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PRODUCTS LIABILITY

Mark Geistfeld
New York University School of Law

Abstract

Designing the products liability system to promote efficiency is justifable because the injurer (seller) and victim (consumer) typically are in a contractual relationship. Contracting will not lead to efficient outcomes when consumers undervalue the benefits of seller liability, as would occur, for example, when consumers underestimate product risk. Although tort liability often would reduce product risk in these situations, forcing sellers to pay for product-caused injuries is likely to increase the average cost of injury compensation. This tension between safety and insurance considerations makes it difficult to reach firm conclusions regarding the efficiency properties of the main products liability doctrines. Nevertheless, in many instances the legal rules do not depend upon the relevant economic considerations, suggesting that the current system could be made more efficient.
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1. Introduction

Products liability - the body of law governing the allocation of losses caused by product use - has rapidly gained prominence over the past 50 years. The importance of products liability stems from the substantial social cost of product-caused injuries. According to government data, product accidents in the United States cost roughly $50 billion per year (Keeton et al., 1989, p. 2). These data are crude, however (Viscusi, 1984, pp. 48-55). Relying on survey evidence, Hensler et al. (1991) estimate that accidents in the United States, excluding those resulting in latent injuries, institutionalization, or death, impose direct and work-loss annual costs of $175.9 billion or 4 percent of Gross National Product. Approximately 30 percent of these accidents involved product use, and another 18 percent were associated with motor-vehicle use. The social cost of nonfatal product accidents is substantial, then, and including fatalities and latent injuries (like those caused by exposure to toxic substances) considerably increases the total. The magnitude of these losses and the volume of product transactions indicate that products liability rules have a significant

impact on producers, consumers, and the general economy. Consequently, products liability has become one of the most important, and politically controversial, forms of civil liability.

Legal scholars who analyzed the emerging field of products liability rarely addressed efficiency concerns (McKean, 1970a; Priest, 1985). Similarly, court opinions in products liability cases have paid little or no explicit attention to efficiency (Henderson, 1991). But as the economic analysis of products liability has developed over the past few decades, so too have legal decision -makers become more concerned about the economic consequences of these liability rules. Today efficiency considerations often strongly influence the formulation of products liability laws, as reflected by the Restatement (Third) of Torts: Products Liability (American Law Institute, 1997). This emphasis on efficiency is defensible. Sellers include their liability costs in the product price. Consumers (potential victims) accordingly pay for and receive the benefits of tort liability, so their preference for efficient liability rules - those that maximize the net benefit of seller liability - should govern.

By analyzing products liability with an economic perspective, it becomes apparent that this body of law could be merely a specific application of contract law, since if unregulated market transactions were efficient, courts would only have to enforce contractual allocations of product risk in order to ensure efficient outcomes. Many product-caused injuries are governed by tort law, however, making it necessary to identify the market failures that may justify tort regulation. Sections 2 through 10 accordingly develop the economic framework for evaluating different liability rules. Sections 11 through 13 describe the impact that the products liability system has had on product safety, innovation, and the market for liability insurance. The remaining sections discuss the efficiency properties of the main doctrines in products liability.

2. The Basic Model for Analysing the Efficiency Properties of Contracting and Tort Liability

Much of the economic analysis of products liability can be described in terms of a simple model. Shavell (1987) and Spulber (1989) provide more rigorous analyses of many of these issues.

As the focus of the inquiry is on product-caused injuries, the model does not consider any product characteristics unrelated to the risk of injury (such as aesthetics, functionality, and durability). Hence the ‘product’ to be analyzed is homogeneous in all respects except for the risk of injury posed by the product and the extent of contractual liability the seller incurs under the product warranty. The following assumptions are also unrealistic, but most will be relaxed in the ensuing discussion. All firms have identical production

technologies and sell the product, exclusive of safety and liability costs, in a perfectly competitive market at the unit cost of p. By making safety investments of s per unit of product, a firm affects the probability or risk $r(s)$ that the product will cause injury. Increased safety investments reduce the risk of injury at a decreasing rate [$r'(s) < 0; r''(s) > 0$]. All injuries caused by the product have a monetary equivalent of L that is suffered by risk-neutral buyers who are identical and unable to influence the risk of injury.

In light of these assumptions, the total cost or 'full price' **P** of the product is given by

$$\mathbf{P} = p + s + r(s)L. \tag{1}$$

If perfectly informed consumers bear the injury cost L in the event of accident, they pay a purchase price of $p + s$ for the product but recognize that this cost is increased by the expected accident cost $r(s)L$. Consequently, consumers make their purchase decisions on the basis of the full price P rather than the price they pay to purchase the product, so consumer demand $Q^D = Q^D(\mathbf{P})$. Sellers then compete by offering the amount of safety and warranty coverage that minimize **P**.

Under these conditions, it does not matter whether a perfectly informed consumer or the seller is liable for the injury (for example, Hamada, 1976). If the consumer is liable, the seller must choose the amount of safety investments to minimize P, which from equation (1) implies that the seller chooses the amount s^* defined by

$$1 = -\, r'(s^*)L. \tag{2}$$

In other words, the seller invests in safety until the last dollar spent reduces expected injury costs by one dollar. Such a product is optimally safe.

If the seller is fully liable for the consumer's injuries, it sells the product and warranty at a price of $p + s + r(s)L = \mathbf{P}$. Once again, the seller must minimize the full price, so it chooses the optimal amount of safety investment s^*. Whether the consumer or producer is liable for the product-caused injury therefore does not affect product safety or the full price.

3. The Significance of Imperfectly Competitive Markets

An early, influential justification for tort regulation was based on the notion that manufacturers can take advantage of their market power by supplying unsafe products (Priest, 1985). However, the results obtained from the basic model are unaffected if the market is not perfectly competitive (for example, Epple and Raviv, 1978). A seller's market power can be represented by the amount it can increase the product's full price above the competitive level. By

increasing the product price by this amount, the seller increases its profits per sale by that same amount. Alternatively, by reducing safety investments below the optimal level s^*, the seller can also increase the product's full price as each $1 of reduced safety investment necessarily increases expected accident costs $r(s)L$ by more than $1. This strategy does not affect the seller's profits per sale, however, because the product must sell for a reduced price equal to the unit cost of $p + s$ (any price above cost is equivalent to an increase in the product price). Hence a monopolist can make higher profits by selling perfectly informed consumers an optimally safe product at a supracompetitive price. Similar reasoning shows that if it would be efficient for the seller to bear full liability under the warranty, then a monopolist would maximize profits by offering a full warranty while selling the product at a supracompetitive price (for example, Heal, 1977).

It is possible, though, for market structure to affect product safety. The basic model assumes a constant marginal cost of safety investment (the term s) per unit of product. Consequently, a manufacturer's decision regarding safety investments does not depend upon its output level (as reflected by equation (2) above), implying that product safety will be unaffected by the reduced quantity of output that occurs in imperfectly competitive markets. Many product risks are likely to depend upon the quantity of products sold or consumed by an individual, however. As Marino (1988a, 1988b) points out, toxic chemicals may present a health hazard due to their cumulative effect on consumers. Conversely, consumers may develop a tolerance from cumulative exposure, thereby reducing the risk. The higher prices, and reduced consumption, of products sold in imperfectly competitive markets would affect these kinds of product risk. In addition, when the cost of safety investments depends upon a manufacturer's output level, the amount of safety investments made by a monopolist depends on the cross-effects of safety investments and output on the monopolist's costs (Spulber, 1989, pp. 407-410). Whether sellers in imperfectly competitive markets supply products that are insufficiently safe therefore is a difficult empirical question. But if such market failures exist, they probably are better addressed by the antitrust laws.

4. The Role of Consumer Information About Product Risk

The analysis so far has assumed that consumers are perfectly informed of risk, an assumption typically made by early economic analyses of products liability (for example, McKean, 1970a; Oi, 1973). But as Goldberg (1974) argued, product safety becomes a regulatory problem only if consumers are inadequately informed. Subsequent economic analyses focused on the effects of imperfect information.

When imperfectly informed consumers are liable for their injuries, they

must estimate their expected injury costs, denoted $E[r(s)L]$, and hence the full price, denoted $E[\mathrm{P}]$. Consequently, equation (1) above is changed to

$$E[\mathrm{P}] = p + s + E[r(s)L]. \qquad (1')$$

In this setting, a seller must minimize $E[\mathrm{P}]$ if consumers are to buy its product, so sellers choose the amount of safety investment $\underline{s}$ that minimizes $E[\mathrm{P}]$:

$$1 = -E[r'(\underline{s})L]. \qquad (2')$$

Thus, when consumers are imperfectly informed of product risk, the seller invests in safety until the last dollar spent on safety reduces *the consumer's estimate of* expected injury costs by one dollar (Spence, 1977). If consumers underestimate the decrease in expected injury costs, they will undervalue risk reduction and demand less than the optimal amount of safety; that is, if $-E[r'(s)L] < -r'(s)L$, then $\underline{s} < s^*$. A similar result occurs when consumers cannot observe manufacturer safety investments, because consumers who cannot tell the difference between a low-risk and high-risk product treat the differential in safety as if $-E[r''(s)L] = 0$ when in fact $-r'(s)L > 0$. Manufacturers have no incentive to incur the higher cost of producing the low-risk product, so they supply only high-risk products, an outcome analogous to the 'lemons problem' analyzed by Akerlof (1970).

Imperfect information need not result in overly unsafe products. If consumers overestimate the way in which increased safety investments reduce risk, they will attribute too great a value to safety investments and demand more than the optimal amount of safety. Although this outcome is inefficient, it seems unwise to construct a regulatory regime, with its attendant administrative costs, in order to reduce product safety. Hence there is a pressing need to regulate market transactions only if consumers undervalue safety investments.

5. Market Mechanisms that Promote Product Safety

Landes and Posner (1987, pp. 280-281) argue that it is too costly for consumers to obtain perfect information about product risks, and imperfectly informed consumers tend to underestimate the small risks ordinarily posed by products, causing them to undervalue safety investments. In assessing this argument, we must recognize that the cost consumers incur to get risk-related information, and their need for it, depends upon a variety of market mechanisms. For example, manufacturers have an incentive to provide optimally safe products if there is a large enough proportion of well-informed 'shoppers' in the market (Schwartz and Wilde, 1983a). The information held by some consumers therefore may benefit others who undervalue product safety. Similarly, consumers who communicate among themselves by 'word of mouth'

advertising may increase the amount of high-quality goods in the market (Rogerson, 1983). Consumers also can purchase product-related information from intermediaries, and such information may come from sellers.

Brand names, for example, are a method sellers use to implicitly guarantee superior quality (Klein and Leffler, 1981), because product quality must be sufficiently high if the seller is to attract repeat purchases (for example, Shapiro 1982, 1983). For the same reason, sellers can convey indirect information about product quality through advertising and prices (Milgrom and Roberts, 1986). The way in which price signals quality is highly dependent on the market context, however, as in some settings low prices signal high quality, whereas in other settings high prices signal high quality (Tirole, 1990, pp. 110-12). In addition, prices signal product quality only if consumers have at least some brand-specific information about quality, although this information need not be perfect (Wolinsky, 1983). As long as consumer experience with a product brand provides enough information so that consumers are more likely to believe the brand is of high quality when in fact it is, high-quality firms will attract more customers (Rogerson, 1983).

The need to protect their reputation or brand name may force sellers to provide more safety than is suggested by the analysis in the prior section. Nevertheless, it is unlikely that unregulated market transactions will yield optimally safe products when consumers are imperfectly informed of product risk. A seller's reputation can remain intact even though its product is not optimally safe, because consumers often have little or no ability to learn from product use about the product's safety characteristics. Many risks are latent and do not become manifest for years (like carcinogens). In addition, many safety characteristics are not observable during normal product use (such as whether a motor vehicle is optimally designed to minimize the risk of injury for different types of accidents). Given the very low probabilities of most product-caused injuries and the fact that optimally safe products typically pose some risk of injury, very little information will be conveyed by a consumer's experience of 'no accident' or 'accident'. For example, suppose an unsafe product doubles the risk of injury from 1 in 10,000 to 2 in 10,000. Based upon their experience, it could take consumers a long time (involving numerous iterations of Bayesian updating) to discover the increased risk. Another problem is that the price-quality relationship depicted by signalling models is based on equilibrium conditions for products that vary in one dimension of quality. Even within the confines of such a simplified market, it is doubtful that consumers ordinarily will have enough information about the market context to draw the correct inferences about product safety. And once one allows for the (realistic) possibility of disequilibria in markets for products that are heterogeneous in more than one dimension, it becomes even less likely that consumers will be able to obtain good information about product safety from

prices. Indeed, one empirical study found that price might serve as a quality signal for only one type of product - frequent but unimportant purchases (Caves and Greene, 1996).

Given the limited amount of information provided by market mechanisms, it is puzzling why sellers do not voluntarily disclose risk-related information, particularly since such disclosures would be credible due to the legal prohibition against fraud. Because only high-quality sellers would benefit from voluntary disclosure, consumers could infer from the fact of nondisclosure that a seller is not offering an optimally safe product. All sellers therefore would have to disclose, forcing them to provide optimally safe products.

It is possible that high-quality sellers do not voluntarily disclose risk-related information because consumers tend to overreact to negative information about products (see the sources cited in A. Schwartz, 1988, p. 381). Consequently, any seller that discloses risk-related information could cause consumers to believe that its product is unsafe, so high-quality sellers are better off by not disclosing. Burrows (1992) provides other reasons why sellers might not voluntarily disclose information about product risk, and Geistfeld (1997) explains why a system of voluntary disclosure would function much like a tort regime of negligence.

6. Do Consumers Undervalue Product Safety?

As the previous discussion suggests, individuals often process risk-related information in a manner that does not correspond to the standard economic model of decisionmaking. A substantial literature on cognitive psychology seeks to understand how individuals assess risks (for example, Kahneman, Slovic and Tversky, 1982). Based on these studies, A. Schwartz (1988, 1992) concludes that consumers tend to overestimate product risks, whereas Latin (1994) concludes that consumers usually underestimate risk and thus undervalue product safety. Both agree these studies find that individuals tend to overestimate risks that are brought to their attention (which may explain why sellers do not voluntarily disclose risk-related information). Latin, however, persuasively argues that most product risks are not salient because product-caused injuries are a rare occurrence for most individuals, leading consumers to infer (erroneously) from the more common or representative experience of safe product use that risk is not present or worth worrying about. Consequently, as Landes and Posner claimed, imperfectly informed consumers tend to underestimate product risks.

Although consumer understanding of product risk is relevant to the regulatory problem, it should also be recognized that consumers can undervalue product safety even if they are perfectly informed of product risks. Suppose consumers are risk averse and find it worthwhile to purchase a fully compensatory health insurance policy. Suppose also that the product-caused

injury would be fully covered by this policy. Insurance companies ordinarily do not adjust premiums to reflect the riskiness of products purchased by their policyholders (Hanson and Logue, 1990). As the consumer's health insurance premium is unaffected by her consumption choices, neither it nor the expected cost of injury (which is fully insured) are relevant to the consumer's purchase decision. The full price to the consumer consequently is given by $\mathbf{P} = p + s$, and sellers minimize this full price by setting $s = 0$. Simply put, fully insured consumers have no need for risk reduction, so it does not pay for sellers to invest in product safety. Of course, this example is extreme (because insurance policies rarely provide full coverage), but the conclusion is general: fully informed consumers will undervalue product safety when they can externalize some of their injury costs onto an insurance company.

7. Product Warranties and the Use of Seller Liability to Promote Safety

As discussed in Section 2, when the seller is fully liable for product-caused injuries, the price at which the product sells on the market equals the full price, forcing the seller to provide the cost-effective amount of product safety. In these circumstances, imperfectly informed consumers only need to find the product that sells for the lowest price in order to get the optimally safe product. Seller liability therefore remedies the consumer's informational problem in a straightforward way, creating the possibility that imperfectly informed consumers might be able to rely on warranties to obtain optimally safe products. For example, assume as in Grossman (1981) that the manufacturer is the least-cost insurer and that consumers are unable to observe manufacturer safety investments. In this setting, insurance costs are minimized if the manufacturer provides a warranty that fully compensates the consumer for any product-caused injuries. A manufacturer that provides full warranty coverage must also provide an optimally safe product in order to minimize the market price (which equals the full price) of its product. A manufacturer that does not provide the optimally safe product therefore would signal this fact to consumers due to the product's higher market price, so to avoid this outcome such a manufacturer cannot offer a full warranty. Imperfectly informed consumers would infer this type of behavior, though, and assume that products without full warranty coverage must not be optimally safe. Manufacturers accordingly have no choice but to offer imperfectly informed consumers optimally safe products with full warranty coverage.

Thus, when sellers are the least-cost insurers, imperfectly informed consumers can use product warranties to attain efficient outcomes: by choosing warranties that impose full liability on sellers, consumers can ensure that

products will be optimally safe and insurance costs will be minimized. Full warranties (or seller liability in tort) might not result in such equilibria, though, if sellers purchase insurance to cover their liability under the warranty. A study directed by the US Department of Commerce found that liability insurance in the 1970s was rarely priced in a manner that reflected the degree of risk posed by the manufacturer-policyholder's products (Inter-Agency Task Force on Products Liability, 1977). Although such insurance reduces the manufacturer's incentive to invest in product safety (as the increased accident costs do not increase premiums), developments in the liability-insurance market have significantly restored this incentive. Based on estimates of firms' total liability costs, Priest (1991) found that self-insurance costs accounted for 4.9 percent of the total in 1970 and increased to 51.7 percent in 1979. The amount of uninsured risk exposure faced by firms probably increased in the 1980s. Moreover, products liability insurance policies now commonly rely on pricing elements that are responsive to the level of risk posed by the policyholder's products (G. Schwartz, 1990, pp. 320-321). Hence there are good reasons for expecting that the prospect of liability gives sellers an incentive to invest in safer products.

8. Are Product Sellers the Least-Cost Insurer?

Despite the safety benefits of seller liability, warranties that make sellers fully liable for product-caused injuries are unlikely to be efficient because sellers rarely are the least-cost insurer for all product risks. Although manufacturers are likely to have a comparative advantage in insuring against some risks, like those involving repair of complicated machinery, consumers typically will have a comparative advantage in insuring against other risks (Priest, 1981). In particular, risk-averse consumers ordinarily will have a comparative advantage in insuring against many of the risks associated with physical injury, because the cost consumers incur in making their own insurance arrangements - 'first-party insurance' - often is lower than the cost sellers incur in making insurance arrangements to cover product-caused injuries suffered by consumers - 'third-party insurance'. In part, first-party insurance is cheaper because it is more capable of minimizing the costs of moral hazard and adverse selection (Epstein, 1985; Priest, 1987). The primary reasons for the cost differential between the two insurance mechanisms stem from the event that triggers coverage and the scope of coverage.

Coverage under many first-party insurance policies, such as health insurance, is triggered by the fact of loss (like medical expenses), making the cause of injury irrelevant in most cases. The fact of injury or loss usually is easy to prove (submitting bills), so policyholders typically do not have to hire a lawyer to receive insurance proceeds. By contrast, the third-party insurance

supplied by product sellers is triggered only if the product caused the injury. Often, many products are causally implicated in an accident, and a potentially contentious factual inquiry may be needed to resolve the liability question (Geistfeld, 1992). Some items of damages, particularly those pertaining to pain-and-suffering damages and future economic loss, are also costly to determine. The resultant litigation expenses increase the cost of third-party insurance, which probably explains why the administrative costs of third-party insurance per dollar of coverage exceed the administrative costs of first-party insurance (Geistfeld, 1992, pp. 639-642).

With respect to the scope of coverage, third-party insurance provides compensation for pain-and-suffering injuries whereas first-party insurance typically does not. It might be inefficient for consumers to insure against pain-and-suffering injuries (for reasons given in Section 20 below). If so, it would be more efficient for consumers to suffer these injuries without compensation (a form of first-party insurance), providing another cost advantage for first-party insurance.

In other respects, the scope of coverage provided by third-party insurance is not extensive enough, as it does not cover losses unrelated to product use. To cover these contingencies (like medical expenses due to illness), individuals need to purchase other insurance. But since first-party insurance coverage is usually triggered by the fact of loss rather than its cause, individuals who have such insurance might receive double compensation when injured by products: the first-party insurer is obligated to pay whenever the policyholder suffered an insured-against loss; and the seller is obligated to pay (due to the collateral-source rule) even though the consumer received other insurance proceeds. Double recovery can be avoided if the first-party insurer exercises a contractual or statutory right to indemnification out of the tort recovery received by the policyholder, but the separate legal proceeding often is complicated and expensive due to the need to determine which part of the tort award or settlement is covered by the policy. For this and other reasons, many insurers do not exercise this right. Insurance provided by product sellers therefore may be an inefficient form of double insurance or otherwise increase the administrative cost of first-party insurance policies, providing another reason why consumers may reduce their insurance costs if they disclaim seller liability under the warranty.

Sellers therefore will typically not be the least-cost insurer for all product risks. Hence, imperfectly informed consumers ordinarily will not be able to rely on full warranty coverage to ensure that products are optimally safe and insurance costs are minimized. It is still an open question, though, whether tort regulation would be efficiency-enhancing.

9. The Regulatory Problem

To account for differences in the cost faced by consumers and manufacturers in insuring against product losses, L_I will denote the consumer's cost of compensating the injury and L_W the seller's cost of compensating the injury under the product warranty. Whether the seller is liable for the injury may affect product safety, so the seller's safety investment will be denoted by s_I when the consumer insures against the injury and by s_W when the seller is liable under the warranty. Finally, we will assume that any insurance costs faced by the consumer equal the actuarially fair amount $r(s_I)L_I$. (The other extreme - the case in which premiums do not depend on risk - was discussed in Section 6.)

There are two possible full prices to consider:

$$\mathbf{P}_I = p + s_I + r(s_I)L_I. \tag{3}$$

$$\mathbf{P}_W = p + s_W + r(s_W)L_W. \tag{4}$$

Consumers will disclaim seller liability when doing so would reduce the full price (that is, when $\mathbf{P}_I < \mathbf{P}_W$), and otherwise will purchase full warranty coverage (when $\mathbf{P}_I > \mathbf{P}_W$).

To illustrate how the difference in insurance costs affects the analysis, suppose consumers are unable to observe manufacturer safety investments. For reasons given in Section 4, manufacturers will set $s_I = 0$. Consumers, however, will infer such behavior on the manufacturer's part, recognizing that the full price is given by $\mathbf{P}_I = p + r(0)L_I$. By contrast, when the manufacturer is fully liable under the warranty, it provides an optimally safe product. Hence $\mathbf{P}_W = p + s_W^* + r(s_W^*)L_W$. Even though product safety increases when the manufacturer is fully liable under the warranty ($s_W^* > s_I = 0$), if the consumer has a comparative advantage in compensating the injury ($L_I < L_W$), it is possible that $\mathbf{P}_I < \mathbf{P}_W$. Consumers therefore may be better off with the less-safe products and reduced insurance costs than with the safer products and more expensive insurance provided by full product warranties.

Thus, there often is a tradeoff between safety and insurance considerations when consumers are imperfectly informed: although increasing the amount of seller liability can lead to safer products, it is also likely to increase the average cost of compensating an injury. This inefficiency does not necessarily create a need for tort regulation, however (Geistfeld, 1995a). As long as imperfectly informed consumers can accurately compare $\mathbf{P}_I$ and $\mathbf{P}_W$, as in the example just given, they will choose warranties that strike the appropriate balance between the costs and benefits of seller liability. At best, a tort rule could achieve a similar balance, but more likely it will not. Inefficiencies in product markets therefore need not create an efficiency-enhancing role for tort liability.

Imperfectly informed consumers will not choose appropriate warranties, though, when they underestimate product risk and thus underestimate the product's full price. (If $E[r(s)] < r(s)$, then $E[\mathbf{P}_I] < \mathbf{P}_I$.) In this case, consumers sometimes choose warranties that disclaim manufacturer liability when it would be inefficient do so (that is, when $E[\mathbf{P}_I] < \mathbf{P}_W < \mathbf{P}_I$). A tort rule that imposes full liability on sellers would be efficiency enhancing in this situation. It is also possible, however, that consumers disclaim manufacturer liability when it would be efficient to do so (because $E[\mathbf{P}_I] < \mathrm{P}_I < \mathbf{P}_W$). Consequently, tort regulation is not necessarily efficiency enhancing when consumers underestimate product risk.

The type of market failure that might justify tort regulation accordingly depends upon conditions that cause consumers to disclaim seller liability when it would be inefficient to do so. This conclusion is not affected by extending the analysis to include the possibility that consumers can affect the risk of injury by exercising care while using the product. As long as sellers cannot observe the amount of consumer care, full warranty coverage is likely to reduce the consumer's incentive to take costly efforts to avoid (the fully insured) injury. Yet, the reduction in warranty coverage reduces the manufacturer's incentive to make costly safety investments, so the warranty must balance conflicting safety and insurance considerations (Cooper and Ross, 1985a; Emons, 1988). Holding manufacturers liable in tort for product-caused injuries does not solve the informational problem, however, so this form of tort regulation cannot improve upon a warranty that efficiently allocates liability given the informational constraint.

An additional consideration arises if consumers have different risk profiles due to differences in product use, abilities to reduce risk for a given level of care, or damages. Although 'low-risk' and 'high-risk' consumers may demand products of different qualities, manufacturer liability can force sellers to provide only one level of quality. According to Oi (1973), that outcome is inefficient because low-risk (that is, low-damage) consumers are forced to subsidize high-risk consumers. Absolving sellers of liability would eliminate this inefficiency, because sellers could then provide products of different quality at different prices in a manner that sorts low-risk and high-risk consumers into the appropriate product markets. However, Ordover (1979) shows that in order for such separating equilibria to occur, low-risk consumers must differentiate themselves from high-risk consumers by purchasing incomplete warranty coverage. There may be cases in which the benefits of successful differentiation are less than the benefits of mandated seller liability. Hence tort regulation is not necessarily inefficient even though some consumers would be better off without such regulation.

10. The Choice Between Negligence and Strict Liability

We have been analyzing seller liability in terms of a rule that holds sellers strictly liable for injuries caused by product use. Most product accidents are governed by a rule of negligence, however, which makes sellers liable for injuries caused by products that are not reasonably safe. According to the economic interpretation of negligence, a product is not reasonably safe if it contains less than the optimal amount of safety s^* defined by equation (2) above. Because each dollar of safety investment below s^* increases expected accident (and thus liability) costs by more than one dollar, sellers minimize total costs by making total safety investments equal to s^*. Thus, a negligence standard that is properly defined and perfectly enforced gives sellers an incentive to supply optimally safe products, the same incentive created by strict liability. Negligence differs from strict liability in that consumers under a negligence rule bear liability for injuries caused by optimally safe products, giving them the opportunity to enter into insurance arrangements that minimize the cost of injury compensation. In theory, then, a negligence regime can yield optimally safe products while enabling consumers to minimize insurance costs.

Nevertheless, negligence will not lead to efficient outcomes, when consumers are imperfectly informed of product risk (Shavell, 1980; Polinsky, 1980). Because sellers are not liable for injuries caused by their (optimally safe) products, the product sells for $p + s^*$. Consumers in a negligence regime therefore need to estimate expected injury costs $r(s^*)L_I$ in order to determine the product's full price **P**. Consumers who underestimate product risk will underestimate the full price, increasing their demand above the amount they would choose if they were perfectly informed. Thus, even though products are optimally safe, consumers will purchase too many products (and there will be too many firms in the industry). This overconsumption increases the total number of injuries above the efficient amount whenever optimally safe products pose a positive risk of injury.

Another problem with a negligence rule is that it often will be difficult (and expensive) for the plaintiff to show that the product should have been made differently. Consider, for example, the complicated issues that must be resolved in order to determine whether a product is optimally designed. The cost of litigating these issues may undermine the safety incentives of negligence liability. Prior to filing suit, injured consumers who are not well-informed about manufacturer safety investments often will be unable to determine whether the product is reasonably safe. These consumers (or their contingent-fee attorneys) may be unwilling to incur the cost of proceeding with the lawsuit, enabling some manufacturers with suboptimally safe products to escape liability. Under these conditions, a proportion of manufacturers choose to be negligent (Simon, 1981).

Another reason for expecting that the negligence standard will not be perfectly enforced stems from the possibility that judges and juries will make mistakes. The complicated issues in products liability cases (many of which are discussed below) make court error possible. Hylton (1990) shows that a negligence standard with court error and costly litigation can lead to over- or underdeterrence. Overdeterrence can occur because sellers of optimally safe products may be held liable due to court error. By increasing product safety, the seller decreases the risk of injury, thereby reducing the likelihood that it will be subjected to a lawsuit and an erroneous imposition of liability. But even though court errors can increase product safety, the increased legal uncertainty has deleterious effects (also discussed later). Moreover, overdeterrence may involve the withdrawal of socially beneficial products from the marketplace.

Strict liability, by contrast, is less costly for plaintiffs and easier for courts to administer, which increases the likelihood that it will be perfectly enforced. In addition, strict liability can lead to the efficient level of risk even though consumers are imperfectly informed. Hence strict liability has a better potential for reducing product risk. Negligence, on the other hand, allows for a greater range of insurance arrangements and accordingly has more potential to reduce the average cost of compensating an injury. The choice between negligence and strict liability therefore reflects the same safety-insurance tradeoff described earlier: increased seller liability (that is, strict liability) is likely to increase safety and per-injury insurance costs, whereas decreased seller liability (negligence) is likely to reduce safety and the average cost of compensating an injury.

11. Empirical Studies of the Effect of Seller Liability on Product Safety

Whether seller liability reduces product risk is a difficult empirical question, because the available accident data are not sufficiently refined and the injury rate is affected by a number of other factors such as changes in technology and the composition of products and users. Indeed, data limitations undermine the conclusions one can draw from attempts to measure the impact that seller liability has had on product safety. For example, Priest (1988a) compares the amount of products liability litigation to death rates and the rate of product-related injuries requiring emergency room treatment, concluding that the expansion in litigation had no discernible effect on accident rates. Although Priest acknowledges that the study is exploratory, Huber and Litan (1991, p. 6) assert that it raises ‘serious doubts that the benefits of expanded seller liability have been large’. But as Dewees, Duff and Trebilock (1996, p. 203) point out, Priest’s study does not necessarily show anything about the relationship between seller liability and accident rates. The accidents in the study could be caused by a number of factors unrelated to manufacturer safety investments.

Moreover, increased seller liability should reduce the number of 'defective' (suboptimally safe) products, but the injury data are not segregated into accidents involving defective and nondefective products, making it difficult to draw useful conclusions from the study. For example, the prior level of tort liability could have significantly increased the number of nondefective products on the market. Greater consumption of these nondefective products (due to increased wealth, for example) could increase the overall injury rate, even though the expansion in seller liability reduced product risk by reducing the amount of defective products on the market.

Higgins (1978) relies on accidental fatalities in the home as a proxy for product-caused injuries. The econometric analysis finds that producer liability reduces the frequency of these accidents in states with low levels of educational attainment and increases it in states with high levels. If low educational attainment corresponds to imperfectly informed consumers, this study partially supports the claim that producer liability increases safety when consumers are not well informed of risk. However, in addition to the previously mentioned problems of relying on such aggregated accident data, this study is problematic because it measures the impact of producer liability in a state by reference to the year when its highest court expanded producer liability by eliminating the contractual requirement of privity. It is doubtful that this expansion in seller liability was significant enough to produce observable results, particularly since the numerous exceptions to the privity doctrine meant that sellers were already exposed to considerable liability for injuries suffered by victims with whom there was no direct contractual relationship.

Graham (1991) attempts to determine the relationship between products liability and passenger-car death rates. The regression does not detect any beneficial impact of liability on aggregate death rates, with the extent of liability measured by an index based on the annual number of crashworthiness cases reported in the LEXIS database. Measuring liability rules by published judicial opinions is particularly problematic, however, because most lawsuits are settled prior to trial. A very effective liability rule, for example, could cause all cases to settle, giving sellers a strong incentive to reduce risk. Yet Graham's model would not impute this risk reduction to the liability rule. Moreover, MacKay (1991) argues that federal regulations of automobile design have forced all manufacturers toward a common standard, which undermines the attempt to derive a simple causal link between products liability and traffic accidents.

Other studies have circumvented these data problems (and created others) by asking producers how their behavior has been influenced by liability. Eads and Reuter (1983) conducted interviews with nine large manufacturers, concluding that products liability significantly influences product-design decisions. Based on interviews with 101 senior-level corporate executives from the largest publicly held companies in the United States, Egon Zehnder

International (1987) found that over half of these companies had added safety features as a result of liability concerns. About 20 percent of the companies chose not to introduce new products on account of products liability. Two other studies conducted by the Conference Board surveyed risk managers and CEOs of major corporations, finding that products liability concerns led to significant safety improvements while also causing a significant number of firms to discontinue product lines or not introduce new products (Weber, 1987; McGuire, 1988). The Egon Zehnder survey is probably the most reliable due to its excellent response rate; the Conference Board surveys had poor return rates and may have been influenced by a variety of biases (G. Schwartz, 1994a, pp. 408-410).

A different approach to evaluating the effects of seller liability examines the impact of prominent products liability lawsuits on stock prices. Viscusi and Hersch (1990) find that news stories reporting on products liability suits significantly decrease a firm's stock value. Similarly, Jarrell and Peltzman (1985) (criticized by Hoffer, Pruitt and Reilly, 1988) and Rubin, Murphy and Jarell (1988) find that safety-related administrative actions (product recalls) substantially reduce stock prices. In all of these studies, adverse publicity concerning product safety costs the firm more due to the reduced stock value than does the associated liability or recall costs. These findings suggest that firms suffer a loss of reputation when there is an adverse event (litigation or administrative action) pertaining to the safety of its product. As described earlier, a firm's reputation for safety is important when consumers are not well-informed of product risk. These studies therefore indirectly confirm that individuals are not perfectly informed of product risks. Moreover, the loss in stock value gives firms an additional incentive to avoid products liability litigation, providing another reason for believing that seller liability increases safety.

12. The Impact of Tort Liability on Innovation

The political debate regarding products liability reform in the US has often involved the claim that tort liability reduces innovation and consequently undermines the competitiveness of domestic products in a global economy. Although tort liability probably has reduced some types of innovation, the welfare effects of that reduction are unclear. Moreover, tort liability has also induced beneficial innovation, making it even more difficult to assess the net impact of tort liability on innovation.

Tort liability can increase a producer's cost, relative to a rule of no liability, by forcing the firm to increase its safety investments. Tort liability also requires that firms make disclosures in product warnings so that imperfectly informed consumers can better estimate accident costs (see Section 18 below). Insofar as tort liability increases safety investments and consumer estimates of accident

costs, there is an increase the product's full price. Consequently, tort liability is likely to encourage safety innovations much in the same way that other cost-driven price increases, such as those stemming from labor scarcity, induce innovation. An increase in cost enhances the profitability for the firm of any innovation which reduces that cost. The resultant increase in firm demand for such technical change should produce more innovation, a theory of technical change called 'induced innovation'. This theory has substantial analytical and empirical support for innovations unrelated to product safety (Thirtle and Ruttan, 1987). There is no apparent reason why the theory is not also applicable to safety innovations.

For example, an optimal research and development (R&D) program without a fixed budget will expend resources until the marginal cost of additional research equals the marginal benefit. The benefit depends on the potential cost savings from the research, savings that are increased as firms face increased tort liability. Expansions in tort liability therefore should increase R&D expenditures for safety technologies. This conclusion is consistent with the analytical results obtained by Daughety and Reinganum (1995), and the empirical study by Egon Zehnder International (1987) which found that over half of the surveyed companies had increased their R&D expenditures as a result of liability concerns. Insofar as the increased R&D expenditures have yielded more safety innovations, tort liability has promoted safety innovation.

A liability rule that increases the product's price can also have a negative effect on innovations unrelated to product safety. Assuming that the increased price reduces consumer demand, both theory (Binswanger, 1974) and historical evidence (Schmookler, 1966) indicate that the reduced profitability of the product line discourages innovation. But insofar as the change in demand reflects consumer response to a product price that more accurately reflects accident costs, the reduced innovation may be welfare enhancing.

Viscusi and Moore (1991a, 1991b, 1993) study the effect of liability costs on innovation, finding that firms with new products have higher liability insurance costs. Econometric analysis shows that increased seller liability increases safety incentives, but at some point further increases in liability reduce innovation by making new products unprofitable (ibid., 1991b, 1993). One study (1993) shows that 10 industry groups were at or near this threshold in the mid-1980s, indicating that the incentive effects of seller liability vary across industries. This variable effect is confirmed by case studies of different industries regarding the impact of tort liability on innovation (Ashford and Stone, 1991; Craig, 1991; Graham, 1991; Johnson, 1991; Lasagna, 1991; Martin, 1991; Swazey, 1991).

Products liability can also affect innovation due to its influence on the structure of business organization. If a firm suspects that a product may pose risks that are long term and likely to result in widespread injury, it has an incentive to avoid paying damages by divesting production tasks that involve

such products. To insulate itself from legal liability, the parent company must divest early in the R&D stage. This dynamic is consistent with an empirical study of the US economy which found that increased seller liability appears to have increased the number of small corporations in hazardous sectors between 1967 and 1980 (Ringleb and Wiggins, 1990; see also Merolla, 1998). The cost of innovation for products involving such risks will be increased by the need to divest an operation that can more cost-effectively (absent liability concerns) be administered within a single organization. The increased cost in turn provides some disincentive for innovation.

13. The Relationship Between Tort Liability and the Market for Liability Insurance

A report published by the US Attorney General's Tort Policy Working Group concluded that increased tort liability was a major cause of the so-called 'liability insurance crisis' that occurred in the mid-1980s (US Department of Justice, 1986). The liability-insurance market was in turmoil during this period: premium revenues tripled and the supply of coverage severely contracted (Viscusi, 1991a). It is not evident why a contraction in the liability-insurance market would be caused by legally mandated expansions in seller liability, however, as expansions in tort liability should increase the demand for liability insurance. This conundrum has attracted much attention, leading to a number of different explanations for the liability-insurance crisis (surveyed in American Law Institute, 1991a, pp. 66-97). For our purposes, the most interesting finding to emerge from this literature pertains to the way in which legal uncertainty affects the cost of liability insurance.

A standard liability-insurance policy covers a product seller's legal liability for personal injury or property damage that 'occurs' to third parties during the policy year. Often a number of years pass before legal liability is incurred by the policyholder (who is then indemnified by the insurer). During the period between the issuance of the policy, manifestation of injury, and conclusion of the lawsuit, any changes in tort law may affect the costs the insurer will incur under the policy. Thus, in order to forecast its expected costs for a group of policies, a liability insurer needs to predict how tort standards, damage rules, and insurance law (like the interpretation of an 'occurrence') will change over time. In periods of legal stability, the insurer can be fairly confident about its predicted liability exposure. However, as Abraham (1987) and Trebilcock (1987) emphasize, there were various sources of legal uncertainty that liability insurers faced in the 1980s, making it difficult to predict the likelihood or magnitude of covered losses. In theory, this increased uncertainty increased the variance of the insurer's expected loss and thus the cost of bearing that risk

(Venezian, 1975). Empirical studies also show that legal uncertainty increases the cost of liability insurance. Kunreuther, Hogarth and Meszaros (1993) surveyed actuaries, underwriters and insurers, finding that they will add an additional cost above the expected value of loss when there is uncertainty (or 'ambiguity') regarding the probability or magnitude of the insured-against loss. Similarly, in an econometric study involving a large number of insurance policies issued during 1980-84, Viscusi (1993a) concludes that risk ambiguity tended to exert a positive influence on actual premium rates, controlling for the regulated rate. Winter (1991) provides a theoretical explanation for why this uncertainty can also affect the industry supply of liability insurance. It seems likely, then, that any increased legal uncertainty created by the tort system contributed to the liability-insurance crisis in the 1980s.

In response to this and an earlier insurance crisis in the 1970s, a number of states enacted legislation limiting a seller's tort liability. Most of these measures also reduced legal uncertainty (for example, by placing caps on the most unpredictable elements of damages). Viscusi (1990a) finds that both the profitability and availability of liability insurance were enhanced during 1980-84 by prior legislative reforms that limited firms' liability. Viscusi et al. (1993) find that the reforms adopted by the states between 1985 and 1988 reduced liability costs and the premiums for liability insurance. This study also concludes that its findings are consistent with the possibility that the fact of comprehensive reform is more consequential than its components. One way to explain such an outcome is that the enactment of legislative reform reduces legal uncertainty by indicating that the legal climate is not hospitable to expanded tort liability for product sellers. In such a climate, liability insurers may be more confident that they will not be exposed to unanticipated expansions in legal liability, thereby reducing the cost of legal uncertainty that is built into premiums for liability insurance.

But even if the reductions in seller liability mandated by these legislative reforms reduced liability costs and premiums, it does not follow that the reforms were efficient. Croley and Hanson (1991) argue that the rise in liability-insurance costs reflected a more efficient level of deterrence due to the internalization of costs that had been externalized prior to the expansion of seller tort liability. Indeed, due to the higher cost of third-party insurance, increased seller liability should have a pronounced effect on insurance costs. Moreover, because increased tort liability will decrease demand when consumers underestimate risks (see Sections 10 and 11 above), Manning's (1996) empirical finding that tort liability reduced consumer demand for childhood vaccines does not necessarily establish, as he claims, that consumers place no value on this form of tort insurance. Instead, the relevant question for policy purposes is whether the increased insurance costs of tort liability, and any decline in consumer demand, are justified by a reduction in product risk.

14. Introduction to the Economic Analysis of Products Liability Doctrines

Depending on the issue involved, the current products liability regime in the US relies upon contracting, negligence, or strict liability to allocate liability for product-caused injuries. The prior analysis of the costs and benefits of these methods therefore can be used to analyze the efficiency properties of various products liability doctrines. Consequently, the ensuing discussion will delineate the role of contracting, negligence, and strict liability while raising a number of previously undiscussed considerations relevant to the economic analysis of products liability law. Epstein (1980) provides a more comprehensive overview of products liability law and discusses the economic implications of various doctrines. The American Law Institute (1991b) provides more extensive economic analysis of the main products liability doctrines.

Although this focus on US law is limiting, the doctrines to be disscused have influenced the development of products liability laws in other countries, particulary the European Community and Japan.

15. The Focus of the Legal Inquiry and Its Implications for the Choice of Liability Rules

Sellers are liable for their negligent conduct resulting in product-caused injuries. In the vast majority of states and the European Community, sellers are also liable for injuries caused by product 'defects'. Although this rule is commonly called 'strict products liability', it is not the same as strict liability because liability depends upon the existence of a defect.

In most states, defect is defined by reference to the product itself. As discussed in the ensuing sections, the choice between negligence and strict liability follows from the definition of defect and is not based on the efficiency properties of these tort rules. Other states and the European Community define defect by reference to consumer expectations. Although it is easier to give this approach an economic interpretation, it too does not rely upon efficiency considerations in making the choice between negligence and strict liability. More precisely, the consumer expectations test can operate like a rule of strict liability, since an optimally safe product is defective if it does not conform to consumer expectations. This outcome occurs when consumers underestimate risk, as products will always be more dangerous than consumers expect them to be. Conversely, when consumers are well-informed of product risk, the product always conforms to consumer expectations and consequently absolves the seller from tort liability. The consumer expectations test therefore limits tort liability to the cases in which it has the greatest potential to be

efficiency-enhancing (when consumers underestimate risk), but it does not rely upon an economic rationale for its choice of strict liability over negligence.

16. Manufacturing Defects

Manufacturing defects are physical deviations from a product's intended design, thereby implicating the quality control of manufacturing and inspection processes. These processes usually cannot be made perfect, so some products containing manufacturing defects will reach the marketplace. Whenever such a defect causes physical injury, the seller is liable even if it employed the most efficient quality-control measures. Defining defect by reference to the product accordingly results in a rule of strict liability for these cases. Jurisdictions that rely on the consumer expectations test also employ strict liability for these cases by assuming that consumers do not expect a product to contain a manufacturing defect.

Most agree that strict liability is the better rule for these cases. G. Schwartz (1979, pp. 459-462), for example, argues that most manufacturing defects are attributable to negligence, but it often will be difficult for plaintiffs to prove that the seller or one of its agents did not use appropriate quality-control measures. Thus, even though negligence in principle would eliminate tort liability whenever increased deterrence is not desirable - that is, when efficient quality-control measures already are being used - the benefit in these few cases is less than the costs that would be created for all cases if the plaintiff had to prove that the defect was caused by inadequate quality control. Strict liability may also be more efficient because it gives sellers a better incentive to foster advances in technology that reduce the incidence of manufacturing defects (Landes and Posner, 1985).

17. Design Defects

A product that conforms to the manufacturer's design specifications is defective if the design is defective. Unlike manufacturing defects, which can be determined by reference to deviations from product design, there is no readily available definition of design defect. Consequently, courts had to develop such a definition.

Many jurisdictions define defect by reference to consumer expectations. This test, however, suffers from an inherent ambiguity. The inquiry could address consumer expectations of product risk. As previously noted, because consumers who underestimate risks will always find a product to be more dangerous than they expect, sellers are subjected to liability even if the product

design satisfies the cost-benefit test. This logic explains the controversial result in *Denny v. Ford Motor Company*, and is consistent with the rule that consumer expectations justify holding sellers strictly liable for manufacturing defects. Alternatively, the inquiry could address consumer expectations of product safety. Consumers who underestimate risk ordinarily expect less safety than is contained in a product. For example, consumers who are unaware of risk expect there to be no safety investments, implying that any amount of product safety surpasses consumer expectations, even if the product is less safe than would be efficient. That consumer expectations tend to establish a safety standard below that of the cost-benefit test was recognized in the influential case *Barker v. Lull Engineering Company*. Whether consumer expectations should be defined by reference to risk or safety is an issue that can only be resolved by determining why consumer expectations matter, an issue that courts have not adequately addressed. The choice between risk and safety does not matter, though, for jurisdictions that define defectiveness by reference to reasonable consumer expectations.

A reasonable consumer expects that sellers would reduce product risk in the most cost-effective manner. Hence a product design does not conform to consumer expectations only if the seller failed to take measures that efficiently reduce product risks. The consumer expectations test therefore can be turned into a negligence test for design defects. Note, though, that the logic needed to justify a negligence rule for design defects is inconsistent with the rationale for making sellers strictly liable for manufacturing defects, since reasonable consumers also expect that sellers ordinarily are unable to eliminate all manufacturing defects.

The other approach for defining a design defect is based on the risk-utility test. The traditional formulation of this test is not limited to the factors relevant to the issue of whether the product design efficiently minimizes product risk (A. Schwartz, 1988; Viscusi, 1990b). However, the Restatement (Third) of Torts: Products Liability states that 'the test is whether a reasonable alternative design would, at reasonable cost, have reduced the foreseeable risks of harm posed by the product, and if so, whether the omission of the alternative design ... rendered the product not reasonably safe' (American Law Institute, 1997, p. 19). The risk-utility test therefore has evolved into a cost-benefit test. Because this test absolves sellers from liability (there is no defect) when the design efficiently minimizes risk, these cases, in effect, are governed by a negligence rule.

The biggest problem with a negligence standard for design defects relates to the court's ability to evaluate the technical engineering issues involved in product design (Henderson, 1973; A. Schwartz, 1988). An erroneous finding of design defect is particularly problematic, because tort liability potentially attaches to the entire product line. Consequently, any legal uncertainty in this area will have significant repercussions, suggesting that design-defect litigation

has significantly influenced developments in the market for liability insurance (Viscusi, 1991b).

Courts could avoid these difficult issues by defining defectiveness on the basis of relative safety, but that type of approach is unlikely to yield efficient outcomes (Boyd and Ingberman, 1997a). First consider a rule which holds that a product is not defectively designed if it conforms to industry custom. Because conformance to custom immunizes firms from tort liability, custom reflects market equilibria absent tort regulation. As such equilibria are often characterized by inefficiently low safety levels, adherence to custom is not ordinarily sufficient to establish that the product is properly designed (see Section 9 above). Now consider an alternative rule that defines a product as being defectively designed whenever a safer product is available on the market ('state of the art'). A seller whose product is defective under this definition is fully liable for all injuries, so it usually minimizes costs by choosing the efficient amount of safety. The seller, however, could avoid liability altogether by increasing its safety investments above the efficient amount if doing so would make its product safer than others on the market. This liability rule therefore might give sellers an incentive to provide an inefficiently high amount of safety. Hence efficient safety levels ordinarily will not be obtained if courts determine defectiveness solely on the basis of relative safety considerations pertaining to custom or state of the art.

The difficulty of determining whether a product is defectively designed has led the courts to limit the scope of tort liability for design defects. Usually courts are unwilling to consider whether a product is defective no matter how it is designed, recognizing that they cannot competently evaluate the total costs and benefits of a product except in the most extreme cases (Henderson and Twerski, 1991). For example, courts will not consider whether a subcompact car is defectively designed merely because larger (more expensive) cars are safer. Instead, design-defect litigation tends to involve modifications to existing product lines (like redesigning the gasoline tank in a subcompact car to reduce risk). Limiting the scope of tort liability in this manner allows the market to determine the viability of product lines (subcompact cars versus larger, safer cars), which enhances the likelihood that product lines can be varied to better satisfy consumers with different preferences. Under strict liability, by contrast, manufacturers make design choices by reference to the average consumer, thereby reducing the variety of product lines offered in the market and the likelihood that heterogeneous consumers can find products that closely match their preferences (Oi, 1973).

18. Warning Defects

A product can be defective because it does not adequately warn or instruct the consumer about product risks. As was true for design defects, the courts had to develop a definition for this type of defect, with most choosing to define warning defects in terms of a cost-benefit or risk-utility test. In principle, to satisfy this test the warning must provide the minimal amount of information necessary for the representative consumer to estimate the product's full price, which can occur only if the warning increases the consumer's information by describing unavoidable material risks and cost-effective methods of use that reduce risk (Geistfeld, 1997). Courts have recognized that warnings which satisfy these criteria are not defective and accordingly absolve the seller of liability, even if the warning did not disclose a risk that injured the plaintiff. The liability standard for warning defects therefore operates like a rule of negligence.

By contrast, the consumer expectations test functions like a rule of strict liability for nondisclosed risks that are not sufficiently appreciated by the ordinary consumer. One implication of this approach is that the seller is liable even if the risk was not scientifically knowable at the time of sale. In order to make this and other cost-related considerations relevant to the liability determination, the test must adopt the expectations of a consumer who reasonably expects sellers to disclose risks whenever it would be cost-effective to do so.

At present, the most problematic aspect of this form of tort liability relates to the cost of disclosure. A warning is defective if it does not disclose, sufficiently describe, or properly emphasize the risk which caused injury. Even if the benefit of a proposed warning alteration is slight, courts often find the warning to be defective on the ground that the cost of the requested disclosure is minimal or nonexistent (Henderson and Twerski, 1990). This is a mistake. Empirical studies have found that the amount and format of hazard information contained in a product warning affects consumers' ability to recall the information, so that added disclosures can reduce the effectiveness of other disclosures in the warning (for example, Magat and Viscusi, 1992). Additional disclosures also increase the time consumers must spend to read warnings. Because these costs of disclosure are not sufficiently recognized by the courts, sellers have an incentive to disclose more than the optimal amount of risk information, thereby reducing the effectiveness of the warning for most consumers. For example, upon reading disclosures that offer little or no benefit, most consumers may rationally decide that the cost of reading the entire warning is not worth the effort.

Some courts have recognized that the risk-utility test for warnings should account for information-processing costs. This position is taken by the Restatement (Third) of Torts: Products Liability (American Law Institute,

1997, p. 32). Indeed, ignoring the way in which information costs affect consumer behavior is inconsistent with the various rules regarding an adequate warning (Geistfeld, 1997, p. 328). As virtually all jurisdictions have adopted these rules, there is ample precedent for courts to rely upon information costs when evaluating warnings. If they do, jury instructions can be formulated that would significantly improve the likelihood that jurors will properly evaluate warnings (ibid, pp. 329-37), although some argue that jurors and judges cannot competently evaluate information-processing costs (Latin, 1994, p. 1284).

Another reason for believing that the warning doctrine is not currently producing efficient outcomes pertains to the method of disclosure. The most effective form of risk communication probably involves symbols and common formats (A. Schwartz, 1992; Viscusi, 1993b). The public-good nature of effective risk communication may require a regulatory rather than judicial solution.

For this reason, strict liability is unlikely to result in efficient warnings, contrary to the argument of Croley and Hanson (1993). Cooter (1985) shows that strict liability may lead to inefficiently strong warnings because the manufacturer only considers how disclosure affects profits rather than social welfare. This result is hard to understand, however. For risks that are unavoidable or inherent in the product, disclosure will not reduce risk (or liability costs) unless it induces the buyer not to purchase the product. In some situations, disclosure would induce only high-risk buyers to opt out of the market, so the seller could reduce average liability costs by disclosing. But if disclosure does not reduce average liability costs, the seller has no incentive to disclose even when disclosure would be efficient. By contrast, when disclosure pertains to care that the consumer must exercise in order to reduce risk, the strictly liable seller has an incentive to disclose the efficient amount of information - that which minimizes average liability (injury) costs.

Strict liability also gives sellers an incentive to discover the efficient amount of information (Shavell, 1992). But since sellers are liable for risks that were not scientifically knowable at the time of sale, strict liability could result in inefficient outcomes. Firms that otherwise are financially viable may be forced into bankruptcy by unanticipated liability costs that could not have been discovered by a cost-effective R&D program (A. Schwartz, 1985). Negligence avoids this problem, but different formulations of the negligence rule are possible and not all of them induce sellers to acquire the efficient amount of information (Shavell, 1992). And because plaintiffs often will have a hard time proving that a seller was negligent for not having discovered information, sellers apparently do not have a sufficient incentive to research product risk (Wagner, 1997).

19. Defenses Based on Consumer Conduct

In most states and the European Community, recovery is reduced for plaintiffs whose misuse of the product combined with the defect in causing the injury. Whether 'comparative fault' is less efficient than barring the plaintiff from recovery depends upon a variety of factors (Shavell, 1987, pp. 83-104), but it seems unlikely that comparative fault reduces the consumer's incentive to use the product properly under ordinary circumstances. Survey evidence shows that for product-associated injuries that are serious but do not result in latent injuries, long-term institutionalization, or death, only 7 percent of victims in the US take action to initiate a liability claim if the injury did not occur at work, and 16 percent take action if the injury occurred at work (Hensler et al., 1991, p. 127). For the vast majority of cases, then, individuals do not expect to recover any damages from the seller, so comparative fault plays little, if any, role in the individual's decision regarding product use. Denying recovery to those individuals who misused the product for other reasons, or due to inadvertence, would reduce the seller's incentive to invest in product safety. This seems to be a large price to pay in exchange for the occasional benefit of denying recovery to those plaintiffs who intentionally misused the product because they expected to receive some compensation from the seller, particularly since the compensation that such individuals receive depends upon proof of defect and is likely to be substantially reduced by comparative fault principles.

A more worrisome question is whether a product that is nondefective in normal use can become defective when misused. Many jurisdictions require sellers to design products to account for foreseeable misuse. Landes and Posner (1987, pp. 299-301) argue that this doctrine could be efficient if properly limited.

Difficult issues also surround the defense of assumption of risk, which in some jurisdictions bars a plaintiff from recovering. The defense could be efficient if it limits seller liability to those cases in which consumers are not well-informed of risk. But merely because a consumer is aware of a risk does not imply that she is well-informed, particularly since perfect information involves an understanding of how different safety configurations affect risk (and price). Moreover, availability of the defense gives sellers an incentive to make design defects visible or to disclose the risk in the warning. Latin (1994) argues that warnings ordinarily are less effective at reducing risk than are design changes.

20. Nonmonetary Damages

Plaintiffs can recover monetary damages for nonmonetary injuries such as pain and suffering. These damages may be inefficient. Nonmonetary injuries alter the individual's utility function (the victim receives less utility for any given

level of wealth following the accident), which can affect the marginal utility of wealth in different ways. These different effects are important, because an individual maximizes welfare by purchasing insurance (a transfer of money from the noninjured state to the contingent, injured state) until the marginal utility of wealth in the 'injury' and 'no injury' states of the world are equalized. For nonmonetary injuries that increase the marginal utility of wealth, individuals prefer a positive amount of insurance compensation. The insurance proceeds reduce the marginal utility of wealth in the injured state so that it equals the marginal utility of wealth in the noninjured state. But for injuries that decrease the marginal utility of wealth (like when the victim is comatose), negative insurance is efficient, as the individual would be better off by transferring money from the injured state (unconscious) to the noninjured state (healthy and conscious), where more utility can be derived from each dollar (Cook and Graham, 1977). Because consumers (potential victims) do not prefer to pay for insurance against these kind of injuries, fully compensatory tort awards for nonmonetary injuries may be inefficient. Survey evidence is consistent with this view (Calfee and Winston, 1993).

Many point to pain-and-suffering damages as a primary source of inefficiency in the current system (for example, Danzon, 1984; Calfee and Rubin, 1992; A. Schwartz, 1988). One proposed remedy is to eliminate tort damages for nonmonetary injuries (thereby eliminating the insurance inefficiency) while requiring that firms pay a fine to the state equal to the amount needed for efficient deterrence (Shavell, 1987; Polinsky and Che, 1991). Eliminating pain-and-suffering damages within the current system is unlikely to be efficient, however. The absence of widespread first-party insurance for these injuries does not necessarily indicate a lack of consumer demand, but could stem from supply-side problems related to the cost of moral hazard and adverse selection (Croley and Hanson, 1995). Moreover, the analysis which shows that pain-and-suffering damages are inefficient unrealistically assumes that there is no deterrence value to the tort award; that consumers are optimally insured against all other tortiously caused injuries; and that sellers are forced to internalize the cost of all tortiously caused nonmonetary injuries. Revising the analysis to account for more realistic assumptions shows that pain-and-suffering tort damages in the current system could be efficient if courts were to instruct juries on how to calculate the appropriate award, which is based on consumer willingness to pay to eliminate the risk (Geistfeld, 1995b).

21. Punitive Damages

Punitive damages have become a focal point in the debate over products liability reform in the United States, even though they are awarded infrequently

(Daniels and Martin, 1990; Rustad, 1992). Punitive damages can be efficient when victims with valid legal claims do not sue, enabling sellers to escape liability in some cases (Cooter, 1989a). For example, if only 50 percent of all victims sue, compensatory damages must be doubled if the seller is to internalize the full cost of injury. Punitive damages can also be used to deter sellers from sending misleading signals of product quality (Daughety and Reinganum, 1997). The optimal adjustment to the compensatory damages award can be positive or negative, however, because it depends upon a variety of other factors such as the possibility of court error (Polinsky and Shavell, 1989), the impact of litigation costs on social welfare (Polinsky and Rubinfeld, 1988), insolvency (Knoll, 1997), and risk aversion (Craswell, 1996).

It is doubtful that punitive damage awards are set on the basis of these economic considerations, as juries typically are given little or no instruction on how to compute the appropriate award. It is also doubtful that punitive damages are awarded when it would be efficient to do so (American Law Institute, 1991b, pp. 243-248). The legal standards governing the availability of punitive damage awards have been substantially, if not wholly, influenced by intentional torts (for which punitive damages were available under the early common law). These standards create problems in the products liability context, where the critical issue is not whether the manufacturer's actions were deliberate (they usually are), but whether the manufacturer knew it was selling a defective product. By focusing on deliberate conduct rather than on the seller's awareness of defect, the inquiry can easily lead to unwarranted punitive damages. If hindsight shows that the manufacturer erred in concluding that the cost of a safety improvement outweighed the benefit of risk reduction, then even if the manufacturer thought the product was optimally safe, the legal standard for punitive damages may be satisfied. In choosing not to decrease risk out of cost concerns, the manufacturer engaged in 'wanton' or 'wilful' conduct that 'consciously disregards the rights or safety of others'. Any type of cost-benefit balancing involving the risk of injury therefore might be subjected to punitive damages, so manufacturers in design-defect cases often are unwilling to admit that they made safety decisions on the basis of cost considerations (G. Schwartz, 1991a). This is a perverse result given that the legal test for design defects relies on cost-benefit balancing, and indicates that the punitive damages standard undermines the accuracy of legal determinations of design defect.

22. The Enforceability of Contractual Waivers of Seller Liability

Contract terms that disclaim a seller's liability for product defects ordinarily are not enforceable unless the disclaimer pertains to cases in which a product damages itself, causing economic loss such as lost profits, but does not cause

personal injury or damage to any other property. Contracting probably is a more efficient way to allocate these damages ('economic losses'), because buyers have better control over and information regarding the magnitude of loss (Jones, 1990). Moreover, allowing sellers to disclaim liability for economic loss is unlikely to have significant deterrence effects, as the seller remains liable for any physical injury or property damage caused by the product defect. In some jurisdictions, sellers can also disclaim liability for physical loss if the buyer is a commercial party. These buyers tend to be sophisticated and knowledgeable about the consequences of risk allocation, so contracting in these situations is more likely to be efficient.

A number of scholars argue that it would be efficient if courts were to enforce a greater variety of contractual limitations of seller liability (for example, Epstein, 1989; Rubin, 1993). But unless the contracting process is structured to give consumers risk-related information, these proposals raise the same safety-insurance tradeoff presented by any proposal to limit a seller's tort liability. One way contracting can increase risk-related information is if the enforceability of a disclaimer is conditioned on the requirement that the seller provides a separate price quotation of its liability costs under a rule of strict liability. Such a price tells consumers something about the product's safety and enables them to compare safety across brands (Geistfeld, 1988; A. Schwartz, 1988). Nevertheless, imperfectly informed consumers are still likely to disclaim seller liability when it would be inefficient to do so (Geistfeld, 1994). Giving consumers the opportunity to sell their 'unmatured tort claims' to third parties also has interesting possibilities (Cooter, 1989b; Choharis, 1995), although this reform may also lead to inefficient reductions in seller liability (A. Schwartz, 1989a). But even though these proposals do not resolve the regulatory problem, measures like them that enhance information and facilitate contracting are a promising approach to efficient reform (A. Schwartz, 1995).

23. Directions for Future Research

It is commonplace to say that more empirical research is needed, but developments over the past decade provide a good opportunity for studying the relationship between tort liability and injury rates. Prior empirical studies of this issue suffer from the common problem of being unable to adequately define when seller liability expanded by an amount significant enough to be captured by statistical analysis. The evolutionary nature of common-law change makes such a definition elusive. The change in liability standards has been more abrupt since the mid-1980s, however, as the insurance crisis has spawned numerous reforms that limit seller liability. Because these widespread reforms occurred over a short period of time and were the result of legislative

enactment, the timing of the change in liability can be readily defined, which should make it easier to uncover any statistical relationship between seller liability and injury rates.

Regarding issues amenable to theoretical analysis, it would be useful to discover whether prices signal product safety under market conditions that are more realistic than those previously studied. A pressing issue concerns the relationship between liability and innovation, which relative to its importance is the most understudied aspect of products liability. There are also a number of products liability doctrines that have not been subjected to rigorous economic analysis. For example, an issue of present concern relates to the conditions under which suppliers of raw materials should be liable for injuries caused by the final product. Those who grapple with the issue have done so largely without the benefit of economic analysis, making it difficult to understand how lawmakers could place much reliance on efficiency considerations in deciding how to resolve the issue. Absent more widespread economic analysis of the range of doctrines that comprise products liability, it seems likely that efficiency considerations will continue to exert an uneven influence on the development of this area of the law.

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