SIXTH EDITION

Law & Economics

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6 An Economic Theory of Tort Law

The early law asked simply, "Did the defendant do the physical act which damaged the plaintiff?" The law of today, except in certain cases based upon public policy, asks the further question, "Was the act blameworthy?"

JAMES BARR ADAMS,
LAW AND MORALS, 22 HARV. L. REV. 97, 99 (1908)

Even if there is no negligence, public policy demands that responsibility be fixed wherever it will most effectively reduce the hazards to life and health inherent in defective products that reach the market.

JUDGE ROGER TRAYNOR,
ESCOLA V. COCA-COLA BOTTLING COMPANY, 150 P.2D 436 (1944)

PEOPLE OFTEN HARM each other by doing something wrong: Motorists collide on the highway; a patron in a bar punches the person standing next to him; an intrauterine birth control device causes infertility; a newspaper inaccurately reports the arrest of a businessman for soliciting a prostitute; a professor gives an unfair exam; and so forth. Some of these wrongs are accidental and some are intentional; some are serious and others are trivial; some are crimes and others are annoyances.

Suppose that the victim in each of these cases initiates a lawsuit. Under what body of law can the victim sue? Because the plaintiff and defendant are private persons (not the state), the suit belongs to "private law," as does contract and property law. The victim cannot sue under contract law (which we will discuss in later chapters) because a broken promise did not cause the injury in any of these cases. The victim cannot sue under property law for damage to body, reputation, or scholastic record because these things are not *property*. (You cannot transfer your body, bequeath your reputation, or sell your scholastic record.) Large losses can escape contract or property law, such as the explosion of British Petroleum's *Deepwater Horizon* oil rig in the Gulf of Mexico in 2010 that resulted in billions of dollars of losses (as well as dead birds, fish, and aquatic plants).

These facts demonstrate the need for a third major body of private law other than property and contracts. The third body of law concerns compensable wrongs that do not arise from breach of contract and cannot be remedied by an injunction against future interference. Here are some more detailed examples:

Example 1: Joe Potatoes has been driven to distraction by the escapades of his wife, Joan Potatoes. At the end of a hard night's work at the loading dock, Joe is approached by Jim Bloggs. Suspecting that Jim has been romancing Joan,

Joe insults and strikes him, breaking his nose. Bloggs subsequently sues for the injury to his reputation and his nose.

Example 2: Three hunters go into the woods after pheasants. They are spread out in a straggling line about 25 yards apart, walking in the same direction. The hunter in the center flushes a bird that flies up, its wings pounding. The hunters to his left and right turn toward the bird in the middle and fire. The bird escapes, but the hunter in the middle is blinded by birdshot. One of the two hunters certainly caused the harm, but there is no way to determine which one of them it was. The victim sues both of them.

Example 3: A manufacturer produces automobile fuel additives that demand careful control over quality. If quality control is maintained at a high level, the chemical mixture in the product is correct, and it never causes damage to automobile engines. If, however, quality control is relaxed and allowed to fall to a low level, some batches of the chemical mixture will be flawed. A few of the cars using the flawed batch will be harmed, specifically, the engine will throw a rod and tear itself to pieces. After a rod is thrown, an alert mechanic can detect the cause of the harm by examining the car's fuel and other signs. The manufacturer determines that a high level of quality control costs more than the harm to some automobile engines caused by a low level of quality control, so the manufacturer adopts a low level of quality control. The owner of a damaged car sues the manufacturer and asks for punitive damages.

In English-language countries, the name for the body of common law relevant for these cases is *tort* law. After the Normans conquered England in 1066, they soon lost the French language, but they retained a peculiar form of it for writing about law. *Tort* is "law-French," itself derived from the Latin word *tortus* (twisted). The common law of torts overlaps the law of "civil responsibility" in continental Europe. The continental Europeans use this phrase to refer to private suits over injuries, as opposed to criminal prosecutions. However, different legal traditions locate the boundaries of these broad areas of law somewhat differently and adopt somewhat different legal doctrines.

Example 1 illustrates an "intentional tort," so named because the injurer intentionally inflicted the harm on the victim. Many intentional torts are also crimes, such as assault, battery, false imprisonment, and intentional infliction of emotional duress. The person who commits such an act may be sued for damages under tort law by the victim and also prosecuted under criminal law by the state. Intentional torts are so much like crimes that we shall not discuss them here. Instead, we shall rely upon our analysis of crime in Chapter 12 to serve as an introduction to intentional torts.

Most of the wrongs that we shall consider in the two chapters on torts are *unintentional*, that is, inadvertent accidents. To illustrate, Example 2 describes a hunting accident. Example 3 is more complicated. The manufacturer's low level of quality control is deliberate, and the resulting harm to automobiles is statistically predictable, but the harm to particular cars is accidental. Example 3 also differs from the other two examples in that the injurer sold a product to the victim, so the two parties participated in a commercial transaction.

The law of accidents was one of the first bodies of private law successfully analyzed using formal economic models. Following the pattern throughout the book, this chapter focuses on general theory, and the next chapter turns to particular topics, including proposals to reform the tort liability system.

I. Defining Tort Law

We began this chapter by listing examples of harm for which the laws of contracts and property offer no remedy. The victim cannot use these laws to sue when there is no breach of contract, no damage to property, or no continuing harm to enjoin. This gap creates the need for tort law. Now we want to demonstrate that this gap in the law of property and contracts *necessarily* exists and, by doing so, we shall describe the economic essence of tort law.

A. Economic Essence of Tort Law

Bargaining enables people to cooperate over many kinds of harm that one person imposes upon another. Recall the examples that we discussed when explaining the Coase Theorem, such as the rancher's cows and the farmer's crop, or the electrical company's smoke and the laundry's white clothes, or the sparks from the railroad and the farmer's wheat fields. For some kinds of harm, however, the costs of bargaining are so high that the parties cannot cooperate together. The hunters in Example 2 could negotiate an agreement to allocate the cost of an accident before they begin shooting pheasants. However, the cost of negotiating (including the unpleasant atmosphere it creates) is large relative to the small probability of a hunting accident. Similarly, every driver cannot negotiate with every other driver and agree among themselves concerning how to allocate the costs of future automobile accidents.

In Example 1, Joe Potatoes was not in a frame of mind to negotiate when he broke the nose of Jim Bloggs. The obstacle to cooperation in Example 1 is emotions, not costs. In Example 3, where defective fuel additives destroy automobile engines, the manufacturer may think that most consumers will remain ignorant of the dangers caused by defective fuel additives. Consequently, the manufacturer of fuel additives may not want to alert consumers by mentioning the danger in the consumer contract or the product's warranty. The obstacle to cooperation in Example 3 is consumers' ignorance and the producer's strategic decision to keep information private.

Recall that the Coase Theorem treats all obstacles to bargaining—including bargaining costs, emotions, cognitive imperfections, private information, and strategy—as "transaction costs." We can use this idea to explain the boundary between the law of contracts and torts. Contract law concerns relationships among people for whom the transaction costs of private agreements are relatively low, whereas tort law concerns relationships among people for whom transaction costs of private agreements are relatively high. Economists describe harms that are outside private agreements as *externalities*. The economic purpose of tort liability is to induce injurers and victims to *internalize* the costs of harm that can occur from failing to take care. Tort law internalizes these costs by making

the injurer compensate the victim. When potential wrongdoers internalize the costs of the harm that they cause, they have incentives to invest in safety at the efficient level. *The economic essence of tort law is its use of liability to internalize externalities created by high transaction costs.*

Tort liability is only one of several policy instruments available to internalize externalities created by high transaction costs. Alternative policy instruments include criminal statutes, safety regulations, and tax incentives. Each alternative has its advantages and disadvantages. This chapter will explain the strengths and weaknesses of tort liability as an instrument for internalizing externalities.

QUESTION 6.1: According to the conclusion to Chapter 4, ". . . property rights are part of the law that makes owners internalize the social costs and benefits of alternative uses of the goods that they own." Torts are also an essential part of that law. Explain why.

B. The Traditional Theory of Tort Liability

We described the essence of tort law in terms of its economic function. Before analyzing these functions, we describe a traditional legal theory of torts. In the early twentieth century, a legal theory specified the essential elements of a tort. This traditional theory of tort law enjoyed substantial acceptance in America 100 years ago. We discuss it now because the essential elements of a tort as stipulated by it serve as building blocks in the economic model of tort liability.

Three elements must be present for recovery by the plaintiff under the traditional theory of torts:

1. The plaintiff must have suffered *harm*;
2. The defendant's act or failure to act must *cause* the harm; and
3. The defendant's act or failure to act must constitute the *breach of a duty* owed to the plaintiff by the defendant.

We will explain each element in turn and develop an economic account of it.

1. Harm The first element required for a plaintiff to sue in tort is that he or she must have suffered harm. Without harm, there can be no suit in tort, even if the act was dangerous. To illustrate, suppose that the manufacturer in Example 3 sold a batch of fuel additives that were harmless in cars with conventional carburetors and dangerous in cars with turbocharged carburetors. The owner of a car with a conventional carburetor might feel outrage when these facts become known, but outrage is not compensable. His car must have actually been damaged.

Harm has a simple economic interpretation: a downward shift in the victim's utility or profit function. To illustrate, Charlie's utility function in Figure 6.1 is defined over two goods—health (along the horizontal axis) and wealth (along the vertical axis). An indifference curve in that figure, such as u_0 or u_1, depicts all the combinations of health and wealth that give Charlie the same level of satisfaction. Higher indifference curves indicate more satisfaction. Thus, any combination of health and wealth that lies

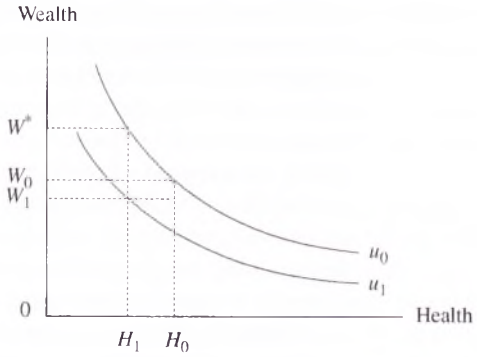

FIGURE 6.1
Showing harm as a displacement from a higher to a lower indifference curve and the measures of compensation.

above u_0 is more desirable to Charlie than any combination that lies on or below u_0. The shape of Charlie's indifference curves indicates that he is willing to trade off one good to get more of the other and maintain overall well-being. To illustrate, as Charlie moves down u_0, his wealth decreases at a rate that exactly offsets his improving health. Similarly, as Charlie moves up u_1, his health declines at a rate that exactly offsets his increasing wealth.

Suppose that Charlie initially has health in the amount H_0 and wealth in the amount, W_0, which results in utility $u_0 = u(H_0, W_0)$. Now suppose that Amanda injures Charlie, causing his health to fall to H_1 and his wealth to fall to W_1. Charlie has been harmed in that he has been pushed from u_0 down to u_1 by Amanda. Perfect compensation requires Amanda to restore Charlie's satisfaction to level u_0. Money damages are the traditional means of doing this. Assume that costly medical treatment can restore Charlie's health. Typically, those damages would constitute a sum equal to $(W_0 - W_1)$ to compensate for the lost wealth and a sum equal to the cost of providing $(H_0 - H_1)$ units of health. This would restore Charlie to his original position before the wrong was done to him.

Suppose, however, that the accident did irreparable damage to Charlie's health, so that he is stuck at H_1 forever. Amanda could, nonetheless, restore his preaccident level of satisfaction by increasing his wealth, not to its preaccident level of W_0, but rather to level W^*. Because Charlie trades off wealth and health, Amanda can give him the monetary equivalent of his irreparable decline in health.

Figure 6.1 illustrates the ideal of perfect compensation. In reality, tort law limits the harms for which victims can receive compensation from their injurers. Traditionally, courts were willing to compensate for tangible losses that are easy to document, such as medical costs, lost income, the costs of replacing or repairing damaged property, and the like. By contrast, courts were traditionally reluctant to compensate for intangible losses or those that are difficult to measure, such as emotional harm, distress, loss of companionship, and "pain and suffering." Over the years, however, American courts have steadily expanded the list of compensable harms to include many intangibles. To illustrate by Example 1, Bloggs may receive compensation for the emotional distress of being reviled and struck by Potatoes. Other countries have also expanded the scope of compensable harms, but not so far as the United States.

Expanding the scope of compensable harm has advantages and disadvantages. On the one hand, this expansion allows compensation for real harms that would have gone unredressed, as illustrated by the following historical example. Suppose that a motorist accidentally kills one of the dependent children of a loving family. The death of the child entails no loss of income to the rest of the family; on the contrary, death saves the family the expense of raising the child. This fact once posed a difficult problem for courts: They wished to confine compensable damages to economic losses that are measurable, and yet no such losses follow from the death of dependent children. For the surviving members of the family to recover damages, courts had to allow compensation for emotional distress and loss of companionship.[1]

Expanding the scope of compensable harm also creates a vexing problem: How is the court to assign a dollar value to intangible (but real) losses? As explained, *perfect compensation* means a sum of money sufficient to make the victim of an injury equally well off with the money and the injury as he or she would have been without the money or the injury. Perfect compensation is the right goal for courts that are trying to internalize costs, but implementing the goal is difficult for intangible, but real, harms. Implementation is difficult because the court cannot observe and measure the plaintiff's subjective valuation of the loss of companionship, emotional distress, or pain and suffering. Even worse, the very idea of perfect compensation sometimes fails in court. Compensation for a child's death is not an amount of money such that the parents would just as soon have the money as their child.

Confusion over intangible damages contributes to *liability disparity*, which occurs when the same court awards different amounts of compensation to victims who suffered the identical injury. Similarly, court-awarded damages to victims with the same injury differ markedly across countries, with Americans giving higher damages than Germans, and Germans giving more damages than Japanese. Fairness and efficiency seem to require reducing liability disparity in each court and harmonizing damages across jurisdictions. Economics suggests how to reduce liability disparity by adopting better grounded and more predictable ways to calculate damages for intangible harms.

QUESTION 6.2: Suppose that a person who is burned in an accident suffers intense pain for 1 week and then fully recovers. What does "perfect compensation" mean in principle as applied to the burn? Why do you expect actual compensation to be imperfect?

QUESTION 6.3: Describe some difficulties in implementing perfect compensation for the destruction by fire of Blackacre, the estate of the Gascoyne-Stubbs family for 15 generations.

2. Cause According to the traditional theory, the second element of a tort is "cause." In order for the plaintiff to sue, according to the traditional theory, the defendant must have *caused* the plaintiff's harm. To illustrate by modifying Example 1,

[1] In a similar vein, many legal systems used to hold that a person's legal causes of action died with him or her. So, if someone was killed in an accident, his estate could not, on this theory, bring an action against the injurer. We shall return to a discussion of this matter, as well as compensation for difficult-to-measure losses, in the next chapter.

suppose that just as Potatoes's fist was about to strike Bloggs's nose, the floor board broke under Bloggs, and he fell down, breaking his nose when he struck the ground. The fall enabled Bloggs to avoid Potatoes's fist, but he broke his nose anyway. In this new example, there is a wrong (throwing a punch), and there is damage (a broken nose), but the former did not cause the latter. Without causation, the wrongdoer who threw the punch is not liable in tort law for the harm.

The element of causation sharply differentiates torts from morality. To illustrate, suppose that in Example 2, both of the hunters were equally reckless when they discharged their guns at the pheasant. It was a matter of mere chance that one of the hunters actually blinded the victim and the other hunter missed. Because they were equally reckless, they are on the same plane morally. They may be equally blameworthy, but they are not equally liable. Under traditional rules of tort liability, only the hunter who actually *caused* the harm is liable; the hunter who missed is not liable.

The idea of causation may seem simple—perhaps an image comes to mind of billiard balls colliding with each other—but this impression is misleading. Causation is a notoriously difficult philosophical topic, and that difficulty carries over into law. The law distinguishes two types of causes. The first and more comprehensive is "cause-in-fact." Lawyers often use a simple criterion, called the "but-for test," to decide whether action *A* was the cause-in-fact of event *B*: "But for *A*, would *B* have occurred?" If the answer to this question is "no," then *A* is the cause-in-fact of B. If the answer to this question is "yes," then *A* is not the cause-in-fact of *B*.

To illustrate, we apply the but-for test to Example 3. An automobile owner cannot recover unless the defective fuel additive was the cause-in-fact of her engine's having thrown a rod. But for the defective fuel additive, would the car have thrown a rod? If the answer is "no," then the defective fuel additive is the cause-in-fact; if the answer is "yes," then the defective fuel additive is not the cause-in-fact.

The but-for test can determine causation in many legal cases, but in some cases it is useless or misleading. It is often useless in cases involving multiple causes of harm. To illustrate by changing Example 1 again, suppose that Potatoes takes a swing at Bloggs, who dodges the punch and lands on some rotten floorboards that collapse under him, and the fall breaks Bloggs's nose. But for Potatoes's trying to strike Bloggs, would Bloggs have broken his nose? The answer depends upon whether Bloggs would have stepped on the rotten floorboards even if he did not have to dodge the punch from Potatoes. It is unclear whether Potatoes's punch was the cause-in-fact of the broken nose. The punch might not have been a necessary condition for the harm to occur, although it was part of a sufficient set of conditions.[2]

Multiple causes can also increase the probability of harm, as when a person whose parents died from lung cancer lives in a house with asbestos siding, works in a factory with carcinogenic chemicals, and smokes. The courts have struggled to develop a workable theory to assign liability when probabilistic harms actually materialize. An economist might use a regression analysis to estimate the increase in probability of

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[2] A famous article in philosophy argues that a cause is an Insufficient but Necessary part of an Unnecessary and Sufficient set of conditions (INUS). See J. L. Mackie, *Causes and Conditions*, 2 AM. PHIL. Q. 245 (1965).

lung cancer caused by heredity, asbestos siding, chemicals at work, and smoking.[3] All variables with positive coefficients are contributing causes, and the variable with the largest coefficient is the most substantial cause. If the person develops lung cancer and sues someone, the court could assign full liability to the most substantial cause, apportion liability among the contributing causes, or find no liability.

Another problem arises when applying the but-for test to a sequence of events that precede an injury: The but-for test allows distant causes to have the same weight as proximate causes.[4] To illustrate, return to the original Example 1, in which Potatoes's fist breaks Bloggs's nose. The fist is the cause-in-fact of Bloggs's broken nose, but so are many other things. For example, but for having been born, Potatoes would not have broken Bloggs's nose; but for Joe's parents conceiving him, he would have not been born; so Joe's parents are a cause-in-fact of Bloggs's broken nose. The but-for test does not discriminate between the proximate cause (Joe's fist) and the remote cause (Joe's conception).

The defendant's act must not only be a cause-in-fact; it must be the *proximate* cause of the plaintiff's harm to establish legal liability under the traditional theory. Proximity is a matter of degree, so the question arises, "How close must the connection be in order for a particular cause to be 'proximate' in law?" One of the most famous cases addressing this problem is *Palsgraf v. Long Island Railway Co.* (248 N.Y. 399, 162 N.E. 99 [1928]). The relevant facts, as determined by the court, were these:

> Plaintiff [Mrs. Palsgraf] was standing on a platform of defendant's railroad after buying a ticket to go to Rockaway Beach. A train stopped at the station, bound for another place. Two men ran forward to catch it. One of the men reached the platform of the car without mishap, though the train was already moving. The other man, carrying a package, jumped aboard the car, but seemed unsteady as if about to fall. A guard on the car, who had held the door open, reached forward to help him in, and another guard on the platform pushed him from behind. In this act, the package was dislodged, and fell upon the rails. It was a package of small size, about fifteen inches long, and was covered by

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[3] "Regression analysis" is a standard statistical technique that economists (and others) use to investigate correlations and causal relationships among variables. In a regression, the investigator seeks to investigate how a set of independent or explanatory variables correlates with or causes changes in a dependent variable. In the text example, the dependent variable would be the "probability of contracting lung cancer" (typically measured as the percentage of a particular group—say the residents of the United States in 1990—who have lung cancer. And the independent or explanatory variables would be such things as heredity, the presence of asbestos siding, exposure to chemicals, whether the subject smoked, age, annual income, and so on. The regression analysis produces values for the coefficients of the independent or explanatory variables and estimates of the statistical significance of those coefficient that allow the investigator to draw inferences about the relationship between each of the independent variables (and all of them collectively) and the dependent variable.

[4] A famous illustration of how great events can be said to be caused by remote causes comes from *Mother Goose:*

> For want of a nail, the shoe was lost;
> For want of a shoe, the horse was lost;
> For want of a horse, the rider was lost;
> For want of a rider, the battle was lost;
> For want of the battle, the kingdom was lost;
> And all for the want of a horseshoe nail.

> a newspaper. In fact it contained fireworks, but there was nothing in its appearance to give notice of its contents. The fireworks when they fell exploded. The shock of the explosion threw down some scales at the other end of the platform many feet away. The scales struck the plaintiff, causing injuries for which she sues.

The New York court determined that the railroad was not liable for Mrs. Palsgraf's injuries because the railroad guard's actions in pushing the passenger were too remote in the chain of causes to be deemed the legal cause of the plaintiff's harm.[5] As this case illustrates, "proximity" in law is imprecise, although sometimes decisive, for liability.

A famous philosopher, Bertrand Russell, argued that science advances by replacing the imprecise concept of "cause" with the precise mathematical concept of a "function."[6] The idea of cause in tort law connects to functions in economic models. In economic models, the consumer's preferences are described by a utility function, and the producer's technology is described by a production function. The values of the variables in the utility function determine the consumer's level of utility, and the values of the variables in the production function determine the level of output. The consumer chooses the values of variables that he or she controls in the utility function to maximize it, and the producer chooses the values of the variables that he or she controls in the production function to maximize profits. One person harms another when the variables that he or she controls lower the utility or production of someone else. For example, the Long Island Railway Company controlled variables affecting its production that also affected Mrs. Palsgraf's utility. The functional representation of cause in tort law is a variable controlled by one person that appears in the utility or production function of someone else.

To illustrate, assume that Amanda enjoys smoking, which we indicate by the function $u_A = u_A(S, \ldots)$, where u_A denotes Amanda's utility, S denotes the amount that Amanda smokes, and ". . ." indicates all the other variables affecting Amanda's utility. Charlie's utility depends upon his health and wealth, which we write $u_C = u_C(H, W)$. Assume that Charlie's health is a decreasing function of Amanda's smoking: $H = H(S)$. Amanda's utility function, $u_A = u_A(S)$, and Charlie's utility function, $u_C = u_C(H(S), W)$, both contain the variable S. The variable S that Amanda controls directly affects Charlie's utility. (By further complicating the preceding functions, we could represent a probabilistic relationship between Amanda's smoking and Charlie's health.[7])

When the same variable appears in different people's utility or production functions, the functions are "interdependent." Interdependent utility or production functions constitute an externality when obstacles prevent the parties from bargaining together and reaching an agreement to set the interdependent variable at the efficient value. "Cause" in tort law typically involves an externality created by interdependent utility or production functions.

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[5] As is often true with famous cases, the facts are not as straightforward as generations of law students are led to believe. See JOHN NOONAN, PERSONS AND MASKS OF THE LAW 127 (1976).

[6] Bertrand Russell, *On the Notion of Cause*, 13 PROCEEDINGS OF THE ARISTOTELIAN SOCIETY (1912–1913).

[7] To illustrate, let $H = 1$ indicate "no cancer," and $H = 0$ indicate "cancer." Let p indicate the probability of cancer, where $p = p(S)$ is an increasing function. Charlie's expected utility can be written $p(S)u_C(0, W) + (1 - p(S)u_C(1, W))$.

QUESTION 6.4: Suppose that a car stalls on the railroad tracks because its carburetor is badly maintained. A train collides with the car because the train's brakes are badly maintained. What is the proximate cause of the accident? Did the train or the car have the "last clear chance" to avoid the accident? (A note in Chapter 3 discusses the doctrine of the last clear chance.)

3. Breach of a Duty In some circumstances, the first two elements that we have just identified—harm and proximate cause—are sufficient to establish liability in tort for the defendant. A rule of liability based upon harm and causation is called "strict liability." For example, a construction company that uses dynamite to clear rocks from the path of a road is liable in common law for any harm caused by the blasting. In general, the common law applies a rule of strict liability to "abnormally dangerous activities" like blasting with dynamite.[8]

In the usual case, however, the victim must demonstrate more than harm and cause in order to recover damages from the defendant. In addition to these two elements, the plaintiff must usually demonstrate that the defendant breached a duty that he or she owed to the plaintiff, and that the breach caused the plaintiff's harm. To illustrate, Joe Potatoes in Example 1 breached a duty not to strike Bloggs. When an injurer breaches a legal duty, he or she is said to be "at fault" or to have been "negligent." For example, one or both of the hunters in Example 2 was at fault in handling a gun because one or both of them breached a duty of care that he or she or they owed to the victim.

A rule of liability requiring the plaintiff to prove harm, causation, and fault is a "negligence" rule. Unlike a rule of strict liability, a negligence rule permits the defense when the defendant is the proximate cause of the plaintiff's harm. Under a negligence rule, the defendant escapes liability if he satisfied the applicable standard of care to avoid the harm that he caused.

We want to develop an economic representation of fault. Some fault is binary (either-or, yes-no, on-off). For example, either a passenger fastens her seat belt or she does not fasten it; either a swimming pool has a lifesaving ring or it does not have one. Sometimes, however, the legal standard of care applies to a continuous variable. For example, a car can change speed continuously, and the trustee can vary continuously the proportion of the trust's portfolio in government bonds (a very safe investment). Economists often prefer to develop theory using continuous variables. Consequently, we denote precaution by the continuous variable x, with larger values of x corresponding to higher levels of precaution. The plaintiff in a tort suit must usually demonstrate that the defendant breached a duty owed to the plaintiff. A duty of care is a legal standard prescribing the minimum acceptable level of precaution. In Figure 6.2, $\tilde{x}$ denotes the legal standard. Precaution below $\tilde{x}$ breaches the duty of care, and precaution equal to $\tilde{x}$ or exceeding it satisfies the duty of care. Precaution $\tilde{x}$ partitions the line in Figure 6.2 and creates two zones—a permitted zone and a forbidden zone. Thus, $x < \tilde{x}$ implies that the actor is at fault, whereas $x \geq \tilde{x}$ implies that the actor is not at fault, where x indicates the actual amount of precaution taken by the injurer. Under a negligence

[8] RESTATEMENT (SECOND) OF TORTS §519(1) (1977).

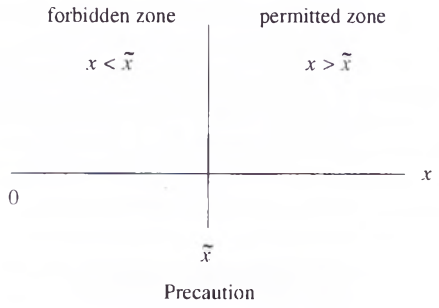


FIGURE 6.2
Legal standard of care of continuous precaution.

rule, decision makers who take precaution as great as or greater than the legal standard escape liability for another person's accidental harms. Those who take less precaution than the legal standard may have to pay compensatory damages for another person's accidental harms.

How is fault determined by law? In many nations, the government imposes precise safety regulations upon certain activities, such as speed limits on highways, whereas other legal duties are left vague, such as the legal definition of "reckless driving." For activities such as reckless driving, the law may draw upon unwritten social norms and community conventions, such as the "rules of the road." Moreover, what counts as "reckless driving" may depend on the weather conditions, the number of cars on the road, and other particularities of the context. Legal traditions differ in their reliance upon broad principles of care and their preferred language for expressing these principles. The common law in the English-language countries stresses the duty of *reasonable* care. This standard compares the defendant's actual care and the care that a *reasonable person* would have taken under the circumstances. The civil codes of Europe are not anchored by the concept of "reasonableness." (See the accompanying box in which Lord Herbert pokes fun at the notion of a "reasonable person.") Continental lawyers often feel discomfort toward a rule of reasonable care, which seems to give too little guidance to people and too much discretion to judges. Consequently, the civil codes often strive for greater specificity in prescribing duties. Civilian lawyers (that is, lawyers in civil law countries) sometimes invoke broad principles, such as "abuse of right" (for example, an owner exercises property rights in a way that harms others), or the "paterfamilias" (a person obligated to treat some other people much like the father treats his family), or "rationality" (choosing effective means to legal ends). As we shall see, economic analysis reveals similarities in behavior underlying these differences in legal language and traditions.

We have used Figure 6.2 to explain the meaning of "negligence." Under that liability rule, proof of negligence is a necessary condition for liability. In contrast, under a rule of strict liability, proof of causation is a necessary condition for liability, and proof of negligence is unnecessary. Some scholars detect a pattern of movement between these two rules over the history of liability law. (See the quote from Professor Adams at the beginning of this chapter.) Strict liability was the usual rule between clans in stateless tribes. Similarly, strict liability was the usual rule in much of Europe before the nineteenth century, but, according to legal historians, negligence became the usual rule by the beginning of the twentieth century. Thus, the requirement of fault as a condition for

liability triumphed recently. The rule of strict liability, however, enjoyed a renaissance in the second half of the twentieth century, especially for the liability of manufacturers to American consumers. Manufacturers in America are now held liable for the harms caused by their defective products, regardless of whether the manufacturer was at fault. (See the quote from Judge Traynor at the beginning of this chapter.) To illustrate by Example 3, the manufacturer of a defective fuel additive is strictly liable for harm it causes to automobile engines.

Web Note 6.1

There is some recent evidence of a discernible trend away from strict products liability—what some authors have described as a "quiet revolution" in products liability. On our website (and briefly in the next chapter) we discuss this evidence.

QUESTION 6.5: Adapt Figure 6.2 to represent the rule that motor vehicles must stay within a designated speed limit (say 90 kilometers per hour).

QUESTION 6.6: Offer an economic explanation for why the owner of a dog is liable for the harm it causes due to his negligence, whereas the owner of a tiger is strictly liable for any harm that it causes.

Conclusion to Part I

The three elements of tort liability fit neatly into a coherent picture of social life. We impose risks upon each other in our daily lives. Society has developed norms that prescribe standards of behavior to limit these risks. People sometimes cause harm by violating these standards of behavior. The cost of the harm must fall upon someone. The courts trace cause of the harm back to the violation of the standard and assign liability either to the party at fault or simply to the party who caused the harm.

Let Us Now Praise Reasonable Men

The following famous parody of the reasonable person standard is from an essay entitled "The Reasonable Man" by Lord A. P. Herbert:

"The Common Law of England has been laboriously built about a mythical figure—the figure of 'The Reasonable Man.' He is an ideal, a standard, the embodiment of all those qualities which we demand of the good citizen. . . . It is impossible to travel anywhere or to travel for long in that confusing forest of learned judgments which constitutes the Common Law of England without encountering the Reasonable Man. . . .

The Reasonable Man is always thinking of others; prudence is his guide, and 'Safety First' is his rule of life. He is one who invariably looks where he is going and is careful to examine the immediate foreground before he executes a leap or bound; who neither stargazes nor is

lost in meditation when approaching trapdoors or the margin of a dock; who records in every case upon the counterfoils of checks such ample details as are desirable, who never mounts a moving omnibus, and does not alight from any car while the train is in motion; who investigates exhaustively the *bona fides* of every mendicant before distributing alms, and will inform himself of the history and habits of a dog before administering a caress; who believes no gossip, nor repeats it, without firm basis for believing it to be true; who never drives his ball till those in front of him have definitely vacated the putting-green which is his own objective; who never from one year's end to another makes an excessive demand upon his wife, his neighbors, his servants, his ox, or his ass; who in the way of business looks only for that narrow margin of profit which twelve men such as himself would reckon to be 'fair,' and contemplates his fellow-merchants, their agents, and their goods, with that degree of suspicion and distrust which the law deems admirable; who never swears, gambles, or loses his temper; who uses nothing except in moderation, and even while he flogs his child is meditating only on the golden mean. [He] stands like a monument in our Courts of Justice, vainly appealing to his fellow-citizens to order their lives after his own example. . . ."

Most torts correspond to this picture, which makes it useful as an introduction to the subject. The actual practices of the courts, however, have departed from the traditional theory of torts. Modern courts sometimes find liability in cases where one of the three elements of a tort is missing. Later we describe some of these departures from the traditional theory, and, in doing so, we sketch the frontiers of liability law in the United States.

Question 6.7: Describe the three elements of a tort in the following situations:

a. Motorists driving on crossing streets come to an intersection with a stop light and collide.
b. The owner of Al's Donut Shop spreads the false rumor that patrons of Betty's Donut Shop got ptomaine poisoning from the jelly in her donuts.
c. The escalator in a store rips a customer's pant leg to shreds.

II. An Economic Theory of Tort Liability

Philosophy concerns meanings, and science concerns causes. Rather than defining "tort" by its essential elements, economic analysis models the effects of liability. We have explained that, when high transaction costs preclude private agreements, tort liability can induce injurers to internalize the costs that they impose on other people. Now we develop the simplest model of cost internalization by tort law, using the economic interpretations of harm, cause, and fault.

A. Minimizing the Social Costs of Accidents

The economic model of tort law builds from the simplest elements: the cost of harm and the cost of avoiding harm. We begin with some notation and simple functions.

The probability of an accident, which we denote p, decreases with increases in precaution, which we denote x. Thus, $p = p(x)$ is a decreasing function of x. If an accident occurs, it causes harm, such as lost income, damage to property, medical costs, and the like. Let A denote the monetary value of the harm from an accident. A multiplied by p equals the *expected* harm in dollars ("expected" because of the probabilistic element).

Like $p(x)$, the expected harm $p(x)A$ is a decreasing function of precaution x.[9] To depict this fact, the horizontal axis in Figure 6.3 indicates the quantity of the actor's precaution, x, and the vertical axis indicates dollar amounts, including the dollar amount of expected harm, $p(x)A$. The curve labeled $p(x)A$ in Figure 6.3 slopes down, indicating that expected harm decreases as precaution increases.

Taking precaution often involves the loss of money, time, or convenience. We assume that precaution costs $\$w$ per unit. To keep the analysis simple, we assume that w is constant and does not change with the amount of precaution x. Consequently, wx equals the total amount spent on precaution. The graph of wx in Figure 6.3 is a straight line through the origin whose slope equals w.

Figure 6.3 depicts two kinds of costs of accidents: the cost of precaution and the cost of expected harm. In the simplest model, we assume that accidents have no other social costs. This simplification, which may strike you as artificial at first, was the crucial step in Guido Calabresi's classic book *The Cost of Accidents* (1970), which systematically compared the incentive effects of alternative tort rules for the first time.

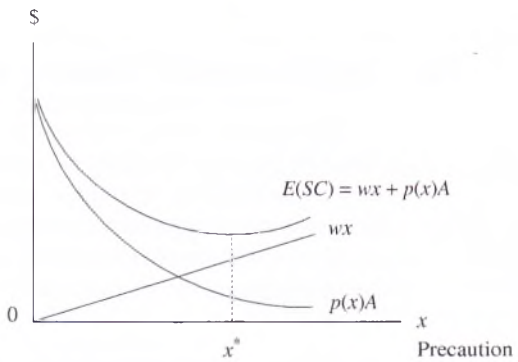
Consequently, we may add the costs of precaution and expected harm to obtain the expected social costs of accidents, which we denote SC:

$$SC = wx + p(x)A. \tag{6.1}$$

The expected social cost curve in Figure 6.3 is thus obtained by adding vertically the line wx and the curve $p(x)A$ at every level of precaution x. The result is the U-shaped curve, which is labeled $SC = wx + p(x)A$.

Because the expected-social-cost curve is U-shaped, a value of x exists that corresponds to the bottom of the U. This value, denoted x^* in Figure 6.3, is the level of

FIGURE 6.3
The expected social costs of accidents shown as the sum of precaution costs and the expected cost of harm.



[9] To keep the graph simple, we assume that A is a constant. The analysis would not be changed by assuming that A is a decreasing function of x, so long as $p(x)A$ is a concave function.

precaution that minimizes the expected social costs of the accident. Efficiency requires minimizing social costs, so x^* is the socially efficient level of precaution or, simply, the efficient level of precaution.

Let us characterize x^* mathematically. The cost of a little more precaution (marginal cost) equals the price per unit w. A little more precaution reduces the expected cost of harm (marginal benefit). This reduction in the expected cost of harm equals the reduction in the probability of an accident, which we denote p', multiplied by the cost of harm A.[10] When precaution is efficient, the cost of a little more precaution (marginal cost) equals the resulting reduction in the expected cost of harm (marginal benefit). Thus, the efficient level of precaution x^* can be found by solving the following equation:

$$\underset{\text{marginal social cost}}{w} = \underset{\text{marginal social benefit}}{-p'(x^*)A}. \tag{6.2}$$

(Those of you who are familiar with calculus can obtain Equation 6.2 by setting the first derivative of Equation 6.1 with respect to precaution equal to zero.) This equation solves the problem, "choose precaution to minimize the cost of accidents and avoiding accidents."

If precaution is less than the efficient amount, then the marginal social cost of precaution is less than the marginal social benefit: $(x < x^*) \rightarrow (w < (p'[x^*]A)$. When the marginal social cost of precaution is less than the marginal social benefit, efficiency requires taking more precaution. In these circumstances, we say that more precaution is "cost-justified." Similarly, if precaution exceeds the efficient amount, then the marginal social cost of precaution exceeds the marginal social benefit: $(x > x^*) \rightarrow (w > (p'[x^*]A)$. In these circumstances, efficiency requires taking less precaution.

Figure 6.3 describes the effects of precaution on social costs. We have not said whose precaution is depicted in Figure 6.3. Sometimes the potential injurer can take precaution and the potential victim cannot, as when a surgeon operates on an unconscious person. Sometimes both the injurer and the victim can take precaution, as when the manufacturer assures the purity of a drug and the consumer takes the recommended dosage. Figure 6.3 can be taken to represent the relationship between social costs and precaution by the victim or the injurer. Remember that *precaution* refers to any behavior reducing the probability or magnitude of an accident. Table 6.1 gives some examples suggesting the range of possibilities.

B. Incentives for Precaution Under No Liability and Strict Liability

Having characterized the efficient level of precaution, we now consider the incentives needed to obtain it. Incentives for precaution in the simple model depend upon who can take precaution against accidents, and how the law allocates the costs of harm. To create efficient incentives, law should align the private benefits and costs of the

[10] The prime (′) after p indicates the slope of the graph of the function $p(x)$ at x. The slope is negative in Figure 6.3, so that minus sign in front of the p makes the expression $-p'(x)$ positive.

TABLE 6.1
Example of Accidents and Precaution

Accident	Injurer's Precaution	Victim's Precaution
Faulty electrical wiring causes house fire	Manufacture wiring more carefully	Fireproof house
Moving car hits parked car	Drive more safely	Park car in safer space
Car hits pedestrian	Drive more safely	Walk more safely
Software fails	Better design of software	Back up data at risk
Exploding coke bottle	Improve quality control by bottler	Handle bottles carefully
Medicine causes side effects	Improve warning on medicine	Study warning on medicine

actors with the social benefits and costs. We shall contrast the incentive effects of several different legal rules for allocating the costs of harm.

First, we consider the case in which there is no liability for accidental injuries. Let us consider first the decisions of the *victim* and denote her precaution by x_v.[11] The victim chooses precaution, which we indicate by placing subscript v on x and w. The victim pays the cost w_v for x_v units of precaution. Now consider the cost of harm A, which is suffered by the victim. Because there is no liability, the victim bears the expected harm $p(x_v)A$. The total costs that the victim expects to bear equal the cost of precaution plus the expected cost of harm: $w_v x_v + p(x_v)A$. The victim has an incentive to minimize the costs that he or she bears. Consequently, the victim chooses x_v to minimize $w_v x_v + p(x_v)A$. The minimum occurs at the level of precaution, denoted x_v^*, where the victim's marginal cost of precaution equals the resulting reduction in the expected cost of harm:

$$\underset{\text{victim's marginal cost}}{w_v} = \underset{\text{victim's marginal benefit}}{-p'(x_v^*)A}. \qquad (6.2')$$

Equation 6.2′ corresponds to the efficiency condition given by Equation 6.2. Thus, we have shown that *the rule of no liability causes the victim to internalize the marginal costs and benefits of precaution, which gives the victim incentives for efficient precaution.* (We'll consider the incentive effect for injurers shortly.)

Now we repeat the analysis with a different legal rule. Consider the victim's incentives for precaution when the injurer is *strictly liable*. As before, the victim bears the cost of precaution, $w_v x_v$, and the victim also bears the expected cost of harm, $p(x_v)A$. In addition, the victim receives damages D when an accident occurs. Thus, total net costs that the victim expects to bear under the rule of strict liability are

$$w_v x_v + p(x_v)A - p(x_v)D.$$

[11] Our exposition assumes that parties who engage in risky behavior know in advance which one will get hurt if an accident occurs. In reality, one usually—but not always—does *not* know *ex ante* whether one will be a victim or an injurer.

Further, assume that the damages compensate the victim perfectly: $D = A$. (Although unrealistic, the assumption of perfect compensation is very useful analytically.) With perfectly compensatory damages, total *net* costs reduce to the cost of precaution: $w_v x_v$. The victim has an incentive to minimize the costs that he or she bears. Consequently, the victim chooses x_v to minimize $w_v x_v$. Because x_v cannot fall below zero, the minimum occurs when precaution is zero: $x_v = 0$. Thus, we have shown that the rule of strict liability with perfectly compensatory damages gives the victim no incentive to take precaution.

This conclusion has a simple explanation. With a rule of strict liability and perfect compensation, the victim is indifferent between an accident with compensation and no accident. The victim pays the cost of his or her own precaution and gains no advantage from reducing the probability or severity of accidents. In other words, the victim internalizes the costs of precaution and externalizes the benefits. So, the victim has an incentive not to take any precaution.

We have analyzed the effects of the rule of no liability and the rule of strict liability on the victim's incentives for precaution. The first rule gives incentives for efficient precaution by the victim, and the second rule gives the victim no incentives for precaution.[12] Now we consider the effect of these two rules on the injurer's incentives for precaution. We denote the amount of precaution taken by the injurer as x_i. The injurer pays the cost w_i for x_i units of precaution. The harm A, however, is suffered by the victim. Unless the law reallocates the cost of the harm, the injurer will externalize it.

Assume that the rule of law is strict liability with perfect compensation. Thus, whenever an accident occurs, the injurer must pay damages equal to the cost of the harm: $D = A$. The injurer's expected liability equals the probability of an accident multiplied by the harm caused by it: $p(x_i)A$. The total costs that the injurer expects to bear under the rule of strict liability with perfect compensation equal $w_i x_i + p(x_i)A$. The injurer has an incentive to minimize the costs that he or she bears. Consequently, the injurer chooses x_i to minimize $w_i x_i + p(x_i)A$. The minimum occurs at the level of precaution, denoted, x_i^* where the injurer's marginal cost of precaution equals the resulting reduction in the expected cost of harm:

$$\underset{\text{(injurer's marginal cost)}}{w_i} = \underset{\text{(injurer's marginal benefit)}}{-p'(x_i^*)A}. \qquad (6.2'')$$

Equation 6.2″ corresponds to the efficiency condition given by Equation 6.2. Thus, we have shown that *the rule of strict liability with perfect compensation causes the injurer to internalize the marginal costs and benefits of precaution, which gives him or her incentives for efficient precaution.*

Finally, we consider the effect of the rule of no liability on the injurer's incentives for precaution. Assume that precaution x_i is chosen by the injurer, so the injurer bears the cost of precaution $w_i x_i$. The harm A, however, is suffered by the victim, and, under the rule of no liability, A remains where it falls on the victim, and the injurer pays no

[12] Again we note our assumption—frequently not true—that *ex ante* an accident a party knows that he will be the injurer.

TABLE 6.2
Efficiency of Incentives Created by Liability Rules*

yes indicates efficient incentives;
no, inefficient incentives; and
zero, no incentive.

Legal Rule	Precaution		Activity Level	
	Victim	Injurer	Victim	Injurer
No liability	yes	zero	yes	no
Strict liability	zero	yes	no	yes
Simple negligence	yes	yes	yes	no
Negligence + contributory negligence	yes	yes	yes	no
Strict liability + contributory negligence	yes	yes	no	yes
Comparative negligence	yes	yes	yes	no

*assumes perfect compensation and legal standards equal to efficient precaution

damages: $D = 0$. The total costs paid by the injurer thus equal $w_i x_i$. The injurer has an incentive to minimize the costs that he or she bears. Consequently, the injurer chooses x_i to minimize $w_i x_i$. Because x_i cannot fall below zero, the minimum occurs when precaution is zero: $x_i = 0$. Thus, we have shown that *the rule of no liability gives the injurer no incentive to take precaution*. This conclusion has a simple explanation: With no liability, the injurer is indifferent between an accident and no accident. Thus, the injurer internalizes the costs of precaution and externalizes the benefits.

Table 6.2 summarizes many conclusions about the incentives of alternative tort rules. For now, focus on the first two rows and the first two columns of Table 6.2, which summarize our conclusions about the rules of no liability and strict liability. Notice the symmetry: The victim's incentives for precaution under "no liability" are the same as the injurer's under "strict liability," and vice versa. The table suggests how the law could create incentives for efficient precaution. If only the victim can take precaution, then a rule of no liability provides incentives for efficient precaution. If only the injurer can take precaution, then a rule of strict liability with perfect compensation provides incentives for efficient precaution.

C. Bilateral Precaution

We have explained that a rule of no liability causes the victim to internalize the cost of harm and the injurer to externalize it. Consequently, the victim has efficient incentives, and the injurer has inefficient incentives. Conversely, a rule of strict liability with perfect compensation causes the injurer to internalize the cost of harm and the victim to externalize it. Consequently, the injurer has efficient incentives, and the victim has inefficient incentives. We have arrived at a dilemma: *Neither the rule of strict liability nor the rule of no liability creates incentives for efficient precaution by both parties.*

We will restate this proposition in technical terms. *Unilateral precaution* describes circumstances in which only one party to an accident can take precaution against it.

Bilateral precaution describes circumstances in which the victim and the injurer can take precaution, and efficiency requires both of them to take it. (Bilateral precaution is also called "joint precaution.")

With bilateral precaution, the social cost function has the form

$$SC = w_v x_v + w_i x_i + p(x_v, x_i)A.$$

Under strict liability, the injurer chooses x_i to minimize SC, but the victim does not choose x_v to minimize SC. Under no liability, the opposite is true. *Under bilateral precaution, neither the rule of strict liability nor the rule of no liability creates incentives for efficient precaution by both parties.*

We cannot escape this dilemma by dividing the costs of harm between the victim and injurer. Dividing the costs of harm between them causes each of them to externalize part of it, so both of them have incentives for deficient precaution.[13] We call this fact the "paradox of compensation." We will resolve this paradox by the end of Section E.

QUESTION 6.8: Assume that you park your car in a legal parking space on a corner, and a driver who comes around the corner too fast rams the bumper of his truck into your car, damaging your car but not his truck. A rule of no liability gives the driver of the truck the same incentives to avoid such accidents as the incentives given to you to park your car in a safe place under a rule of strict liability with perfect compensation. Explain why.

QUESTION 6.9: Explain why the incentive problem in the previous question cannot be solved by a rule of strict liability with imperfect compensation (say, actual compensation equal to 50 percent of perfect compensation).

D. Incentives for Precaution Under a Negligence Rule

The solution to the paradox of compensation lies in a negligence rule. We shall now prove that a negligence rule can give efficient incentives to the victim *and* the injurer. A negligence rule imposes a legal standard of care with which actors must comply

[13] To see why, assume that the rule is strict liability with *deficient* compensation, by which we mean that actual compensation falls short of the amount required for perfect compensation ($D < A$). Under strict liability with deficient compensation, the injurer *in*ternalizes the fraction of harm *ex*ternalized by the victim (specifically, D), and the injurer externalizes the fraction of harm internalized by the victim (specifically, $A - D$). Consequently, the rule of strict liability with deficient compensation does not provide incentives for efficient precaution by the injurer. To repeat the argument in notation, efficiency requires the injurer to choose x_i to minimize $w_i x_i + p(x_v, x_i) A$, whereas a rule of strict liability with compensatory damages D causes the injurer to minimize $w_i x_i + p(x_v, x_i) D$. If $D = A$, then the injurer's incentives are efficient; if $D < A$, then the injurer's incentives are deficient.

This same argument can be repeated for the victim.

in order to avoid liability. We assumed that courts apply a definite standard requiring a fixed amount of precaution, and this assumption permitted us to represent the legal standard, denoted $\tilde{x}$, as partitioning precaution into permitted and forbidden zones in Figure 6.2. Then, we developed the economic analysis of incentives to take care using Figure 6.3. Now, we combine these two ideas into a representation of a negligence rule in Figure 6.4.

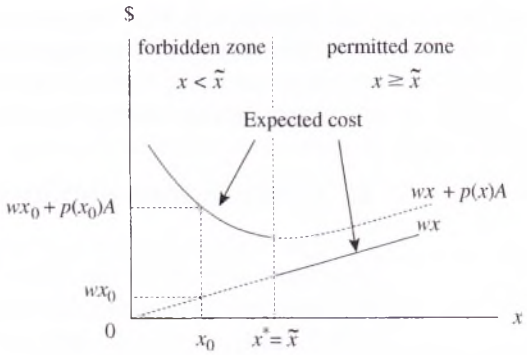
The legal standard in Figure 6.2 is denoted $\tilde{x}$, and x^* denotes the efficient level of precaution in Figure 6.3. To combine the figures, we must say how $\tilde{x}$ relates to x^*. The simplest assumption, which we justify later, is that the legal standard equals the efficient level of care: $\tilde{x} = x^*$. This assumption permits us to combine the figures as represented in Figure 6.4. The forbidden zone ($x < \tilde{x}$) in Figure 6.4 corresponds to deficient precaution relative to the efficient level ($x < x^*$), and the permitted zone ($x \geq \tilde{x}$) corresponds to excessive precaution relative to the efficient level ($x \geq x^*$). Precaution at the boundary between the two zones equals efficient precaution ($x = x^*$).

Consider the injurer's costs as a function of his level of precaution. In the permitted zone, injurers are not liable, so they bear the cost of their own precaution $w_i x_i$ but they do not bear the cost of the victims' harm. Thus, the injurer's costs in the permitted zone ($x_i \geq \tilde{x}$) are indicated by the straight line $w_i x_i$ in Figure 6.4. In the forbidden zone, injurers are liable, so they bear the cost of their own precaution $w_i x_i$ and the expected harm to the victim $p(x_i)A$. Thus, the injurer's expected costs in the forbidden zone ($x_i < \tilde{x}$) are indicated by the curve $w_i x_i + p(x_i)A$ in Figure 6.4. Thus, the injurer's costs under a negligence rule are indicated in Figure 6.4 by a smooth curve that jumps down at $x = \tilde{x}$ and then becomes a straight line.[14] The lowest point on this curve occurs when the injurer's precaution equals the legal standard: $x = \tilde{x}$. The injurer has an incentive to set precaution at this level in order to minimize costs. We have shown that *a negligence rule with perfect compensation and the legal standard equal to the efficient level of care gives the injurer incentives for efficient precaution.*

To illustrate the incentive effects of a negligence rule, consider how the injurer would find his or her preferred level of care. Assume the injurer sets his precaution equal to x_0 in Figure 6.4, in which precaution costs him $\$wx_0$ and he expects to pay $\$p(x_0)A$ in liability for accidents. The cost to the injurer of taking one more unit of precaution beyond x_0 is less than the resulting savings in expected liability because of the lower probability of an accident. Consequently, the rational injurer will take more precaution. He or she will continue taking more precaution until he or she reaches x^*, where liability falls to zero. Having reached x^*, the injurer has no incentive to increase precaution. If injurers' precaution exceeds x^*, they pay only for their own precaution.

[14] The jump occurs to the extent that the negligent injurer is held liable for the accidents that he caused, not just for the accidents that his negligence caused. To illustrate, if a railway negligently fails to install a filter to trap sparks emitted by the train, the railway will be held liable for fires caused by sparks emitted by the train, not just for fires caused by sparks that a filter would have trapped. Insofar as courts solve this problem and only find liability for accidents that nonnegligent behavior would have prevented, injurer's costs do not jump at the legal standard.

FIGURE 6.4
Expected costs with a discontinuity a x^*.



which costs w_i per unit, but their liability remains zero, so they will not take additional precaution beyond x^*.[15]

Recall that we began this section with a dilemma: How can a liability rule provide incentives for efficient precaution by the injurer and the victim? We have explained how a negligence rule can provide incentives for efficient precaution by the injurer. Now it is simple to explain how a negligence rule can provide incentives for efficient precaution by the victim. As explained, a rational injurer takes precaution at the legal standard $(x_i \geq \tilde{x})$ in order to avoid liability for the harm caused by accidents. When the injurer is not liable, the victim of an accident receives no compensation for accidental harm. Consequently, the victim responds as if the rule of law were no liability. We have already proved that a rule of no liability causes the victim to internalize the marginal costs and benefits of precaution, which gives incentives for efficient precaution. In general, a negligence rule that induces the injurer to escape liability by satisfying the legal standard provides incentives for efficient precaution by the victim.[16] Our conclusions about the incentives created by a negligence rule are summarized in the third line of Table 6.2.

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[15] We can prove this more formally. Given a negligence rule with perfect compensation and the legal standard equal to the efficient level of care, the injurer faces the following cost function:

$$x < x^* \text{ (forbidden zone)} \quad \rightarrow \quad \text{injurer's costs} = w_i x_i + p(x_i)A;$$

$$x \geq x^* \text{ (permitted zone)} \quad \rightarrow \quad \text{injurer's costs} = w_i x_i.$$

In the forbidden zone, the injurer's costs approach a minimum as x approaches x^*. In the permitted zone, the injurer's costs are minimized when x equals x^*. Therefore, the injurer minimizes costs by setting x equal to x^*.

[16] Note that under our formulation the potential injurer and potential victim may both take precaution that may be efficient but *duplicative*. It is possible that the precaution of one or the other of them would have prevented the accident or minimized its severity so that the precaution by the other party adds nothing by way of marginal benefit. However, because of our (realistic) assumption that parties cannot negotiate before an accident takes place, they have no opportunity to discover that only one of them needs to take care. Suppose that A's marginal cost of precaution is \$50 and that the expected marginal benefit of that precaution is \$60. Further suppose that B's marginal cost of precaution is \$53 and the expected marginal benefit is also \$60. Each party, acting independently, will reckon that he or she should take care because the marginal cost of precaution is less than the anticipated marginal benefit. The total amount spent of precaution—\$103—is, however, excessive. The same benefit could have been realized if only A had incurred a precautionary cost of \$50 (or if only B had acted at a cost of \$53). This duplicative investment in precaution seems wasteful but unavoidable, in light of our assumption that the transaction costs of the two parties' bargaining together are high.

QUESTION 6.10: A game is in equilibrium when no player can increase his or her payoff by changing strategy, so long as the other players do not change their strategies.[17] Prove that the simple liability game is in equilibrium when the injurer and the victim take efficient care.

E. Contributory Negligence and Comparative Negligence

The negligence rule has several different forms. We have been discussing its simplest form, which holds the injurer liable for accidents that he or she causes if, and only if, precaution is below the legal standard, regardless of the victim's level of precaution. Symbolically, we may describe simple negligence as follows:

simple negligence:

$$\text{injurer at fault, } x_i < x_i^* \quad \rightarrow \quad \text{injurer liable;}$$
$$\text{injurer faultless, } x_i \geq x_i^* \quad \rightarrow \quad \text{injurer not liable.}$$

Chapter 3 explained that English common law originally developed the simple negligence rule and later developed a more complex rule allowing a defense of contributory negligence. Under the rule of negligence with a defense of contributory negligence, the negligent injurer can escape liability by proving that the victim's precaution fell short of the legal standard of care. The defense of contributory negligence imposes a legal standard of care upon the victim. Symbolically, we may represent this form of the negligence rule as follows:

negligence with a defense of contributory negligence:

$$\text{injurer at fault, } x_i < x_i^*, \text{ and victim faultless, } x_v \geq x_v^* \quad \rightarrow \quad \text{injurer liable;}$$
$$\text{injurer faultless, } x_i \geq x_i^*, \text{ or victim at fault, } x_v < x_v^* \quad \rightarrow \quad \text{injurer not liable.}$$

Here's an example of the difference between (simple) negligence and negligence with a defense of contributory negligence. Someone dives into a swimming pool and strikes her head on the bottom. She sues the owner of the pool for failing to post signs warning that the pool was too shallow for diving. The pool owner admits that he posted no warnings, but he also asserts that the victim was negligent for diving without checking the depth of the water. If both parties are negligent, the pool owner is liable under a rule of simple negligence, and the pool owner is not liable under a rule of negligence with a defense of contributory negligence.

These two forms of the negligence rule, however, have been displaced by a new form of the negligence rule for most accidents in the United States. Under the rules of simple negligence or negligence with a defense of contributory negligence, one party is responsible for all the costs of accidental harm, even though both parties are at fault. The new form of the negligence rule, called "comparative negligence," divides the cost

[17] This is the definition of a *Nash equilibrium.*

of harm between the parties in proportion to the contribution of their negligence to the accident. For example, if the victim's negligence is 20 percent responsible for her accidental harm, and the injurer's negligence is 80 percent responsible for her accidental harm, then the victim may recover 80 percent of her losses from the injurer.

Symbolically, we may represent the rule of comparative negligence as follows:

comparative negligence:

injurer at fault, $x_i < x_i^*$, and victim faultless, $x_v \geq x_v^*$ → injurer bears 100 percent;

injurer faultless, $x_i \geq x_i^*$, and victim at fault, $x_v < x_v^*$ → victim bears 100 percent;

injurer at fault, $x_i < x_i^*$, and victim at fault, $x_v < x_v^*$ → bear cost in proportion to negligence.[18]

We have discussed the rules of simple negligence, negligence with a defense of contributory negligence, and comparative negligence. Other forms of the negligence rule exist. For example, the rule of *strict liability with a defense of contributory negligence* assigns the cost of accidental harm to the injurer, regardless of his or her level of precaution, unless the victim was at fault:

strict liability with a defense of contributory negligence:

victim at fault, $x_v < x_v^*$ → injurer not liable;

victim faultless, $x_v \geq x_v^*$ → injurer liable.

To illustrate, consumer products are sometimes subject to the rule of strict liability with a defense of contributory negligence. Under this rule, the manufacturer of a defective product is liable for the harm it causes to nonnegligent consumers and not liable for the harm it causes to negligent consumers.[19]

We have characterized four different forms of the negligence rule. The economic analysis of law proved a startling fact about the simple model of tort liability:

> Assuming perfect compensation and each legal standard equal to the efficient level of care, every form of the negligence rule gives the injurer and victim incentives for efficient precaution.[20]

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[18] The extent of the injurer's negligence equals $\bar{x} - x_i$. The extent of the victim's negligence equals $\bar{x} - x_v$. The proportion of each party's negligence, which can be used to divide liability under a rule of comparative negligence, is given as follows:

$$\bar{x}_i - x_i/[(\bar{x}_i - x_i) + (\bar{x}_v - x_v)] = \text{negligent injurer's proportion of liability;}$$

$$\bar{x}_v - x_v/[(\bar{x}_i - x_i) + (\bar{x}_v - x_v)] = \text{negligent victim's proportion of liability.}$$

To illustrate, if a car going 40 kph collides with a car going 35 kph on a street with a speed limit equal to 30 kph, then the two motorists divide liability in the proportions 2/3 and 1/3, respectively.

[19] The different forms of the negligence rule have an elegant mathematical symmetry, which we describe in the appendix to this chapter.

[20] This result is sometimes referred to in the professional literature as the "equivalence result."

It is easy to explain why. Recall that the simple negligence rule provides incentives for efficient precaution by both parties: A rational injurer takes precaution equal to the legal standard in order to escape liability, and, knowing this, a rational victim internalizes the harm from accidents, which gives incentives for efficient precaution. We can generalize this proof to every form of the negligence rule. Assume perfect compensation and each legal standard equal to the efficient level of precaution. Under every form of the negligence rule, *one* of the parties can escape bearing the cost of harm by satisfying the legal standard. This party will take efficient precaution in order to avoid the cost of harm. The *other* party will, consequently, internalize the cost of the harm from accidents, which creates incentives for efficient precaution. Table 6.2 summarizes our conclusions about liability rules and incentives for precaution.

We have been analyzing bilateral precaution, which we defined as a situation where efficiency requires the injurer and the victim to take precaution. Another possibility is *redundant precaution*, which we define as a situation where both parties can take precaution and efficiency requires only one of them to do so. To illustrate, the manufacturer and the homebuilder can check electrical wire for defects, but the manufacturer can check at less cost than the homebuilder. The preceding analysis of alternative legal rules applies to redundant precaution that is continuous, such as expenditure on quality control by a manufacturer of electrical wire.

The preceding analysis of alternative legal rules, however, can fail for technical reasons when redundant precaution is discontinuous. To illustrate, assume that the driver of a car can fasten a seat belt with less effort than the manufacturer can design a seat belt to fasten automatically. By assumption, efficiency requires the driver to fasten the seat belt and the manufacturer not to install automatic fasteners. However, a (simple) negligence rule might cause manufacturers to install automatic fasteners.[21]

Notice that buckling a seat belt is a discontinuous choice (yes–no). For discontinuous precaution, the relative efficiency of different rules depends upon particular facts. In general, discontinuous variables and cost functions yield messy results about optima, whereas continuous variables and cost functions yield clean results. It is usually best to build theory from clean results and then handle any messy results as exceptions.

QUESTION 6.11: Suppose that *B*'s faulty driving causes an accident that injures driver *A*. *A* was not at fault in her driving, but she was not wearing her seat belt, and this fact aggravated her personal injury. Discuss liability under

[21] Suppose that the manufacturer does not install an automatic fastener, the driver fails to fasten his seat belt, and an accident occurs. The driver sues the manufacturer and argues that the manufacturer was negligent for not installing an automatic fastener. (Installing an automatic fastener is cheaper than the harm from accidents). The driver might win the suit under a (simple) negligence rule. Foreseeing this fact, the manufacturers might install automatic fasteners. This is inefficient because it is cheaper for drivers to fasten their seat belts.

the rules of simple negligence, negligence with a defense of contributory negligence, and comparative negligence.

We have been discussing accidents in which one party, called the injurer, harms the other party, called the victim. Both parties can take precaution to reduce the probability and magnitude of an accident. In technical language, these accidents involve unilateral harm and bilateral precaution. We concluded that every form of the negligence rule can provide incentives for efficient precaution for both parties. In many accidents, however, both parties suffer harm, such as when two cars collide. These accidents involve bilateral harm and bilateral precaution. Does our major conclusion about incentives still apply when harm is bilateral?

With rare exceptions, the law allows the injured parties in an accident to sue each other. If, for example, my car collides with yours, you may sue me for the damage to your car, and I may counterclaim for the damage to my car. Such a suit can be factored into two parts and analyzed as if it were two separate accidents. Think of the damage to my car as one accident in which I was the victim and you were the injurer, and think of the damage to your car as another accident in which I was the injurer and you were the victim. Applying the analysis developed in this chapter to each accident separately usually reaches the same conclusions as would a more complicated analysis applied to both accidents simultaneously.[22]

QUESTION 6.12: Would the efficiency of a rule of simple negligence increase by imposing a standard of care on victims? Explain your answer by reference to the simple model.

F. Activity Levels

In the simple model, the rules of no liability and strict liability provide incentives for efficient precaution by the victim or injurer, but not both, whereas the various forms of the negligence rule create incentives for efficient precaution by the injurer and victim. Thus, the simple model provides a policy reason to prefer a negligence rule whenever precaution is bilateral. The simple model does not, however, provide a reason for preferring one form of the negligence rule to another. A complication of the model will provide an efficiency argument for distinguishing different forms of the negligence rule.

In the simple model, the injurer and victim choose precaution. Now we complicate the model by allowing them to make an additional choice. The probability of an automobile accident depends upon the level of precaution when driving, and the *amount* that one drives. By driving 10,000 miles a year, the probability that you will

[22] Any form of the negligence rule will induce efficient precaution by the injurer-victims when the legal standard is set by the Hand rule, which is discussed later in this chapter. See Jennifer H. Arlen, *Reexamining Liability Rules when Injurers as Well as Victims Suffer Losses*, 10 INTERNAT. REV. OF LAW & ECON. 233 (1990).

injure someone in an accident is approximately 10 times higher than it would be if you drove only 1000 miles per year. We shall compare the incentive effects of different liability rules on the amount of risky activities, such as driving, that people engage in.[23]

First, we contrast the rules of simple negligence and strict liability. Under a negligence rule, a driver can escape liability by conforming to the legal standard of care, no matter how much he or she drives. So, the driver can increase driving by tenfold, which increases the risk of harm to others by tenfold, without increasing his or her expected liability. Under a negligence rule the marginal risk of harm to others from more driving is externalized.

The incentive structure is quite different under a rule of strict liability. If a driver is strictly liable for the harm caused, then he or she internalizes the social costs of accidents from whatever source—whether from the activity level or a lack of precaution. Strict liability induces the potential injurer to set every variable affecting the probability of an accident at its efficient level. So, the rule of strict liability can induce both efficient precaution and an efficient activity level by drivers.[24]

We can generalize this conclusion to all activities and all liability rules. Some liability rules induce some actors to avoid liability by satisfying the legal standard of care. In the end, however, someone must bear the cost of accidental harm. We call that person the *ultimate* bearer of harm. To illustrate by the simple model, the victim is the ultimate bearer of harm under the simple negligence rule, whereas the injurer is the ultimate bearer of harm under the rule of strict liability with a defense of contributory negligence. In general, *the ultimate bearer of harm internalizes the benefits of any of his or her actions that reduce the probability or severity of accidents, including more precaution and less activity.*

We can use this generalization to expand Table 6.2. The last two columns show the effect of alternative liability rules on the incentives for the activity levels of the victim and injurer. Under each rule, the ultimate bearer of harm has incentives for an efficient activity level, whereas the party who escapes bearing the cost of accidental harm has incentives for an inefficient activity level.

Table 6.2 provides a useful guide for lawmakers to choose among liability rules. First, consider the problem of efficient incentives for precaution. If efficiency requires only one party to take precaution, then "no liability" and "strict liability" are just as efficient as a negligence rule. If efficiency requires bilateral precaution, then a negligence rule provides more efficient incentives for precaution than "no liability" and "strict liability." Second, consider the problem of efficient incentives for the activity level. Usually one party's activity level affects accidents more than the other party's activity level. Efficiency requires choosing a liability rule so that the

[23] See Aaron Edlin & Pinar Karaca-Mandic, *The Accident Externality from Driving*, 114 J. POL. ECON. 931 (2006).

[24] The original statement of this result is found in Steven Shavell, *Strict Liability Versus Negligence*, 9 J. LEGAL STUD. 1 (1980).

party whose activity level most affects accidents bears the ultimate costs of accidental harm.

Besides providing a useful guide, Table 6.2 shows some limits of liability law in creating efficient incentives. To illustrate, the different liability rules can provide incentives for an efficient activity level by either one of the parties but not by both of them. In other words, *bilateral activity levels* create a dilemma for lawmakers. In general, policymakers have difficulty hitting two targets with one policy variable. To hit two policy targets, two controls are usually required, just as two stones are usually needed to hit two birds. Thus, an additional control variable from outside liability law may be needed to control activity levels. For example, the number of miles driven by motorists can be influenced by a gasoline tax or an insurance policy whose premiums increase with the number of miles driven.

QUESTION 6.13: Who is the ultimate bearer of the costs of harm under a rule of comparative negligence? Explain your answer.

QUESTION 6.14: In Table 6.2, no liability and strict liability have the opposite incentive effects upon activity levels. Why?

QUESTION 6.15: For purposes of the theory of accidents, how would you define the *activity level* of a railroad? An airline? For some activities, the *level* relevant to the probability of an accident is difficult to define. Can you define an activity level relevant to a homeowner's maintenance of her front steps? A pharmaceutical company's sale of a drug with dangerous side effects?

G. Setting Legal Standards: The Hand Rule

Our discussion of negligence rules assumes that the legal standard equals the efficient level of precaution ($\bar{x} = x^*$). Now we want to explain how lawmakers can identify the efficient level of precaution when setting the legal standard. An American judge developed a famous rule to solve this problem in the case called *United States v. Carroll Towing Co.*[25]

The case concerned the loss of a barge and its cargo in New York Harbor. A number of barges were secured by a single mooring line to several piers. The defendant's tug was hired to take one of the barges out of the harbor. In order to release the barge, the crew of the defendant's tug, finding no one aboard in any of the barges, readjusted the mooring lines. The adjustment was not done properly, with the result that one of the barges later broke loose, collided with another ship, and sank with its cargo. The owner of the sunken barge sued the owner of the tug, claiming that the tug

[25] 159 F.2d 169 (2d Cir. 1947).

owner's employees were negligent in readjusting the mooring lines. The tug owner replied that the barge owner was also negligent because his agent, called a "bargee," was not on the barge when the tug's crew sought to adjust the mooring lines. The bargee could have assured that the tug's crew adjusted the mooring lines correctly. In deciding the case, Judge Learned Hand formulated his famous rule as follows:

> L. HAND, J . . . It appears from the foregoing review that there is no general rule to determine when the absence of a bargee or other attendant will make the owner of a barge liable for injuries to other vessels if she breaks away from her moorings. . . . Since there are occasions when every vessel will break away from her moorings, and since, if she does, she becomes a menace to those about her; the owner's duty, as in other similar situations, to provide against resulting injuries is a function of three variables: (1) the probability that she will break away; (2) the gravity of the resulting injury, if she does; (3) the burden of adequate precautions. Possibly it serves to bring this notion into relief to state it in algebraic terms: if the probability be called P; the injury, L; and the burden, B; liability depends upon whether B is less than L multiplied by P, i.e., whether $B < PL$. . . . [Judge Hand subsequently applied the formula to the facts of the case and concluded that, because $B < PL$ in this case, the barge owner was negligent for not having a bargee aboard during the working hours of daylight.]

Judge Hand's statement of his rule is unclear as to whether the variables refer to marginal values or total values. If we assume that he was a good economist who had marginal values in mind, then we can translate his notation into our notation as used in the simple model of precaution:

Hand's name	Our name	Hand's notation	Our notation
Burden	Marginal cost of precaution	B	w_i
Liability	Cost of accidental harm	L	A
Probability	Marginal probability	P	p'

Substituting our notation into Hand's formula, we obtain the following rule:

$$\text{marginal Hand rule: } w_i < -p'A \rightarrow \text{injurer is negligent.}$$

The marginal Hand rule states that the injurer is negligent if the marginal cost of his or her precaution is less than the resulting marginal benefit. Thus, the injurer is liable under the Hand rule when further precaution is cost-justified. Further precaution is cost-justified when precaution falls short of the efficient level ($x < x^*$).

To escape liability under Hand's rule, the injurer must increase precaution until the inequality becomes an equality:

$$\underset{\text{marginal social cost}}{w} = \underset{\text{marginal social benefit}}{-p'(x^*)A}. \tag{6.3}$$

If the injurer's precaution is efficient ($x = x^*$), then the marginal social cost equals the marginal social benefit ($w_i = -p'A$). At this point, further precaution is not cost-justified.

American courts frequently use the Hand rule to decide questions of negligence.[26] Repeated application of the Hand rule enables adjudicators to discover the efficient level of care. In a series of cases, the adjudicators ask whether further precaution was cost-justified. If the answer is "yes," then the injurer has not satisfied the legal standard, and the injurer is liable. Injurers will presumably respond to this decision by increasing their level of precaution. Eventually a case will reach the adjudicators in which further precaution is not cost-justified. Just as a climber can reach the peak of a smooth mountain in a fog by always going up, so the court can discover the efficient level of care by holding defendants liable for failing to take cost-justified precautions. In fact, the Hand rule follows the same search pattern used by some computer programs to maximize a function.[27]

To apply the Hand rule, the decision maker must know whether a little more precaution costs more or less than the resulting reduction in expected accident costs. Calculating the expected accident costs, $p(x)A$, can be difficult. For example, if you increase your driving speed from, say, 40 mph to 50, will the average loss resulting from an accident increase by $1,000,000, or by $10, or something in between? Cost-benefit analysis demands a lot of information from anyone who uses it, whether an injurer, a court, a legislature, or an administrator. Liability law should take into account who is in the best position to obtain information about accidents.

Case-by-case application of the Hand rule is one way for courts to find an efficient legal standard. At trial, courts will hear expert witnesses give testimony on the relevant probabilities. If courts can obtain accurate information about accidents at moderate cost, this fact favors case-by-case adjudication. Another approach is to draft regulations or statutes specifying a legal standard that equals the efficient level of precaution. For example, highway officials may compute the efficient speed for motorists on a particular road, taking into account the value of the time of motorists and the reduction in accidents from driving more slowly. The officials can then declare the efficient speed to be the legal speed limit. Politicians and bureaucrats sometimes behave in this way. If a legislature or regulator can obtain accurate information about accidents at moderate cost and is willing to use it, these facts favor a system of public law for accidents, like workers' compensation for on-the-job injuries.

Another approach is for the law to enforce social customs or the best practices in an industry. In this approach, the lawmakers do not try to balance marginal costs and

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[26] The Hand rule is enshrined in the definition of negligence offered by the American Law Institute in the RESTATEMENT (SECOND) OF TORTS.

[27] The maximum of a continuous, concave function can be found by going in the direction where the derivative is largest.

benefits. Rather, the lawmakers rely upon the community of people who created the norm, or the industry that engages in the practice, to balance costs and benefits. For example, a residential community has norms concerning the maintenance of steps leading to houses, and the accounting industry has practices concerning careful auditing. When enforcing these "community standards," the courts need much less information than when they compute the marginal costs and benefits of precaution. Before enforcing the community standard, however, the lawmakers should ascertain whether the community actually balances costs and benefits. In Chapter 11 we will return to this topic when we consider the evolution of social norms toward efficiency.

American courts have persistently erred in applying the Hand rule in a way that significantly affects results. In applying the Hand rule, the court must balance the injurer's burden against the *full* benefit of precaution. The full benefit includes the reduction in risk to plaintiff ("risk to others") and reduction in risk to injurer ("risk to self"). Courts have, remarkably, overlooked the reduction in self-risk and, consequently, set the standard too low. To illustrate, assume the bank robber injures a bank's customer during the robbery of an unguarded bank. The customer sues the bank alleging that the bank should have had a guard at the bank to deter robberies. If the court applies the Hand rule to determine whether the bank was negligent, the court must compare the cost of hiring a guard with the expected reduction in harm. The expected reduction in harm includes protecting customers from getting hurt ("risk to others") and protecting the bank from getting robbed ("risk to self"). The court will leave out more than half of the benefit of having a guard if it fails to consider the reduction in the bank's risk.[28]

As another example, assume that the court must determine whether the speed at which a driver took a curve was unreasonably dangerous. The court must balance slowing down and the benefit of reducing the risk of accidents to others and the driver. In applying the Hand rule, however, courts typically focus on reducing the risk to others and lose sight of the value of reducing the risk to the injurer. Losing sight of self-risk will cause the court to allow more speed than allowed by the correct application of the Hand rule.

Omitting self-risk is a logical error in applying the Hand rule. Instead of being logical, people often make predictable errors of which tort law ought to take account. Psychologists have investigated systematic biases that affect perception. Especially strong biases affect the perception of probabilities. One of these biases concerns the difference between foresight and hindsight estimates of probability. Assume that a citizen estimates in May that the probability equals 0.5 of a particular candidate's winning the presidential election in November. When November comes, the candidate wins. In December the citizen is asked what he thinks the candidate's probability of winning was back in May. The citizen says that it was 0.7. The hindsight estimate of 0.7 is higher than the foresight estimate of 0.5. Another example of the "hindsight bias" is the investor who observes an increase in the price of a stock and thinks that its rise was a "sure thing." In general, the hindsight-probability is higher than the foresight-probability for

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[28] Robert Cooter & Ariel Porat, *Does Risk to Oneself Increase the Care Owed to Others?*, 29 J. LEGAL STUD. 19 (2000). We recognize that the principal goal of tort law is to induce the internalization of precaution that confers a benefit on another. Tort law does not generally seek to induce potential injurers to take care to minimize their own harms.

events that materialize. Applied to accidents, the hindsight bias may cause courts to overestimate the effects of untaken precaution on the probability of accidents that actually occurred. Hindsight probabilities can thus result in liability under the Hand rule in circumstances where foresight probabilities result in no liability. As a result, injurers may feel that they are being treated unfairly: They took what seemed to them, at the time, to have been sufficient care but were later deemed to have been at fault. If this result is widespread, it is possible that potential injurers will respond by taking more precaution than they really believe to be necessary. There is, thus far, no empirical evidence on this matter, but it is intriguing.

QUESTION 6.16: Suppose that the sunken barge in *United States v. Carroll Towing Co.* and its cargo are worth $100,000. Assume that the probability that the barge would break loose if the bargee is not present equals 0.001. If the bargee is present, then the probability of the barge's breaking loose is reduced by half, to 0.0005. Paying the bargee to stay on the barge will cost the barge owner $25. If the barge owner does not incur this $25 expense, is his behavior negligent under the Hand rule?

QUESTION 6.17: Courts have to decide whether to defer to community norms when setting a standard of negligence or to set a legal standard independently from the community norm. A community of homeowners has norms for maintaining the safety of steps leading to the front porch of a house. Similarly, hospitals and private companies that collect blood have norms for storing it safely. Make arguments for why a court might appropriately show more deference to community standards for porch steps than to a community standard for storing blood.

H. Errors

We have explained that a negligence rule can create efficient incentives for injurer and victim, whereas strict liability can only create efficient incentives for the injurer. Despite this fact, the twentieth century saw the scope of strict liability rules expand and the scope of negligence rules contract, especially with respect to consumer product injuries. What justifies this change? The answer concerns information. Proving causation is much easier than proving negligence. To illustrate, it is much easier to prove that an exploding Coke bottle harmed a restaurant worker than to prove that the manufacturer followed negligent bottling procedures. If liability requires the victim to prove negligence, as with a negligence rule, then many manufacturers will avoid liability, and they will take little precaution. Conversely, if liability only requires the victim to prove causation, as with a rule of strict liability, then few manufacturers will avoid liability, and most of them will take much precaution.

In tort disputes, mistakes are often made concerning the extent of harm, the cause of the accident, and the actor's fault. Such mistakes are unavoidable by courts and lawmakers because accidents are shrouded in a fog of uncertainty, interested parties such as the plaintiff and defendant provide biased information, and few people have expert

information about risks and precaution. In this section we explain how courts and lawmakers should take account of their own fallibility.

First, consider how a mistake by the court in estimating harm affects precaution. The effects are different under a rule of strict liability and a rule of no liability. The injurer's incentives for precaution are efficient under a rule of strict liability with perfect compensation. But suppose the court consistently estimates harm inaccurately and consistently fails to set damages equal to perfect compensation. If the damages actually awarded by the court consistently fall short of perfect compensation, then the injurer will externalize part of the cost of accidental harm; so, he or she will have incentives to take deficient precaution. Conversely, if the damages actually awarded by the court consistently exceed perfect compensation, then the injurer will have incentives to take excessive precaution. In general, *consistent court errors in setting damages under a rule of strict liability cause the injurer's precaution to respond in the same direction as the error.*

Second, consider mistakes in determining who caused an accident under a rule of strict liability. Specifically, assume that the court sometimes fails to hold someone liable who caused an accident. This kind of error lowers the expected liability of the injurer, just like awarding deficient damages. The effect of lowering the probability of liability is the same as the effect of lowering the amount of damages: Future potential injurers take less precaution. In general, *consistent court errors in failing to hold injurers liable under a rule of strict liability cause subsequent injurers to take less precaution.* (Conversely, consistent errors in the direction of holding a person liable for accidents that she did not cause may induce other persons to avoid activities where mistaken liability can occur.)[29]

The situation is different under a negligence rule. Under a negligence rule, the injurer is not liable if his precaution equals the legal standard, and he is liable if his precaution falls below the legal standard. Thus the injurer's expected costs jump up as his precaution falls below the legal standard $\tilde{x}$ as depicted in Figure 6.4. To the left of this discontinuity, the injurer's expected costs are $\$[wx + p(x)A]$; to the right of this discontinuity, the potential injurer's expected costs are $\$wx$. To escape liability and avoid the jump in costs, the injurer satisfies the legal standard $(x = \tilde{x})$. This is true whether the jump in costs is large or small. So, the injurer will want to satisfy the legal standard and escape liability even if the court makes errors in measuring damages. In general, *injurer's precaution does not respond to modest court errors in setting damages under a negligence rule.*[30]

This fact is illustrated in Figure 6.5, where lines *A* through *D* indicate different levels of expected accident costs. When the court awards perfectly compensatory damages, assume that the injurer's expected liability costs in Figure 6.5 are given by curve *B*.

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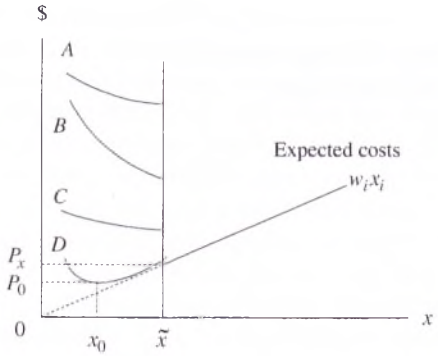
[29] Thanks to Nick Tideman for correcting imprecision in an earlier formulation of this principle.

[30] Here is a more precise, and more technical, statement of the contrast: Many injurers respond a little to changes in damages under a rule of strict liability (response on the intensive margin), whereas a few injurers respond a lot to change in damages under a negligence rule (response on the extensive margin, with nonconvexity in the expected-cost function).

FIGURE 6.5
A single legal standard and different expected accident costs.



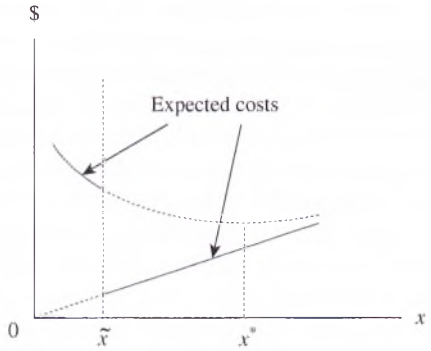
Above curve *B*, the courts award excessive damages, which results in an expected-cost curve such as *A*. Below curve *B*, the courts award deficient damages, which results in an expected-cost curve such as *C*. Regardless of these court errors, the injurer's expected costs jump down to when the injurer satisfies the legal standard; so, the injurer still minimizes expected costs by setting his or her precaution equal to the legal standard, $x = \tilde{x}$. To change the injurer's cost-minimizing precaution, the error made by the court in awarding damages must be very large, as illustrated by the curve labeled *D*. In that case, the cost-minimizing level of care will be less than the legal standard.

Rather than interpreting Figure 6.5 as depicting errors by courts, we can interpret the figure as depicting errors by injurers. For example, think of curves *A*, *B*, *C*, and *D* as depicting the expected costs of four different injurers. Curve *B* depicts the injurer who predicts court behavior accurately, curve *A* depicts the injurer who errs by overestimating court damages, and curve *C* depicts the injurer who errs by underestimating court damages. Regardless of these errors, the injurer's expected costs jump down to $w_i x$ when he or she satisfies the legal standard. So, each injurer still minimizes expected costs by setting precaution equal to the legal standard, $x = \tilde{x}$. To change the injurer's cost-minimizing precaution, the error in predicting damages must be very large, as illustrated by the curve labeled *D*. There the erring injurer perceives the cost-minimizing level of precaution to be x, far below the efficient level. In general, *injurer's precaution does not respond to injurer's modest errors in predicting damages under a negligence rule.*

We have interpreted the different expected-cost curves in Figure 6.5 as indicating an error by the court in computing damages or the injurer in predicting damages. Alternatively, the different expected-cost curves could be interpreted as indicating an error in determining who caused the accident. In general, *injurer's precaution does not respond to a court's modest errors in determining who caused an accident under a negligence rule.*

Having discussed errors in computing damages and determining causes, we turn to errors in setting the legal standard. By "errors," we mean situations in which lawmakers set the legal standard at a level different from the efficient level of precaution. Most injurers minimize their costs by conforming exactly to the legal standard, regardless of whether it exceeds or falls short of efficient precaution. Consequently, an excessive legal

FIGURE 6.6
Expected cost when the legal standard is less than the social optimum.



standard causes excessive precaution, and a deficient legal standard causes deficient precaution. In general, *injurer's precaution responds exactly to court errors in setting the legal standard under a negligence rule.*

To illustrate, Figure 6.6 depicts the injurer's expected costs under a negligence rule when the legal standard is less than the efficient level of precaution: $\tilde{x} < x^*$. The solid curves in Figure 6.6 indicate the injurer's costs as a function of the level of precaution. The injurer minimizes costs by setting precaution equal to the legal standard: $x = \tilde{x}$. His or her precaution is less than the efficient level: $x < x^*$. Consequently, too many accidents occur, and the harms they inflict are too severe.

QUESTION 6.18: Use a graph to explain the efficiency consequences of a legal standard that exceeds the efficient level of care: $\tilde{x} > x^*$.

QUESTION 6.19: "In general, the injurer's precaution responds to court errors in setting the legal standard under a negligence rule." Is this statement true for all forms of the negligence rule, or only for the simple negligence rule?

I. Vague Standards and Uncertainty

We have analyzed precise rules—both precisely efficient rules and precisely inefficient rules—that are called "bright-line rules" because their meaning is as clear as a bright line. In reality, however, legal commands are often vague and unpredictable, frequently referred to as "standards." Vague and unpredictable tort standards leave people uncertain about the legal consequences of their acts. We shall discuss how people adjust their precaution in response to legal uncertainty.

Assume that the court makes purely random errors, or, what amounts to the same thing, assume that the injurer makes purely random errors in predicting what courts will do. By "purely random," we mean that excess is just as probable as deficiency, so that the average error is zero. (Technically, we assume that errors follow a random distribution with zero mean.) We shall consider purely random errors in damages and standards.

First, consider purely random errors by the court in computing damages or by the injurer in predicting damages. A purely random error in damages does not change the

expected liability of the injurer. Expected liability remains unchanged because errors of excess offset errors of deficiency on average. Because expected liability remains unchanged, an injurer who minimizes expected costs does not change his or her precaution in response to purely random errors in damages.[31] This is true for every liability rule. In general, *the injurer who minimizes expected costs does not change his or her precaution in response to random errors in computing or predicting damages under any liability rule.*

The situation is different, however, for random errors concerning the legal standard in a negligence rule. To keep the analysis simple, consider the injurer's legal standard of care, $\tilde{x}_i$, under a rule of simple negligence. Assume that the court makes random errors in setting the legal standard $\tilde{x}_i$, or the court makes random errors in comparing the injurer's precaution x to the legal standard $\tilde{x}_i$, or the injurer makes random errors in predicting the legal standard $\tilde{x}$. Given any of these possibilities, injurers are uncertain about whether a particular level of precaution on their part will result in the court's finding them liable or not liable for accidents. If the court finds that their precaution exceeded the legal standard, then they will have taken unnecessary precaution. Unnecessary precautions cost them a little. Alternatively, if the court finds that their precaution fell short of the legal standard, then they will be liable. Liability costs them a lot. This asymmetry gives injurers an incentive to take more precaution in order to create a margin of error within which they will not be liable. In general, *small random errors in the legal standard imposed by a negligence rule cause potential injurers to increase precaution.*

Table 6.3, which summarizes our conclusions about precise errors and vague standards, suggests some prescriptions for lawmakers and courts. First, with a rule of strict liability, consistent errors by the court in computing damages distort precaution; so, the court should avoid these errors. Second, with a rule of negligence, consistent errors by the court in setting standards distort precaution more than consistent errors in computing

TABLE 6.3
Consequences of Errors of Excess

Liability Rule	Court's Error	Injurer's Error	Effect on Injurer
Strict liability	Excessive damages	Overestimates damages	Excessive precaution
Negligence	Excessive damages	Overestimates damages	None
Negligence	Excessive legal standard	Overestimates legal standard	Excessive precaution
Strict liability	Random error in damages	Random error in damages	None
Negligence	Random error in legal standard	Random error in legal standard	Excessive precaution

[31] In technical terms, the solution to Equation 6.2 does not change if we replace A with $E(A + \mu)$, where E is an expectation operator and μ is a random variable with zero mean and constant variance.

damages; so, the court should concentrate on avoiding errors in setting the standard of care. Given these two prescriptions, a court that assesses damages more accurately than standards for a given class of cases should favor a rule of strict liability, whereas a court that assess standards more accurately than damages for a given class of cases should favor a rule of negligence. Third, with a rule of negligence, vague standards cause excessive precaution; so, the court should apply vague standards leniently in order to avoid aggravating the problem of excessive precaution.

QUESTION 6.20: "Excessive damages increase expected liability under a negligence rule, which results in excess precaution." Explain the mistake in this proposition.

QUESTION 6.21: "If the legal standard of care in a negligence rule is necessarily vague, the court should set it below the level of efficient precaution." Explain the economic argument in favor of this proposition.

Rules V. Standards

A law can be precise like "The speed limit is 50 kilometers per hour," or a rule can be imprecise like "Drive at a reasonable speed." Law and economics scholars call precise laws "rules" and they call imprecise laws "standards."[32] Determining whether behavior complies with a precise rule is easier than an imprecise standard. Officials who enforce laws, and citizens who must obey them, appreciate the certainty and predictability of rules. The human imagination, however, cannot anticipate all of the circumstances in which a precise rule prescribes the wrong behavior, as when the policeman stops the car for speeding to the hospital with a passenger who is about to give birth to a baby. A system of rules tries to overcome inflexibility through exceptions, such as the rule that speed limits do not apply in emergencies. The exceptions to a rule, however, are an open set; so, no rule can enumerate all of them. As unforeseen circumstances arise, exceptions mount and a system of rules becomes increasingly complex. Conversely, a system of standards reaches precision through cases. When a case arises, its resolution precisely specifies the standard's application to the circumstances. The novel application of the standard in a case constitutes a precedent. Common law is a system of standards with many cases, whereas regulatory law is a system of rules with many exceptions. Civil codes also contain many imprecise standards.

Which is better, rules or standards? In Chapter 9 we will discuss precise contract terms like "Pay $100 for each day that delivery is late," and vague contract terms like "Make your best efforts to deliver on time." Our discussion of contracts will conclude that parties prefer precise terms when they can stipulate efficient behavior in advance, and they prefer imprecise terms when they want courts to decide whether behavior was fair and efficient after it occurs. Verifiable and unverifiable terms in contracts resemble rules and standards in tort law. Tort law should use rules when it can stipulate efficient and fair behavior in advance, and the law should use standards when courts can identify efficient and fair behavior in cases after disputes arise.

[32] See Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L. J. 557 (1992). Note that instead of "standards," philosophers often use "principles" to refer to imprecise laws.

J. Administrative Costs and Tailored Rules

In the simple model, the economic goal of the tort liability system is to minimize the sum of the costs of precaution and the harm caused by accidents. A more complex model includes another important element of costs: administration. Administrative costs are incurred to allocate the costs of accidental harm. For example, a system of private law incurs the costs of lawyers, judges, and other officials involved in resolving legal disputes. Similarly, a public system to compensate workers injured on the job must collect taxes, decide claims, and pay benefits.

We begin by analyzing administrative costs in isolation from the costs of precaution and accidental harm. In private law, injurers compensate victims, whereas in public law, injurers pay fines to the state. Private law can lower administrative costs because the victims, who know a lot about the cause and extent of their injuries, sue the injurers. In contrast, public law requires an administrator to discover injurers who violate rules. For many injuries, but not all, private enforcement is more efficient than public enforcement. We postpone a more systematic comparison between public and private enforcement in order to focus on the administrative costs of three rules: no liability, strict liability, and negligence.

The rule of no liability leaves the costs of accidental harm where they fall, without attempting to reallocate them. Consequently, a rule of no liability eliminates the administrative costs of reallocating the costs of accidental harm. In contrast, the rule of strict liability and the rule of negligence reallocate the costs of accidental harm under certain conditions. Thus, a rule of no liability saves administrative costs relative to a rule of strict liability or a rule of negligence liability.

This fact has led reformers to advocate adopting the rule of no liability for most motor vehicle accidents. Under a so-called "no fault" rule, each of the parties to an automobile accident bears his or her own costs of accidental harm. In practice, this means that each accident victim recovers from his or her own insurance company, rather than recovering from the insurance company of the injurer.[33] The rule of no liability has the disadvantage that it gives injurers no incentive to take precaution. For example, the owners of trucks with steel cattle guards welded to the front of the vehicle may respond to a rule of no liability by driving aggressively. Thus, the no-fault systems presumably save administration costs and erode incentives for precaution.

Now we compare the administrative costs of a rule of strict liability and a rule of negligence. Recall that a rule of strict liability requires the plaintiff to prove harm and cause, whereas a rule of negligence requires the plaintiff to prove harm, cause, and fault. The additional element of proof in negligence requires an additional decision, which increases administrative costs. Thus, *a rule of strict liability lowers administrative costs relative to a rule of negligence by simplifying the adjudicator's task.*

This advantage of strict liability may be offset by a disadvantage. A rule of strict liability gives more victims the right to recover damages than a rule of negligence. Specifically, a rule of strict liability gives every victim who suffers harm caused by the

[33] There has been, in the recent past, discussion of implementing a no-fault regime for medical harms. We discuss this proposal in the next chapter.

injurer's *activity* the right to recover, whereas a rule of negligence gives every victim who suffers harm caused by the injurer's *fault* the right to recover. Thus, *a rule of negligence lowers the administrative costs relative to a rule of strict liability by reallocating the cost of harm in fewer cases*. In summary, a rule of strict liability results in more claims that are simpler to settle, whereas a rule of negligence results in fewer claims that are more complicated to settle.

We have contrasted the administrative costs of strict liability and negligence. Besides the form of the liability rule, administrative costs also depend upon the simplicity and breadth of the rules. Simple rules are based upon easily proven facts, and broad rules lump together many different cases. Conversely, complicated rules are based upon facts that are difficult to prove, and narrow rules apply to a few cases. We may characterize the extremes of simplicity and breadth as *wholesale* rules, and we may characterize the extremes of complicated and narrow as *case-by-case* adjudication. Wholesale rules are cheaper to make, enforce, and understand. However, wholesale rules distort incentives by treating people alike who have different utility and cost functions. In general, *wholesale rules save administrative costs and distort the relationship between the marginal cost of precaution and the marginal reduction in harm, whereas case-by-case adjudication has the opposite effects*.

Besides allocating the cost of accidental harm, the law also allocates the costs of administration. Different countries allocate administrative costs differently. To illustrate, an accident victim who successfully sues in the United States recovers damages for the harm suffered but does not usually recover costs of litigating. In contrast, many European countries require the loser of a lawsuit to pay the litigation costs of the winner. The allocation of administrative costs decisively affects the incentives of the victim to sue and the incentives of the parties to settle out of court. We shall analyze these incentives in a later chapter.

Because administrative costs are purely instrumental, reducing them without increasing accidents is a pure gain. To retain the same level of deterrence of injurers, the law can increase the magnitude of liability and reduce its probability. To illustrate, assume that negligent injurers must pay damages of 100. Now change the rules and assume that a flip of a coin will determine whether a negligent injurer pays damages of 200 or pays nothing. After randomizing, the expected liability remains 100, so deterrence will not change for many injurers. Administrative costs, however, should fall because damages are collected from half as many injurers. In general, increasing liability and reducing the frequency of trials can often save administrative costs without affecting the number of accidents. These facts suggest that efficiency requires a high magnitude and low probability of liability.

Increasing the magnitude of liability, however, encounters obstacles. Private law typically restricts the injurer's liability to the damages required to compensate the victim. Some theorists want to circumvent this obstacle by "decoupling" damages, so that the injurer pays compensation to the victim and also a fine to the state.[34]

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[34] A. Mitchell Polinsky & Yeon-Koo Che, *Decoupling Liability: Optimal Incentives for Care and Litigation*, 22 RAND J. ECON. 562–570 (1991).

In principle, decoupling enables the law to save administrative costs by increasing the magnitude of liability and decreasing its probability. You will encounter this same principle in Chapter 12 when we analyze the optimal magnitude and certainty of criminal punishments.

QUESTION 6.22: Doctors are liable when their negligence injures patients. Suppose the rule was changed from negligence to strict liability. How would administrative costs change?

QUESTION 6.23: The rungs of ladders must be constructed to support the weight of the people who climb them. Compare the relative efficiency of a precise government standard for all ladders concerning the weight that the rungs must support, as opposed to the rule that the strength of the rungs should be determined as suits arise on a case-by-case basis using the Hand rule.

K. Consumer Product Injuries: Between Torts and Contracts

At the beginning of this chapter we explained that tort law uses liability to internalize externalities created by high transaction costs. The model of torts applies when transaction costs prevent the injurer and victim from dealing with each other before the accident, as with most automobile accidents. When the parties have a market relationship, however, the analysis must change, as we now show with an example of consumer product injuries.

Table 6.4 reproduces the numbers from a hypothetical example developed by Polinsky.[35] Consumers face a choice between buying soda in bottles or cans. Bottles are cheaper to produce than cans, as indicated by column 1, but bottles are twice as likely to cause an accident to the consumer, as indicated by column 2, and the accidents involving bottles are more severe, as indicated by column 3. The expected loss in column 4 equals the probability of an accident in column 2 multiplied by the loss in

TABLE 6.4
Cost of Soda

Behaviour of Firm	Firm's Cost of Production Per Unit	Probability of Accident to Consumer	Loss if Accident	Expected Accident Loss	Full Cost Per Unit
	(1)	(2)	(3)	(4)	(5)
Use bottle	40 cents	1/100,000	$10,000	10 cents	50 cents
Use can	43 cents	1/200,000	$4000	2 cents	45 cents

[35] A. MITCHELL POLINSKY, AN INTRODUCTION TO LAW AND ECONOMICS (2d ed. 1989), Table 11, p. 98.

column 3. The full cost per unit, indicated by column 5, equals the sum of the cost of production in column 1 and the expected accident loss in column 4.

Notice that the full cost of bottles (50 cents) in this hypothetical example exceeds the full cost of cans (45 cents). Thus, efficiency requires the use of cans, not bottles. Let us consider whether consumers will actually use cans instead of bottles. The behavior of consumers depends upon the information that they possess, liability law, and the market for sodas. We assume that the market is perfectly competitive. Competition drives the price of a good down to its cost, as explained in Chapter 2. The cost of supplying soda depends upon production and liability. We assume that the price of a unit of soda equals the production cost plus the cost of the manufacturer's liability. Under a rule of no liability, the price of a unit of soda thus equals the production cost as shown in column 1 : 40 cents per bottle and 43 cents per can. Under a rule of strict liability, the price of a unit of soda equals its full cost as shown in column 5 : 50 cents per bottle and 45 cents per can.

First, consider the behavior of *perfectly informed* consumers under a rule of *no liability*. Being perfectly informed, the consumers know the expected accident costs and the fact that they must bear these costs. Consequently, consumers will prefer the soda whose full cost to them is lower, specifically, soda in cans. *Thus, perfectly informed consumers will choose the most efficient product under a rule of no liability.*

Second, consider the behavior of *imperfectly informed* consumers under a rule of *no liability*. Being imperfectly informed, the consumers do not know the expected accident costs. If consumers overestimate the greater danger associated with bottles, they will buy cans. If consumers underestimate the greater danger associated with bottles, or if they disregard the danger, they may buy bottles to obtain the (perceived) lower price of 40 cents per bottle, as opposed to the higher price of 43 cents per can. *Thus, imperfectly informed consumers will not necessarily choose the most efficient product under a rule of no liability.*

Third, consider the behavior of imperfectly informed consumers under a rule of *strict liability*. Strict liability and perfect competition cause the price of soda to equal its full cost, which is 50 cents per bottle and 45 cents per can. Consumers will prefer cans rather than bottles, regardless of whether they overestimate, underestimate, or disregard the greater danger associated with bottles. *Thus, imperfectly informed consumers will choose the most efficient product under a rule of strict liability.*

This example provides the basic rationale for holding manufacturers strictly liable for the harm that defective products cause consumers: The cost of liability will be captured in the price, thus directing consumers toward efficiency despite having imperfect information. This analysis, however, ignores many shortcomings of a system of strict liability for consumer product injuries, such as administrative costs, the lack of incentives for precaution by victims, and overinsurance of consumers by producers. We will discuss these shortcomings in detail in the next chapter.

QUESTION 6.24: In effect, a rule of strict liability requires the seller to provide the consumer with a joint product: soda and insurance. What inefficiencies arise from such a compulsory purchase?

Conclusion

In communist countries like the former Soviet Union, planners could not get the information that they needed to manage an increasingly complex economy, which caused the economy to deteriorate. An increasingly complex economy must rely increasingly upon markets, which decentralize information. In this respect, making law resembles making commodities. As the economy grows in complexity, central officials cannot get the information that they need to make precise regulations. Instead of centralized lawmaking, the modern economy needs decentralized lawmaking analogous to markets. Tort liability removes many decisions about accidents from bureaucrats and politicians and allows judges to make laws, plaintiffs to decide when to prosecute violators, and courts to determine how much the violators must pay. Thus, the liability system decentralizes much of the task of internalizing externalities. In this chapter we developed the fundamental theory required to understand tort law. The next chapter refines the economic theory in order to address the problems that beset tort law everywhere in the world.

Suggested Readings

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