher, *Ford Intends to Replace 13 Million Firestone Wilderness Tires*, N.Y. TIMES, May 23, 2001, at C1.

⁶⁹ Erica McCallum, *Rearranging Deck Chairs on the Titanic: Will the Early Warning Reporting Required by the TREAD Act Uncover Deadly Defects Soon Enough?*, 44 ARIZ. L. REV. 939, 944 (2002).

⁷⁰ Kevin M. McDonald, *Don't TREAD on Me: Faster Than a Tire Blowout, Congress Passes Wide-Sweeping Legislation That Treads on the Thirty-Five Year Old Motor Vehicle Safety Act*, 49 BUFF. L. REV. 1163, 1172 (2001) [hereinafter McDonald, *Don't TREAD on Me*].

⁷¹ *Id.* Tread separation occurs when the outer steel belt and tread of the tire separate from the tire and become completely detached. *Henry v. Bridgestone/Firestone Inc.*, 63 Fed.App'x 953, 956 (7th Cir. 2003).

⁷² *In re Ford*, 184 F.Supp.2d at 269; *Henry*, 63 Fed.App'x at 956.

⁷³ *In re Bridgestone/Firestone, Inc. Tires Products*, 155 F.Supp.2d 1069, 1080 (S.D. Ind. 2001).

vestigation.⁷⁴ Firestone responded by announcing a voluntary recall of all ATX and ATX II tires that had been manufactured since 1991.⁷⁵

B. Traditional COI Costs

According to news reports, between 271 and 476 people died as a result of the Ford SUV rollovers in the United States, and there were over 800 serious injuries.⁷⁶ News reports also indicate that Ford settled approximately 1,500 Explorer-related cases and Firestone settled more than 1,300 lawsuits.⁷⁷ Based on these figures, we estimated traditional COI costs.

Since we could not verify the news reports of the number of fatalities, we adopted the most conservative approach and chose 271 deaths, the low end of the available estimates. In comparison, we assumed that the reports of over 800 non-fatal injuries captured only some of these injuries, for two reasons. First, it is not cost-effective for tort lawyers to take cases involving only a small amount of damages, which means the number of serious injuries does not reflect the total number of injuries. Second, the work by Finkelstein and his collaborators indicates that there are far more injuries from accidents that involve no hospital visit than injuries that require hospitalization.⁷⁸

To estimate the number of non-fatal injuries involving hospitalization, we calculated ratios of hospitalized injuries to fatal injuries based on data from Finkelstein's work which indicated by age group and sex the number of motor vehicle accidents that resulted in hospitalizations as compared to the number of fatalities for the same age groups and sex.⁷⁹ We used a similar methodology to estimate the number of injuries not requiring hospitalization based on data from the same source. We calculated ratios of non-hospitalized injuries to fatal injuries from data that indicated by age group and sex the number of motor vehicle accidents

⁷⁴ McDonald, *Don't TREAD on Me*, *supra* note 70, at 1172-73. Firestone did not comply with NHTSA recommendation to expand the recall to the "Wilderness AT" model tire, but agreed to replace those tires on a case by case basis. Ford, however, agreed to a recall to replace all "Wilderness AT" tires on Explorers with a different brand of tire. *Id.* at 1173-74.

⁷⁵ *Id.* at 1173.

⁷⁶ See Kevin M. McDonald, *Separations, Blow-Outs, and Fallout: A TREADise on the Regulatory Aftermath of the Ford-Firestone Tire Recall*, 37 J. MARSHALL L. REV. 1073, 1079 (2004) [hereinafter McDonald, *Separations, Blow-Outs, and Fallout*]; Jon S. Vernick et al., *Role of Litigation in Preventing Product-Related Injuries*, 25 EPIDEMIOLOGIC REVIEWS 90, 92 (2003).

⁷⁷ McDonald, *Don't TREAD on Me*, *supra* note 70, at 1078.

⁷⁸ See FINKELSTEIN ET AL., *supra* note 8, at 48 Appendix 1.4 (indicating number of motor vehicle accidents resulting in fatalities, hospitalization, and no hospitalization by age, group, and sex).

⁷⁹ See *id.* (indicating number of motor vehicle accidents resulting in fatalities and hospitalization by age group and sex).

that did not result in hospitalizations and the number of fatalities for the same age groups and sex.⁸⁰

We assumed gender and age compositions to be the same as those for all motor vehicle crash deaths in the Fatal Accident Reporting System from NHTSA.⁸¹ Table 4 presents the results by gender, age, and the nature of injuries suffered in each gender and age category. The first row of the second column contains the number 0.2077, meaning that men who are 20 years old or younger comprised 20.77 percent of all injuries to men and women in our synthetic cohort. The sum of the percentages in the second column and the sixth column equals 100 percent. The number 56 in the first row of the third column represents the estimated number of men who are 20 years old or younger who died as the result of a Ford-Firestone rollover. The numbers 307 and 5,375 represent the number of men who are 20 years old or younger who were hospitalized and who were not hospitalized as a result of their injuries, respectively.

TABLE 4: FORD-FIRESTONE COHORT NUMBERS

Age	Men				Women			
	Percent of all injuries	Number of			Percent of all injuries	Number of		
		Fatal injuries	Hospital	Non - Hospital		Fatal injuries	Hospital	Non - Hospital
20	0.2077	56	307	5,375	0.1023	28	151	2,647
40	0.2211	60	327	5,722	0.1089	30	161	2,818
60	0.2412	65	357	6,239	0.1188	32	176	3,074

The next step was to match medical costs and lost production to this distribution of fatalities, hospitalized, and non-hospitalized injuries. The data for direct and indirect COI costs were drawn from Finkelstein and his colleagues, who compiled this information to estimate the total cost of injuries in the United States.⁸² We multiplied the number of injuries identified in Table 4 by these per-person costs to generate total costs. The costs were adjusted to reflect the value of the dollar in the year 2007. These results are presented in Table 5.

⁸⁰ See *id.* (indicating number of motor vehicle accidents resulting in fatalities and no hospitalization by age group and sex).

⁸¹ Fatality Analysis Report System Encyclopedia (FARS), available at <http://www-fars.nhtsa.dot.gov/Main/index.aspx>.

⁸² See FINKELSTEIN ET AL., *supra* note 8, at 56, 97.

TABLE 5: FORD-FIRESTONE COI ACROSS AGE AND GENDER

Age	Medical	Lost Production	Total
Men			
20	\$17,748,443	\$130,544,249	\$148,292,692
40	\$17,155,266	\$136,055,456	\$153,210,722
60	\$19,645,879	\$96,133,696	\$115,779,574
Sub-total, Men	\$54,549,588.08	\$362,733,401	\$417,282,989
Women			
20	\$7,463,776	\$40,523,454	\$47,987,230
40	\$7,272,527	\$42,991,472	\$50,263,999
60	\$8,317,103	\$30,994,466	\$39,311,569
Sub-total, Women	\$23,053,407	\$114,509,392	\$137,562,798
Total			\$554,845,787

C. Extended Costs

In this section, we describe three possible scenarios involving extended external costs caused by an SUV rollover and explain our methodology for estimating those hypothetical costs. These scenarios produce extended costs ranging from \$288,000 to \$2.4 million per family.

1. Permanent Quadriplegia

The first scenario assumes that a man, age forty-six, with two children who are sixteen and eighteen years old, suffers permanent quadriplegia as a result of a Ford-Firestone rollover. His wife, age forty-six, falls back to part-time employment to care for her husband, and the older child drops out of college to take on dual work and caregiving roles. After two years, the family loses one car and its home, prompting them to file for bankruptcy, a relatively common occurrence in this situation.⁸³ The younger child graduates from high school, but foregoes a college education and immediately enters the work force. In addition, the employers of family members bear the costs of lost productivity due to caregiving burdens. Table 6 summarizes the extended costs associated with these circumstances, which total \$740,454, discounted at 3 percent, and without taking into account any future inflation.

⁸³ The assumption of bankruptcy is based on data indicating that approximately 50 percent of bankruptcies in families relate to medical events. See David U. Himmelstein et al., *MarketWatch: Illness and Injury as Contributors to Bankruptcy*, 24 HEALTH AFF. (WEB EXCLUSIVE) W5-63, W5-66-67 (2005), available at <http://content.healthaffairs.org/cgi/reprint/hlthaff.w5.63v1>.

TABLE 6: FORD-FIRESTONE EXTENDED COSTS—SCENARIO ONE

Costs	Amount
Caregiving	\$115,165
Two children: No college	\$401,124
Lost equity in home	\$108,000
Lost vacation	\$23,080
Lost Social Security	\$27,216
Lost productivity to employers of family members	\$65,869
TOTAL	\$740,454

We estimated the value of the spouse's caregiving based on published data providing the value of informal caregiving per hour,⁸⁴ and the average out-of-pocket cash outlays by such caregivers.⁸⁵ The cost to the children of foregoing a college education is based on data from the Department of Labor comparing median earnings of college and high school graduates.⁸⁶ The lost equity calculation assumes the victim lived in a \$200,000 home and had the average amount of equity that individuals in the United States have as measured by their ownership interest.⁸⁷ Two weeks of lost vacation per year for twenty years is valued on the basis of the annual \$30,000 compensation of the husband prior to the accident. The husband's lost Social Security payments are calculated using worksheets provided by the Social Security Administration.⁸⁸ We assumed no benefits for the wife or children. The value of lost productivity to the employers of family members was based on data indicating the average cost of decreased productivity of workers caring for disabled family members.⁸⁹

⁸⁴ See MARY JO GIBSON & ARI N. HOUSER, AARP PUBLIC POLICY INST., ISSUE BRIEF: VALUING THE INVALUABLE: A NEW LOOK AT THE ECONOMIC VALUE OF FAMILY CAREGIVING 3 (2007), available at http://assets.aarp.org/rgcenter/il/ib82_caregiving.pdf (calculating the value of informal caregiving as \$10,400 per year).

⁸⁵ See *id.* at 4 (indicating that family and friends who are caregivers spend an estimated \$2,400 per year for groceries, medicine, and other out-of-pocket cash outlays for the care recipient).

⁸⁶ See Theresa Cosca, *Earnings of College Graduates in 1996*, OCCUPATIONAL OUTLOOK Q., Fall 1998 (indicating persons with a high school degree earn 36 percent less than persons with a Bachelor's degree). This estimate does not take into account how much money the children saved by not attending college.

⁸⁷ See ALAN GREENSPAN & JAMES KENNEDY, SOURCES AND USES OF EQUITY EXTRACTED FROM HOMES 27 (Federal Reserve Board, Finance and Economics Discussion Series No. 2007-20, 2007), available at <http://www.federalreserve.gov/pubs/feds/2007/200720/200720pap.pdf>.

⁸⁸ SOC. SEC. ADMIN., YOUR RETIREMENT BENEFIT: HOW IT IS FIGURED, SSA PUBLICATION No. 05-10070 (2008), available at <http://www.ssa.gov/pubs/10070.pdf>.

⁸⁹ See Walter F. Steward et al., *Cost of Lost Productive Work Time Among US Workers with Depression*, 289 J. AM. MED. ASSOC. 3135, 3135 (2003) (indicating an average cost of \$3,600 per year).

2. Multiple Family Injuries Including Child in Persistent Vegetative State

In our second scenario, a rollover results in the death of a grandmother, injuries to a mother and father, and injuries to their two children. The older child, age ten, has several broken bones and the younger child, age eight, is left in a persistent vegetative state. Because the grandfather is unable to live alone, he must move into an assisted living facility. An aunt cares for the older child in her home for two months, and then moves in with the family for six months to provide support while the parents get back on their feet. Due to her injuries (an arm amputation and facial scarring), the mother, age thirty-eight, loses her job and cannot find a new one for two years, eventually settling on a position paying less than one-half as much as her prior position. She becomes clinically depressed and requires psychotherapy for eight years. The family attempts to care for the disabled child at home, but after two years the father becomes unable to cope with the constant stress and abandons the family. This forces the mother and older son to move to subsidized housing for six years and to rely on TANF, food stamps, and Medicaid. With the mother's agreement, after the abandonment, the comatose son becomes a ward of the state for the remaining twenty-eight years of his life. This step was necessary because the mother lacked the financial resources to care for the child. Table 7 summarizes the extended costs associated with this scenario, which total \$1,476,136 in 2007 dollars, discounted at 3% and without taking into account future inflation.

TABLE 7: FORD-FIRESTONE EXTEND COSTS—SCENARIO TWO

		Family	Public Sector
Funeral Expenses - Grandmother	Airfare	\$4,920	-
	Hotel and per diem	\$10,890	-
	Funeral costs	\$7,323	-
Grandfather	Assisted living	\$256,106	-
Aunt	Hosting old son	\$927	-
	Related household costs	\$1,200	-
	Leave without pay	\$25,000	-
Mother and Older Son	Subsidized housing	-	\$36,199
	TANF	-	\$26,296
	Food Stamps	-	\$5,809
	Medicaid	-	\$22,893
	Medicaid prescription	-	\$9,817
Mother	Unemployment insurance	-	\$4,195
	Lost wages	\$65,600	-
	Lower income	\$310,444	-
	Psychotherapy	\$38,229	-
Disabled Son	Attendant service	\$209,181	-
	Medicaid	-	\$28,261
	Medicaid prescription	-	\$1,954
	Physical therapy	\$50,999	-
	Nursing home (Medicaid)	-	\$359,893
SUBTOTAL		\$980,819	\$495,317
TOTAL		\$1,476,136	

We assumed that fifteen family members traveled to the grandmother's funeral incurring average travel expenses.⁹⁰ Funeral costs likewise reflect average costs.⁹¹ The cost of assisted living for the grandfather is based on insurance company data.⁹² The aunt's cost of

⁹⁰ See Press Release, U.S. Dep't. of Trans., Average Third-Quarter Air Fares Fell 0.8 Percent from 2006 (January 30, 2008), available at <http://www.bts.gov/pressreleases/2008/bts00508/pdf/bts00508.pdf>.

⁹¹ See Press Release, National Funeral Directors Association, NFDA Releases Results of General Price List Survey (June 2, 2008), available at <http://www.nfda.org/pressRelease.php?eID=293> (indicating the median national cost of funerals in 2006 was \$7,323).

⁹² See Press Release, MetLife Mature Market Inst., *Private and Semi-Private Nursing Home Room Rates Increase 3% in 2007 Assisted Living Rates Remain Steady, According to MetLife Market Survey*, Oct. 30, 2007, available at <http://www.metlife.com/assets/cao/mmi/publications/mmi-pressroom/mmi-pressreleases-nursing-home-asst-living-2007L.pdf?SCOPE>

hosting the oldest son uses U.S. Census data on the weekly cost of raising a child,⁹³ and her costs of taking care of the family are based on average household costs.⁹⁴ We assume that she took a leave without pay from her job, losing \$25,000 in lost income. The costs to the public sector of providing subsidized housing,⁹⁵ TANF,⁹⁶ food stamps,⁹⁷ and Medicaid⁹⁸ were derived from government data and our assumptions about the duration of these benefits as indicated in the footnotes. The cost of unemployment insurance for the mother is based on the 2006 national average.⁹⁹ For her lost income, we assumed that she earned \$24,000 after the accident compared to \$50,000 prior to the accident.¹⁰⁰ The cost of her psychotherapy is based on a national average cost.¹⁰¹ Likewise, the disabled son's costs for attendant services (two shifts per

=Metlife&MSHiC=65001&L=10&W=2007%203%20Home%20Increase%20Nursing%20Private%20Rates%20Room%20SemiPrivate%20and%20in%20&Pre=%3CFONT%20STYLE%3D%22background%3A%23ffff00%22%3E&Post=%3C/FONT%3E (indicating a monthly cost for assisted living of \$2,969/month) [hereinafter *MetLife Press Release*].

⁹³ See U.S. CENSUS BUREAU, WEEKLY CHILD CARE COSTS PAID BY FAMILIES WITH EMPLOYED MOTHERS: 1985–2005 tbl.C2 (2005), available at <http://www.census.gov/population/www/socdemo/child/weeklychildcare.xls> (indicating cost per week of \$107).

⁹⁴ See GIBSON & HOUSER, *supra* note 84, at 4 (indicating that family and friends who are caregivers spend an estimated \$2,400 per year for groceries, medicine, and other out-of-pocket cash outlays for the care recipient).

⁹⁵ See U.S. DEP'T OF HOUS. & URBAN DEV., ISSUE BRIEF NO. II: ECONOMIC COST ANALYSIS OF DIFFERENT FORMS OF ASSISTED HOUSING (1998), available at <http://www.huduser.org/publications/pdf/economic.pdf> (indicating the average operating cost of single room occupancy for Section 8 housing is \$298 per month).

⁹⁶ See OFFICE OF POLICY & OFFICE OF RESEARCH, EVALUATION & STATISTICS, SOC. SEC. ADMIN., ANNUAL STATISTICAL SUPPLEMENT TO THE SOCIAL SECURITY BULLETIN, 2005 9.14–15 tbl.9.G (2006), available at <http://www.ssa.gov/policy/docs/statcomps/supplement/2005/9g.pdf> (indicating cost of TANF benefits). We assume the mother and son were eligible for TANF for one year.

⁹⁷ See U.S. DEP'T OF AGRIC., SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM: HOW MUCH COULD I RECEIVE?, available at <http://www.fns.usda.gov/isp/applicantrecipients/BEN.HTM> (indicating food stamps cost the government a maximum rate of \$298 for a family of two for FY2008 and a maximum of \$162 for one person). Our calculation uses the minimum amount of food stamp benefits available from the government. The maximum amount of food stamps is three times as much. Our estimate assumes that two members of the family received food stamps for six years and one member of the family received food stamps for twenty-five years.

⁹⁸ See OFFICE OF POLICY & OFFICE OF RESEARCH, EVALUATION & STATISTICS, SOC. SEC. ADMIN., ANNUAL STATISTICAL SUPPLEMENT TO THE SOCIAL SECURITY BULLETIN, 2006, 58 (2007), available at <http://www.socialsecurity.gov/policy/docs/statcomps/supplement/2006/supplement06.pdf> (indicating that Medicaid per person is \$2,215 per year, on average) [hereinafter 2006 STATISTICAL SUPPLEMENT]. We assumed Medicaid for two people for six years and for one person for twenty-five years.

⁹⁹ 2006 STATISTICAL SUPPLEMENT, *supra* note 98, at 6 (indicating a \$266.60 average weekly benefit, for 15.3 weeks).

¹⁰⁰ Our calculation does not take into account any loss of benefits and subtracts the unemployment compensation that she received.

¹⁰¹ See ERWIN BROWN, JR. & KAREN BEAUREGARD, AGENCY FOR HEALTHCARE RESEARCH & QUALITY, STATISTICAL BRIEF NO. 157: REGIONAL DIFFERENCES IN TOTAL AND OUT-OF-POCKET EXPENDITURES FOR SELECTED TYPES OF OFFICE-BASED VISITS, 2004 1

day for two years),¹⁰² physical therapy (one hour daily for two years),¹⁰³ Medicaid,¹⁰⁴ and a nursing home,¹⁰⁵ are based on data indicating the average or reimbursable cost of these services and on our conservative assumptions about their duration.

3. Woman Suffering Serious Mental Illness

In the final scenario, a woman becomes mentally ill after her husband and two children die in a rollover crash and fails to recover. She is 40 years old and must be institutionalized for the remaining 40 years of her life.¹⁰⁶ For that period, the economic cost from this single rollover event is \$2,554,783 in 2007 dollars, discounted 3 percent over 40 years.¹⁰⁷ This estimate does not account for any inflation in the cost of her institutionalized care.

D. Discussion

Our estimate of the number of fatalities is based on news reports indicating between 271 and 476 persons died as the result of Ford SUV rollovers.¹⁰⁸ Since we chose the low end of this estimate, our calculation of traditional COI costs may understate actual costs. Our calculation of COI costs concerning injuries requiring hospitalization and not requiring

(2007), available at <http://www.meps.ahrq.gov/mepsweb/datafiles/publications/st157/stat157.pdf> (indicating average hourly cost of \$106.08).

¹⁰² See METLIFE MATURE MKT. INST. & LIFEPLANS, INC., THE METLIFE MARKET SURVEY OF ADULT DAY SERVICES & HOME CARE COSTS 4 (2007), available at <http://www.metlife.com/assets/cao/mmi/publications/studies/mmi-studies-2007-adult-day-services-and-study.pdf> (indicating national average hourly cost of \$19) [hereinafter METLIFE MARKET SURVEY].

¹⁰³ See TOM SUEHS & PAM McDONALD, TEX. HEALTH AND HUMAN SERV. COMM'N, PRESENTATION TO THE HOUSE COMMITTEE ON HUMAN SERVICES 19 (Mar. 13, 2008), available at http://www.hhsc.state.tx.us/news/presentations/0308HHSC_Presentation.pdf (indicating a cost/recommended rate of \$77.65 per hour for SFY04-05).

¹⁰⁴ See 2006 STATISTICAL SUPPLEMENT, *supra* note 98, at 5 (indicating average vendor payment of \$23,882 for nursing facility services in 2003).

¹⁰⁵ See THE NAT'L SPINAL CORD INJURY STATISTICAL CTR., UNIV. OF ALA. AT BIRMINGHAM, SPINAL CORD INJURY: FACTS AND FIGURES AT A GLANCE 2 (2006), available at <http://images.main.uab.edu/spinalcord/pdffiles/Facts06.pdf> (finding that an individual injured at age 20 who survived at least a year and remained ventilator dependent at any level, had a life expectancy of 23.3 years).

¹⁰⁶ See HSIANG-CHING KUNG, PH.D. ET AL, CDC, DIVISION OF VITAL STATISTICS, NATIONAL VITAL STATISTICS REPORTS, DEATHS: FINAL DATA FOR 2005 7, available at http://www.cdc.gov/nchs/data/nvsr/nvsr56/nvsr56_10.pdf (showing life expectancy for females in the United States at 80.4 years).

¹⁰⁷ See HOUS. DIV., WASH. STATE DEP'T OF COMTY., TRADE AND ECON. DEV., TEN-YEAR HOMELESS PLAN 15 (2006) (indicating that the cost per day for institutionalized care in a mental hospital in the state of Washington is \$555, or \$202,575 per year), available at http://cted.wa.gov/_CTED/documents/ID_3356_Publications.doc.

¹⁰⁸ See *supra* note 76 and accompanying text.

hospitalization may likewise understate actual costs because we extrapolated these estimates from our estimate of the number of fatalities.¹⁰⁹

We assumed that the gender and age compositions for all motor vehicle crash deaths as indicated by NHTSA data were representative of the gender and age compositions for gender and age compositions for Ford rollover injuries and fatalities.¹¹⁰ Because the accidents we studied involved SUVs, there may be more women and children involved than in the average crash.¹¹¹ However, we were unable to locate data that would permit us to fine-tune our gender and age compositions.

The per-injury medical cost for fatalities for all ages ranged from \$5,910 to \$8,755 for males and from \$6,800 to \$10,072 for females.¹¹² If anything, these results appear to underestimate the costs associated with a fatality. Zaloshnja and Miller indicate that a fatal vehicle crash entails medical costs of \$20,655, and this estimate assumes instant death, rather than the costlier outcome of critical injuries causing death weeks later.¹¹³

Our per-injury estimate of medical costs and indirect costs for fatalities ranges from \$448,581 to \$1,409,627.¹¹⁴ Department of Transportation data suggests these estimates are generally accurate, if one assumes that Firestone/Ford rollover accidents were at least as severe as other motor vehicle accidents. According to DOT, each motor vehicle fatality entails an average discounted lifetime cost of \$977,000 and each critically injured survivor represents costs averaging \$1.1 million.¹¹⁵

Our estimate of traditional costs includes minor injuries, which we defined as injuries not involving hospitalization. Presumably persons with relatively minor injuries did not sue Ford or Firestone, particularly if the cost of their injuries was covered by medical insurance. We incorporated the cost of treatment for these minor injuries into traditional

¹⁰⁹ See *supra* notes 78–80 and accompanying text.

¹¹⁰ See *supra* note 81 and accompanying text.

¹¹¹ See Jack Hitt, *The Hidden Life of SUVs*, MOTHER JONES, July/August 1999, available at http://4wheeldrive.about.com/gi/dynamic/offsite.htm?zi=1/XJ&sdn=4wheeldrive&cdn=autos&tm=14&gps=132_94_1020_622&f=00&su=p706.15.336.ip_&tt=2&bt=1&bts=0&st=16&zu=http%3A/www.motherjones.com/mother_jones/JA99/rant.html (stating that 40 percent of all SUV sales are to women, and the proportion is growing); Public Citizen, *Hazards of SUVs for Children*, available at <http://www.citizen.org/autosafety/boosterseat/childmsuv/index.cfm>.

¹¹² COI Methodology Appendix, *supra* note 49, at 8.

¹¹³ See Eduard Zaloshnja et al., *Crash Costs in the United States by Crash Geometry*, 38 ACCIDENT ANALYSIS & PREVENTION 644 (2006).

¹¹⁴ To derive these figures, we added the per-injury medical costs and per-injury indirect costs for males, ages 20, 40, and 60, and for females, ages 20, 40, and 60. The lowest combined cost is for females, age 60, and the highest combined cost is for males, age 20. See COI Methodology Appendix, *supra* note 49, at 8, 11.

¹¹⁵ U.S. DEP'T OF TRANSP., NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., *THE ECONOMIC IMPACT OF MOTOR VEHICLE CRASHES 1* (2000), available at <http://www-nrd.nhtsa.dot.gov/Pubs/809446.PDF>.

costs to produce a more accurate estimate of COI. On the other hand, we do not include the cost of the property damage to the vehicles that were in the rollovers, costs which are presumably paid for by a person's automobile insurance. Once again, this omission suggests that our estimates of COI understate true social costs.

Our estimate that the SUV accidents involved almost \$555 million in direct costs, excluding pain and suffering, gains credence from correlating figures in published reports, which indicate that Ford was defending over \$590 million in personal injury and class action lawsuits, and that Firestone had set aside \$800 million for lawsuits relating to the ATX and ATX II tires.¹¹⁶ Assuming the accuracy of these newspaper reports, they suggest that our estimates understate COI. This discrepancy may be explained at least in part by the fact that we relied on figures that underestimated the number of fatalities and injuries. As discussed earlier, we used the low number of fatalities as the starting point for our calculations, so our estimates may not capture the costs for all of the injuries or fatalities resulting from Ford SUV rollovers. Our estimate may also be too low because we excluded pain and suffering, assuming that the Ford and Firestone payments included compensation for pain and suffering.

Our estimate that extended costs range from \$740,000 to \$2.55 million depends on the particular projections made about the nature of the injuries that were suffered and the duration of various costs. We believe that we have made realistic assumptions, but the amount of extended costs will vary based on the projected outcome of the accident.

The estimates of extended costs involving medical expenses may also understate costs because they are not adjusted for future inflation, which is significant given the potential time periods. Consider, in scenario three, an estimate of the cost of institutionalized care for 40 years. The discounted cost of the care is about \$2.55 million using a 3 percent discount rate.¹¹⁷ The rate of inflation for medical services, however, was 109 percent for the decade spanning 1998-2007, as compared to an increase in the general Consumer Price Index of 44 percent.¹¹⁸ If we assume that the cost of medical services, such as institutional care, increased 10 percent per year (a conservative estimate, given that from 2006 to 2007 medical services prices rose nearly 15 percent), the cost of care is nearly \$28.5 million in 2007 dollars, again using a discount rate of 3 percent.

¹¹⁶ McDonald, *Separations, Blow-Outs, and Fallout*, *supra* note 76, at 1078. Both amounts are probably stated in 2000 dollars.

¹¹⁷ See *supra* note 107 and accompanying text.

¹¹⁸ U.S. DEP'T OF LABOR, BUREAU OF LABOR STATISTICS, available at <http://www.bls.gov/cpi/#tables> (Data input for this comparison is for all commodities and for medical services, 1998-2007).

Conversely, some of our estimates of extended costs may overstate costs because the discrete costs that factor into the estimate do not produce a net reduction in social wealth as large as the cost itself. For example, in scenario one, we counted as a cost the equity that the family lost in the value of their home (\$100,800) when they filed for bankruptcy.¹¹⁹ The purchase price of the house, however, may have been discounted to some extent because it was sold as part of a bankruptcy proceeding, which means an economic gain for some other family would have offset the loss of wealth to the family to some extent. Since the information needed to compare social costs to actual costs depends on a wide array of external factors and is often unknown, we treated the entire loss of equity as a loss of social wealth.

A similar objection concerns the loss of wages in scenario two. Analysts who follow a “friction cost” approach believe that the only decrease in social wealth occurs during the time it takes a firm to find a healthy replacement worker.¹²⁰ While this may correctly describe the cost to the individual employer, it is not an appropriate measure of the loss from society’s point of view. Consider the process of hiring a replacement worker after the original worker is killed in an SUV accident. From the point of view of society—the proper perspective from which to measure externalities—both the deceased worker, had he or she lived, and the replacement worker would have added value to aggregate social wealth over their lifetimes. The problem with the “friction cost” approach is that it assumes the potential healthy replacement worker would be unemployed for a lifetime, which is unlikely.

Even in the short run, the “friction cost” approach is problematic because it employs the unrealistic assumption that replacement workers are available for all of the persons who are unable to work due to injuries from dangerous products. Based on data from Finkelstein and his colleagues¹²¹ and from Lawrence and his coauthors,¹²² we can estimate that dangerous products were responsible for over 22,000 deaths and over 25 million injuries in 2000. If we assume that “full employment” corresponds to a 4 percent unemployment rate, the number of potential replacement workers available for those jobs left vacant by the deaths and injuries would be zero in 2000 and roughly one million in 2001.¹²³

¹¹⁹ See *supra* Table 6; note 87 and accompanying text.

¹²⁰ See Magnus Johannesson & Göran Karlsson, *The Friction Cost Method: A Comment*, 16 J. HEALTH ECON. 249 (1997).

¹²¹ See FINKELSTEIN ET AL, *supra* note 8.

¹²² See Lawrence, *supra* note 9.

¹²³ There are no workers available in 2000 because the unemployment rate for that year was 4.0 percent. There are one million workers available in 2001 because the unemployment rate for that year was 4.7 percent. The difference between 4.0 percent unemployment and 4.7 percent unemployment is one million workers. See U.S. Census Bureau, U.S. Statistical Ab-

Finally, it is easy enough to imagine that our conservative approach means that our scenarios understate the external costs of an SUV rollover by excluding other likely expenses. In scenario one, for example, we did not include any costs that would be borne by the public sector. These costs could run into the hundreds of thousands of dollars if the family qualifies for Social Security Disability payments, and perhaps food stamps and housing and utility subsidies.

IV. BAYCOL

The second case study is of the social costs associated with serious adverse effects caused by the pharmaceutical drug Baycol. This section first describes the product defect that made this drug a dangerous product. We then discuss how we derived our estimate of a total of \$284 million in traditional COI costs and from \$159,000 to \$2.2 million in extended costs per family, both in 2007 dollars. We again end with a discussion of our results.

A. *Product Defect*

The generic name for Baycol is cerivastatin and, as this name indicates, it is a member of a class of drugs known as statins.¹²⁴ Statins reduce cholesterol levels in the body, thus decreasing the probability of heart attacks and strokes.¹²⁵ Generally, statins are safe, but some individuals' muscles are sensitive to elevated levels of statins, thereby causing a muscular disease known as myopathy.¹²⁶ Statins can also cause a severe form of myopathy known as rhabdomyolysis,¹²⁷ which can lead to permanent damage, significant disability, or even death.¹²⁸

While all statins carry a risk of myopathy and rhabdomyolysis, patients taking Baycol experienced higher incidence of these side effects. Part of the problem may have been that researchers designed Baycol to be 60 to 200 times more potent than other statins on the market.¹²⁹ Consequently, the FDA limited its approval of the use of Baycol to smaller

tract: 2008, at 373, tbl.569 (indicating unemployment data for 2000 and 2001), available at <http://www.census.gov/prod/2007pubs/08abstract/labor.pdf>.

¹²⁴ See *In re Baycol Products Litigation*, 218 F.R.D. 197, 201 (D. Minn. 2003).

¹²⁵ Jane E. Brody, *Statins: Miracles for Some, Menace for a Few*, N.Y. TIMES, Dec. 10, 2002, at F7.

¹²⁶ Scott M. Grundy, *The Issue of Statin Safety: Where Do We Stand?*, 111 CIRCULATION 3016, 3016 (2005).

¹²⁷ Amy Haavisto Kind et al., *Rhabdomyolysis from the Combination of a Statin and Gemfibrozil: An Uncommon but Serious Adverse Reaction*, 101 WIS. MED. J. 53, 54 (2002).

¹²⁸ Jeanne Bruno-Joyce et al., *Cerivastatin and Gemfibrozil—Associated Rhabdomyolysis*, 35 THE ANNALS OF PHARMACOTHERAPY, 1016, 1018 (2001).

¹²⁹ *Id.* at 1016.

doses.¹³⁰ In an attempt to improve Baycol's effectiveness, Bayer asked the FDA to approve higher dosages, which it eventually did.¹³¹

Problems began to occur when people took Baycol in higher doses,¹³² particularly in elderly women with smaller bodies.¹³³ Reports of side effects that physicians sent to the FDA from 1990 to 2002 indicated that the probability of Baycol-induced rhabdomyolysis was 65 times higher than the probability of this side effect in all other statins combined.¹³⁴ A subsequent FDA-supervised analysis found that rhabdomyolysis-related mortality rates for Baycol users were 16 to 86 times higher than for users of other statins.¹³⁵

Bayer removed Baycol from the market on August 8, 2001.¹³⁶ Documents, including e-mails, memos, and sworn depositions uncovered during class action litigation against Bayer, suggest that company executives were aware of the serious health risks associated with the drug prior to the recall.¹³⁷ Despite this, Bayer continued to market the drug in a manner that prompted an FDA warning to Bayer that its marketing materials were "false, lacking in fair balance or otherwise misleading" and that they downplayed "the most important risk information."¹³⁸

¹³⁰ Bruce M. Psaty et al, *Potential for Conflict of Interest in the Evaluation of Suspected Adverse Drug Reactions: Use of Cerivastatin and Risk of Rhabdomyolysis*, 292 J. AM. MED. ASS'N 2622, 2622 (2004). Bayer has responded to this article and many of its claims. See Joseph D. Piorkowski, *Bayer's Response to "Potential for Conflict of Interest in the Evaluation of Suspected Adverse Drug Reactions: Use of Cerivastatin and Risk of Rhabdomyolysis,"* 292 J. AMERICAN MEDICAL ASS'N 2655 (2004).

¹³¹ *In re Baycol Products Litigation*, 218 F.R.D. at 202; Psaty et al., *supra* note 130, at 2624.

¹³² Gina Kolata & Edmund L. Andrews, *Anticholesteral Drug Pulled After Link With 31 Deaths*, N.Y. TIMES, Aug. 9, 2001, at A12.

¹³³ Psaty et al., *supra* note 130, at 2628.

¹³⁴ *Id.* at 2625.

¹³⁵ *Id.* FDA also found that mortality rates for Baycol users was 10 to 50 times higher than for the use of other statins when individuals used both Baycol and Gemfibrozil, another drug often prescribed with Baycol. *Id.* at 2626. The two drugs were prescribed together because, when combined, they greatly increased the reduction in cholesterol, but when used together, even individuals using a relatively low-risk statin experienced some muscle destruction. Kind, *supra* note 127, at 55.

¹³⁶ Philip J. Hilts, *Drug's Problems Raise Questions on Warnings*, N.Y. TIMES, Aug. 21, 2001, at F1.

¹³⁷ See Melody Petersen & Alex Berenson, *Papers Indicate That Bayer Knew of Dangers of Its Cholesterol Drug*, N.Y. TIMES, Feb. 22, 2003, at A1; Psaty et al., *supra* note 130, at 2623 (describing warning labels that appeared on Baycol bottles).

¹³⁸ Petersen & Berenson, *supra* note 137, at C14. Responding to mounting pressure in May 2001, three months before the recall, Bayer issued a "Dear Healthcare Professional" letter, warning physicians of the potential side effects of the drug, and highlighting that gemfibrozil created a particular hazard. See *In re Baycol Products Litigation*, 218 F.R.D. at 202

Baycol was linked to at least 100 deaths by early 2002,¹³⁹ and between 1,000 and 1,600 severe nonfatal injuries.¹⁴⁰ In January 2007, parties in a multidistrict class action concerning Baycol reported to the court that defendants had settled 3,067 cases with a total value of \$1,154,343,835.¹⁴¹ They also reported that the number of active cases was approximately 1,200.¹⁴²

B. Traditional COI Costs

We assumed that Baycol caused 3,067 total injuries based on the report that Bayer had settled 3,067 cases in the multidistrict class action litigation.¹⁴³ Our assumptions about the number of fatalities and long-term disabilities were based on an analysis of FDA data.¹⁴⁴ We assumed that 3.6 percent, or 110, of these 3,067 injuries resulted in deaths based on statistical data detailing the frequency of deaths among Baycol users.¹⁴⁵ We further assumed there were 159 injuries that resulted in long-term disability (5.2 percent of the 3,067 total injuries).¹⁴⁶ For the remaining 2,798 injuries,¹⁴⁷ we assumed each injury resulted in acute disease and a single hospitalization. Finally, based on the same FDA data, we assumed that the injuries occurred in two age categories (50 to 64 and 65+), 30 percent of the cases were in the first category and 70 percent were in the second, and 52.35 percent of those injured were male.¹⁴⁸

We matched available cost data to the fatal and nonfatal categories as well as to the age and gender categories identified above. Hospital

¹³⁹ Petersen & Berenson, *supra* note 137, at A1.

¹⁴⁰ See *In re Baycol*, 218 F.R.D. at 202 (reporting injuries of at least 1,000 persons); Expert Witness Report of R. Samuel Mayer, MD, at 4, *In re Baycol Products Litigation*, No. MDL 1431, 2005 WL 2464940 (D. Minn. 2005), available at 2005 WL 1341252 (referring to 1,579 reports of severe muscle damage from toxic rhabdomyolysis); Petersen & Berenson, *supra* note 137, at A1 (reporting injuring of approximately 1,600 persons); Ameet Sachdev, *Attorney Fired On Perjury Charge: Kenneth Moll Loses Key Post*, CHI. TRIB., Apr. 16, 2004, at § 3, 7.

¹⁴¹ See Baycol Product Liability Litigation, Current Developments, United States District Court, District of Minnesota, available at <http://www.mnd.uscourts.gov/MDL-Baycol/#current>.

¹⁴² See *id.*

¹⁴³ See *supra* note 141 and accompanying text.

¹⁴⁴ See generally Mohamed A. Omar & James P. Wilson, *FDA Adverse Event Reports on Statin-Associated Rhabdomyolysis*, 36 ANNALS OF PHARMACOTHERAPY 288 (2002).

¹⁴⁵ See *id.* at 291.

¹⁴⁶ *Id.* The article is not clear about the definition of disability, but the authors present separate categories for persons who suffered disabilities and persons who were only hospitalized, which is the same distinction that we make.

¹⁴⁷ The number of remaining injuries was calculated by deducting the previous two numbers from the total number of injuries; i.e., 3,067 (total injuries) – 110 (deaths) – 159 (long-term disability) = 2,798.

¹⁴⁸ See Omar & Wilson, *supra* note 144, at 291.

charges and costs were drawn from government health care data.¹⁴⁹ We estimated all medical costs with the traditional total-to-hospital costs method.¹⁵⁰ We again used data from Finkelstein's work for our estimate of lost production due to fatalities and to injuries.¹⁵¹ We then assumed that the lost production costs for permanent injuries were the same as for fatalities. All of these estimates were adjusted upward for inflation from the years 2000 and 2003 to the year 2007. Table 8 summarizes the results of the previous calculations.

¹⁴⁹ See Agency for Health Care Research and Quality, U.S. Dep't of Health and Human Serv., Welcome to HCUPnet, available at <http://hcupnet.ahrq.gov>. From this source, we obtained data for the cost of treating rhabdomyolysis using cost estimates for all disorders of muscle, ligament, and fascia (ICD9 = 728.8 and number 728). These data, however, need to be deflated because they are expressed as charges, not true hospital costs. The actual hospital charges reflect the interaction of insurance companies and the hospitals because insurance companies routinely challenge initial charges. Since the Healthcare Cost and Utilization Project estimated that the ratio between hospital charges and actual costs is 0.3554, we multiplied by the charges for the treatment of rhabdomyolysis by 0.3554 to produce our treatment cost estimates.

¹⁵⁰ In this method, a multiplication factor is calculated based upon the ratio of the percent all medical costs for all diseases and injuries (100%) divided by hospital-only costs for all diseases and injuries (in our case 100% / 30.7%). See HCUP FACTS AND FIGURES, STATISTICS ON HOSPITAL BASED CASE IN THE UNITED STATES, 2005, available at http://www.hcup-us.ahrq.gov/reports/factsandfigures/HAR_2005.pdf. We assumed average medical costs would apply to our "hospitalizations" category, but that our categories of death and disability involved higher medical costs. For fatalities, we assumed that medical costs would be twice the average medical costs for hospitalizations. See HCUPnet, *supra* (indicating a mean medical cost for treating disorders of muscle, ligament, and fascia of \$17,762 and a median cost of \$11,857). Since the mean cost is much higher than the median cost, and because this suggests that medical costs have long right-tail, it is reasonable to assume fatal costs are at least twice the average. For disabilities, we assumed that medical costs for persons in the 50-to-64 age category would be four times the average medical costs of hospitalizations, and for persons in the 65 and older category, we assumed these costs to be twice this average. The medical cost estimates from HCUPnet reflect only one year. Permanent disability will likely generate medical costs for every year until the person dies. For persons who were permanently disabled, we assumed those in the 50-to-64 age category will live longer and require four times more medical care than the average cost. We assumed those persons in the 65 and older category would only require two times as much care as the average cost since these persons would not live as long as those in 50-to-64 age category.

¹⁵¹ See FINKELSTEIN ET AL., *supra* note 8, at 119, 121.

TABLE 8: BAYCOL TOTAL MEDICAL AND LOST-PRODUCTION COSTS

	Medical Costs	Lost Production	Total
Male fatalities by age			
60 years	\$795,399	\$18,351,815	\$19,147,214
70 years	\$2,375,358	\$9,797,022	\$12,172,381
Female fatalities by age			
60 years	\$724,038	\$10,590,987	\$11,315,041
70 years	\$2,162,098	\$ 7,927,349	\$10,089,447
Disabled men by age			
60 years	\$4,598,900	\$26,526,715	\$31,125,590
70 years	\$6,866,945	\$14,161,1517	\$21,028,095
Disabled women by age			
60 years	\$4,186,302	\$15,308,791	\$19,495,093
70 years	\$6,250,428	\$ 11,458,623	\$17,709,051
Hospitalized men by age			
60 years	\$10,116,024	\$23,264,086	\$33,379,670
70 years	\$30,209,212	\$16,526,222	\$46,736,460
Hospitalized women by age			
60 years	\$9,208,448	\$12,213,264	\$21,421,711
70 years	\$27,497,019	\$12,674,779	\$40,172,732
TOTAL	\$104,990,171	\$178,800,805	\$283,792,485

C. *Extended Costs*

We also estimated that Baycol caused extended costs of between \$159,000 and \$2.2 million per family based on the three following hypothetical scenarios.

1. Individual with Severe Leg Pain

A sixty-year-old divorced woman, following an episode of rhabdomyolysis after taking Baycol, requires twice-weekly physical therapy for two years for leg pain. During this period, she can hardly walk and cannot drive her car. She takes early retirement from a \$30,000 per year job and must rely on Medicaid rather than private health insurance. Her daughter postpones college for two years to care for her mother full time and thereby delays entering the workforce. As summarized in Table 9, these extended costs total nearly \$160,000 in 2007 dollars, discounted at 3 percent and without any adjustment for inflation.

TABLE 9: BAYCOL EXTENDED COSTS—SCENARIO ONE

	Family	Public Sector
Physical therapy	\$14,572	-
Reduced retirement account	\$14,139	-
Medicaid	-	\$62,479
Daughter delay into workforce	\$68,159	-
TOTAL	\$96,870	\$62,479
GRANT TOTAL	\$159,349	

We estimated physical therapy costs based on therapy twice a week based on the conservative assumption that they lasted for two years and used reimbursement rates presented to the Texas state health commission.¹⁵² The cost of early retirement assumes that the woman contributed ten percent of her total compensation to her 401(k) and earned a five percent return. The Medicaid estimate assumes five years of support and is based on cost data published by the federal government.¹⁵³ The cost to the daughter of delaying entry into college is based on the loss of two years of income at the median annual earnings of college graduates.¹⁵⁴

2. Individual Unable to Walk

The second scenario assumes that a sixty-eight-year-old man loses his ability to walk due to Baycol-induced rhabdomyolysis, resulting in clinical depression. Because his sixty-eight-year old spouse cannot care for her husband, both move to a nursing home for seven years. A daughter, aged fifty, moves back to the city where her parents are located to provide support for them, taking a 20 percent pay cut. Her productivity in her new job is adversely affected by her caregiving role for her parents. After the wife dies, the husband moves to a less expensive, Medicaid-funded nursing home for the remaining five years of his life. As summarized in Table 10, these extended costs total slightly over \$1.0 million in 2007 dollars, discounted at 3 percent and without any adjustment for inflation.

¹⁵² See SUES & McDONALD, *supra* note 103 (indicating rate of \$77.65 per hour).

¹⁵³ See 2006 STATISTICAL SUPPLEMENT, *supra* note 98, at 58 (indicating disabled individuals on Medicaid had a cost in 2003 of approximately \$12,855 per year).

¹⁵⁴ See Cosca, *supra* note 86 (indicating persons with a college degree have a median income per year of \$36,155). Our estimate assumes she graduates college and that there is no significant loss in pension or Social Security benefits.

TABLE 10: BAYCOL EXTENDED COSTS—SCENARIO TWO

		Family	Public Sector
Husband	Nursing home	\$392,638	-
	Less Expensive nursing home	-	\$116,073
Wife	Nursing home	\$392,638	-
Daughter	Moving costs	\$10,700	-
	Lost income (12 years)	\$84,166	-
	Increased health premium	\$20,200	-
	Lost pension income	\$11,222	-
Daughter's Employer	Lost productivity	\$30,300	-
TOTAL		\$941,864	\$116,073
GRAND TOTAL		\$1,057,937	

The estimate of the nursing home costs assumes that the couple resided there for seven years. It relies on published insurance company data indicating the cost of a semi-private room in a nursing home.¹⁵⁵ The cost of the less expensive nursing home is based on Medicaid data and assumes five years of occupancy.¹⁵⁶ The moving costs reflect data on the average cost of interstate moves.¹⁵⁷ The daughter's lost income is based on an assumption that she went from a job at \$50,000 to a job at \$40,000 for twelve years. In addition, we hypothesize that she has \$200 per month higher health care premiums with no increase in the cost of insurance from year to year until she becomes eligible for Medicare. We calculated that the change in jobs reduces the contribution to her 401(k) by \$1,000 per year, an amount which would have earned a 5 percent annual return had she made the contributions. The estimate of lost productivity of the employer is based on a study of the cost of lost productive work time among workers with depression and assumes twelve years of employment.¹⁵⁸

¹⁵⁵ See *MetLifePress Release*, *supra* note 92 (indicating average cost of a semi-private room is \$189 dollars per day, or \$68,985 a year based on a 365-day calendar in 2007 data).

¹⁵⁶ See 2006 STATISTICAL SUPPLEMENT, *supra* note 98, at 5 (indicating average cost of Medicaid nursing facility services in 2003 of \$23,882).

¹⁵⁷ See STATE OF WASH., MOVING EXPENSE REGULATION AND GUIDE (indicating average interstate move weighing 9,000 pounds cost \$10,700), available at www.ga.wa.gov/PCA/forms/a33form.doc.

¹⁵⁸ See Steward et al., *supra* note 89 (indicating an average cost of \$3,600 per year).

3. Individual on Dialysis

The final scenario assumes a forty-five-year-old man who is on dialysis for the remaining twenty-five years of his life as a result of Baycol-induced rhabdomyolysis. He is forced to give up his job as partner at a major law firm. His wife takes on major caregiving responsibilities. A physical therapist visits his home once a week to ease his leg pain. As summarized in Table 11, the estimated extended costs are \$2,206,630, discounted at 3 percent and not taking into account the impact of inflation.

TABLE 11: BAYCOL EXTENDED COSTS—SCENARIO THREE

		Family
Lawyer	Lost earnings	\$1,791,020
	Lost vacation time	\$101,033
	Reduced 401(k) assets at retirement	\$191,042
	Physical therapist	\$46,149
Spouse	Caretaker costs 10 years	\$77,386
TOTAL		\$2,206,630

We included lost earnings in this hypothetical as an extended cost because it is likely that the lawyer's annual earnings exceeded the lost earnings reflected in our earlier calculation of traditional COI costs, which was based on the average lost earnings of accident victims. We assumed for purposes of our calculation that the lawyer earned \$200,000 more than the average victim, would have worked for an additional twenty-five years but for his illness, and received \$50,000 a year in disability payments. The estimate of lost vacation time is based on the value of the lawyer's compensation for five weeks per year. The reduced money in the victim's 401(k) assumes that contributions to his retirement fund constituted 20 percent of the \$400,000 (with no interest accruing). The value of the wife's caregiving is calculated on the basis of an AARP study on the economic value of family caregiving,¹⁵⁹ and assumes the spouse provides care for ten years. The cost of the physical therapist's services is based on insurance data indicating the average cost of such services,¹⁶⁰ and assumes that the services were provided once a week for twenty-five years.

¹⁵⁹ See GIBSON & HOUSER, *supra* note 84 (indicating individual provides approximately \$10,400 a year in unpaid care).

¹⁶⁰ See SUEHS & McDONALD, *supra* note 103 (indicating a \$77.65 per hour rate).

D. Discussion

Our calculations of traditional COI costs assumed a total of 3,067 injuries based on the number of settlements reported in a multidistrict class action litigation concerning Baycol.¹⁶¹ This appears to understate the number of injuries because the parties in the litigation also reported that 1,200 cases that remained unresolved,¹⁶² and because it is likely that some Baycol victims never sued. Based on a study by Omar and Wilson, we further assumed that 3.6 percent, or 110, of these 3,067 resulted in deaths.¹⁶³ This assumption is consistent with reports that Baycol was linked to 100 deaths by early 2002.¹⁶⁴

Our estimate of \$284 million in traditional COI costs is considerably less than the \$1.154 billion in settlements that Bayer is reported to have paid.¹⁶⁵ Since this number is based on a report to the court by the litigants, we assume that it is valid. Our methodology may have understated COI costs for a number of reasons.

First, our medical costs were drawn from hospital data on the costs of treating disorders of muscle, ligament, and fascia.¹⁶⁶ Our estimate does not include the cost of dialysis because we do not know how many persons taking Baycol needed this medical treatment, but if a significant number of patients who suffered Baycol-induced rhabdomyolysis required dialysis, our medical costs may be too low by a significant margin.

Second, our medical costs estimates involved certain assumptions about the relationship of long-term medical costs to the average cost of hospitalizations.¹⁶⁷ For example, we assumed that medical costs for persons in the 50-to-64 age category would be four times the average costs of hospitalization because we lacked actual data on the hospital costs of patients in this category who were injured by taking Baycol. While we believe that these assumptions are reasonable ones, they are assumptions and may not precisely reflect the true cost of medical costs in the relevant categories. Indeed, since our COI estimates are significantly less than \$1.154 billion in settlements that Bayer is reported to have paid, we may have significantly underestimated the relationship of long-term medical costs to the average cost of hospitalizations.

Finally, our estimate of traditional COI costs excludes pain and suffering. We are uncertain of the extent to which the money paid by Bayer

¹⁶¹ See *supra* note 141 and accompanying text.

¹⁶² See *supra* note 142 and accompanying text.

¹⁶³ See *supra* note 144 and accompanying text.

¹⁶⁴ See *supra* note 139 and accompanying text.

¹⁶⁵ See *supra* note 141 and accompanying text.

¹⁶⁶ See *supra* note 150.

¹⁶⁷ *Id.*

in Baycol settlements reflects compensation for this dimension of injury, but our exclusion of the cost of pain and suffering may explain some of the discrepancy between our estimate and the total amount of the Baycol settlement.

Our calculations of extended costs that range from \$159,000 to \$2.2 million per family are subject to the same qualifications mentioned in the discussion of our SUV rollover estimates. First, our estimate of extended costs depends on the assumptions that we made about the nature of the injuries that individuals suffered and the duration of various costs. Second, because the estimates of extended costs of medical expenses do not take into account future inflation, they are understated by some unknown amount. Third, we treated the loss of employment as a reduction in social wealth based on the existence of frictional employment. Finally, our estimates of extended costs may have been understated because we did not include additional costs that could occur in the type of situation we have hypothesized. Consider the daughter in scenario two who is forced to take a lower paid job in order to be with her parents. It is easy to imagine that she might become isolated and depressed, resulting in additional medical expenses if she sought treatment.

V. ALL TERRAIN VEHICLES

Our final case study estimates the external costs of three-wheeled ATVs. We follow the same format as before, with a description of the product defect that made these ATVs a dangerous product followed by an explanation of how we derived our estimate of a total of \$3.9 billion in traditional COI social costs and \$289,000 to \$2.36 million of extended costs per family. We conclude with a discussion of the results.

A. *Product Defect*

All-terrain vehicles were introduced to the American market in 1970.¹⁶⁸ An ATV is a three- or four-wheeled motorized vehicle with large, low-pressurized tires, a seat designed to be straddled, and handlebars for steering, that is intended for use on non-paved terrain. During the 1980s, there was both a substantial increase in ATV sales and in the number of persons injured and killed in ATV accidents. As Table 12 indicates, sales increased by over 50 percent between 1984 and 1985, peaking at 600,000 units. During the same period, there was an 80 percent increase in injuries and fatalities.

¹⁶⁸ Michael J. Moore & Wesley A. Magat, *The Injury Risk Consequences of the All-Terrain Vehicle Consent Decrees*, 17 INT'L REV. L. & ECON. 379, 380 (1997).

TABLE 12: ATV SALES, FATALITIES, INJURIES¹⁶⁹

Year	Sales (1,000s)	Reported Deaths	Reported Injuries
1972-1977	139	n.a.	n.a.
1978-1979	154	n.a.	n.a.
1980	126	n.a.	n.a.
1981	100	n.a.	n.a.
1982	290	29	10,100
1983	457	85	32,100
1984	625	156	77,900
1985	602	251	105,700
1986	481	347	106,000
1987	399	283	93,600
1988	217	286	74,600
1989	145	258	70,300
1990	129	250	59,500
1991	138	256	58,100
1992	152	251	58,200
1993	173	136	49,800

The Consumer Product Safety Commission (CPSC), a federal administrative agency, became alarmed about the increasing number of death and injury reports and issued a series of safety alerts in late 1984.¹⁷⁰ In 1985, CPSC published an advanced notice of proposed rulemaking concerning ATVs, the first step required under its statutory mandate to establish a product safety standard.¹⁷¹ CPSC then requested that manufacturers cease producing ATVs designed for use by children 12 years and under.¹⁷² After ATV manufacturers rejected that request, CPSC referred the matter to the Department of Justice, which filed a legal action in 1987 seeking to have ATVs designed for use by children declared an imminently hazardous consumer product.¹⁷³ In 1988, the

¹⁶⁹ See U.S. CONSUMER PRODUCT SAFETY COMMISSION, 2003 ANNUAL REPORT OF ALL-TERRAIN VEHICLE (ATV)-RELATED DEATHS AND INJURIES 4 tbl. 1, 9 tbl. 5 (2005) (reporting on number of fatalities and injuries); Gary T. Ford and Michael B. Mazis, *Informing Buyers of Risks: Analysis of the Marketing and Regulation of All Terrain Vehicles*, 30 J. CONSUMER AFF. 90, 92 tbl. 1 (1996) (indicating number of ATVs sold during each given year).

¹⁷⁰ Ford & Mazis, *supra* note 169, at 94; Moore & Magat, *supra* note 168, at 383.

¹⁷¹ Ford & Mazis, *supra* note 169, at 95. Before CPSC can publish a notice of proposed rulemaking for a new safety standard, it must publish an advanced notice of proposed rulemaking that solicits proposals for the standard. See 15 U.S.C. § 2058(a) (2006); Teresa Schwartz, *The Consumer Product Safety Commission: A Flawed Product of the Consumer Decade*, 51 GEO. WASH. L. REV. 32, 71 (1982) (describing the CPSC rulemaking process).

¹⁷² Ford & Mazis, *supra* note 169, at 95.

¹⁷³ *Id.*

five major ATV manufacturers settled this lawsuit and agreed to stop sales of all three-wheel vehicles, among other actions.¹⁷⁴

Four aspects of ATVs made them dangerous for consumers. First, the ATV design impeded riders from safely using the machines in two ways. The low inflation tires functioned to absorb the impact from rugged terrain at higher speeds, but increased the likelihood of an accident when riders intuitively slowed at significant bumps.¹⁷⁵ The ATVs design also allowed even a small amount of over-steering to cause a tip-over.¹⁷⁶ According to CPSC analysis, 70 percent of ATV accidents involved tip-overs.¹⁷⁷ Second, the triangular configuration of the three-wheel ATVs made the model less stable and more prone to overturning than the four-wheel model.¹⁷⁸ Third, a sizable number of the injuries and fatalities were among inexperienced users and children, whose weaker skills exacerbated the difficulty of ATV use.¹⁷⁹ Finally, the high percentage of accidents and fatalities among inexperienced drivers and young drivers appeared to be linked to inadequate warnings and a lack of consumer education.¹⁸⁰

¹⁷⁴ Moore & Magat, *supra* note 168, at 384. The manufacturers also agreed to engage in educational efforts to warn new and past purchases about age appropriate use of ATVs and other risks and to adopt a voluntary industry-wide design standard to make ATVs safer to use. The CPSC approved the voluntary standard adopted by the industry later in 1988, and it was adopted by the American National Standards Institute in 1990. *Id.* at 385.

¹⁷⁵ Ford & Mazis, *supra* note 169, at 97. Slowing down compromised the tire's ability to compensate for impacts, creating a rebound effect that could unbalance the ATV and throw the rider. At the same time, the under-inflation of the balloon tires tended to create a large amount of friction; the gripping effect could potentially pull the ATV into a roll when the machine was operated on pavement. *Id.*

¹⁷⁶ *Id.* at 96. This propensity resulted from certain ATV design features: a high center of gravity; a solid rear axle; and a relatively narrow wheel base. When turning the vehicle, riders are supposed to shift their weight outwards while turning the handlebars inward. This action is not intuitive, particularly for motorcyclists or bikers who are accustomed to leaning into a turn. On an ATV doing so would actually increase the possibility of a rollover. *Id.*

¹⁷⁷ *Id.* (indicating that 70 percent of all ATV accidents involved the ATV rolling or tipping over).

¹⁷⁸ Daniel L. Rubinfeld & Gregory B. Rodgers, *Evaluating the Injury Risk Associated with All-Terrain Vehicles: An Application of Bayes' Rule*, 5 J. RISK & UNCERTAINTY 145, 149, 156 n. 10 (1992).

¹⁷⁹ In the first half of the 1980s, 13 percent of all accidents involved a first-time rider, and riders with less than one month's experience had thirteen times the risk of being in a serious accident than average. Moore & Magat, *supra* note 168, at 386. Furthermore, a pproximately 38 percent of all ATV fatalities and 40 percent of all serious injuries between 1985 and 1993 involved children under 16 years of age. Ford & Mazis, *supra* note 169, at 94.

¹⁸⁰ Prior to the consent settlement, manufacturers and dealers failed to train a substantial percentage of novice drivers, and failed to supply much information about ATV safety hazards. Ford & Mazis, *supra* note 169, at 113. In addition, there is little evidence that ATV advertising stressed safety or the potential additional risks of three-wheel vehicles. Rubinfeld & Rodgers, *supra* note 178, at 153.

Claimants filed an estimated 1,500 tort cases against ATV manufacturers prior to 1992.¹⁸¹ As of that time, 1,000 cases had been resolved, with about 95 percent of the cases settling. Of the settlements, 40 percent were in the \$50,000 to \$250,000 range, 40 percent were in the \$250,000 to \$1,000,000 range, and 20 percent were over \$1 million.¹⁸² Insurance data from Honda reveals that the average value of claims settled by the company for accidents between 1978 and 1988 was \$859,003.¹⁸³ Another source indicates that Honda had paid \$84 million dollars in settlements through 1990.¹⁸⁴ Based on this source and Honda's 75 percent market share, and by assuming that other manufacturers had comparable settlement rates and outcomes, Ford and Mazis estimate that the industry paid \$113 million in settlements through 1990.¹⁸⁵ Although there are no data on the overall results of cases that went to trial, it is noteworthy that in 1994 the United States Supreme Court affirmed a decision of the Oregon courts granting \$5 million in punitive damages, in addition to \$735,000 in actual damages, for a 1985 Honda ATV accident.¹⁸⁶

B. Traditional COI Estimates

We based our estimate of traditional COI costs on the number of fatalities and injuries avoided due to the decision of ATV manufacturers to stop making three-wheeled models. Put another way, we estimated the cost of fatalities and injuries that would have occurred if three-wheel ATVs had not been removed from the market for the period from 1990 through 2002. As noted earlier, the three-wheel models were particularly prone to tipping over,¹⁸⁷ and the five major manufacturers of ATVs had stopped making three-wheelers by the time of the CPSC settlement.¹⁸⁸ This section summarizes the methodology we used to make the COI estimate.

We choose the years 1985 through 1989 as baseline for measuring percent of deaths due to three- and four-wheelers because three-wheeled

¹⁸¹ See Rubinfeld & Rodgers, *supra* note 178, at 157 n.24. The authors base this estimate on a conversation with an expert who testified in ATV tort litigation.

¹⁸² *Id.*

¹⁸³ See John C. Cabaniss, *Honda ATV Litigation in Retrospect*, available at <http://library.findlaw.com/1992/Nov/1/130577.html>. Cabaniss indicates that his source for this figure is an insurance claim printout from Honda in his possession.

¹⁸⁴ See Ford & Mazis, *supra* note 169, at 113 (citing Ralph B. Wegis, *Honda ATV Litigation in Retrospect*, TRIAL, November, 1992, at 37).

¹⁸⁵ *Id.* at 114. The authors estimate that the industry had paid \$336 million dollars in settlements and legal fees. Since this estimate assumed that legal fees were twice as much as payments to plaintiffs, the settlement amount is \$113 million. *Id.* at 113.

¹⁸⁶ *Honda Motor Co., Ltd. v. Oberg*, 512 U.S. 415 (1994).

¹⁸⁷ See Rubinfeld & Rodgers, *supra* note 178 and accompanying text.

¹⁸⁸ Moore & Magat, *supra* note 168, at 385.

vehicles ceased to be a significant cause of ATV fatalities after 2002.¹⁸⁹ CPSC lacks data on the number of fatalities prior to 1982.¹⁹⁰ The percent of all deaths due to accidents involving four-wheelers from 1985 through 1989 was 39.6 percent,¹⁹¹ which means that 60.4 percent of all deaths involved three-wheelers. Using the same approach, we estimated that three-wheeled ATVs injured 67.0 percent more persons from 1985 through 1989 than four-wheeled ATVs based on the CPSC data.¹⁹²

Based on the percentage of fatalities and injuries caused by three-wheeled vehicles during the base period, we estimated the numbers of deaths and other injuries that would have occurred from 1990 onwards had manufacturers continued to produce three-wheeled vehicles. For example, the CPSC data indicate that there were 151 deaths in 1990 involving four-wheelers.¹⁹³ Based on this number, we estimate that had three-wheeled vehicles remained on the market, there would have been 61 additional fatalities in 1990.¹⁹⁴ Using this methodology, we estimated that, had three-wheeled vehicles remained on the market between 1990 and 1993, there would have been 1,543 additional fatalities during that period.

Using published data on ATV-related hospitalizations,¹⁹⁵ we assumed 80 percent of all injuries were among men and 20 percent were among women. The same source estimates that 30 percent of all injuries

¹⁸⁹ According to a CPSC report, the following percentages of fatalities were associated with 4-wheelers between 1985 and 2002: 19% (1985), 27% (1986), 45% (1987), 53% (1988), 59% (1989), 60% (1990), 91% (1999), and 94% (2002). ROBIN L. INGLE & ROBIN A. STREETER, U.S. CONSUMER PRODUCT SAFETY COMMISSION, ANNUAL REPORT OF ATV DEATHS AND INJURIES/AMENDED 9 tbl.4 (2005), available at <http://www.cpsc.gov/library/atv2005.pdf>. We calculated these percentages by dividing the estimated number of deaths involving four wheeled ATVs (column 4) by the estimated number of total fatalities associated to ATVs (column 3).

¹⁹⁰ See U.S. CONSUMER PRODUCT SAFETY COMMISSION *supra* note 169 and accompanying table.

¹⁹¹ We calculated this percentage by dividing the total number of fatalities involving four-wheeled vehicles (55+95+126+152+153) by the total number of estimated fatalities (258+286+282+347+295), where the first set of numbers are deaths due to four-wheelers from 1985 to 1989 and second set are all deaths. See INGLE & STREETER, *supra* note 189, at 9 tbl.4.

¹⁹² Moore and Magat, *supra* note 168, at 391, interpret earlier published data as establishing "three-wheel ATVs are likely to experience between 57 and 86% more injuries than four-wheel ATVs." The average between these percentages is 67 percent.

¹⁹³ INGLE & STREETER, *supra* note 189, at 9 tbl.4.

¹⁹⁴ We arrive at this estimate by multiplying 151 by 0.604 and then multiplying the result by 0.67. The first calculation is based on our assumption, that three-wheeled vehicles caused 60.4 percent of all fatalities during the base period. See *supra* notes 191-193 and accompanying text. But, based on our baseline assumption, the three-wheeled vehicles would have injured 67 percent more persons than the four-wheeled vehicles. We therefore multiplied the number of three-wheeled fatalities by 0.67 to obtain the number of additional fatalities that would have been attributable to three-wheeled vehicles, had they remained on the market.

¹⁹⁵ James C. Helmkamp et al., *All-Terrain Vehicle-Related Hospitalizations in the United States, 2000-2004*, 34 AM. J. OF PREV. MED. 239, 239 (2008).

were among persons who were seventeen years old or younger and that 70 percent of all injuries were among persons who were older than seventeen.¹⁹⁶ For clarity, we constructed the synthetic cohort to consist of only two ages: exactly seventeen years old and exactly thirty-five years old. We assumed the seventeen-year olds accounted for 30 percent of all injuries and deaths and that thirty-five-year olds accounted for the other 70 percent. These assumptions are summarized in Table 13.

TABLE 13: ATV PERCENTAGES OF MEN, WOMEN, AGE 17 AND AGE 35

	Men, 80%	Women, 20%
Age=17, 30%	24%	6%
Age=35, 70%	56%	14%

Finkelstein and his colleagues identify the number of persons who have been killed or hospitalized as a result of motorcycle injuries.¹⁹⁷ Because we assumed that injuries related to motorcycle accidents were similar to ATV injuries, we took the ratio of these two numbers and applied it to ATV accidents to estimate the number of persons requiring hospitalization.¹⁹⁸ Based on this ratio, we estimate that had manufacturers continued making three-wheeled ATVs, there would have been 12,377 additional hospitalizations. The same publication has data on the number of persons injured in motorcycle accidents who did not require hospitalization.¹⁹⁹ We used the ratio of this number and the number of persons who died in motorcycle accidents to determine the number of persons whose injuries did not require hospitalization. Based on the second ratio, we estimate that had manufacturers continued making three-wheeled vehicles, there would have been 124,369 additional injuries not requiring hospitalization. Table 14 distributes the additional fatalities, injuries involving hospitalization, and injuries not involving hospitalization among the cohort identified in Table 13.

¹⁹⁶ *Id.*

¹⁹⁷ FINKELSTEIN ET AL., *supra* note 8, at 46, app. 1.3. The ratio of persons hospitalized as compared to the number who died was 8.0213 (22,957/2,862).

¹⁹⁸ Finkelstein and his co-authors do not have data limited exclusively to ATVs. Further, we reasoned that his category of "motorcycle" injuries and fatalities was more analogous to ATVs than his category of "motor vehicle occupant." *See id.*

¹⁹⁹ FINKELSTEIN ET AL., *supra* note 8, at 46 app. 1.3. The ratio of the number of persons whose injuries did not require hospitalization to the number of fatalities was 80.602 (230,983/2,862).

TABLE 14: ATV TOTAL FATALITIES, INJURIES WITH AND WITHOUT HOSPITALIZATIONS

	Deaths	Injuries with hospitalizations	Injuries without hospitalizations
Men	1,234	24,674	99,495
Age 17	370	2,970	29,849
Age 35	864	6,931	69,646
Women	309	2,475	24,874
Age 17	93	742	7,462
Age 35	216	1,733	17,412
Total	1,543	12,377	124,369

Using data from Finkelstein and his colleagues, we estimated three categories of medical costs: fatalities, injuries requiring hospitalization, and injuries not requiring hospitalization.²⁰⁰ We also estimated the indirect costs associated with these three types of injuries using data from the same source.²⁰¹ Table 15 summarizes the results. As it reveals, if manufacturers had not stopped making three-wheel ATVs, there would have been an additional \$3,892,537,700 in COI costs because of the injuries that the vehicles would have caused during the years 1990 to 2002.

²⁰⁰ FINKELSTEIN ET AL., *supra* note 8, at 91-92 apps. 2.1-2.2. To estimate costs for seventeen year olds, we used Finkelstein's data for the 15-to-24 age category. To estimate costs for thirty-five-year olds, we used the source's data for 25-to-44 age category. Whereas Finkelstein has data for fatal injuries and injuries involving hospitalization, the source does not have data for injuries that do not involve hospitalization. We instead used their "outpatient" category which appeared to be near the middle of the difference between their "ER treated" and "Doctor's office" categories.

²⁰¹ *Id.* at 119 app. 3.1, 121 app. 3.3. We again used the 15-to-24 age category for seventeen-year olds and the 25-to-44 age category for thirty-five-year olds. We used Finkelstein's data for the categories of fatal injuries, injuries involving hospitalization, and injuries not requiring hospitalization, but we used data for "productivity losses" rather for lost "wages and fringe benefits," reasoning that lost home production should be counted in lost indirect costs from society's perspective. This inclusion is standard in the literature. *See id.* at 97.

TABLE 15: ATV TOTAL COI COSTS, 2007

	Deaths	Injuries with hospitalizations	Injuries without hospitalizations	Total
Men				
Age 17	\$533,571,500	\$346,344,620	\$108,141,620	\$988,057,740
Age 35	\$1,259,968,900	\$763,129,770	\$334,448,434	\$2,357,547,000
Women				
Age 17	\$82,099,229	\$62,345,400	\$22,822,595	\$167,267,210
Age 35	\$172,971,910	\$136,260,840	\$70,433,121	\$379,665,870
TOTAL	\$2,048,611,500	\$1,308,080,500	\$535,845,760	\$3,892,537,700

C. Extended Costs

This section presents three scenarios involving extended social costs resulting from ATV rollovers. The scenarios involve extended costs that range from \$288,000 to almost \$2.4 million per family. After presenting each scenario, we summarize our methods and results.

1. Young Amputee

The first scenario assumes that an eighteen-year old, riding his ATV, is thrown off balance. The ATV flips on him, resulting in a leg injury that requires amputation. He is unable to take advantage of a football scholarship that he won to attend a Class I university, causing him to fall into a clinical depression for two years, during which time he does not work. He needs weekly physical therapy for a year and psychotherapy for ten years. He never goes to college, resulting in a loss of income. As Table 16 indicates, the extended costs in this scenario are \$289,000, discounted at 3 percent and without taking into account the impact of inflation.

TABLE 16: ATV EXTENDED COSTS—SCENARIO ONE

	Family
Lost income	\$39,212
Lost lifetime income for not going to college	\$200,561
Psychotherapy	\$45,054
Physical therapy	\$3,865
TOTAL	\$288,692

We estimated the young man's lost income for the two years that he was unable to work by assuming he would have earned \$10 per hour during that time period and that he had no lost benefits. The estimate of

income he lost because he did not attend college is based on data published by the U.S. Bureau of Labor Statistics indicating the difference in median annual earnings between college and non-college graduates.²⁰² The cost of psychotherapy²⁰³ and physical therapy²⁰⁴ is based on national average hourly costs and our assumptions about the frequency of these services indicated above.

2. Child with Moderate Brain Injury

In this scenario, we assume that a twelve-year-old boy suffers a moderate traumatic brain injury in an ATV accident. His recovery at home includes a year of mental health counseling. At school, he receives special education for three years, and his eventual graduation from high school is delayed for one year. Due to his injury, he is unable to go to college as originally planned. After he is injured, his mother, age forty-one, quits her job to take care of him. She finds another job, but at reduced pay, as well as reduced vacation, retirement, and health benefits. Due to the increased hours she must work, she must pay for additional child care, as well as the services of someone to transport her children to and from after-school activities. As a result of reduced health care benefits, she must pay out-of-pocket for orthodontics for her two daughters, ages eight and ten years at the time of the accident, glasses for her son, and dental services and drugs for all four family members. As Table 17 summarizes, this scenario produces nearly \$600,000 in extended costs in 2007 dollars, discounted at 3 percent and without taking into account the impact of inflation.

²⁰² See Cosca, *supra* note 86 (indicating that in 1996, persons with a high school degree had a median income of \$23,317 per year as compared to \$36,155 per year for high school graduates).

²⁰³ See BROWN, JR. & BEAUREGARD, *supra* note 101 (indicating average hourly cost of \$106.08).

²⁰⁴ See SUEHS & McDONALD, *supra* note 103 (indicating cost of \$77.65 per hour).

TABLE 17: ATV EXTENDED COSTS—SCENARIO TWO

		Family	Public
Injured Child	Mental health therapy	\$6,055	-
	Lost wages	\$23,317	-
	Lost life time earnings	\$200,561	-
Mother	Mother's lost income	\$30,000	-
	Reduced Income	\$186,023	-
	Lost two-weeks vacation	\$27,554	-
	Lost paid holidays	\$8,275	-
Family	Orthodontics	\$10,285	-
	Dental check-ups	\$8,909	-
	Eye exams	\$2,765	-
	Eye wear	\$603	-
	Pharmacy	\$31,182	-
	Child care and support services	\$9,643	-
School System	Special education	-	\$32,232
TOTAL		\$545,172	\$32,232
GRAND TOTAL		\$577,404	

Our estimate of the cost of the boy's psychotherapy is based on national average hourly costs and assumes weekly sessions for one year.²⁰⁵ The estimate of his lost wages for his delayed entry into the workforce uses government data indicating the average earnings of a high school graduate.²⁰⁶ The income the boy loses because he did not attend college is based on the same data source, which also compares median annual earnings of college graduates and non-college graduates.²⁰⁷ The mother's lost income while she cared for her child is based on her leaving the workforce for six months, and assumes that she had been paid \$5,000 per month. The estimate of her reduced income is based on our assumption that her new job paid \$10,000 less than her old one, and that she was employed for 25 years in this position. We calculated the value of her lost vacation days by assuming that she had two more weeks of vacation at her prior job, and we based the value of the lost vacation days on her prior compensation. We further assumed that she lost three paid holidays per year and valued this loss on the same

²⁰⁵ See BROWN, JR. & BEAUREGARD, *supra* note 101, at 4 (indicating an average hourly cost of \$106.08).

²⁰⁶ See Cosca, *supra* note 86 (indicating in 1,966 persons with a high school degree had a median income of \$23,317 per year).

²⁰⁷ See *id.* (indicating in 1,966 persons with a high school degree had a median income of \$23,317 per year as compared to \$36,155 per year for high school graduates).

basis. The costs of orthodontics,²⁰⁸ dental care expenses,²⁰⁹ eye examinations,²¹⁰ drugs,²¹¹ and child care²¹² are based on data indicating the average amount of these expenses. We based our estimate of the cost of special education on data from the National Education Association.²¹³

3. Child with Brain Injury and Brother with Severe Emotional Problems

Our last scenario involves an ATV rollover that left a younger child comatose and an older child with serious emotional issues of guilt, survivorship, and anger. Their mother, age forty, quits her job to become a full-time caregiver, but she is unable to cope with the situation and spends one year in a psychiatric hospital. After rejoining the family, she continues therapy and is not able to work again. A grandmother quits her job and moves into the house to help. Eventually the father decides the family is unable to care for the younger child and the child is moved into institutionalized care. The older child requires tutoring and psychological counseling, and after graduating from high school, is unable to attend college. As summarized in Table 18, this scenario involves over \$2.36 million in extended costs in 2007 dollars, based on a three percent discount rate and without taking into account the impact of inflation.

²⁰⁸ See Phil Galewitz, *Brace Yourself: New Types Feel Better*, USA TODAY, Oct. 15, 2006, available at http://www.usatoday.com/news/health/2006-10-15-braces_x.htm (indicating orthodontics costs between \$5,000 to \$6,000).

²⁰⁹ See TEX. HEALTH AND HUMAN SERV. COMM'N, COST AND BENEFIT ANALYSIS FOR SENATE BILL 34 (2002), available at <http://www.hhsc.state.tx.us/medicaid/reports/122002sb34DentalCare.html#Costs> (indicating Texas Medicaid Reimbursement rate of \$50 for an examination, \$90 for cleaning, and \$150 for X-rays).

²¹⁰ See CONNECTICARE, THE AVERAGE COST OF CARE, at 2 (2007), available at <http://www.connecticare.com/member/costofcare/costofcare.pdf> (indicating the Connecticut Medicaid reimbursement rate of \$90 for eye examinations); CONSUMERREPORTS.ORG, EYE GLASSES, http://www.consumerreports.org/cro/money/shopping/where-to-buy/eyeglasses-1106/overview/1106_eye_ov.htm (last visited Dec. 2, 2008) (indicating inexpensive plastic glasses cost \$120 per year). We assumed that the family purchased six pairs of eye glasses.

²¹¹ See TEX. HEALTH AND HUMAN SERV. COMM'N, HEALTHCARE COSTS IN HEALTH AND HUMAN SERVICES PROGRAMS, PRESENTATION TO SENATE FINANCE COMMITTEE (2001), available at <http://www.hhsc.state.tx.us/news/presentations/HealthcareCosts102401.pdf> (indicating that the average cost of drugs is \$866.85).

²¹² See METLIFE MARKET SURVEY, *supra* note 102, at 4 (indicating that average cost of child care was \$18 per hour). We further assumed that she used these services for three hours a day, five days a week, during a thirty-six week school year for four years, and that the costs were shared with two other families.

²¹³ See NAT'L EDUC. ASS'N, SPECIAL EDUCATION AND THE INDIVIDUALS WITH DISABILITIES EDUCATION ACT (2007), available at <http://www.nea.org/specialed/index.html> (indicating that special education cost \$9,369 more than an average student cost of \$7,552).

TABLE 18: ATV EXTENDED COSTS—SCENARIO THREE

		Family	Public Sector
Mother	Mental health facility	\$208,345	-
	Psychotherapy (twice per week for 9 years)	\$83,530	-
	Lost income	\$344,449	-
Grandmother	Moving expenses	\$4,500	-
	Lost income	\$160,948	-
	Lost health benefits	\$16,555	-
	Lost vacation days	\$12,381	-
	Lost 401(k) contributions	\$16,095	-
	Incidental Expenses	\$16,555	-
Older Child	Home tutoring costs	\$31,236	-
	Mental health care	\$41,765	-
	Loss of lifetime income	\$200,562	-
Younger Child	Nursing home care	-	\$928,286
	Loss of life-time income	\$300,437	-
TOTAL		\$1,437,358	\$928,286
GRAND TOTAL		\$2,365,644	

We estimated the cost of the mother's one year of institutionalized care based on data from the State of Washington.²¹⁴ We assumed that the mother required additional psychotherapy twice a week for nine years, and we used published data indicating the average cost of such therapy.²¹⁵ Her lost income was based on the assumption that her inability to work meant forgoing twenty-two years of income, and, that she had earned \$30,000 per year prior to the accident. The grandmother's moving expenses were based on average interstate moving expenses.²¹⁶ For her lost income, we assumed that she did not work for a period of six years, and had previously earned \$35,000 per year and \$300 per month in health benefits. We further assumed that she lost two weeks of paid vacation per year and ten days of paid holidays per year, which we valued

²¹⁴ Hous. Div., Wash. State Dep't of Comty., Trade and Econ. Dev., Hous. Div., Ten-Year Homeless Plan, at 15 (2006), available at <http://cted.wa.gov/CTED/documents/ID3356Publications.doc> (indicating that the costs per-day of institutionalized care in a mental hospital is \$555, or \$202,575 per year).

²¹⁵ See BROWN, JR. & BEAUREGARD, *supra* note 101, at 1 (indicating an average hourly cost of \$106.08).

²¹⁶ See STATE OF WASH., MOVING EXPENSE REGULATION AND GUIDE (2005), available at <http://www.acadweb.wvu.edu/BFA/BusinessServices/a33form.pdf> (indicating average intra-state moving expenses when moving 8,400 pounds is \$4,500).

on the basis of her \$35,000 annual salary. Another assumption is that contributions to the grandmother's pension fund constituted 10 percent of that income, and would have earned a return of 5 percent annually. Finally, we assumed she spends approximately \$2,400 a year of her own money on expenses for the other family members over the nine years she stayed with the family.

We further assumed that the older child requires tutoring three times a week during the four years of high school, and mental health counseling once a week for nine years. These costs reflect published data on average costs for tutoring²¹⁷ and mental health care.²¹⁸ The older child's loss of income is based on the difference in median earning capacity of high school and college graduates.²¹⁹ The cost of nursing home care for the younger child is based on average rates and assumes twenty-five years of care.²²⁰ His loss of life-time income assumes he would have worked for forty years and would have graduated from college.²²¹

D. Discussion

Our estimate of the number of fatalities and injuries that would have occurred had manufacturers not stopped making three-wheel vehicles is based on CPSC data on the numbers of persons killed by three-wheeled ATVs prior to their removal from the market. While this gives our estimate credibility, it does assume that the three-wheeled ATVs would have caused the same number of fatalities as they have in the past had they remained on sale. Since our estimates of the numbers of persons whose injuries required and did not require hospitalization is extrapolated from our estimate of the number of fatalities, the accuracy of these estimates also depends on the reliability of our estimate of the number of fatalities.

Our estimate of \$3.893 billion dollars in traditional COI costs is considerably higher than a published estimate that the ATV industry paid \$113 million in settlements through 1990.²²² This is despite the fact that our estimate does not include pain and suffering costs. We question the reliability of the \$113 million number, and this is borne out by published

²¹⁷ See Sam Dillon, *For Children Being Left Behind, Private Tutors Face Rocky Start*, N.Y. TIMES, Apr. 16, 2004, at A1 (indicating that private high school tutoring costs of \$40 to \$80 an hour).

²¹⁸ See BROWN, JR. & BEAUREGARD, *supra* note 101, at 4 (indicating an average hourly cost of \$106.08).

²¹⁹ See Cosca, *supra* note 86, at 21 (indicating persons with a college degree have a median income of \$36,155 a year compared to a median income of \$23,317 for high school graduates).

²²⁰ See *MetLife Press Release*, *supra* note 92, at 1 (indicating the average cost of a private room in a nursing home is \$213 per day, or \$77,745 a year, for a private room).

²²¹ See Cosca, *supra* note 86, at 21 (indicating the median compensation of college graduates is \$36,155 per year).

²²² See *supra* note 185 and accompanying text.

insurance data suggesting that the \$113 million total is too low to represent the amount paid by the industry. Insurance data indicate that Honda's average settlement per claim was \$859,000,²²³ while another source says that 40 percent of settlements were between \$250,000 and \$1 million and another 20 percent were more than \$1 million.²²⁴

Our calculations of extended costs between \$288,900 and \$2.4 million per family are subject to the same qualifications as the Ford-Firestone SUV and Baycol scenarios. The ATV estimates likewise depend on assumptions made about the nature of the injuries that were suffered and the duration of various costs. While a different construction of the scenarios would produce a different estimate, we believe the scenarios represent a realistic range of outcomes of ATV accidents. Nevertheless, each scenario could be alternatively constructed to produce both lower costs and higher costs. The calculations underestimate extended costs, because inflation is not taken into account. We treat the loss of employment as a reduction in social wealth based on the existence of frictional employment.

CONCLUSIONS

No one has previously attempted a direct measurement of the external costs of dangerous products. Our efforts support several conclusions regarding public policy.

First, the tort system provides a valuable service for society to the extent it successfully deters the sale of dangerous products. The three case studies reveal that dangerous products have the potential to create significant external costs. According to a COI measurement, the three products we studied alone created nearly \$4.7 billion in external costs,²²⁵ and this estimate does not include the cost of pain and suffering or any of the extended costs described in our scenarios. Although the tort system does not necessarily succeed in forcing the manufacturers of dangerous products to internalize all external costs, it does cause manufacturers to bear some meaningful portion of those costs. The tort system therefore serves societal interests by deterring the sale of dangerous products, and the value of this deterrence, in economic terms, is very substantial.

Second, it appears compensation awarded in the tort system falls short of the actual costs created by dangerous products. However, our evidence for this conclusion is subject to two caveats. First, we had difficulty comparing our results with payouts by manufacturers because of the lack of reliable, complete information about such payouts. Second,

²²³ See *supra* note 183 and accompanying text.

²²⁴ See *supra* note 182 and accompanying text.

²²⁵ This total was derived by adding the sum of the COI costs for each of the three products: \$554,845,787 + 248,209,044 + 3,892,537,700 = \$4,695,592,531.

our results are mixed, with ATV-COI costs being substantially higher than payouts (\$3.893 billion versus \$113 million),²²⁶ Ford-Firestone SUVs COI costs being less than payouts (\$555 million versus \$590 million (Ford) and \$800 million (Firestone)),²²⁷ and Baycol COI costs being substantially less than payouts (\$284 million versus \$1.154 billion).²²⁸ However, we may have significantly underestimated SUV costs because our starting point was the lowest available number of fatalities and injuries from the SUV crashes.²²⁹ Likewise, we may have significantly understated Baycol costs because of the limitations in available data. Our medical costs, for example, were drawn from hospital data on the costs of treating disorders of muscle, ligament, and fascia, and our estimate does not include the cost of dialysis.²³⁰ Finally, the available COI estimates likely underestimate the actual COI because they do not take into account extended costs, although we have no way of estimating the impact of this omission.

TABLE 19: TRADITIONAL AND EXTENDED COSTS COMPARED ACROSS DANGEROUS PRODUCT EXTENT OF INJURY, AND FAMILY SITUATION

Dangerous Product	Traditional Costs	Extended Costs	Ratio of Extended Costs to Traditional Costs
Firestone Tire/Ford Explorer			
Low Range	\$4,194	\$740,254	177-1
Medium Range	\$74,325	\$1,476,136	20-1
High Cost Range	\$1,697,279	\$2,554,783	2-1
Baycol			
Low Range	\$45,582	\$159,349	3-1
Medium Range	\$333,916	\$1,057,037	3-1
High Cost Range	\$1,246,472	\$2,206,630	2-1
All Terrain Vehicles			
Low Range	\$4,045	\$288,692	71-1
Medium Range	\$84,023	\$577,404	7-1
High Cost Range	\$1,422,085	\$2,385,644	2-1

Third, product defects produce significant costs beyond the medical costs and lost productivity we measured by the COI methodology. Our

²²⁶ See *supra* note 222 and accompanying text.

²²⁷ See McDonald, *Separations, Blow-Outs and Fallout*, *supra* note 76, at 1077-78.

²²⁸ See *supra* note 141 and accompanying text.

²²⁹ *Id.*

²³⁰ See *supra* note 149 and accompanying text.

results, shown in Table 19, suggest that extended costs may far outstrip traditional costs. For Table 19, we created a low-, medium-, and high-range scenario of traditional COI costs for each case study,²³¹ and compared these costs to the extended cost scenarios used in each of our case studies.²³² While traditional costs ranged from \$4,045 to \$1,697,279 per case, extended costs ranged from \$159,349 to \$2,554,783. All numbers are in 2007 dollars. In each case study, whether for a low, medium, or high level of expenditures, extended costs were at least two times greater than traditional costs.

It is difficult to compare cost categories because each medical case is unique, and the way that each family responds to tragedy is also unique. The specific injuries described in the traditional costs column do not necessarily correlate with the specific injuries described in the extended cost scenarios. Despite these variables, as a general trend, the table strongly suggests that families or other third parties bear substantial costs not accounted for by traditional COI methodology. This is significant because, as our scenarios suggest, families can suffer unfortunate, life-altering changes when one or more family members are seriously injured by dangerous products. In addition, because our estimates of extended costs do not take into account future inflation, they understate the full economic impact on families.

The ultimate impact on families depends on the extent to which they can recover compensation for traditional as well as extended social costs. We have no way of knowing the extent to which this occurs. However, we suspect that due to imperfections in the tort system, when one or more family members are injured or killed by dangerous products, the

²³¹ For Firestone/Ford Explorer, the low range COI cost is based on a male, age sixty, who had injuries not requiring hospitalization. The medium range estimate assumes a female, age forty, who had injuries requiring hospitalization. The high cost estimate contemplates a male, age 20, who died from his injuries. See discussion *supra* Part III.B–C. The number-of-persons figures were divided by the total cost figures in the COI Methodology Appendix to arrive at the per-person costs that appear in Table 19. See COI Methodology Appendix, *supra* note 49, at Ford/Firestone Table 8. For Baycol, we based the low range cost on a male, seventy years old, who was hospitalized. The medium estimate assumes a female, older than seventy years old, with a permanent severe disability. The high cost estimate is based on a male, age sixty, who has a permanent severe disability. The number-of-persons figures were divided by the total cost figures in the COI Methodology Appendix to arrive at the per-person costs that appear in Table 19. See discussion *supra* Part IV.B–C. Finally, the low cost ATV estimate reflects the COI costs of a female, age thirty-five, who suffers injuries but is not hospitalized. The medium estimate is calculated on the basis of a female, age seventeen, who is injured and hospitalized. We measured the high cost estimate on the basis of a male, age seventeen, who died from his injuries. The number-of-persons figures were divided by the total cost figures in the COI Methodology Appendix to arrive at the per-person costs that appear in Table 19. See discussion *supra* Part V.B–C.

²³² The lowest estimate of extended costs for each set of scenarios is treated at the low-range estimate. The middle estimate is treated as the medium-range estimate. The highest estimate is considered to be the high-range estimate.

amount of compensation may be considerably less than the costs paid by families over the long-term.

When a family is unable to bear the costs of dangerous products, some of those costs will be shifted to taxpayers via public sector programs. If, for example, a family does not recover compensation to pay for a health aide or housekeeper to help a disabled person, taxpayers will pay for these services if the disabled person qualifies for a safety net program. Though this means that taxpayers are likely on the hook for some of the external costs of dangerous products, the extent of this shift in costs cannot be determined for purposes this study.

Finally, it is simply not possible to account for the permanent, life-changing aspects of the tragedies associated with the three products we have studied. Psychological trauma and physical suffering are not measured, nor are other burdens that cannot be monetized. This limitation does not make these “costs” any less real to those who suffer them. Consequently, the deterrence function of the tort system provides incalculable value by protecting many families against the pain, grief, and suffering caused by dangerous products.

