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11 Products liability

*Mark A. Geistfeld**

11.1 Introduction

Products liability is a field of tort law governing liability for injuries caused by defective products that were commercially sold or transferred. Under the rule of strict products liability, a product seller is strictly liable for the physical harms caused by a defect in its product. The US rule of strict products liability closely corresponds to the EC directive 85/374, which establishes a strict liability regime for defective products in all member countries of the European Union. As compared to the US, the liability rule has had much less of an impact in Europe. The US rule and EC directive, in turn, have influenced products liability rules in other countries, including Japan.

The problem of product-caused injury is one of the most important issues addressed by tort law. Based on government data and 17 other large data sets, nonfatal consumer product injuries in the US had an estimated total social cost of approximately \$500 billion in 1996 (Lawrence et al., 2000). This cost would be considerably increased by the inclusion of fatalities, such as the annual deaths caused by automobiles, chemicals, drugs, and firearms. The vast majority of these accident costs are not covered by tort liability payments (compare Hensler et al., 1991, finding that tort liability payments constituted less than 10 percent of compensatory payments for accidental injuries). For those product accidents resulting in tort litigation, one government estimate found that plaintiffs won 37.1 percent of all products liability cases, excluding asbestos, that went to trial in state courts in 1996, receiving a median award of \$177,000 (Congressional Budget Office, 2003, p. 8). For such cases tried in federal courts, plaintiffs won 26.6 percent of the cases and received a median award of \$368,500 (ibid.). Most product-caused injuries do not result in tort litigation because only a fraction are caused by product defects.

Products liability first emerged as a significant form of liability in the 1960s. Legal scholars who analyzed the emerging field rarely addressed efficiency concerns (McKean, 1970a; Priest, 1985). Similarly, court opinions

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typically gave little or no explicit attention to efficiency (Henderson, 1991). But as the economic analysis of products liability has developed over the past few decades and the economic consequences of liability have become more apparent, legal decisionmakers have paid increased attention to the economics of products liability. Today efficiency considerations often strongly influence the formulation of products liability laws. References to efficiency and cost-benefit analysis recur throughout the *Restatement (Third) of Torts: Products Liability* (American Law Institute, 1998), the successor to the highly influential section 402A of the *Restatement (Second) of Torts* (American Law Institute, 1965), which first promulgated the rule of strict products liability.

The economic orientation of products liability, however, is not ordinarily apparent. Courts regularly emphasize that the primary purpose of products liability is to fairly protect consumer interests. Based on these cases, the *Restatement (Third)* concludes that 'it is not a factor . . . that the imposition of liability would have a negative effect on corporate earnings or would reduce employment in a given industry' (§ 2, comment f). Similarly, EC consumer law emphasizes consumer interests (Wilhelmsson, 2006). The objective of products liability is one of fairness, not efficiency.

Upon inspection, the fair protection of consumer interests justifies efficient liability rules (Geistfeld, 2006, pp. 35–40). Cost-benefit analysis depends on prices, which in turn depend on the initial allocation of property rights. The specification of these legal entitlements, and thus the substantive content of any liability rule, necessarily requires noneconomic justification of some sort, presumably normative. These initial entitlements define the appropriate baseline for evaluating the distributive impact of tort liability. At the normatively justified baseline, the equilibrium product price must cover all of the seller's costs, including liability costs. At this baseline, the consumer pays for the full cost of tort liability, explaining why the liability rules exclusively focus on consumer interests. An exclusive focus on consumer interests, in turn, justifies efficient liability rules. Consumers both pay for and receive the benefits of tort liability, and so their preference for efficient liability rules – those that maximize the net benefit of tort liability – should govern.

As a matter of efficiency, products liability does not have to be a form of tort liability, except for cases involving bystander injuries (to be discussed separately). If unregulated market transactions were efficient, courts would only have to enforce contractual allocations of product risk in order to maximize consumer welfare. Courts, though, do not ordinarily enforce contractual disclaimers of seller liability, making it necessary to identify the market failures that may justify tort regulation. Sections 11.2 through

11.10 accordingly develop the economic framework for evaluating different liability rules. Sections 11.11 through 11.13 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.

11.2 The basic model for analyzing the efficiency properties of contracting and tort liability

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

The inquiry addresses product-caused injuries, and so 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 a price p equal to the unit cost. By making safety investments 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* \mathbf{P} of the product is given by

$$\mathbf{P} = p + s + r(s)L. \quad (11.1)$$

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, while also recognizing that this cost is increased by the expected accident cost $r(s)L$ for which they are liable. Consequently, consumers make their purchase decisions on the basis of the full price \mathbf{P} rather than the price they pay to purchase the product, making consumer demand a function of the full price: $Q^D = Q^D(\mathbf{P})$. Sellers then compete by offering the amount of safety and warranty coverage that minimizes \mathbf{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 \mathbf{P} , which from equation (11.1) implies that the seller chooses the amount s^* defined by

$$1 = -r'(s^*)L. \quad (11.2)$$

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^* . Under these conditions, whether the consumer or producer is liable for the product-caused injury does not affect product safety or the full price.

11.3 The significance of imperfectly competitive markets

An early justification for tort regulation was based on the claim that manufacturers can take advantage of their market power by supplying unsafe products (discussed in Priest, 1985). This claim is not supported by the basic model (for example, Epple and Raviv, 1978).

A seller's market power can be represented by the amount that it can increase the product's full price above the competitive level. When the product price is increased by this amount, the seller's profits per sale are increased by the same amount. As an alternative strategy, the seller could achieve an identical increase in the full price by reducing safety investments below the optimal level s^* . Each \$1 of reduced safety investment necessarily increases expected accident costs $r'(s^*)L$ by more than \$1, thereby increasing the product's full price. 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, the alternative strategy under consideration). 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).

Once the assumptions of the basic model are relaxed, market structure can affect product safety. The basic model assumes a constant marginal cost of safety investment per unit of product (the term s). Consequently, a manufacturer's decision regarding safety investments does not depend on its output level (as reflected by equation (11.2) above), implying that product safety will be unaffected by the reduced quantity of output that

occurs in imperfectly competitive markets. The magnitude of many product risks, though, is determined by the quantity of products sold or otherwise consumed by an individual (Marino, 1988a, 1988b). The risks posed by many chemicals often depend on cumulative exposure. The magnitude of these risks would be affected by the higher prices, and reduced consumption, of products sold in imperfectly competitive markets. In addition, the cost of safety investments can be influenced by a manufacturer's output level, in which case 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. 407–10). For either reason, sellers in imperfectly competitive markets could supply products that are insufficiently safe. Such market failures, however, are probably best addressed by the antitrust or trade competition laws.

11.4 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 product safety becomes a regulatory problem only if consumers are inadequately informed (Goldberg, 1974). Subsequent economic analyses focused on the safety effects of imperfect information about product risk.

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 $E[\mathbf{P}]$. Consequently, equation (11.1) above is changed to

$$E[\mathbf{P}] = p + s + E[r(s)L]. \quad (11.1)$$

Consumer demand now depends on the estimated full price $E[\mathbf{P}]$, not the actual full price. A seller must minimize $E[\mathbf{P}]$ if consumers are to buy its product, inducing sellers to choose the amount of safety investment S that minimizes $E[\mathbf{P}]$:

$$1 = -E[r'(s)L]. \quad (11.2)$$

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 $S < s^*$. A similar result occurs when consumers cannot observe manufacturer safety investments. Consumers who

cannot tell the difference between a low-risk and high-risk product will treat the differential in safety as if $-E[r'(s)L] = 0$, when in fact $-r'(s)L > 0$. Price competition prevents manufacturers from incurring the higher cost of producing a low-risk product for which these uninformed consumers are unwilling to pay. The market supplies only high-risk products, an outcome analogous to the well-known 'lemons problem' (Akerlof, 1970).

Imperfect information does not necessarily yield equilibria in which producers supply 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.

11.5 Do consumers undervalue product safety?

The way in which individuals evaluate risk has been extensively studied by psychologists. These studies have found that imperfectly informed consumers frequently rely on rules-of-thumb or heuristics to make decisions about risk (for example, Kahneman et al., 1982). Individuals tend to overestimate risks that are brought to their attention. This finding could mean that consumers tend to overestimate product risks (A. Schwartz, 1988, 1992). Most product risks, though, 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 (Latin, 1994). Due to this heuristic, imperfectly informed consumers tend to underestimate product risks and undervalue product safety.

Market competition also forces a seller to portray its product in a manner that causes consumers to underestimate risk, which decreases their estimate of the product's full price and increases aggregate demand. To do so, the seller does not have to commit fraud. Rather than misrepresenting risk, the seller can emphasize only those product attributes that are likely to trigger consumer heuristics resulting in the underestimation of risk. The dynamics of market competition predictably lead sellers to exploit consumer heuristics in the very manner that justifies tort liability (Hanson and Kysar, 1999a, 1999b).

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. Suppose consumers are covered by health insurance that would fully indemnify them for the product-caused injury. The amount an individual pays for health insurance, whether privately or publicly provided, does not

ordinarily depend on the riskiness of products purchased by the individual (Hanson and Logue, 1990). Since the consumer's cost of health insurance is unaffected by her consumption choices, neither that cost nor the expected cost of injury (which is fully insured) is relevant to the consumer's purchase decision. The full price to the consumer 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, eliminating demand for product safety. Of course, this example is extreme (because insurance plans rarely provide full coverage), but the conclusion is general: fully informed consumers will undervalue product safety when some of their injury costs are borne by an insurance plan.

11.6 Informational mechanisms in product markets

An uninformed consumer can learn about product risk, presumably in the hope of making fewer mistaken product choices. The increased knowledge, however, typically comes at a cost – the additional time and effort the consumer must expend to acquire and process the information. These information costs explain why consumers are not perfectly informed of product risk. The consumer might not have enough time to collect all the information, or the available information can take too much time to evaluate. The benefit of learning about a 1-in-10,000 risk of being injured by a particular configuration of a car's steering wheel, for example, is likely to be lower than the cost the consumer would incur to become informed of the risk. For such risks, the ordinary consumer would rationally decide to remain uninformed.

The cost consumers incur to get risk-related information, and their need for it, depends on a variety of market mechanisms. For example, 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; Price and Dawar, 2002), 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 (for a literature survey, see Riley, 2001, pp. 451–5). The price-quality signal, however, is highly dependent on the market context. 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 provide a signal of product quality only if consumers have at least some brand-specific information about quality, although this information does

not have to 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, then 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 depicted by the basic economic model of products liability, but these market mechanisms do not solve the safety problem. 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 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 with the product.

For example, suppose an unsafe product doubles the risk of injury from 1-in-10,000 to 2-in-10,000. Based on their experience, it will take consumers a long time (involving numerous iterations of Bayesian updating) to discover the increased risk. In the interim, consumers may not have the amount of brand-specific information required for signaling.

Moreover, the price-quality relationship depicted by signaling 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 and cost structures to draw the correct inferences about product safety (Kirmani and Rao, 2000, pp. 72–3).

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. Automobiles, for example, contain dozens of safety components that interact in complicated ways (Burrows, 1992, pp. 465–6). The number of product choices is also staggering. Over 30,000 items are available in the typical US supermarket (Cross, 2000). Experience with a brand may provide the consumer with some knowledge, but even that is short-lived. From 1972 to 1997, almost two-thirds of the US manufacturing firms that remained in operation over a five-year manufacturing census period changed their product mixes, with the product switches involving almost half of existing products (Bernard et al., 2006). Product switching increases the consumer's difficulty of evaluating product risk, a problem that is then compounded by the increased complexity of products. Who has the time, energy and desire to evaluate each individual product risk, particularly given the range of other decisions we face on a daily basis?

Given the limited amount of information provided by signaling mechanisms, it is puzzling why sellers do not voluntarily disclose risk-related information. Under realistic assumptions, firms can choose either to signal or voluntarily disclose product quality (Daughety and Reinganum, 2006b). It is an open question, though, whether these mechanisms induce the same responses from consumers, even when their informational content is otherwise substantively equivalent. When price signals product safety, consumers may frame the signaled safety as a positive attribute of the product. But when sellers instead choose to disclose voluntarily, consumers may frame the disclosed risk as a negative product attribute. The frame matters, because consumers tend to overreact to negative information about products (see the sources cited in A. Schwartz, 1988, p. 381). Insofar as consumers overreact to risk disclosures, 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.

Indeed, market mechanisms that transmit information can exacerbate the safety problem. 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 can benefit others who are uninformed about product safety. This informational externality, however, reduces consumer incentives to acquire costly information in the first instance (Geistfeld, 2006, pp. 47–8). When information is costly to acquire and process, any consumer may rationally decide to free ride on the informed choices of others, thereby saving the information costs. The consumer can get the benefits of information (safe products) without incurring the costs of acquiring and processing the information. Reasoning similarly, other consumers will make the same choice. The free-rider problem may result in no consumer incurring the costs necessary for making informed decisions about product safety.

11.7 Product warranties

Rather than attempting to evaluate all product risks, consumers can instead purchase a product warranty that subjects the product seller to liability for product-caused injuries (for a literature survey, see Murthy and Djamaludin, 2002). As discussed in Section 11.2, 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. Product warranties can remedy the consumer's informational problem in a straightforward way, unlike other signaling

mechanisms that require consumers to engage in complex calculations (other differences in these mechanisms are discussed in Noll, 2004).

For example, assume 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 would signal this fact to consumers via the product's higher market price. To avoid this outcome, the manufacturer cannot offer a full warranty. Imperfectly informed consumers, however, would infer that products without full warranty coverage must have less than the optimal amount of safety, making this strategy undesirable for the manufacturer. To maximize profits, manufacturers must offer imperfectly informed consumers optimally safe products with full warranty coverage (Grossman, 1981).

Full warranties 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 cause a commensurate increase in premiums), developments in the liability-insurance market have significantly restored this incentive. Based on estimates of firms' total liability costs, self-insurance costs accounted for 4.9 percent of the total in 1970 and increased to 51.7 percent in 1979 (Priest, 1991). The amount of uninsured risk exposure faced by firms probably increased in the 1980s for reasons discussed in Section 11.13, strongly suggesting that the prospect of liability gives sellers an incentive to invest in safer products.

Like any other form of legal liability, warranties will not necessarily induce optimal care when product sellers are judgment proof. For example, firms can reduce the expected cost of liability by accumulating less capital (Mason, 2004); going out of business before latent hazards cause injury and result in legal liability (Boyd and Ingerman, 2003; Mason, 2004; Merolla, 1998; Wiggins and Ringleb, 1992); or financing the business with debt rather than equity (for example, Lopucki, 1996). The mere fact that a seller warrants the quality of its product does not make the commitment credible, a problem with warranties that can be somewhat ameliorated by a tort rule subjecting all sellers in the distribution chain to liability for the defective product (see Section 11.19).

11.8 Insurance costs and warranty liability

The efficient outcome involves both the optimal amount of product safety and optimal insurance coverage for any residual product risks. Unless sellers are the least-cost insurer for all product risks, warranties that make sellers fully liable for all product-caused injuries will not satisfy this efficiency condition.

Manufacturers are likely to have a comparative advantage in insuring against some risks, like those involving repair of complicated machinery, but consumers can 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, typically called *first-party insurance*, often is lower than the cost sellers incur in making insurance arrangements to cover product-caused injuries suffered by consumers, typically called *third-party insurance*. Due to the higher cost of third-party insurance, full seller liability under product warranties creates an insurance inefficiency.

As compared to third-party insurance, first-party insurance 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 usually 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 substantially exceed the administrative costs of first-party insurance (see sources cited in Shavell, 1987, pp. 262–4).

In order to provide full coverage, third-party insurance must indemnify the consumer for pain-and-suffering injuries. It might be inefficient for consumers to insure against these nonmonetary injuries (see Section 11.23). If so, it would be cheaper for consumers to suffer or 'self-insure' these injuries, 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 be insured against these contingencies (like medical expenses due to illness), individuals must be covered by other insurance plans. But since first-party insurance coverage is 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 (medical expenses), and despite this payment, the seller may also be obligated to pay the consumer for the injury (due to the collateral-source rule). Double recovery can be avoided if the first-party insurer exercises a contractual or statutory right to indemnification out of the warranty 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 damages award or settlement is covered by the policy. Consequently, 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.

The higher cost of third-party insurance can have a feedback effect on the safety benefits that would otherwise be produced by full warranty coverage (Wickelgren, 2005). Once the product is available to the consumer in the marketplace, the manufacturer has already made its investments in product safety. The consumer knows that purchasing full warranty coverage at this point will not affect the product's safety attributes, and so she rationally chooses to reduce the purchase price by waiving warranty coverage in favor of the less costly first-party insurance. Manufacturers will anticipate this consumer behavior, which in turn erodes their incentive to supply safe products. The safety problem cannot be solved by voluntary warranties, because the higher cost of third-party insurance prevents consumers from being able to credibly commit to warranties. The commitment problem does not exist when warranties are mandatory, in which case liability is based on tort law and not contract law (for discussion of how warranty provided the doctrinal basis for strict products liability, see Geistfeld, 2006, pp. 10–19).

11.9 The regulatory problem

Due to the significance of insurance costs, the basic model must be revised to account for differences in the insurance costs of consumers and manufacturers. Let L_I denote the consumer's cost of compensating the injury with first-party insurance, 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, 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 11.6.)

There are two possible full prices to consider:

$$\mathbf{P}_I = p + s_I + r(s_I)L_I. \quad (11.3)$$

$$\mathbf{P}_W = p + s_W + r(s_W)L_W. \quad (11.4)$$

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 that consumers are unable to observe manufacturer safety investments. For reasons given in Section 11.4, in the absence of any warranty liability, manufacturers will set $s_I = 0$, yielding a full price $\mathbf{P}_I = p + r(0)L_I$. By contrast, when the manufacturer is fully liable under the warranty, it provides an optimally safe product, yielding a full price $\mathbf{P}_W = p + s_W^* + r(s_W^*)L_W$. 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 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.

Whether sellers should be subject to mandatory liability when consumers are imperfectly informed, therefore, depends on a tradeoff between safety and insurance considerations. Increasing the amount of mandatory seller liability will predictably increase manufacturer investments in product safety, but is also likely to increase the average cost of compensating product-caused injuries.

This regulatory problem involves an additional consideration when consumers have different risk profiles due to differences in product use, abilities to reduce risk for a given level of care, or damages. Suppose that consumers are of two types, either low risk or high risk, with each type demanding products of different qualities. Mandatory liability can force sellers to provide only one level of quality that is efficient for the average consumer, but inefficient for both the low-risk and high-risk consumers (Endres and Lüdeke, 1998a; Oi, 1973). Mandatory seller liability can inefficiently reduce product variety.

The foregoing analysis also relies on partial equilibrium conditions within each product market, subjecting it to problems posed by the theory of second best. Increased product prices, for example, could cause consumers to purchase fewer products like prescription drugs that reduce risk, or to substitute towards more risky, nonmarket activities, with the net result that seller liability increases total risk (Henderson and Twerski, 1991).

These tradeoffs only exist when consumers are not adequately informed about product risk. Consequently, mandatory seller liability can be efficient only when limited to cases in which information costs prevent consumers from making adequately informed decisions about product safety. To be efficient, a tort rule must balance the safety benefits of seller liability against the costs of reduced product differentiation and increased insurance expenses.

11.10 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 their products. An alternative liability rule of negligence holds sellers liable only for those injuries caused by unreasonably dangerous products.

According to the economic interpretation of negligence liability, a product is unreasonably dangerous if it contains less than the optimal amount of safety s^* defined by equation (11.2) 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^* . When this liability rule is perfectly enforced, sellers have an incentive to supply optimally safe products. The same incentive is also created by strict liability (see Section 11.2). Negligence differs from strict liability in that consumers in a negligence regime incur the cost of injuries caused by optimally safe products, giving them the opportunity to utilize insurance arrangements that minimize the cost of injury compensation. In theory, a negligence regime can yield optimally safe products while enabling consumers to minimize insurance costs, unlike strict liability. The limitations of liability in a negligence regime can also be formulated to promote product variety, unlike a complete regime of strict liability (compare Section 11.17).

Negligence will not lead to efficient outcomes, however, 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 need to estimate expected injury costs $r(s^*)L_I$ in order to determine the product's full price \mathbf{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. This overconsumption increases the total number of injuries above the efficient amount and can affect product-safety attributes dependent on the quantity of output (discussed in Section 11.3).

In a negligence regime, it is also often difficult (and expensive) for the plaintiff to enforce the standard of reasonable product safety. Consider, for example, the complicated issues that must be resolved in order to determine whether a product is optimally designed. To prove that the existing design is unreasonably dangerous, the plaintiff must identify an alternative design that would reduce risk in a cost-effective manner (see Section 11.17). The difficulty of litigating these issues can undermine the manufacturer's safety incentives. 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).

The complicated issues in products liability cases (many of which are discussed below) also make court error possible. A negligence standard with court error and costly litigation can lead to inefficiently high or low levels of safety (Hylton, 1990). An imperfectly enforced negligence standard can also give manufacturers inefficient incentives for adopting new safety technologies (Endres and Bertram, 2006) or acquiring information about risk (Shavell, 1992).

Strict liability, by contrast, is less costly for plaintiffs to enforce and easier for courts to administer, thereby avoiding many of the safety problems generated by an imperfectly enforced rule of negligence liability. In addition, the full price of the product under strict liability equals its sales price, resulting in the efficient amount of aggregate demand even when consumers are imperfectly informed. All told, strict liability is more efficient in the safety dimension.

The choice between negligence and strict liability ultimately involves the same tradeoff described in Section 11.9. Increased seller liability (that is, strict liability) is likely to yield efficient levels of safety and inefficient outcomes with respect to insurance and product variety, whereas decreased seller liability (negligence) is likely to cause safety problems while increasing product variety and reducing insurance costs.

11.11 Empirical studies of the effect of seller liability on product safety

The relationship between seller liability and product risk is hard to identify empirically. The available data do not directly measure the relationship,

and the injury rate is affected by a number of other factors such as changes in technology and the composition of product markets and consumer populations, undermining 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 aggregate 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 et al. (1996, p. 203) point out, Priest's study does not necessarily show anything about the relationship between seller liability and accident rates: 'Because the data sets fail to segregate accidents involving defective products from accidents involving nondefective products, any effect that the expansion of product liability may have had on the production of defective products could easily be lost among the vastly greater number of accidents involving nondefective products'.

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. Insofar as low educational attainment makes it more likely that consumers will be imperfectly informed, 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 adopted a form of producer liability involving the elimination of the contractual requirement of privity. This expansion in seller liability was unlikely to be significant enough to produce observable results, particularly since courts had previously recognized numerous exceptions to the privity doctrine, thereby exposing sellers 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, where the extent of liability is measured by an index based on the annual number of reported crashworthiness cases. Measuring liability rules in this manner is particularly problematic, however, because the vast majority of 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. Graham's

model would not impute this risk reduction to the liability rule (nor would the study of Priest, 1988a). 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 US, Egon Zehnder International (1987) found that over half of these companies had increased their research and development budgets devoted to product safety, and 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. 408–10).

A different approach to evaluating the effects of seller liability examines the impact of products liability events on stock prices. Viscusi and Hersch (1990) find that news stories reporting on products liability suits significantly decrease a firm's stock value. Garber and Adams (1998) find no significant effects from verdicts entered against firms in the automobile and pharmaceutical industries, but Prince and Rubin (2002) find that all litigation-related events significantly reduced the value of these firms. Other studies find that product recalls cause a substantial drop in a firm's market value (for example, Jarrell and Peltzman, 1985, criticized by Hoffer et al., 1988; Rubin et al., 1988; Dowdell et al., 1992; Sloan et al., 2005; Takaoka, 2006). The reduced stock value generally costs the firm more than the associated liability or recall costs, although firms recover some of the lost market value as information on actual costs becomes available (Govindaraj and Jaggi, 2004). Any drop in the firm's market value, however, implies that the stock market has not fully accounted for the product costs in question, indirectly confirming that the market underestimates the risk posed by particular products. 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 manufacturer investments in product safety.

Rubin and Shepherd (2007) find that general reductions in tort liability stemming from tort-reform measures adopted by individual states, such as limitations on damage awards, were associated with an estimated 24,000 fewer deaths between 1981 and 2000. In their estimate, tort reforms specific to products liability were responsible for a reduced 16,841 deaths across all years. Rubin and Shepherd attribute the reduced fatalities to decreased prices for 'risk-reducing products such as safety equipment, medicines, or medical services' (ibid., p. 24; compare Manning, 1994, 1997, finding that lower liability costs reduced the price of vaccines and prescription drugs). As Rubin and Shepherd acknowledge, their study involves state-level reforms that may not accurately measure safety effects attributable to national markets. This limitation significantly limits their findings. A reform that reduces liability in one state will not ordinarily affect the safety decisions of a manufacturer supplying the national market (compare Hay, 1992). For these products, an individual state can reduce producer liability without negatively impacting product safety within the state, even though those safety investments are induced by the products liability rules in other jurisdictions. The study is also subject to many of the limitations inherent in Priest (1988a) discussed at the outset of this section, further illustrating the difficulty of teasing out causal relationships from aggregate data sets that do not directly measure how liability rules affect manufacturer investments in product safety or otherwise distinguish between injuries caused by defective and nondefective products.

11.12 The impact of tort liability on innovation and productivity

The political debate regarding products liability reform in the US has often involved the claim that tort liability reduces innovation and undermines the competitiveness of domestic products in a global economy. Tort liability probably has reduced some types of innovation, but the welfare effects of that reduction are unclear, particularly since it is even more likely that tort liability has also induced beneficial safety innovations.

Relative to a rule of no liability, tort liability can increase a producer's cost by forcing the firm to increase its safety investments (see Section 11.4). Tort liability also requires that firms make disclosures in product warnings that enable imperfectly informed consumers to make better estimates of accident costs (see Section 11.18). Insofar as tort liability increases safety investments and consumer estimates of accident costs, there is an increase in the product's full price. In these circumstances, tort liability can 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 of any innovation, reducing 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; Popp et al., 2007). There is no apparent reason why the theory does not apply to safety innovations, particularly since the results from the traditional economic model of tort law are quite analogous to those obtained in a dynamic model of induced innovation (Endres and Bertram, 2006).

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, and those savings 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) finding 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 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. This conclusion finds further theoretical support in Viscusi and Moore (1993), which shows how the firm's increased expenditures on developing safety improvements can decrease R&D expenditures on new products or processes.

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 ten 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). The variable effect finds theoretical support in Takaoka (2005), which identifies parameters under which increased liability will reduce a monopolist's R&D

investments when consumers are uninformed of both those investments and product quality.

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 long-term risks that are likely to cause widespread injury, it has an incentive to avoid paying damages by divesting production tasks that involve such products (MacMinn and Brockett, 1995). This incentive is consistent with empirical studies finding that increased seller liability apparently increased the number of small corporations in hazardous sectors (Ringleb and Wiggins, 1990; see also Merolla, 1998; Brooks, 2002). To insulate itself from legal liability, the parent company must divest early in the R&D stage. Once firms have fully divested the hazardous product lines, economies of scale in care technology will affect the size of these firms, for example, whether the divested firm produces only one type of hazardous product or a number of such products (van't Veld, 2006). But insofar as the reorganized firm is unable to capture fully any economies of scale in care technology, tort liability will have increased innovation costs.

Products liability could also affect social welfare by altering productivity. Campbell, Kessler, and Shepherd (1998) find that states which reduced tort liability by legislative reform during 1970 to 1990 experienced greater increases in aggregate productivity than states that did not. The study measures productivity in terms of constant-dollar gross state product for workers, which has an ambiguous relationship to safety and is a questionable measure of productivity in any event (Klevorick, 1998). 'In particular, if a liability-reform-induced change in relative prices were to change the optimal factor proportions, and specifically the labor-capital mix, the resulting substitution would be reflected [inaccurately] as a change in productivity – when measured, as here, by labor productivity – when in fact there has been no change in the relevant isoquants' (ibid., p. 143). Such an outcome seems highly likely. The study measures reductions in tort liability with legislative reforms, an important governmental signal of a 'business friendly' environment that could readily attract new investment, thereby reducing the cost of capital and increasing the demand for, and cost of, labor within the jurisdiction. Consequently, 'the observed positive relation between state-level labor productivity and reforms that reduce liability pressure then could reflect zero-sum capital flows among the states, not a more efficient allocation of resources at the national level' (ibid., p. 147).

11.13 Products 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). During this period, the amount of net written premiums for liability insurance tripled, the supply of coverage severely contracted, and insurer profitability declined considerably (Priest, 1987; Viscusi, 1991a, pp. 27–30). To stabilize the insurance market, most states enacted tort reform measures that limit tort liability.

It is unclear why the liability-insurance market would contract because of expanded tort liability. Increased liability should increase the demand for liability insurance, causing an expansion of the market and increased profitability. 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). Scholars have subsequently identified a number of factors that explain why the insurance industry goes through cycles of ‘hard’ and ‘soft’ markets (surveyed in Baker, 2005). 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.

The typical liability-insurance policy covers a product seller’s legal liability for personal injury or property damage that ‘occurs’ to third parties during the policy period. In product cases, a number of years typically pass before the policyholder incurs legal liabilities covered by the policy. To forecast its expected costs, a liability insurer needs to predict whether tort law, damage awards, and insurance law (like the interpretation of an ‘occurrence’) will change during the lengthy period between the issuance of the policy, manifestation of injury, and conclusion of the lawsuit. Under conditions of legal stability, the insurer can confidently predict its liability exposure based upon prior experience. In the 1980s, however, liability insurers faced various sources of legal uncertainty, making it difficult to predict the likelihood or magnitude of covered losses (Abraham, 1987; Trebilcock, 1987). This increased uncertainty increased the variance of the insurer’s expected loss and thus the cost of bearing that risk (Venezian, 1975; Froot and O’Connell, 1999). Actuaries, underwriters and insurers report 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 (Kunreuther et al., 1993). Consistently with this result, an econometric study involving a large number of insurance policies issued during 1980–84 finds that risk ambiguity tended to exert a positive influence on actual premium rates, controlling for the regulated rate (Viscusi, 1993a). As a matter of economic theory, uncertainty can affect the industry supply of liability insurance in this manner due to the higher cost of outside capital (Winter, 1991), with a recent example provided by the market response to terrorism insurance after September 11, 2001 (Cummins and Lewis, 2003).

Thus, in addition to affecting the demand for insurance, products liability can affect the supply of insurance by increasing legal uncertainty. The uncertainty can be particularly problematic due to the correlated losses among individual products that are defective in design or warnings (discussed in Sections 11.17 and 11.18). Each product has the same design and warning, and so a finding of defect in an individual case can render the entire product line defective in this respect. The asbestos cases provide an extreme example, involving estimated total liabilities of \$199 to \$264 billion (Congressional Budget Office, 2003, p. 7).

By accounting for the detrimental impact of legal uncertainty on the supply of insurance, it becomes more understandable why liability insurers have lobbied for tort reforms that significantly reduce the demand for their product. The reforms limit liability in various ways, but each addresses a significant source of legal uncertainty (Geistfeld, 1994).

Empirical studies have found that the legislative reductions in tort liability increase the profitability and availability of liability insurance (Born and Viscusi, 1999; Viscusi, 1990a; Viscusi et al., 1993). These findings do not establish that the liability-reducing reforms were efficient, however. The increased insurance costs of the 1980s could have internalized costs that had been externalized prior to the expansion of seller tort liability, producing more efficient levels of deterrence (Croley and Hanson, 1991). Like other issues, empirical findings regarding one market effect do not provide enough information to reach conclusions regarding the overall efficiency of products liability. As a nonpartisan body of the US government recently concluded, 'the current state of data and economic analysis do not allow [us] to judge whether the costs of the tort system are efficient or excessive on the whole' (Congressional Budget Office, 2003, p. 23).

11.14 Introduction to the main doctrines of products liability

In both the EU and US, commercial product sellers are subject to strict liability when a defect in their product causes *physical harm* – bodily injury or damage to other tangible property. The rule is truly one of strict liability, however, only when the defect prevents the product from performing its intended function. For defects of design or warnings, the rule is one of negligence liability for manufacturers. The defect could have been cured by a reasonable design or warning, so manufacturers incur liability only when engaging in unreasonably dangerous practices – the result attained by negligence liability. Subsequent sellers of the product, however, are strictly liable for the defect. The rules of products liability accordingly contain pockets of both negligence liability and strict liability. Regardless of the type of defect, the scope of products liability is then limited by contractual considerations.

Having previously analyzed the costs and benefits of contracting, negligence, and strict liability, we can use those results 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 new considerations relevant to the analysis. Geistfeld (2006) provides a comprehensive overview of US law and discusses the economic implications of various doctrines, and Stapleton (1994) analyzes and discusses the EC law of products liability.

11.15 The requirement of defect

Strict liability only applies to defective products. This requirement substantially reduces insurance costs while allowing tort law to regulate product safety by specifying the safety attributes that are required in order for a product to be nondefective (Geistfeld, 2006, pp. 51–8).

Under the rule adopted by most states and the EC products liability directive, a product is defective when it frustrates the safety expectations of the ordinary consumer. Other states determine whether a product is defective in design or warning with the *risk-utility test*, which balances the reduced risk created by a safety investment against the disutility or cost of the investment. Properly understood, each test is complementary and necessary for completely specifying the liability rules (ibid., pp. 59–68).

The concept of consumer expectations enables tort law to account for the appropriate role of contracting over product risk. When the ordinary consumer faces low information costs and can make the safety decision on an informed basis, both her actual and reasonable expectations of product safety will be satisfied. In these circumstances, contracting adequately protects consumer interests, eliminating the possibility that the consumer could reasonably expect the seller to provide even more safety. Courts exclude these cases from the ambit of tort liability by two different methods. The most common approach expressly recognizes that liability is inappropriate because consumer expectations are satisfied, preventing the product from being defective in the manner alleged by the plaintiff. The alternative approach absolves the product seller of any tort duty in these circumstances without making an express finding on the issue of defect. Regardless of the doctrinal label, products that satisfy both actual and reasonable consumer expectations of safety are not subject to tort liability, thereby protecting an important sphere of consumer choice in product markets.

By contrast, when information costs prevent the ordinary consumer from making an informed safety decision, products can be more dangerous than expected by the consumer, creating an efficiency-enhancing role for tort liability. The tort duty protects consumers only because they are

unable to make informed product choices, and so the tort duty can require the amount of product safety that would be chosen by consumers if they were adequately informed. A well-informed consumer reasonably chooses the amount of product safety that best promotes her interests or well-being, excluding instances of bystander injury (discussed in Section 11.22). Reasonable consumer expectations are frustrated by a product lacking a safety investment that costs less than the associated reduction of expected accident costs, rendering the product defective and subject to liability. The same outcome is produced by the risk-utility test. Rather than representing competing conceptions of tort liability, the otherwise vague concept of reasonable consumer expectations can be concretely expressed by the risk-utility test.

So too, the concept of reasonable expectations gives much-needed content to the risk-utility test. Traditionally, courts in the US have applied the risk-utility test in a manner that does not correspond to the requirements of cost-benefit analysis (Viscusi, 1990b). Indeed, the courts have not even adopted a uniform approach to applying the risk-utility factors (Owen, 1997). Once conceptualized in terms of reasonable consumer expectations, the content of the risk-utility test becomes apparent. Consumers reasonably expect a product design to balance risk reduction against the disutility of the associated safety investment in whatever manner best promotes consumer welfare. The concept of reasonable consumer expectations can provide courts with the missing guidance on how to apply the risk-utility factors, thereby improving products liability both as a matter of efficiency and fairness (see Section 11.1).

11.16 Construction or manufacturing defects

A construction or manufacturing defect occurs when the product departs from its intended design. Materials or component parts of the product can be flawed or contaminated; the product can be improperly assembled or constructed; or the product can be improperly packaged. These defects can also occur after the product has been constructed or manufactured. Delivery of the product can create the defect, as when a soda bottle is mishandled during delivery and incurs hairline fractures that unduly weaken the bottle, causing it to explode when lifted by the consumer. In all these instances, the defect is defined by reference to the product's departure from its intended specifications, obviating the need for the court to define defect by relying on consumer expectations or the risk-utility test.

This type of defect implicates the quality control of manufacturing, inspection, and delivery processes. Perfect quality control ordinarily is neither attainable nor desirable, and so some products containing these defects will reach the marketplace. Whenever such a defect causes physical

harm, the seller is liable regardless of whether it employed the most efficient quality-control measures.

Most agree that strict liability is the efficient rule for these cases. Plaintiffs will often be unable to prove that the seller or one of its agents did not use appropriate quality-control measures, which tend to involve complex systems or unverifiable workplace behavior, posing difficult problems of proof in the courtroom. Insofar as these precautions are effectively immune from negligence liability due to problems of proof, strict liability can restore the seller's incentive to adopt efficient quality-control measures (Shavell, 1980). Strict liability may also be more efficient because it gives sellers a better incentive to foster advances in technology that reduce the incidence of these defects (Landes and Posner, 1985).

11.17 Design defects

Many of the most important and vexing issues in products liability involve defective product design. These claims implicate the entire product line. A finding that the product is defectively designed means that all products with the design are defective. The potential extent of liability vastly exceeds the manufacturer's liability for defects in construction or manufacturing, which usually are aberrational departures from the rest of the product line. The large stakes at issue in design cases create a practical need for well-defined liability rules, which in turn has created a pronounced problem. The courts have had a hard time deciding whether design defects should be defined in terms of consumer expectations, the risk-utility test, or some combination thereof.

The different approaches can be attributed to the path-dependent effects of case selection within a particular jurisdiction, with a more complete set of cases over time causing the various jurisdictions to converge towards the efficient rule (Geistfeld, 2006, pp. 85–102). According to the *Restatement (Third) of Torts: Products Liability*, '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, 1998, p. 19). The way in which the risk-utility test depends on 'reasonableness' can be developed by the concept of reasonable consumer expectations, yielding a cost-benefit test for defective product design (see Section 11.15).

A design is defective if it does not incorporate safety features costing less than the associated reduction of expected injury costs, making it 'unreasonably dangerous' in the parlance of tort law. Proof of such a defect is tantamount to proof of negligence – the creation of an unreasonably dangerous risk – and so this issue is resolved by a negligence rule. (The only

exception involves designs that prevent the product from performing its intended function, which are defective *per se*.)

The biggest problem with this form of negligence liability involves the court's ability to evaluate the complex engineering issues involved in product design (Henderson, 1973; A. Schwartz, 1988). Courts typically do not make this determination by comparing the defendant's product design with other designs in the market, and defining defect in terms of 'relative safety' is unlikely to be efficient in any event (Boyd and Ingberman, 1997a). Since the defect applies to the entire product line, an erroneous finding of liability is particularly problematic. Any uncertainty about the matter will have significant repercussions, suggesting that design-defect litigation has significantly influenced developments in the market for liability insurance (see Section 11.13).

Due to the difficulty of determining whether a product is defectively designed, courts have limited the scope of tort liability for design defects in a manner that fosters product differentiation. Courts are unwilling to consider whether a product is defective no matter how it is designed – a claim of *categorical liability*, recognizing that they cannot competently evaluate the total costs and benefits of a product (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 involves modifications to existing product lines (like redesigning the gasoline tank in a subcompact car to reduce the risk of explosion). 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 of different types.

This limitation of liability is also likely to be efficient. The tort duty requires that the product must be free of manufacturing or construction flaws. The tort duty also requires that each product design within any category must be reasonably safe. These tort duties guarantee the reasonable safety of all products within any category, enabling the ordinary consumer to focus on risk-utility comparisons across product categories. In making choices across product categories, the ordinary consumer also benefits from the duty to warn, which guarantees that the product warning provides the ordinary consumer with the material information required for informed safety decisions (see Section 11.18). Once the information already held by the ordinary consumer is supplemented by the information provided by the product warning, she presumably is able to make an informed categorical choice, illustrating once again how tort liability does not apply to cases in which the ordinary consumer can make adequately informed safety choices.

11.18 Warning defects

When high information costs prevent consumers from making adequately informed decisions about product safety, product sellers will not necessarily voluntarily disclose information about product risk (see Section 11.6). As a result of this informational problem, product sellers have a duty to disclose information about any product risk that would be material to the ordinary consumer's purchase and use decisions. A product that does not adequately warn or instruct the consumer about these product risks is defective.

As in the case of design defects, courts have used either the consumer-expectations test or the risk-utility test to define warning defects. To satisfy either test, the warning must provide the minimal amount of information necessary for the ordinary consumer to estimate the product's full price, which can occur only if the warning increases the consumer's information by describing unavoidable risks and cost-effective safety instructions that are not obvious or otherwise commonly known. By not disclosing such risks, the warning is both defective and unreasonably dangerous, and so the liability rule in this respect is one of negligence.

The most problematic aspect of this form of tort liability relates to the cost of disclosure. '[I]n failure-to-warn cases the common assumption is that warnings can be improved upon but can never be made worse; that is, the issue at stake is always whether the defendant ought to have supplied consumers with more, and by definition better, information about product risks' (Henderson and Twerski, 1990, pp. 269–70). More information is always better only if the cost of warnings is insignificant. Consistently with this reasoning, courts routinely hold that the 'minimal' cost of product warnings 'usually weighs in favor of an obligation to warn' (*Anderson v. Hedstrom Corporation*, 1999, p. 440).

Not surprisingly, this liability rule gives product sellers an incentive to over warn. For example, aluminum extension ladders have had up to 44 different warnings and directions (Waldman, 1988, p. 40). Not only does an added disclosure protect the seller from liability for a warning defect, excessive disclosure also dilutes the overall negative impact of the product warning on the consumer's overall assessment of the product, further benefiting the seller. The consumer incurs a cost by reading and remembering the various disclosures in a warning. Individuals will stop reading a warning if they find that the benefit of reading is not worth the effort. 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). A liability rule that induces the disclosure of too much information is self-defeating.

Due to this problem, an increasing number of courts have held that the risk-utility test for warnings should account for the consumer's costs of processing information. Based on this line of cases, the *Restatement (Third) of Torts: Products Liability* incorporates information costs into the definition of warning defect (American Law Institute, 1998, pp. 29–30). The doctrinal foundation for this rule is substantially broader. Tort law overrides contractual choices of product safety because of the way in which information costs hamper informed consumer decisionmaking about product safety. The tort duty is predicated on information costs, and so the substantive content of any duty to facilitate consumer decisionmaking should also account for those costs.

At present, however, jury instructions in the US do not highlight information costs or require the jury to consider how an additional warning would affect the consumer's understanding of the entire warning. It may be possible to reformulate jury instructions to enable jurors to account for information costs (Geistfeld, 2006, pp. 143–50), although the possibility remains that courts cannot competently evaluate information-processing costs (Latin, 1994, p. 1284).

A warning defect, like a design defect, can be defined by reference to information that is available at the time of trial (the *hindsight test*), even if the risk was not reasonably foreseeable at the time of product sale. A few states have adopted the hindsight test, although the vast majority requires disclosure of only those risks that were known or should have been known at the time of sale. A similar split has occurred among the members of the EU with respect to the *development risk defense*. In all these jurisdictions, the seller is strictly liable for the warning defect, but whether the warning is defective depends either on a rule of negligence liability (reasonable foreseeability/the development risk defense) or strict liability (the hindsight test).

As in the case of quality-control measures, the difficulty of proving negligence can justify strict liability. To prove that the seller should have discovered a previously unknown risk, the plaintiff must show what 'reasonable testing would reveal'. This proof is extraordinarily demanding. The plaintiff must establish the parameters of a reasonable research program covering all product hazards potentially posed by the manufacturer's full line of products, and then show that such a research program would have identified the particular product risk that caused the plaintiff's injury. Establishing an appropriate research budget and scope of research projects requires wide-ranging, costly proof. As a practical matter, plaintiffs ordinarily cannot prove that the manufacturer should have discovered a risk that was not otherwise known within the scientific community. Due to the

difficulty of proof, sellers are effectively immune from this form of liability, undermining their incentives to research product risks (Wagner, 1997).

A full regime of strict liability for all product-caused injuries gives sellers an incentive to discover the efficient amount of information (Shavell, 1992; Kaplow and Shavell, 1996). The hindsight test, however, only creates a pocket of strict liability within a body of negligence liability for design and warning defects, thereby distorting incentives in a manner having ambiguous welfare effects (Ben-Shahar, 1998). Moreover, unforeseeable risks pose a hard actuarial problem for liability insurers, making the provision of insurance substantially more difficult. Liability attaches to the entire product line for risks that were not actually known at the time of sale (and issuance of the policy). This extreme form of uncertainty for highly correlated risks can make the risk uninsurable (compare Faure and Fenn, 2000).

Without data on the respective costs and benefits of each approach, we cannot determine which liability rule is more efficient. This indeterminacy, however, explains why different jurisdictions can reach different conclusions about the appropriate liability rule while still relying on substantively equivalent conceptions of products liability.

11.19 Extended seller liability

The rule of strict products liability applies both to the manufacturer of the defective product and to any other entity that commercially distributes the product, including wholesalers, retailers, and restaurant operators. Product sellers can incur liability regardless of whether they could have reasonably prevented the defect from occurring. In these cases, the rule truly is one of strict liability.

Once the retailer has incurred liability for the product defect, it can be indemnified by other product sellers further up the distribution chain. When all members of the producing and marketing enterprise are solvent, the indemnity actions will pass liability along to the party responsible for the defect, thereby creating the correct safety incentives. Of course, an upstream distributor or the manufacturer can be insolvent, leaving a nonmanufacturing seller without recourse. That prospect, however, gives sellers an incentive to deal with financially sound distributors and manufacturers. And to the extent that a seller is concerned about liability, it has an incentive to engage in independent product testing, a practice that is increasingly being adopted by large US retailers of products manufactured by foreign firms.

To be sure, this efficiency rationale is problematic. Even if the retailer can be indemnified, it must incur substantial legal costs to achieve this outcome. Why permit the plaintiff to sue the retailer when recovery is available from the manufacturer? Inclusion of the retailer in the suit merely

raises the cost of distribution (and product price) without providing any safety benefit. Moreover, a small business can sell hundreds of products from different manufacturers and distributors. Does a small business have knowledge of these varied product risks? Finally, liability concerns can distort other firm decisions and patterns of trade, producing welfare losses (Boyd and Ingerman, 1997b). These problems help to explain why at least 17 states have enacted tort-reform statutes limiting the liability of a non-negligent, nonmanufacturing product seller to cases in which the plaintiff cannot recover from the manufacturer.

11.20 Defenses based on consumer conduct

In most jurisdictions, a plaintiff whose misuse of the product combined with the defect in causing the injury will have her recovery reduced, based upon a comparison of her responsibility with that of the product sellers. Whether comparative responsibility is less efficient than barring the plaintiff from recovery depends on a variety of factors (Bar-Gill and Ben-Shahar, 2003). Nevertheless, the doctrine is unlikely to reduce consumer incentives to exercise care while using products. Numerous studies have found that individuals rarely initiate liability claims for accidental injuries (for example, Hensler et al., 1991, p. 127). Ordinarily, the consumer will not expect to recover any damages from the seller, and so comparative responsibility will not significantly influence her decision of how to use the product. By contrast, denying recovery altogether to someone who misused the product can create safety problems. For example, suppose a car is defective for having tires that explode once the car is driven at least 5 miles per hour above the legal speed limit. Anyone who drives the car at such a speed is acting unreasonably by driving in excess of the legal speed limit. If the plaintiff's contributory negligence always barred recovery, the car manufacturer would never be liable for defects involving the risk of speeding. To give manufacturers an incentive to reduce the risks of foreseeable product misuse, those plaintiffs who misuse the product must be able to receive some damages, the result attained by comparative responsibility. The award of compensatory damages, in turn, makes it possible for the plaintiff to receive punitive damages when required for deterrence purposes, thereby giving sellers an adequate incentive to supply products that are not defective in this respect (see Section 11.24 below).

11.21 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 financial losses such as repair costs and lost profits, but does not cause bodily injury or damage to any other tangible

property. Contracting probably is a more efficient way to allocate liability for this form of damages, typically called *economic loss*, 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 is fully liable whenever the defect causes physical harm.

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). 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 (see Section 11.9).

Contracting could increase risk-related information 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 unmaimed 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, 1989). These proposals do not resolve the regulatory problem, but measures like them that enhance information and facilitate contracting are a promising approach to efficient reform (A. Schwartz, 1995).

11.22 Bystander injuries

By focusing almost exclusively on the consumer, our approach so far reflects the orientation of products liability. The consumer includes the buyer and other users of the product. The buyer pays for the safety precautions and guarantees of injury compensation via the associated price increases. One who buys a product frequently contemplates that it will be used by others, typically family members, friends, or employees. In making the purchase decision, the buyer presumably gives equal consideration to the welfare of these other users, including employees (due to either liability concerns or the need to minimize the cost of compensating the employee for facing work-related risk). The interests of these parties coincide, making it defensible to conceptualize the consumer as including both the buyer and any other reasonably foreseeable user of the product. Most cases involve these types of plaintiffs, explaining why products liability rules are framed in terms of consumer interests.

A liability rule that maximizes consumer welfare, however, may not adequately protect third parties or bystanders from the risk of product-caused injury. If the consumer were strictly liable for bystander injuries and financially capable of paying damages, then consumer-only liability is more efficient than manufacturer liability (Hay and Spier, 2005). But under current law, negligence liability is the default rule for accidental harms, and so the consumer is not forced to internalize fully the costs of third-party injuries. Moreover, the consumer of a defective product is not ordinarily negligent towards bystanders who were injured by the product defect, leaving the manufacturer or other product sellers as the only potentially responsible parties for such liability. Consequently, the US courts quickly extended the rule of strict products liability to encompass bystanders, thereby internalizing these product costs into the product price. The EU accomplishes this objective by framing the liability rule in terms of the safety expectations of a *person* rather than just the consumer.

11.23 Compensatory damages

For cases in which the product defect causes *physical harm* – bodily injury or damage to tangible property – tort law provides the plaintiff with the greatest range of damage remedies. In these cases, the plaintiff can receive compensatory damages for the bodily injury, pain and suffering, property damage, and the economic losses caused by the defect.

A different rule applies to cases in which the plaintiff suffers only economic loss consisting of damage to the product itself and ensuing financial harms, such as repair costs, decreased product value, and reduced profits or earnings. In strong majority jurisdictions, a seller is not liable in tort for these damages pursuant to the *economic loss rule*. By excluding these damages from tort liability, the law allows the parties to allocate purely financial liabilities by contracting, which is probably the most efficient outcome given the consumer's informational advantage regarding the magnitude of the losses and the degree of product safety otherwise guaranteed by the tort duty governing the risk of physical harm (see Section 11.21).

The most controversial component of compensatory damages involves awards for the nonmonetary injuries of pain and suffering. These damages are likely to be an inefficient form of insurance (for example, Danzon, 1984; Calfee and Rubin, 1992; Frech, 1994). One proposed remedy is to eliminate this item of damages (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 these damages within the current system is unlikely to be efficient, however. Even if pain-and-suffering damages inefficiently

insure against that particular injury, a complete efficiency analysis must account for the deterrence value of the tort award; that consumers are not optimally insured against all other tortiously caused injuries, such as legal expenses; and that sellers are not forced to internalize the cost of all tortiously caused nonmonetary injuries, most notably, the loss of life's pleasures caused by premature death. Revising the analysis to account for these factors shows that nonmonetary damages 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).

At present, however, courts do not instruct jurors on how to compute the award, producing variable awards that significantly increase the uncertainty of legal liability (*ibid.*). A large number of states have responded to the problem by limiting these awards, typically by capping the amount at figures like \$250,000. These reforms inequitably shift injury costs to the most severely injured plaintiffs without solving the underlying problem.

11.24 Punitive damages

Punitive or extracompensatory damages have become a focal point in the debate over products liability reform in the US, even though they are awarded infrequently (for example, Rustad, 1992). The awards have undeniable benefits that are offset, perhaps completely, by problems of implementation.

Punitive damages can be efficient when victims with valid legal claims do not sue, enabling sellers to escape liability in some cases (for example, Cooter, 1989a). If only 50 percent of all victims sue, for example, compensatory damages must be doubled if the seller is to internalize the full cost of injury. The optimal adjustment to the compensatory damages award, however, depends on 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), the impact of publicity on the likelihood of suit (Yun, 2004), and risk aversion (Craswell, 1996). Punitive damages can also make product price more capable of signaling product quality (Daughety and Reinganum, 1997).

It is doubtful that jury awards of punitive damages are based on these economic considerations. Juries typically are given little or no instruction on how to compute the appropriate award. Even when provided with the relevant information, (mock) jurors base the award on anchoring effects supplied by the plaintiff's attorney or media coverage of similar awards (Viscusi, 2001).

Indeed, the legal standard governing punitive damages is misleading in product cases. The standard has been substantially, if not wholly

influenced by the intentional torts governing deliberately caused harms (for which punitive damages were available under the early common law). This standard is highly problematic in a products case, where the critical issue is not whether the manufacturer's actions were deliberate (they usually were), 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 that 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 safety of others', the type of behavior subject to punitive damages under standard jury instructions. Any type of cost-benefit balancing involving the risk of injury may be subject to punitive damages, the outcome in some cases that has also been reproduced by a mock juror study (Viscusi, 2000). To avoid this outcome, 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.

11.25 The evolution of products liability, and the evolution of economics

Today, it often is easy to critique products liability with economic analysis. Yet one could just as readily rely on products liability to criticize the methodology of economics. The rule of strict products liability was firmly entrenched in the US by the mid-1970s, with courts relying on consumer informational problems and insurance considerations to justify the imposition of tort liability on product sellers. By contrast, the state of economic analysis was lagging far behind. Economists were still studying the market behavior of perfectly informed, completely rational actors, and the economics of insurance was not well understood. Matters have changed considerably since then, with economists now regularly addressing the types of problems that courts have long had to confront without the aid of economic analysis. Viewed from this perspective, the performance of the legal system is much more impressive than it might otherwise seem. There is still considerable room for improvement, but unlike in the past, legal decisionmakers can now rely on a substantial and growing body of economic literature.

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