CHAPTER 13

External Costs and Benefits

In previous chapters, we have analyzed the gains from trade that accrue to voluntary participants in transactions. However, many transactions involve involuntary participants as well. The neighbors who breathe the smoke from a polluting factory, the naturalist who deplores the "harvesting" of whales, the shoppers who enjoy the spectacle of department store Christmas displays—all are incurring costs or benefits from transactions in which they had no part. Such costs and benefits are said to be **external** and are collectively referred to as **externalities.** External costs (like the annoyance of breathing factory smoke) are called **negative externalities,** and external benefits (like the pleasure from seeing Christmas decorations) are called **positive externalities.**

In this chapter, we will see how externalities can be a source of economic inefficiency. We also will discuss what can be done about that problem.

External costs and benefits, or externalities
Costs and benefits imposed on others.

Negative externalities
External costs.

Positive externalities
External benefits.

13.1 The Problem of Pollution

Pollution is an important example of a negative externality. Cars, for example, cause pollution—both when they are being manufactured and when they are being driven. We will use this example to illustrate all of the key ideas concerning externalities.

Private Costs, Social Costs, and Externalities

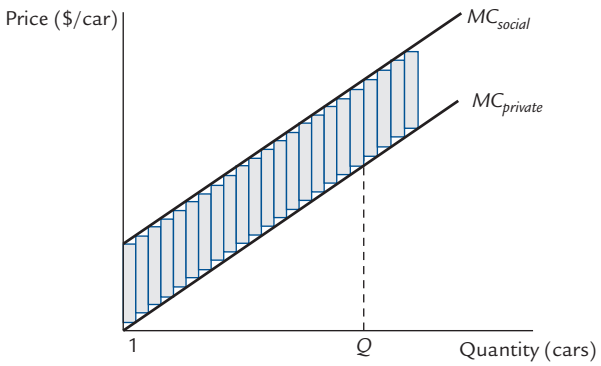
When car companies decide how many cars to produce, they consider such costs as labor, raw materials, and factory space. They typically do not, however, fully consider the costs their cars will impose on bystanders who are forced to breathe exhaust fumes. So when we talk about the cost of building a car, we need to distinguish between the **private cost**—the sum of all those costs the manufacturer accounts for—and the **social cost**—the sum of *all* costs, including both private costs and external costs.

Exhibit 13.1 shows the private and marginal costs of automobile production. The private marginal cost curve includes all the costs *felt by the manufacturers,* while the social marginal cost curve includes all the costs *felt by anyone,* including the manufacturers. Therefore, the social marginal cost curve lies *above* the private marginal cost curve; it includes everything the private curve includes and more besides.

Private cost
The sum of those costs of a decision that are borne by the decision maker.

Social cost
The sum of all of the costs of a decision, including the private costs and the costs imposed on others.

EXHIBIT **13.1** **Measuring Externalities**



The private marginal cost curve accounts for all costs felt by manufacturers (labor, raw materials, factory space, etc.). The social marginal cost curve accounts for everything in the private marginal cost curve *plus* the external costs felt by people who suffer from pollution.

The first shaded rectangle has a height, and hence an area, equal to the external cost of producing the first car; the second has an area equal to the external cost of producing the second car, and so forth. If Q cars are produced, the total external cost is equal to the area between the two marginal cost curves, out to quantity Q.

Measuring the Externality

Look at the first rectangle in Exhibit 13.1. The top and bottom of that rectangle show the private and social marginal costs of producing a single car. The external cost of producing that car is equal to the social cost minus the private cost, which is illustrated by the *height* of the rectangle. Because the rectangle has width 1, we can equally well say that the external cost of producing the first car is equal to the *area* of the first rectangle.

The second rectangle has an area equal to the external cost of producing a second car, and so forth. If Q cars are produced, the total externality is equal to the sum of the areas of the rectangles out to quantity Q; in other words:

The total externality is equal to the area between the two marginal cost curves, out to the quantity produced.

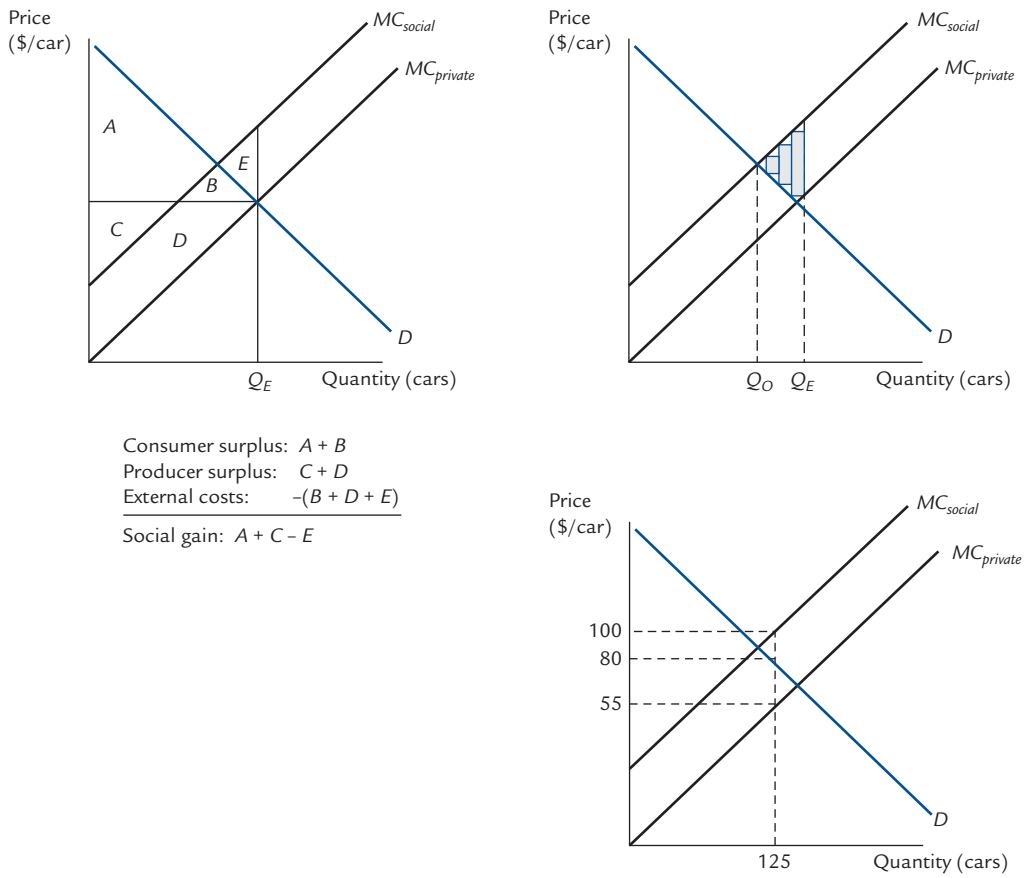
Welfare Analysis

We can now incorporate externalities into our welfare analysis of the car market. Exhibit 13.2 illustrates that market, which we assume is competitive, so that the industry supply curve is equal to the industry's marginal cost curve. *Which* marginal cost curve? Answer: The one that reflects costs firms care about—the *private* marginal cost curve.

The equilbrium quantity of cars is Q_E. At this quantity, consumers earn $A + B$ in surplus and producers earn $C + D$. If there were no external costs, that would be the end of the analysis. But in this case we have to *subtract* the value of the damage done to pollution-sufferers, which (as we learned in Exhibit 13.1) is the area between the marginal cost curves, $B + D + E$. This leaves a social gain of $A + C - E$.

In the right-hand panel of Exhibit 13.2, we reach the same conclusion in a different way. How much does the first car contribute to social gain? Answer: The value of that car to a consumer (measured on the demand curve) minus the cost of producing

EXHIBIT 13.2 Welfare Analysis with an Externality



In equilibrium, Q_E cars are manufactured and the social gain is $A + C - E$, which (in the right-hand panel) is equal to the sum of the "good" (unshaded) rectangles minus the "bad" (shaded) rectangles. If the number of cars were reduced to Q_O, social gain would increase to $A + C$.

The bottom panel shows why the shaded rectangles contribute negatively to social gain. Car number 125 (where 125 is assumed to lie between Q_O and Q_E) is worth \$80 to the consumer, but creates \$100 in costs (\$55 in costs to the manufacturer plus \$45 in costs to the pollution-breathers). Therefore, it contributes *minus* \$(100 − 80) = \$20 to social gain.

that car *including all costs, whether private or external.* In other words, it's the vertical distance between the demand curve and the social marginal cost curve, which is to say the area of the first unshaded rectangle. The second car contributes the area of the second unshaded rectangle, and so on until we reach car number Q_O. The next car after that is worth *less* to the consumer than the social cost of producing it; the difference is measured by the first shaded rectangle, which contributes *negatively* to social gain, as do all the other shaded rectangles. So social gain is equal to the sum of the unshaded rectangles minus the sum of the shaded rectangles—the same area that is labeled $A + C - E$ in the left-hand panel.

Several things are worth noting here. First, the mere fact that cars pollute does not mean that they are necessarily bad things. In Exhibit 13.2, the value of the first car is worth more than the associated cost, even when the cost of pollution is accounted for. That car

adds to social gain, so its production is a good thing according to the efficiency criterion. Of course, if we' d drawn the picture differently, this might not have been the case.

Exercise 13.1 How would the graph look if the first car contributed negatively to social gain?

Next, even though *some* cars contribute positively to social gain, it is definitely not true that *all* cars contribute positively to social gain. All cars after car number Q_O contribute negatively. Suppose, for example, that car number 125 is one of those cars. Then you can see in the bottom panel of Exhibit 13.2 that this car is worth \$80 to a consumer, but it costs \$100 to produce. (That is, it costs the manufacturer \$55 and the pollution-breathers an additional \$45.) Therefore, this car contributes *minus* \$20 to social gain, which is reflected by the first shaded rectangle, which has area 20.

Government Policies

Is there a way to get a better outcome? A glance at the right-hand panel of Exhibit 13.2 reveals that the answer is yes. If manufacturers could somehow be induced to produce only Q_O cars instead of Q_E, we would get all the "good" (unshaded) rectangles of social gain without having to accept any of the "bad" (shaded) rectangles. Social gain would increase to the total area of the good rectangles, which is to say area $A + C$ in the left-hand panel.[1]

How can we get manufacturers to produce fewer cars? There are at least two obvious possibilities. We could set a legal limit on the number of cars produced, or we could tax car production. Let's examine each method, beginning with the tax.

Pigou Taxes

Suppose you want to get producers to build exactly Q_O cars in Exhibit 13.2. How big an excise tax should you impose? Answer: Enough to make Q_O the new equilibrium quantity. For this, you want the industry supply curve to rise from the level of the *private* marginal cost curve to the level of the *social* marginal cost curve. The tax per car, then, should be equal to the vertical distance between the two curves. But that distance is equal to the externality per car.

Pigou tax or Pigovian tax
A tax equal to the amount of an externality.

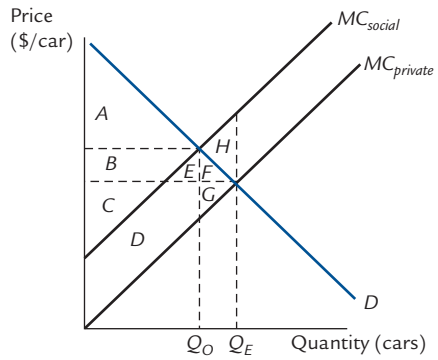
So the right excise tax is one that requires producers to pay a tax per car that is equal to the external cost per car. Such a tax is called a **Pigou tax.** An alternate form of Pigou tax requires consumers, rather than producers, to pay the amount of the externality. We will analyze a tax on producers, but a tax on consumers would have exactly the same effects.

The first panel of Exhibit 13.3 is identical to the panels in Exhibit 13.2 except that the areas have been carved up a bit more finely, and then even more so in the second panel of the exhibit. Without the Pigou tax, we can repeat the analysis of Exhibit 13.2 (though some of the names of the areas have changed). Consumers earn $A + B + E + F$; producers earn $C + D + G$; externalities (which count negative) amount to $D + E + F + G + H$; and social gain is $A + B + C - H$.

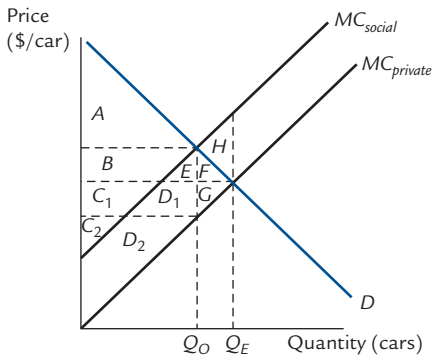
With the Pigou tax, the industry supply curve shifts vertically upward by the amount of the tax per car. But the tax per car is equal to the amount of the externality

[1] The invisible hand theorem tells us that competitive markets maximize social welfare. Exhibit 13.2 seems to present a counterexample. But in fact the reason why the equilibrium in Exhibit 13.2 is suboptimal is precisely that a market is lacking, namely, the market for air. When nobody owns the air, it can be neither bought nor sold. If companies had to purchase the air they pollute, that cost would be included in their private costs and the equilibrium quantity would be the optimal quantity Q_O.

EXHIBIT 13.3 A Pigou Tax



	Without Tax	With Tax
Consumer surplus:	$A + B + E + F$	A
Producer surplus:	$C + D + G$	$B + C$
External costs:	$-(D + E + F + G + H)$	$-(D + E)$
Tax revenue		$D + E$
Social gain	$A + B + C - H$	$A + B + C$



	Without Tax	With Tax
Consumer surplus:	$A + B + E + F$	A
Producer surplus:	$C + D + G$	$C_2 + D_2$
External costs:	$-(D + E + F + G + H)$	$-(D_1 + D_2 + E)$
Tax revenue		$B + E + C_1 D_1$
Social gain	$A + B + C - H$	$A + B + C$

Both panels are identical except that the areas have been carved up a bit more finely on the right. Using either graph, we can compute social gain without a Pigou tax and social gain with a Pigou tax. As we predicted in Exhibit 13.2, the Pigou tax, by reducing quantity from Q_E to Q_O, increases social gain by H.

per car, so the supply curve shifts up by the amount of that externality—which is exactly the vertical distance between the two marginal cost curves. The result, then, is that with a Pigou tax in place, the supply curve shifts upward until it sits directly on top of the *social* marginal cost curve. Indeed, we designed the Pigou tax with exactly this effect in mind![2] The equilibrium quantity is now reduced to Q_O. According to what we said in our discussion of Exhibit 13.2, social gain should rise to $A + B + C$. Let's make sure that this is what happens.

The two panels of Exhibit 13.3 illustrate the analysis in slightly different ways. The first panel is a little simpler, and the second panel is a little more familiar; you can choose whichever makes you comfortable. First, given the new equilibrium price and quantity, consumer surplus falls to A in either panel. Next, producer surplus falls to $C_2 + D_2$ in the second panel (this is the familiar computation). In the first panel, we have represented the same surplus by the triangle $B + C$, which has exactly the same area as $C_2 + B_2$ (it's the same triangle shifted upward).[3] External costs, which are represented by the area between the two marginal cost curves out to the quantity produced, are reduced to $D + E$ in both panels.

Finally, we must not forget the tax revenue. Ordinarily we represent tax revenue by the rectangle $B + E + C_1 + D_1$ in the second panel. That's fine. But it's also fine to

[2] We are assuming for simplicity that the external cost is the same for each car, so that the vertical distance between the two marginal cost curves is the same wherever it is measured. Without this assumption, the picture would look more complicated, but the analysis would be fundamentally unchanged.

[3] This is the analogue for producer surplus of the "other way" to compute consumer surplus in Exhibit 8.13.

notice that *we have set the tax equal to the amount of the externality,* and that amount is $D + E$ in the first panel. Therefore, the tax revenue is also equal to $D + E$. So, we have learned that $D + E$ has the same area as $B + E + C_1 + D_1$. Either way, we get the expected $A + B + C$ for social gain.

Why the Pigou Tax Works

Firms produce too many polluting cars for the same reason that people drop too much litter in the park: They don't have to live with the consequences of their actions. A Pigou tax forces the firm to live with the consequences of its actions by making sure it pays for those consequences. Without the tax, the firm does not care about pollution; with the tax, it does care, at least indirectly.

As a general rule, we tend to get good outcomes when decision makers have to live with the consequences of their choices. In such cases, we say that the decision makers have **internalized** those consequences. A Pigou tax forces car manufacturers to internalize the external cost of pollution.

Internalize
To treat an external cost as a private cost.

Liability Rules as Pigou Taxes

Instead of implementing a Pigou tax, we could just as well institute a rule of law under which the polluter is **liable** for his actions. This means that the victims have the legal right to sue for damages. From the polluter's point of view, paying off lawsuits feels exactly like an excise tax. So, from an economic point of view, a liability rule is equivalent to a Pigou tax, with the revenue paid directly to the victims. (Of course, from a social gain point of view, paying the revenue directly to the victims is neither better nor worse than paying it to anyone else.)

Liable
Legally responsible to compensate another party for damage.

Quantity Restrictions

As an alternative to the Pigou tax, the government could simply require firms to produce fewer cars. If the equilibrium quantity of cars is too high by, say, 30,000 (in other words, if the distance from Q_O to Q_E in Exhibit 13.2 is 30,000), then the government could order each of three firms to produce 10,000 fewer cars (and order other firms not to take up the slack).

This, however, is a very poor solution, because in order to implement it efficiently, we would need to know more than we could plausibly know about each firm's cost curves. Is it more efficient to have firms *A*, *B*, and *C* cut back by 10,000 cars each; or to have firm *A* cut back by 30,000 and the others not at all; or to have firm *A* cut back by 20,000, firm *B* by 9,000, and firm *C* by 1,000? The rectangles in Exhibit 13.2 are drawn on the assumption that cars are produced in the cheapest possible way. But if we make the wrong decisions about who should cut back, that assumption is violated and social gain can be substantially less than what is shown in the picture. (See the discussion surrounding Exhibit 9.3 for more on this point.)

A better idea is to issue exactly Q_O car-building permits, require manufacturers to present a permit each time they produce a car, and allow the permits to be freely traded so they end up in the hands of the firms that can use them most efficiently. Such arrangements are sometimes called **cap-and-trade** systems.

Cap-and-trade
A system of tradable permits to produce goods that create externalities.

In practice, it is not just the car industry that creates pollution. We might also want to mandate the use of permits for other polluting industries, and allow permits to be traded across industries. This is exactly what happens under the various cap-and-trade systems that have been recently implemented in the United States and Europe. To keep things simple, we will assume that our cap-and-trade system is confined to the car industry, but a similar analysis would apply to real-world cap-and-trade arrangements.

The Pigou Tax versus Cap-and-Trade

Which is better—a Pigou tax or a cap-and-trade system? Exhibit 13.4 compares and contrasts the two alternatives.

A Pigou tax causes the quantity of cars to fall to Q_O; so does a cap-and-trade system that limits the number of permits to Q_O. With a Pigou tax, the price of cars increases to the level marked "new price." After paying the tax, suppliers are left with the amount marked "new price to suppliers." With cap-and-trade, the price paid by demanders and the price received by suppliers are determined by the demand and supply curves at the quantity Q_O. As you can see from Exhibit 13.4, this makes both consumers and producers indifferent between the Pigou tax and the cap-and-trade system. The difference between the amount paid by demanders and the amount kept by suppliers is accounted for by the price of a permit; multiplying that price by the number (Q_O) of permits gives the area $B + E + C_1 + D_1$. The government can capture this area as revenue by selling the permits, just as it captures exactly the same area under a Pigou tax.

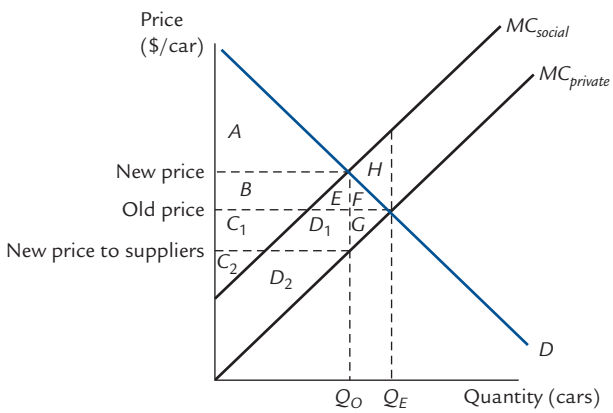
Conclusion: The quantity of cars, the price of cars, the amount kept by sellers, and the revenue to the government are all exactly the same under both systems.

This conclusion makes sense when you think about it. Both the Pigou tax and the cap-and-trade system restrict the quantity of cars to Q_O; in both cases, the cars are produced by the most efficient producers and end up in the hands of the consumers who value them most. In both cases, the price to consumers is bid up until consumers want exactly Q_O cars, and in both cases the part of the price kept by producers is bid down until producers want to provide exactly Q_O cars. So why should anyone care which system is implemented?

The Real World

Our model suggests that there is no reason anyone should have a preference between a Pigou tax and a cap-and-trade system. However, there are a few possibly relevant considerations not accounted for by the model.

EXHIBIT **13.4** **A Pigou Tax versus Cap-and-Trade**



We contrast a cap-and-trade system that restricts quantity to Q_O, on the one hand, with a Pigou tax on the other. In either case, quantity is reduced to Q_O, consumers pay the new price marked on the diagram, producers keep the "new price to suppliers," and the government can capture area $B + E + C_1 + D_1$ as revenue.

First, ideally the Pigou tax is equal to the externality per car. In practice, there might be some uncertainty about this externality. For example, exactly how much damage, in dollar terms, does a Ford Taurus do to the atmosphere? Clearly some guesswork must be involved in any answer to this question. Therefore, the government might mistakenly set the Pigou tax either too high or too low. Ideally, the cap-and-trade system issues exactly Q_O permits (in Exhibit 13.4). In practice, there might be some uncertainty about exactly where the demand and social marginal cost curves cross. Therefore, the government might mistakenly set the quantity of permits either too high or too low. So, in the real world, either system is likely to be implemented imperfectly.

In most cases, however, estimating the right cap-and-trade limit requires considerably more information than estimating the right Pigou tax, and therefore the cap-and-trade system is more prone to error. To get the right Pigou tax, you need to know the external costs. To get the right cap-and-trade limit, you need to know the social marginal cost curve, which includes both those external costs *and* the private costs—and then you need to know the demand curve as well. This is an argument in favor of the Pigou tax.

Second, the Pigou tax is largely "pay as you go." Cap-and-trade permits, depending on how the system is implemented, might have to be purchased well in advance of production—and hence long before revenues start to flow in. As long as firms can borrow against future revenues, this is no problem. But if, for example, small firms have more difficulty borrowing than big firms do, then cap-and-trade gives an advantage to big firms, even though they might be less efficient producers. This is another argument in favor of the Pigou tax.

Third, once you implement a Pigou tax, you can be quite sure that producers will start lobbying to have it repealed. But once you issue cap-and-trade permits, the political pressure could well go in the other direction: Firms that have bought permits will lobby to maintain the system (so as to maintain the value of their permits). So, as a political matter, cap-and-trade might be easier to maintain in the long run. This is an argument in favor of cap-and-trade.

Fourth, at the onset of a new cap-and-trade program, the government has a choice: They can sell permits, or they can give the permits away to existing firms. (Either way, the permits can be freely resold.) By selling permits, the government collects the same revenue that would be generated by a Pigou tax. By giving permits away, the government allows that revenue to end up in the hands of the firms that receive the free permits. There are arguments to be made in favor of either option.[4] Depending on where you stand on this issue, and depending on how you think the issue is likely to be resolved, you might consider this an argument either for or against cap-and-trade.

13.2 The Coase Theorem

Transactions cost
Any cost of negotiating or enforcing a contract.

The modern approach to externalities recognizes that although Pigou taxes can be effective policy instruments, there are some occasions when they are not needed and others when they are actually counterproductive. These points were driven home to economists by the lawyer and legal scholar Ronald Coase, who emphasized the importance of **transactions costs.**[5] A transactions cost is a cost of negotiating or enforcing a

[4] You can read some of these arguments at http://www.landsburg.com/mankiw.html.

[5] His analysis appears in R. H. Coase, "The Problem of Social Cost," *Journal of Law and Economics* 3 (1960): 1–4.

contact. If you hire someone to repair your roof, transactions costs might include the time spent locating an appropriate contractor, time or energy spent haggling over the price, the cost of hiring an inspector to make sure the job has been done correctly, and the potential costs of filing a lawsuit if the roofer fails to make repairs as promised. Anything that interferes with people's ability to engage in mutually beneficial bargaining is a transactions cost.

Coase's analysis of the externality problem led him to two conclusions:

1. In the absence of transactions costs, Pigou taxes are unnecessary.
2. In the presence of transactions costs, Pigou taxes can be counterproductive.

In this section, we will see how Coase was led to the first of these conclusions. In Section 13.3, we will see how he was led to the second.

The Doctor and the Confectioner

In nineteenth-century England, a doctor named Sturges lived around the corner from a confectioner (i.e., a candy-maker) named Bridgman. Sturges saw patients in an office attached to his house, and Bridgman made candy in his basement. They had never been good friends, but they had certainly never been enemies.

That changed when Dr. Sturges decided to expand his office space by building an addition to his house. The day the addition was completed, Sturges discovered for the first time that Brigdman's machines were very loud—so loud, according to Sturges's later testimony, he could not hear his patients' hearts through his stethoscope.

Sturges and Bridgman ended up in court, where the judges ruled that Bridgman would have to stop using his machines. In their decision, the judges said that they were concerned about making sure that the land in the neighborhood would be put to its most valuable use; presumably they believed that an additional doctor was more socially valuable than an additional confectioner.

The judges, in other words, seem to have believed that their decision could affect the future course of Dr. Sturges's medical practice. But they were probably wrong. Let's think through what might actually have happened following the court decision.

Example 1

Suppose for concreteness that Bridgman values his business at $100 and Sturges values his new office at $200. If the judges rule in Sturges's favor, Bridgman retires and Sturges goes on practicing medicine in his new quarters.

But what if the judges had ruled the other way, allowing Bridgman to make all the noise he wanted to? Would Sturges shut down his new office? Not at all. Instead, Sturges walks around the corner, knocks on Bridgman's door, and offers him $150 to turn the machines off. Bridgman accepts and considers himself $50 ahead. So Bridgman retires and Sturges goes on practicing medicine—*exactly as when the judges ruled for Sturges.*

Perhaps the payoff is something other than $150. Perhaps, if Bridgman is a hard bargainer, he can demand $190. Perhaps, if he's a soft touch, he'll settle for $110. But any payoff between $100 and $200 is beneficial for both parties, so there's plenty of room to reach an agreement.

The key point is this: *No matter how the judges rule,* Bridgman is going to stop making noise and Sturges is going to be able to use his new office. Economists sum up this observation by saying that the judges' decision "doesn't matter."

EXHIBIT **13.5** **The Doctor and the Confectioner**

	Judges Rule for Sturges	Judges Rule for Bridgman
Example 1: Bridgman's candy business worth $100; Sturges's medical practice worth $200	Court orders Bridgman to quit. Society gets medical office, no candy.	Sturges bribes Bridgman $150 to quit. Society gets medical office, no candy.
Example 2: Bridgman's candy business worth $200; Sturges's medical practice worth 100	Bridgman bribes Sturges $150 to close office. Society gets candy, no medical office.	Bridgman makes noise; Sturges closes office. Society gets candy, no medical office.

The two rows correspond to two different assumptions about the values of Bridgman's and Sturges's businesses. In each example, we ask what happens if the court rules for Sturges (ordering Bridgman to shut down his machines) and what happens if the court rules for Bridgman (allowing Bridgman to make all the noise he wants to). From a social point of view, the judges' decision never matters—in Example 1, society always gets Sturges's medical office but not Bridgman's candy; in Example 2, the reverse is always true.

Surely Sturges and Bridgman would take exception to the notion that the decision doesn't matter; indeed, it matters very much to Sturges and to Bridgman. Bridgman certainly prefers being paid off to being shut down by the court, and Sturges certainly prefers the opposite. But the judges' decision does not matter in the following limited sense: The decision has no effect on whether Bridgman stays in business, and it has no effect on how Sturges practices medicine. It has no effect on how much candy or medical care will be produced.

This example is summarized in the first row of Exhibit 13.5.

Example 2

Now we reverse the numbers: Suppose Bridgman values his business at $200, and Sturges values his medical practice at $100. If the judges rule in Bridgman's favor (saying, in effect, "go ahead and make all the noise you want to"), then Bridgman stays in business and Sturges gives up his new office. If, instead, the judges rule in Sturges's favor and order Bridgman to shut down, here's what happens: Bridgman walks around the corner, knocks on Sturges's door, and says, "I'd like to keep right on running my machines. I'll give you $150 (or maybe $190 or $110) if you don't turn me in." Once again, Bridgman stays in business and Sturges gives up his new office.

In this example, as in Example 1, the judges' decision does not matter (except to Bridgman and to Sturges). This example is summarized in the second row of Exhibit 13.5.

Alternative Solutions

In Examples 1 and 2, we have made the simplifying assumption that one of two things must happen: Either Bridgman shuts down completely or Sturges abandons his new office. But there may be some other solution. Perhaps Bridgman can acquire more modern machinery that is not as loud. Or maybe Sturges can move his office to the other side of his house. Or perhaps one or the other, or both together, can erect a sound barrier between their properties.

In the absence of transactions costs—that is, as long as Bridgman and Sturges can costlessly negotiate and enforce agreements—they can both come out ahead by finding the cheapest of all possible solutions and agreeing to a payoff or "bribe" that allows everyone to come out ahead. This is true no matter how the judges rule.

Sometimes the cheapest solution is for Bridgman to retire or for Sturges to close his office. Other times the cheapest solution is something more creative. If the judges order an unnecessarily expensive solution, Bridgman and Sturges can always agree to something cheaper, and split the savings between them. The judges cannot change the fact that one solution is cheaper than another, and therefore cannot affect the ultimate choice of solution.

The Bottom Line

The bottom line is this: In both of our examples, and in any other example you might cook up (as long as there are no transactions costs), the parties involved—Bridgman and Sturges, in our examples—are effectively arguing about how to divide up the "pie" consisting of the joint profits from their two enterprises. The one thing they are sure to agree on is that the pie ought to be as big as possible. If only one business can continue to operate, both parties will want it to be the more profitable business; if more profit can be made by installing a sound barrier and keeping both businesses active, they both will agree on that—and then proceed to argue about how to divide that profit.

The Coase Theorem

We can now state the **Coase theorem** in two equivalent forms. First:

Coase theorem

In the absence of transactions costs, all externalities are internalized; therefore, social gain is maximized.

In the absence of transactions costs, social gain is always maximized.

In other words, if Bridgman's business is worth more than Sturges's office, then Bridgman's business will survive; if Sturges's office is worth more than Bridgman's business, then Sturges's office will survive; if a sound barrier is worth erecting, the sound barrier will be erected. Sturges and Bridgman might argue for awhile about who gets the lion's share of social gain, but they will have no trouble agreeing that social gain should be as large as possible. When the pie is bigger, everyone can have a bigger piece.

An equivalent form of the Coase theorem is:

In the absence of transaction costs, all externalities are internalized.

Bridgman's noise creates an externality, but in the absence of transaction costs, he is certain to act as if he cares about that externality—either because the court orders him to act that way or because Sturges bribes him to.

We have already argued that the recipe for optimal outcomes is to internalize all externalities—that's why the Pigou tax works. That also is why the conclusions "all externalities are internalized" and "social gain is always maximized" are equivalent.

Property Rights, Liability Rules, and the Coase Theorem

When Sturges disputes Bridgman's right to run his noisy machines, he is in effect claiming a **property right** to the noise-free air around his office. Surely if Sturges owns the air, he ought to be able to charge Bridgman for its use as a noise receptacle. When Bridgman claims that he is perfectly within his rights to run those machines, he is

Property right

The right to decide how some resource shall be used.

essentially claiming that the air belongs to *him*—and therefore he can use it as a noise receptacle if he wants to.

So what we initially saw as an externality problem can be recast as a dispute over a property right. If the court sides with Sturges and orders Bridgman to turn off his machines, the court is essentially granting the property right to Sturges. If the court allows Bridgman to make all the noise he likes, it is essentially granting the property right to Bridgman.

We have seen that the court's decision has no effect on either Sturges's medical practice or Bridgman's candy business. Therefore, the Coase theorem is often restated in this way:

In the absence of transaction costs, the assignment of property rights does not matter.

Here we must be careful in our interpretation of the phrase "does not matter." The assignment of property rights—that is, the decision of the court—matters considerably to both Sturges and Bridgman. Sturges would much rather win in court than pay Bridgman to shut down; Bridgman would much prefer the opposite. But the court decision has no effect on either man's economic activity, and hence no effect on social gain; this is what economists mean when they say that the court's decision "does not matter."

Ordering Bridgman to shut down amounts to awarding Sturges a property right. Alternatively, the court could allow Bridgman to continue making noise, but order him to reimburse Sturges for the damage. In other words, the court could establish a liability rule favoring Sturges. From an economic point of view, there is no difference between the property right and the liability rule.[6] Under either ruling, Bridgman has to shut down or pay up.

Likewise, allowing Bridgman to continue making noise amounts to awarding Bridgman a property right. This is entirely equivalent to establishing a liability rule that says Bridgman need not reimburse Sturges for any damage. Either way, Sturges still has the option of bribing Bridgman to turn off his machines.

Because the choice of a liability rule is equivalent to the choice of a property right, we can restate the Coase theorem this way:

In the absence of transactions costs, the choice of liability rule does not matter.

Example: The Capitol Records Studio[7]

For over half a century, many of the biggest hits in popular music have been recorded at the Capitol Records Studio in Hollywood, California. The studio features an underground echo chamber whose unique sound is considered irreproducible.

But in 2008, the Los Angeles City Council gave the go-ahead for construction of a 16-story condominium project next door to the Capitol Studio—a project that Capitol says will make its studio unusable because of construction noise while the condos are being built and traffic noise once they are occupied.

As this is written, it is unclear whether Capitol will convince the City Council to overturn its decision, or whether the entire issue might end up being decided in a courtroom.

[6] Later in this chapter, we will see other examples in which property rights and liability rules might *not* be equivalent.

[7] This example is based on an Associated Press story by Solvej Schou that was called to my attention by Cyril Morong.

From an economic point of view, the good news is that it is impossible for any decision to be wrong. In fact, the decision doesn't matter.

More precisely, although the decision matters very much to the owners of Capitol and to the condo developers, it will nevertheless have no effect on how much music is produced at the Capitol Studio. If the studio is more valuable than the condo project, the studio will continue to operate; if the condo project is more valuable than the studio, then the studio will shut down. Or perhaps a third option will be found—some creative use of sound barriers, for example. Whether this third way is adopted will depend on whether it is cost-justified, without regard to what the City Council or a judge decides.

By issuing a building permit for the condo project, the City Council effectively granted the condo developers a property right that allows them to build on that land; by denying a building permit, the City Council would effectively transfer the property right to Capitol Studios. A court that denies Capitol the right to sue for damages would establish a liability rule in the condo developer's favor, which would amount in this case to the same thing as a property right for the developers; alternatively, a court that allowed Capitol the right to sue would be establishing the opposite liability rule and effectively granting the property right to Capitol.

In any event, side payments between Capitol and the condo developers are sure to lead to whatever outcome generates the most joint profit for the two enterprises. This case illustrates the Coase theorem in all its forms: No matter what decision is made, all externalities will be internalized, social gain will be maximized, and the assignment of property rights (or, equivalently, the choice of liability rule) will have no effect on the future of American popular music.

The Coase Theorem in the Marketplace

The case of Bridgman and Sturges involves just two people. But in many real-world situations, externalities affect many people at once. Consider, for example, the polluting industry of Exhibit 13.6 (which is identical to the first panel of Exhibit 13.3). Suppose the vertical distance between the marginal cost curves is \$200 per car. Then, as illustrated in the exhibit, a Pigou tax of \$200 per car causes firms to cut back their collective quantity from Q_E to Q_O and increases social gain by the amount H.

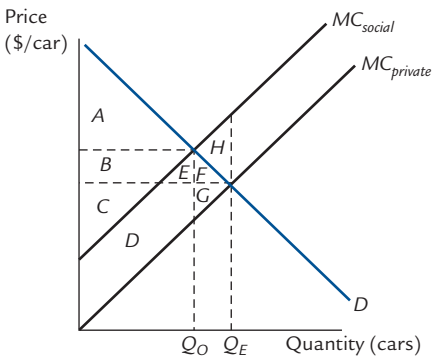
However, in the absence of transaction costs, we get the same outcome even without a Pigou tax. Here's why: The neighbors of the auto makers will offer them up to \$200 per car to cut their output back below Q_E. Therefore, every time the auto makers produce a car, they forgo a \$200 bribe. That \$200 bribe becomes part of the private cost of production, and therefore raises the private marginal cost curve by \$200, just as a Pigou tax would.

As a result, firms cut back to Q_E and we get exactly the same welfare analysis as in the case of a tax—with one additional twist. Because they cut back from Q_O to Q_E, the firms collect a side payment of $(Q_O - Q_E) \times \$200$, which is equal to the area of the trapezoid $F + G + H$. This side payment, which comes out of the neighbors' pockets and goes into the factory owners', has no additional effect on social gain.

The neighbors are willing to pay *up to* \$200 for each car that is not produced. If they are hard bargainers, they might be able to get away with smaller payments.


Dangerous Curve

EXHIBIT **13.6** **The Coase Theorem in a Competitive Market**



	Without Tax	With Tax
Consumers' surplus:	$A + B + E + F$	A
Producers' surplus:	$C + D + G$	$B + C$
External costs:	$-(D + E + F + G + H)$	$-(D + E)$
Tax revenue	—	$D + E$
Social gain	$A + B + C + H$	$A + B + C$

The picture is identical to the first panel of Exhibit 13.3. Each car produced creates an externality of $200, which is the vertical distance between the marginal cost curves. Ordinarily we would expect firms to produce Q_E cars. A Pigou tax can reduce this quantity to Q_O and increase social gain. But in the absence of transactions costs, we achieve the same outcome even without a Pigou tax, because the neighbors are willing to pay up to $200 per car to get the factory owners to reduce output.

Although it's important to understand the logic of the Coase theorem, you should also realize that in this case, the "no transactions cost" assumption is probably highly unrealistic. The logistical problem of organizing hundreds of homeowners to jointly bribe a factory owner is already a formidable transactions cost. In Section 13.3, we will see how our conclusions have to be modified in the presence of just such considerations.

Example: Smoking Bans in Bars

In the past few years, several of the states have banned smoking in public restaurants, bars, and taverns. Supporters of the bans argue that smokers impose externalities on nonsmokers, so that when smoking is permitted the outcome is suboptimal.

The Coase theorem suggests otherwise: Even in the absence of a smoking ban, nonsmokers can always bribe smokers to put out their cigarettes. Such bribes will be successful exactly when they ought to be—that is, exactly when the costs of secondhand smoke exceed the benefits to smokers of their firsthand smoke.

Are such bribes feasible? If nonsmokers had to approach smokers in bars and offer them cash to extinguish their cigarettes, the Coase theorem would not apply, because of the obvious transactions costs (nobody wants to interrupt his dinner for an extended bargaining session involving everyone in the restaurant). But that's not the only form a bribe can take. Each bar has an owner who can charge higher prices to nonsmokers if he bans

smokers from the bar. This leaves the owner with every incentive to *fully internalize the externality*—that is, he treats all external costs to nonsmokers as if they were costs to him personally. The owner bans smoking if the benefits of the ban exceed its costs, and otherwise not. That's because every cost and every benefit hits the owner's pocketbook through customers' willingness to pay, and therefore every cost and every benefit gets weighed in the owner's decision.

In general, when owners set prices, "bribes" easily take place in the form of higher or lower prices, so that transactions costs are typically low and the Coase theorem applies. If the owner chooses to allow smoking, that's because smoking is the efficient outcome. A law that overrides the owners' decision can only convert an efficient outcome to an inefficient one.

The situation would be quite different in, say, a public library where no admissions fees are charged. Here transactions costs are higher because we are back to the case where nonsmokers must negotiate with smokers directly. In this case, nobody would claim that the Coase theorem is applicable.

The Pigou Tax Reconsidered

If transactions are costless, then the Coase theorem tells us that the Pigou tax is unnecessary. In fact, we can say more: If only *some* transactions are costless, it is possible for the Pigou tax to be positively harmful.

To see why, suppose in Exhibit 13.6 that sprocket producers and homeowners can transact costlessly. Then by offering side payments, homeowners will bid the MC_P curve up to the level of the MC_S curve. Now suppose that a Pigou tax is imposed, with the revenue collected by some third party. This will move the MC_P curve up higher yet, so that it now lies *above* the MC_S curve! The number of cars produced will be *less* than the optimal quantity Q_O.[8]

The problem here is that producers receive a double incentive to reduce their output. When the production of a car costs $200 worth of damage, the producer is both charged a $200 tax and made to forgo a $200 bribe, raising his costs by $400. This extra incentive causes him to continue cutting back on output even after the social optimum has been reached.

If *all* parties, including consumers and the recipients of tax revenue, can enter the negotiations, then the social optimum is achieved with or without a Pigou tax. It is always possible to arrange a system of side payments that will benefit everyone when the size of the social pie is maximized. However, the example here shows that when some but not all of the parties can negotiate, the Pigou tax can actually reduce social welfare.[9]

Example: The Nature Conservancy

Environmental pollution is often cited as an example of an externality that cannot be bargained away because of high transactions costs. It is alleged that the large number of people affected suffices to negate any possibility of negotiating side payments. There is undoubtedly much truth in this assertion, but it is far from entirely true.

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[8] The problem does not occur if the Pigou tax is paid to the homeowners rather than a third party. If the homeowners are reimbursed for the pollution, they are indifferent to how much pollution occurs and will therefore not offer bribes.

[9] This point seems to have first been clearly exposited by Ralph Turvey in "On Divergences Between Social Cost and Private Cost," *Economica* 30 (1963): 309–313.

In Arlington, Virginia, a charitable organization called the Nature Conservancy solicits funds from the public and uses those funds exactly in the way that Coase would predict. It purchases land in ecologically significant areas and maintains that land to preserve threatened species and places of special beauty. Its current holdings comprise 2.8 million acres in 4,100 locations. In making its purchases, the Conservancy bids against other potential users of the land, forcing those other potential users to take account of the land's ecological significance.

At the same time, because it pays market prices, the Conservancy must take account of the value of the land in its alternative (nonecological) uses. When a parcel of land has exceptional value in other uses, the price of the land is high and the Conservancy is less likely to acquire it. Thus, from a social point of view, the Conservancy's approach has a distinct advantage over, for example, legally mandating that landowners follow policies that are oriented toward conservation.

Unfortunately, even those who value conservation highly have an incentive to "free ride" on the efforts of groups like the Nature Conservancy, so that the actual level of contributions may inadequately reflect the true demand for conservation. Nevertheless, the organization has been extraordinarily successful. In 1997, it received private contributions of over $150 million. The Nature Conservancy's success is a striking reminder that seemingly insurmountable transactions costs can be at least partially overcome.

External Benefits

Everything we have said about external costs has its analogue regarding external benefits. Suppose that Nabisco can produce a cookie at a (private) marginal cost of 5¢. At the same time, the factory produces a pleasant aroma worth 2¢ to motorists driving by. Then the cookie is produced at a social marginal cost of only 3¢; part of the private costs are returned to society via the external benefit from the aroma. In the presence of external benefits, the social marginal cost curve lies below the private marginal cost curve and too few cookies are produced.

Just as a Pigou tax internalizes external costs, so a "Pigou subsidy" equal to the benefits conferred on others can internalize external benefits, leading to an efficient level of output. However, the Coase Theorem applies in this case as well. In the absence of transactions costs, the recipients of the benefit will offer a bribe in exchange for greater production, and this bribe will operate just like a Pigou subsidy.

Example: The Fable of the Bees

An interesting real-world example is what Professor Steven Cheung has called *The Fable of the Bees.*[10] In the literature of economics, the standard example of a positive externality is the interaction between apple growing and beekeeping. When these two activities are carried on in close physical proximity, one might expect each to confer benefits on the other. More apple trees mean more honey; more bees mean more cross-pollination and eventually more apples. Pigou would have argued (and his disciples did argue) that this situation must result in suboptimal levels of output in both activities. An apple grower

[10] S. Cheung, "The Fable of the Bees: An Economic Investigation," *Journal of Law and Economics* 16 (1973):11–34.

stops planting new trees as soon as the marginal cost of planting exceeds his private marginal benefit, failing to consider that further trees would benefit his neighbor. The beekeeper performs a similar unfortunate calculation. Both could be made better off by a system of taxes and subsidies that encouraged them to consider their neighbor's welfare as part of their own.

Cheung investigated the accuracy of this fable by interviewing apple growers and beekeepers. He found that, contrary to the expectations of Pigou-style economists and exactly as Coase would have predicted, there is an elaborate system of contracts under which the two groups reimburse each other with "bribes" for increasing output to the socially optimal levels.[11] The evidence that such contracts exist is not hard to find; Cheung pointed out that one need only look in the Yellow Pages under nectar and pollination services. Nevertheless, a generation of economists had somehow managed to deny that such contracts were possible.

Exercise 13.2 State an appropriate moral for *The Fable of the Bees.*

Income Effects and the Coase Theorem

According to the Coase theorem, assignments of property rights do not matter from the point of view of economic efficiency. In the example of Exhibit 13.5 an even stronger statement can be made. Not only does a change in property rights have no effect on economic efficiency, it also has no effect on the amounts of medical care and candy that are produced. The "resource" consisting of the air around Bridgman's confectionery and Sturges's office is allocated either to the production of candy (via its use as a "dumping ground" for Bridgman's noise) or to the production of medical care (via its use as a quiet, conducive environment in which Sturges can practice), depending on where it is most valuable and regardless of who has the property rights. We will refer to this outcome as the *strong Coase theorem:*

Strong Coase Theorem: In the absence of transactions costs, the assignment of property rights has no effect on the allocation of resources.

The strong Coase theorem is not universally true. Suppose that a law were passed requiring all classical music lovers to give half of their wealth to people who like rock and roll. Although this is just a change in property rights, the demand for classical records would fall, the demand for rock records would rise, and resources formerly allocated to producing classical music would be reallocated to the production of rock. However, although the allocation of resources has changed, it is still efficient (i.e., Pareto-optimal). Rock fans are happier, classical music lovers are less happy, but social welfare is still being maximized *given* the new wealth distribution. This is an example of what we will call the *weak Coase theorem:*

Weak Coase Theorem: In the absence of transactions costs, the assignment of property rights does not affect the *efficiency* of resource allocation (though it might cause resources to be diverted from one efficient allocation to another).

[11] He also discovered that, contrary to a widespread assertion in economic literature, apples produce almost no honey. Therefore, he extended his investigation to include many other plants.

The weak Coase theorem is always true. The strong Coase theorem is true whenever the reallocation of property rights does not change people's wealth enough to have significant effects on market demand curves. (In other words, the redistribution of income that results from the change in property rights should have negligible income effects.)

Notice that changes in the assets of *firms* do not affect the validity of the strong Coase theorem. Only changes in the assets of individuals are relevant, because individuals are the source of demand curves. For the strong Coase theorem to fail, there must be large changes in the wealth of enough individuals to make a significant difference in the relevant market.

In Exhibit 13.5 a shift in property rights from Sturges to Bridgman makes Bridgman richer. If Bridgman loves candy, this could raise the demand for candy and cause more candy production; if he loves medical care, it could bring about more medical care. (For that matter, if Bridgman loves carrots, it will raise carrot production.) The fact that Bridgman is a *producer* of candy is irrelevant to how demands will shift. In any event, Bridgman as a consumer is undoubtedly such an insignificant part of either market that no real change will come about.

Example: The Reserve Clause in Baseball

Before 1972 all major league baseball players had contracts containing a *reserve clause.* The reserve clause forbade the player from attempting to sell his services to any other team. If the Chicago White Sox wanted to acquire a player from the New York Yankees, the White Sox had to buy that player's contract from the Yankees. They could not simply offer him a higher salary to try to lure him away.

In the 1970s, the reserve clause was substantially weakened, and now a number of players are *free agents* who can sell their services to the highest bidder. At the time, it was argued that the weakening of the reserve clause would enable the wealthiest teams to buy up all of the best players. Let us subject this assertion to some economic analysis.

The weakening of the reserve clause is a transfer of property rights. Player's services, which used to belong to the teams they played for, now belong to the players themselves. The Coase theorem suggests that such a transfer of property rights should not affect the allocation of players to teams.

Consider a player, Frank DeMeyer, who currently plays for the New York Yankees. Having DeMeyer on the team is worth $100,000 to the Yankees. This is because his presence increases the Yankees' revenue by $100,000. He would be worth only $75,000 to the Chicago White Sox.

Under the reserve clause, the Yankees will not sell DeMeyer for any amount less than $100,000, and the White Sox will not offer any amount more than $75,000. No exchange takes place, and DeMeyer continues to play for the Yankees.

On the other hand, suppose that DeMeyer becomes a free agent. Then the Yankees will offer him up to $100,000 to play for them. This is because he can produce an additional $100,000 in revenue for the Yankees and has nothing to do with whether the Yankees are rich or poor. The White Sox will offer DeMeyer up to $75,000. If DeMeyer maximizes his salary, he will play for the Yankees. Thus, free agency has no effect on where DeMeyer plays.

We have implicitly made the simplifying assumption that DeMeyer receives no salary under the reserve clause. If he receives $20,000 in salary, then the Yankees will value his contract at $80,000, not $100,000, and the White Sox will value his contract at $55,000. However, the conclusion that he continues to play for the Yankees does not change.


Dangerous Curve

Exercise 13.3 Assume that DeMeyer is worth $100,000 to the Yankees and $150,000 to the White Sox. For whom does he play under the reserve clause? For whom does he play under free agency?

Now let's throw in a complication. Suppose that DeMeyer hates living in New York, so much so that he would be willing to pay up to $50,000 to move to the White Sox. Under free agency, DeMeyer will move. The White Sox offer him $75,000 and the Yankees offer him $100,000. The additional $25,000 he can earn in New York is not enough to overcome his $50,000 preference for Chicago.

Under the reserve clause, DeMeyer will also move. The White Sox are willing to buy him from the Yankees for $75,000. In addition, DeMeyer himself is willing to "bribe" the Yankees up to $50,000 in exchange for their agreeing to sell him. Thus, the Yankees can collect a total of $125,000 for letting DeMeyer go. Because he is worth only $100,000 to the Yankees, DeMeyer ends up in Chicago.

This example illustrates the strong Coase theorem. The reallocation of property rights that results from free agency has no effect on where DeMeyer plays.

Exercise 13.4 Suppose that DeMeyer is willing to pay only $10,000 to live in Chicago. Where does he play under free agency? Where does he play under the reserve clause?

Finally, let's throw in one additional complication. Suppose that DeMeyer's demand for living in Chicago depends upon his income. When he is a poor reserve player, he is willing to pay only $10,000 to live in Chicago, but when he is a rich free agent, he is willing to pay $50,000. Now under the reserve clause, the Yankees can collect a total of only $85,000 for DeMeyer ($75,000 from the White Sox plus a $10,000 bribe from DeMeyer himself) and will not sell. In this case, DeMeyer continues to play for the Yankees. Under free agency, the $25,000 difference in salary offers does not compensate DeMeyer for his $50,000 preference for Chicago, and so he plays for the White Sox.

The preceding paragraph shows how income effects enter the analysis. A change in property rights can affect the allocation of resources (the resource here being DeMeyer) only if it alters incomes in such a way as to change the demand for some resource (in this case DeMeyer's demand to live in Chicago). In such cases, the strong Coase theorem fails, but the weak Coase theorem is still true. Either allocation of resources is efficient, given DeMeyer's income.

How does free agency affect the allocation of players to teams? If players' preferences about where to live are unaffected by their incomes, then it does not affect the allocation. Otherwise, it increases the wealth of players and makes it more likely that they will choose the teams that they personally value playing for. This means that with the advent of free agency, it is the teams that are desirable to players, not the wealthy teams, that gain an advantage.

13.3 Transactions Costs

In the presence of transactions costs, it might not be possible to negotiate side payments leading to efficient outcomes. In that case, the analysis of Exhibit 13.3 suggests that a Pigou tax can improve social welfare—and indeed it often can.

However, as Ronald Coase first pointed out, there is more to the story. In this section, we will see how, in some situations, a Pigou tax can actually lead to a reduction in social gain.

Trains, Sparks, and Crops

Railway engines create sparks, and these sparks sometimes set fire to crops planted near the tracks. A large number of farmers are affected, and transactions costs prevent deals from being struck between these farmers and the railroad. If the railroad company is not liable for the ensuing damage, it will not consider the effects of this damage in deciding how many trains to run. A liability rule requiring the railroad to indemnify the farmers (in other words, a Pigou tax with proceeds assigned to the farmers) would provide such an incentive. There would be less rail service but more wheat and corn, which appears to be a social improvement.

The Coase theorem says that if there were no transactions costs, this argument would be wrong because even without a Pigou tax, farmers would offer side payments to the railroad in exchange for running fewer trains. The railroad would be bribed into cutting back to the optimal level of rail service regardless of liability rules. But Coase made another, equally important point: When there *are* transactions costs, the conclusion that the railroads should be made liable may still be wrong, though for a different reason.

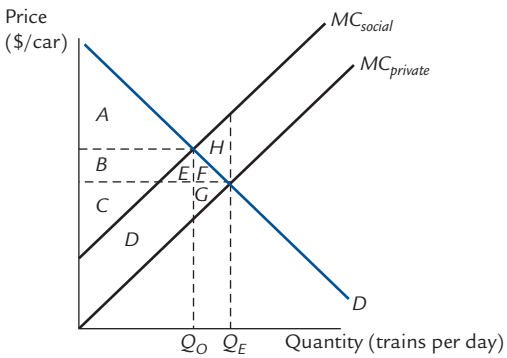
The flaw in the argument is that we do not know the cheapest way to prevent the fires. Suppose that farmers, at very little cost to themselves, can move their crops back a few feet from the railway bed, out of all danger from sparks. This would remove the externality and increase the social gain from the running of the railroad. However, if the railroad reimburses the farmers for all damage done, the farmers have no incentive to move their crops. Crops will be planted and burned, and fewer trains will be run because of the cost of reimbursement. If farmers were made to bear the losses from fires, they would move their crops, to society's benefit.

Exhibit 13.7 shows the picture, assuming a competitive railroad industry. Additional trains mean additional fire damage; the cost of that damage accounts for the difference between the private and social marginal cost curves. The first two columns of the chart reiterate the analysis we have seen before: When they are untaxed, the railroads run Q_E trains and generate a social gain of $A + B + C - H$; when they face a Pigou tax, the railroads run Q_O trains and generate a social gain of $A + B + C$.

But this analysis overlooks the possibility that farmers can avoid damage by moving their crops. The third column analyzes this possibility. If the crops are removed, there is no externality, and the social *MC* curve disappears. We calculate consumer and producer surplus as in the first column. We must also subtract the cost of moving the crops, which we have denoted *X*. Note that *the value of X is not represented anywhere on the graph*—it can't be, because this is a graph about the costs and benefits of railroad trains, not of moving crops. Therefore, without additional information, there is no way to know whether the social gain in the third column is greater or less than the social gain in the second.

Will the farmers actually move their crops? That depends. Notice first that if the Pigou tax is paid directly to the farmers (in the form of reimbursement for crop damage), then the farmers have absolutely no incentive to move. So a Pigou tax paid to the

EXHIBIT **13.7** **Trains, Sparks, and Crops**



	Without Tax	With Tax	Without Tax; crops moved
Consumers' surplus:	$A + B + E + F$	A	$A + B + E + F$
Producers' surplus:	$C + D + G$	$B + C$	$C + D + G$
External costs:	$-(D + E + F + G + H)$	$-(D + E)$	
Tax revenue		$D + E$	
coost of moving			$-X$
Social gain	$A + B + C + H$	$A + B + C$	$A + B + C + D + E + F + G - X$

Railroad trains throw off sparks that start fires and destroy farmers' crops; the fire damage is an externality. If the railroads are untaxed, they run Q_E trains and generate a social gain of $A + B + C - H$; if they face a Pigou tax, they run Q_O trains and generate a social gain of $A + B + C$. This makes it appear that the Pigou tax is socially desirable.

However, the analysis overlooks the possibility that farmers could move their crops to a location where the sparks can't reach them. The third column displays the welfare analysis in that case. The cost of moving the crops, denoted X, appears nowhere in the graph. Without more information, we cannot know whether social gain is higher in the second column or in the third.

The potential problem with a Pigou tax is that it can discourage farmers from moving their crops, eliminating the possibility of reaching the outcome in the third column—an outcome that might or might not be the best possible.

farmers—or, equivalently, a liability rule that requires the railroad to reimburse farmers for damage—guarantees that the third column outcome will never be achieved.

What about a Pigou tax paid to the government? Such a Pigou tax does not completely eliminate the externality, but it does reduce it—from $D + E + F + G + H$ to $D + E$. Farmers will move crops only if the cost of moving is less than the cost of putting up with the externality. Therefore, if the cost of moving—what we have called X—falls between $D + E$ and $D + E + F + G + H$, the Pigou tax will cause farmers to switch from moving their crops to not moving their crops, again eliminating the possibility of the third column outcome.

So a Pigou tax might eliminate that third column option, and will certainly do so if the Pigou tax is paid to the farmers. The third column outcome might or might not be the most efficient solution. Therefore, a Pigou tax might or might not eliminate the most efficient solution.

Does it follow that there should be no Pigou tax, and that the railroad should not be liable for its actions? Not necessarily. Suppose that the railroad can cheaply install safety equipment that will prevent sparks from being thrown by the engines. If the

railroad has no liability for fire damage, it will have no incentive to install this equipment. Once again, it is possible that the low-cost solution has been sacrificed.

Exhibit 13.7 simply does not contain the information necessary to determine how property rights should be allocated. (The property right in question is the right to the unencumbered use of the land adjacent to the tracks—either for agriculture or for spark disposal.) Whoever has the property right has no incentive to seek a solution to the problem. If farmers can move their crops very cheaply, then it is most efficient for the railroad to have the property right so that farmers will have the incentive to move their crops. If the railroad can install safety equipment very cheaply, then it is more efficient for the farmers to have the property right so that the railroad will have the appropriate incentive.

In cases such as this one, courts often concern themselves (or profess to concern themselves) with questions of economic efficiency. If a judge has efficiency foremost in his mind, then he must attempt to determine which party can solve the problem at the lowest possible cost and make that party bear the costs of the damage (i.e., the property right should be assigned to the other party). Unfortunately, this can be difficult. If the judge asks the railroad whether it can prevent spark damage at a relatively low cost (planning to make the railroad bear this cost if the answer is yes), the railroad has every incentive to conceal the truth by claiming that controlling the sparks would be prohibitively expensive. The farmers have the same incentive to exaggerate the cost of moving their crops.

When there is a great deal of uncertainty about the costs of various solutions, a judge may be well advised to assign property rights according to some secondary criterion and then to attempt to reduce transactions costs between the parties. If he can do so (say, by appointing a spokesman for the farmers and facilitating negotiation between this spokesman and the railroad company), then any mistake in the initial allocation of property rights will tend to be mitigated by the action of the Coase theorem.

The Reciprocal Nature of the Problem

In Exhibit 13.7, the choice to run Q_E trains when there are crops planted near the railroad tracks is not socially optimal. The market's failure to produce the optimal outcome is due to the divergence between private and social costs. A Pigou tax remedies this divergence by shifting the private marginal cost curve upward. Coase's observation is that the divergence can be remedied equally well by moving the social marginal cost curve downward (e.g., by having the farmers move their crops).

Why did economists in the Pigovian tradition fail to recognize the alternative remedy? Coarse argues that the error arises from the mistaken notion that the railroad is the "cause" of the fires and therefore must curtail its activities if the damage is to be reduced. In actuality, the railroad is no more the cause of the fires than the crops are. Although it is true that if there were no railroads, there would be no fires, it is equally true that if there were no crops, there would be no fires. Ultimately, the problem is caused by the fact that the railroad and the farmers are attempting to use the same land for two different purposes, and this is no more one party's fault than it is the other's. Either party might be in possession of the cheapest means of dealing with the problem.

Every case of externalities is similarly reciprocal in nature. The neighborhood residents denounce the owner of a polluting factory; the owner might respond that there would be no externality if it weren't for the existence of the neighbors. The factory owner can mitigate the problem through cutbacks in production or pollution-control equipment; the neighbors can contribute equally well to a solution by moving away.

Each of these options has a cost.[12] If the factory owner is allowed to pollute without penalty, he has no incentive to reduce pollution. If the neighbors are fully compensated by the factory for damage to their lungs and houses, they have no incentive to move away. Either liability rule might cause the elimination of the low-cost option; the "right" liability rule depends on the actual costs.

It is often argued that the pollution of a lake or river is an economic problem that must be solved, especially if the water would otherwise be available for recreation. If the pollution is curtailed and the lake is reclaimed, it makes equal sense to say that the boaters and fishermen are the source of a problem in that they cause a reduction in the output of a socially valuable product. Which is worth more, the additional product or the boating and fishing? There is no way to tell without examining actual costs and benefits.

Nonsmokers like to view cigarette smoke as a cost imposed on them unfairly by smokers. The problem, however, is a reciprocal one: It is caused by smokers and nonsmokers wanting to use the same air for two different purposes. Conceivably, it could be cheaper (i.e., less unpleasant) for the nonsmokers to wear gas masks than for the smokers to curtail their smoking.

Automobiles sometimes hit pedestrians, injuring or killing them. The problem is caused by cars and people being in the same place at the same time; it can be partially alleviated by more care on the part of drivers or by more care on the part of pedestrians. In the 1970s the state of California, seeking to give appropriate incentives to drivers, made them legally responsible for any injury they caused to pedestrians. As a result, pedestrians had a greatly reduced incentive to take precautions, and they do, in fact, take fewer precautions. Whether the net effect has been to reduce accidents is unclear.

Sources of Transactions Costs

An understanding of the nature of transactions costs can be useful to one who is attempting to reduce them. The following series of examples illustrates some of the sources from which transactions costs are likely to arise.

Example: Mining Safety and the Principal–Agent Problem

Coal mining is an inherently dangerous activity. Mining companies are able to reduce the frequency of injury to miners by the purchase of various types of safety equipment. If the companies are liable for injuries sustained on the job, they will have an obvious incentive to invest in such equipment until the marginal cost of one more unit of equipment is equal to the marginal benefit of that unit in terms of accident prevention. If, on the other hand, the companies bear no liability, you might at first think that they will have no incentive to make any investment in safety. The Coase theorem suggests that this conclusion is wrong: Miners (who will now have to bear the costs of their own injuries) will be willing to "bribe" the company to buy safety equipment in the optimal amount. The most convenient form of such a bribe is for the miners to accept a lower wage. This is, of course, equivalent to a direct payment from the miners to the mining company.

Now suppose that there is another way to improve mining safety, which involves precautions taken by the miners themselves in the course of their underground activity. If miners bear the costs of their own injuries, they will engage in an appropriate level of precautionary activity. Alternatively, suppose that miners are fully reimbursed for all injuries by the mining company. In this case there appears to be no incentive for miners to take

[12] Of course, the cost of moving does not consist only of the fees paid to the moving companies; it includes the value of the dissatisfaction generated by leaving one's friends and gathering places as well.

appropriate care. (If they are reimbursed but not fully, then they will take some care but less than the optimal amount.)

In the absence of transactions costs, however, the Coase theorem suggests that the company itself will offer to pay the miners a bonus in exchange for their agreement to behave cautiously. Both sides benefit, as the miners collect the bonus and there are fewer injuries whose cost the company must bear.

But, unfortunately, there is no way to guarantee that an individual miner will live up to his part of the bargain. There is nothing to stop a miner from collecting the bonus and then behaving recklessly underground, where there is no one to observe him, knowing that he will be compensated by the company for any injury he sustains.

The fact that the miner's behavior is *unobservable* constitutes a transactions cost that can prevent the enforcement of the optimal contract. If all liability is with the company, and if precautionary behavior by miners is totally unobservable, then there will be no precautionary activity, regardless of what the optimal level might be.

In our simplified model of the mining industry, the most efficient liability rule is one that relieves owners of all responsibility to compensate miners for injuries. This in no way affects the incentives of owners to provide safety equipment, because their workers can still bribe them into behaving optimally. It also has the advantage of giving workers appropriate incentives, which they would not otherwise have because of the transactions costs involved in observing their behavior.[13]

Whenever one party contracts to pay another to behave in a certain way, we call the first party a *principal* and the second an *agent.* If the mine owner attempts to pay the workers for behaving cautiously, then the owner is the principal and the workers are the agents. We say that a *principal–agent problem* arises when the principal cannot verify that the agent is abiding by the bargain, as in this example.[14]

In general, if A's behavior is observable and B's is not, then, in the absence of other transactions costs, it is efficient for B to bear the costs of damage resulting from interactions between A and B. This gives B the appropriate incentives; A has them already because of the Coase theorem.

Example: AIDS and Blood Transfusions

The recipients of blood transfusions sometimes contract infectious diseases as a result. AIDS is the most significant example. Who should bear the costs of such illnesses, the patient or the doctor?

In the absence of transactions costs, the placement of liability would not matter. If doctors were liable, they would adopt appropriate standards of safety in order to avoid lawsuits; if patients were liable (as, in fact, they legally are), they would offer higher fees to doctors and elicit the same standard of safety.

Here we face a close analogy with mining accidents. The patient's behavior is perfectly observable: A simple test reveals whether he has contracted AIDS. The doctor's behavior, however, is not. Thus, there is a principal problem. If a patient pays extra for

[13] An interesting aspect of this choice of liability rule is that in the long run miners themselves will be indifferent to which rule is chosen (unlike Sturges and Bridgman, who cared very much). The reason is that entry and exit from the mining industry will eventually leave mining just as attractive (or just as unattractive) as the alternative occupations.

[14] Principal–agent problems were introduced in a different context in Chapter 9.

blood that is 99% certain to be AIDS-free and is instead given blood that is 95% certain to be AIDS-free, he is likely never to know the difference, whether or not he eventually becomes ill. If he does contract AIDS and suspects the doctor of cheating him, he will have great difficulty proving his suspicion. The inability to monitor doctors' compliance is a transactions cost that suggests that doctors should bear the liability for transfusion-induced illnesses.

We have been assuming that a transfusion patient is unlikely to contract AIDS in any other way. Without this assumption, our analysis must be modified. Suppose that doctors are fully liable when their patients develop AIDS. Then a recent transfusion recipient has reduced incentives to avoid other activities that may lead to the disease. If he contracts AIDS through riotous living, he can blame the doctor and be compensated. As a result, he may engage in such activities to a greater than optimal degree. The unobservability of the patient's behavior constitutes an argument for patient liability.

If doctors are liable to transfusion patients who contract AIDS, then some doctors will have to pay for patients who get the disease elsewhere. Although this might strike you as "unfair," the argument we have made does not concern this unfairness. It concerns only the inefficiency that arises if incentives are distorted so that the number of AIDS cases ends up being either more or less than optimal.


Dangerous Curve

Incomplete Property Rights

Transactions costs also arise when property rights are ill-defined or nonexistent. Not knowing who owns something makes it difficult to bargain over its use. If Jack owns a tree that is worth more to Jill than to him, he will sell it to Jill. If Jill owns the tree and values it more than Jack does, she will keep it. If the tree belongs to some third party, he will sell it to whoever values it the most. In any event, the tree ends up in the hands of whoever values it the most, regardless of who owns it initially—provided *someone* owns it initially.

Suppose, alternatively, that there are no property rights to trees and that a tree belongs to the person who takes it. The tree is worth \$3 to Jack and \$5 to Jill. Nevertheless, if Jack is first to spot the tree, he will claim it for his own. If Jack had a well-defined property right, he could agree to sell the tree to Jill; unfortunately, unless he uses the tree immediately, Jill will claim it for her own. Jack takes the tree for himself.

You might think that Jack could call Jill on the phone, warn her that he is about to claim the tree, and offer to leave it standing for her if she will pay him \$4. Unfortunately, Jack has 13 identical cousins, all named Jack, each of whom is prepared to present Jill with the same threat. To save the tree for herself, she would have to pay $13 \times \$4 = \$52$, or \$47 more than it is worth to her. She passes up this opportunity, and the tree goes to one of the Jacks, who values it less than Jill does.

The lack of property rights in trees can present other problems as well. In the absence of property rights, nobody will plant or nurture trees, even though the benefit from doing so may exceed the cost. Another difficulty arises if Jill values a tree most for its decorative beauty. A tree left standing is a tree left vulnerable to expropriation, so Jill uses the tree for firewood, reducing its value to her and creating a social loss.

Liability Rules as Incomplete Property Rights

In Section 13.2 we treated liability rules and property rights as different ways to describe the same thing. In the examples considered there, this was an accurate depiction. In other instances, however, liability rules can better be viewed as *incomplete* property rights.

Consider again Bridgman the confectioner and Sturges the doctor. Bridgman makes noise damaging to Sturges's practice. If Bridgman is granted the right to make noise, we say either that he has a property right to the air or that there is a liability rule in his favor.

However, we must distinguish between two different legal situations. Is it *Bridgman* personally who is granted a right to the air, or is it *confectioners in general* who have this right? In the first case, any other confectioner who wants to make noise in the neighborhood must first purchase the right from Bridgman. And Bridgman will take Sturges's desires into account, because Sturges will offer to pay him *not* to sell the right to a confectioner.

But if all confectioners, just by being confectioners, acquire the right to make noise, and hence the opportunity to be bribed by Sturges, then some people in other industries might become confectioners just in order to collect these bribes. As a result, there will be overproduction of candy, because the bribes from Sturges constitute a subsidy and an artificial incentive to enter the candy industry. Similarly, there will be a suboptimal number of doctors, as each potential doctor recognizes that he will be subject to such extortion and takes this into account in his decision about whether to enter the profession.

The reason for the inefficiency here is that when the air belongs to confectioners generally, it does not really belong to anybody. Like the tree in the forest, it belongs to whoever takes it. If the efficient use of the air is to sell it to Sturges as a quiet zone, this outcome cannot be achieved, because after Sturges pays Bridgman to keep quiet, he will still have to contend with Bridgman's 13 identical cousins, all named Bridgman.

As long as the number of firms in each industry is fixed, a liability rule is the same as a property right. But if the number of practitioners in either industry can change, then the liability rule is likely to convey only a partial property right and hence can lead to inefficiency.[15]

Free Riding

Free riders

People who benefit from the actions of others and therefore have reduced incentives to engage in those actions themselves.

Another important source of transactions costs is the problem of **free riders.** Suppose that a factory causes pollution that adversely affects the lives of 50 families. The families would like to take up a collection to bribe the owner of the factory so that he will reduce the scale of his operation. There are logistical difficulties involved in communicating with so many people at one time, but we shall suppose that these have been overcome. Each family would be willing to pay $100 to reduce pollution and is therefore asked to contribute $100 to the fund. However, each family reasons as follows: "We don't know whether the other families are contributing their share. If they are, the fundraising drive is bound to be successful even without our contribution. Everyone else will pay and we

[15] The importance of this distinction between property rights and liability rules was clarified by H. E. Frech III in "The Extended Coase Theorem and Long Run Equilibrium: The Nonequivalence of Liability Rules and Property Rights," *Economic Inquiry* 17 (1974): 254–268. There has been much confusion among both economists and legal scholars about this issue. Frech points out that in most of the examples that are used to illustrate the Coase theorem (such as the case of Bridgman and Sturges), there are fixed numbers of participants, so that liability rules and property rights are equivalent.

will share in the benefits; we can 'ride for free' while others pay the fare. Another possibility is that the other families aren't paying, in which case our $100 certainly won't be enough of a bribe to make a significant difference. Either way, let's not contribute."

You might recognize this reasoning; it is precisely that of the prisoners in the Prisoner's Dilemma. It is rational reasoning on the part of each individual family, but it prevents the socially optimal contract from being reached, and as such can be counted as a transactions cost. An alternative view is that this is just another example of ill-defined property rights: If property rights to the newly clean air were well established, those who have bought it could demand payment from other families who make use of it.

13.4 The Law and Economics

Historically, English and U.S. courts have often expressed a desire to adopt liability rules and systems of property rights that have the effect of fostering economic efficiency. The system of legal precedents that has evolved from centuries of court decisions is known as the **common law.** The common law promotes efficiency both when it directly creates incentives for problems to be solved in the least expensive way and when it acts to reduce transactions costs so that the parties to a dispute can reach low-cost solutions not directly observable by the court.

Common law
The system of legal precedents that has evolved from court decisions.

The Law of Torts

The law of torts provides some interesting examples. A **tort** is an action that intentionally or unintentionally causes damage to another party. Once this damage has been done, there is generally no way to rectify it. If you hit a pedestrian with your car, causing him injury and 6 months' lost income, those costs become sunk at the moment of the accident. Regardless of whether the court orders you to pay for these damages, the damages still exist. The court can redistribute income, but it cannot change the size of the social pie. In this sense, it seems that the court's decision is irrelevant to social welfare.

Tort
Acts that injure others.

However, this view fails to take account of how the court's decision affects the future behavior of others. While a ruling in favor of the pedestrian will not affect social welfare in the current case, it will send a signal to future drivers in similar situations that they are likely to be held liable as well, and it may affect their behavior in ways that have important social consequences.

Standards of Liability

The common law assigns liability according to different standards in different sorts of cases. One standard is the standard of **negligence.** Under this standard a defendant is held liable for the costs of an accident if those costs, multiplied by the probability of the accident occurring, exceed the cost at which he could have prevented the accident.[16] Suppose that your barbecue grill sets fire to your neighbor's garage, causing $1,000 worth of damage, and that the court determines that there was initially a 25% chance of

Negligence
A defendant's failure to take precautions whose cost is less than the damage caused by an accident multiplied by the probability that the accident will occur.

[16] The legal literature defines negligence in a variety of ways. At least to a rough approximation, the definitions are all equivalent (although to an economist not trained in the law, some of them seem vague to the point of incomprehensibility). The one we are adopting here was stated explicitly by Judge Learned Hand when he decided the case of *United States* v. *Carroll Towing Co.*, 159 F.2d 169, 173 (2d Cir. 1947).

the fire's getting started. Then you are negligent (and hence liable under a negligence standard) if you could have taken safety precautions to prevent the fire at a cost to you of less than $250; you are not negligent if those same precautions would have cost more than $250. This standard encourages low-cost precautions while discouraging precautions whose cost exceeds their value.

There is a problem with the negligence standard, however. Suppose that you can prevent fires at a cost of $200, while your neighbor can fireproof his garage at a cost of $100. In this case a negligence standard will hold you liable for fire damage, leaving your neighbor no incentive to implement the true low-cost solution. For this reason, the negligence standard is often modified by allowing a defense of **contributory negligence,** under which the plaintiff (i.e., the accident victim) cannot collect for damages in cases where he himself could have prevented the accident at a cost less than the cost of the accident multiplied by the probability of occurrence.[17]

Contributory negligence
A plaintiff's failure to take precautions whose cost is less than the damage caused by an accident multiplied by the probability that the accident will occur.

The contributory negligence standard can also lead to inefficient outcomes. Continue to assume a $1,000 fire that had a 25% chance of occurring. Suppose that you could prevent the accident at a cost of $100, while your neighbor could fireproof his garage for $200. Under contributory negligence, he cannot collect for damages, so you have no incentive to guard against starting fires, even though it would be efficient for you to do so.

There is another reason why a negligence standard, with or without the allowance of contributory negligence, can lead to an outcome that is socially undesirable. Suppose that your barbecuing has a 25% chance of causing a $1,000 fire, which cannot be prevented at any reasonable cost *so long as you continue to barbecue.* But suppose that the cheapest way to prevent the fire is for you to give up barbecuing altogether, which would cause you only $75 worth of regret. This $75 figure is known only to you and is completely unobservable to the court. Therefore, as long as you continue to take all other reasonable precautions, the court cannot find you negligent just for operating a barbecue, and you are left with no incentive to switch to indoor cooking.

The problem can be solved by scrapping negligence and instituting a standard of **strict liability,** according to which barbecue owners are liable for all fires involving barbecues, regardless of whether there is negligence. The good news about a strict liability standard is that if you expect to cause more damage than your barbecue is worth to you, you will give it up voluntarily. The bad news is that it leaves your neighbor with absolutely no incentive to take any precautions against a fire.

Strict liability
Liability that exists regardless of whether the defendant has been negligent.

We can illustrate the relative merits of negligence and strict liability by considering the law that governs auto accidents. Suppose that only negligent drivers are held liable for the accidents they cause. Then pedestrians have appropriate incentives to be cautious; the pedestrian who darts recklessly into traffic will not be compensated for injuries and will therefore think twice before darting in the first place.

On the other hand, under a negligence standard, drivers make socially inappropriate calculations about whether to drive in the first place. Suppose that a trip to the grocery store gives you $1 worth of consumers' surplus and that, on average, such trips cause $2 worth of damage to others via accidents *that do not involve your own negligence.* Under a negligence standard, you are not liable for that damage and hence do not treat it as a private cost. You will choose to drive to the store even though it is socially inefficient. But under a standard of strict liability, you are liable for all accident damage and will therefore make the socially correct decision to forgo the trip.

[17] As with our definition of negligence, our definition of contributory negligence is one among several roughly equivalent definitions that appear in the legal literature.

In general, negligence can provide incentives for people to take appropriate precautions once an activity (like driving or crossing the street) is under way, whereas strict liability can provide incentives for people to make appropriate decisions about whether to undertake the activity in the first place.

Example: Heartbreak Hotels

A defibrillator is a $2,000 device that can restart a heart following cardiac arrest. Given the low cost and high potential benefit, you might expect defibrillators to be common in highly trafficked areas, such as hotels. But according to *The Wall Street Journal,* fewer than 13% of hotels have defibrillators on hand.[18] Why? Because they worry they'll be sued for not using them properly.

This is a problem with the negligence standard. If hotels were held to a standard of strict liability for all deaths on their premises, regardless of the circumstances, then you can be sure that every hotel would keep an efficient number of defibrillators on hand.

That doesn't prove that strict liability would be desirable in this case—only that it has at least one advantage. Can you think of any offsetting disadvantages?

Criminal Penalties and Punitive Damages

In 1989, the *Exxon Valdez* oil tanker went aground off Prince William Sound in Alaska, creating an oil spill of historic proportions. Exxon spent between $2 and $3 billion settling lawsuits and cleaning up the mess. However, government prosecutors argued that Exxon should pay *additional* penalties, in excess of the damage that the oil spill had actually caused. These penalties were effected by charging Exxon with a *criminal* act and assessing a $100 million fine. Exxon agreed not to contest this fine.

In 1991, Federal Judge Russel Holland overturned Exxon's agreement with the government, arguing that the criminal penalty should be far greater, so as to send a message that environmental spills will not be tolerated. What are the efficiency consequences of Judge Holland's ruling?

Let us suppose that an oil tanker traveling in the vicinity of Prince William Sound can be expected to cause, on average, $1 million worth of damage. (Most tankers cause almost no damage; an occasional tanker causes a great deal of damage; we assume that the average damage is $1 million.) In that case, it is efficient for Exxon to employ such tankers when and only when the resulting net benefits exceed $1 million. If Exxon is responsible for the full costs of oil spills, it has every incentive to make efficient choices.

But if an oil spill results in both full liability for the damage *and* a criminal penalty, then Exxon's private costs are driven *above* social costs and it will employ fewer tankers than are socially optimal. A more dramatic way to put this is that there will be *too few* oil spills. The optimal number of oil spills is likely not to be zero, given the costs of prevention (e.g., shipping much less oil). But the prospect of a sufficiently large criminal penalty could drive Exxon out of using tankers altogether, to the net detriment of society. Indeed, Judge Holland made his intentions clear on this matter when he suggested that the criminal penalty be increased so as to avoid sending the message that "spills are a cost of doing business that can be absorbed."[19]

[18] "Why Hotels Resist Having Defibrillators," *Wall Street Journal,* February 24, 2009.

[19] Judge Holland did go on to express skepticism about the wisdom of the law that he felt bound to enforce.

Punitive damages
Additional charges levied against one who commits a tort as punishment for his behavior.

Liability together with criminal penalties can raise private cost above social cost, with the result that too little of an activity is undertaken. A closely related institution that can similarly raise private cost above social cost is the assessment of **punitive damages,** under which someone who has committed a tort must pay to the victim a sum *greater* than the actual damage, as punishment for his actions. Punitive damages are most often assessed when a tort is judged to have been intentional or a result of grossly wanton misconduct.

Suppose that you are planning to build a dam in an area where there is some possibility that the dam will break and the resulting flood will damage the property of those living nearby. The larger the dam, the less likely it is to break. The courts have determined that it is negligent to build a dam under 15 feet high. Thus, if you build a 12-foot dam and it breaks, you are negligent and liable for the full damage to surrounding property.

Now suppose that you believe that a 12-foot dam can be expected to cause, on average, about $1 million worth of property damage via flooding. You also believe that by building a 12-foot dam instead of a 15-foot dam, you can save $2 million in building costs. Assuming that your estimates are correct, it is efficient for you to build the smaller dam, and under a negligence standard you will choose to do so. However, a negligence standard combined with large criminal penalties or punitive damages could deter you from making the efficient choice and induce you to build a 15-foot dam instead.

If judges knew as much about dams as people who build dams know about dams, there would be no problem: In this example, building an efficient 12-foot dam would not have been deemed negligent in the first place. Because judges sometimes make mistakes—and because they tend to have less information available to them than people who are actively involved in making economic decisions—it is desirable for dam builders to "override" judges' wisdom by accepting the penalties for negligence when they believe it is efficient to do so. Criminal penalties or punitive damages can deter the dam builder from making the best use of his specialized information and professional judgment.

In cases like this, punitive damages are rarely assessed, so that legal doctrine does encourage efficient behavior. Next we will learn about a positive theory of the common law that predicts that such outcomes are to be expected.

A Positive Theory of the Common Law

Judge Richard Posner, of the Seventh Circuit Court of Appeals, argues that, as a matter of historical fact, the common law has tended to embody standards that encourage economic efficiency.[20] Posner presents this viewpoint as a *positive* (as opposed to normative) theory of the common law. That is, he argues that the positions of the courts can be predicted on the basis of the assumption that they are attempting to promote efficiency. Of course, he makes no attempt to argue that every court decision fits this mold, but he does make the case that the broad outlines of legal doctrine, and the directions in which those doctrines evolve over time, are consistent with this positive theory.

[20] You can read his arguments in "A Theory of Negligence," *Journal of Legal Studies* 1 (1972): 29, in his book *Economic Analysis of Law* (Little, Brown, 1972), and in *The Economic Structure of Tort Law* by William Landes and Richard Posner (Cambridge, MA: Harvard University Press, 1987). Many of the examples in this section are adapted from these sources.

Law students are frequently told that the key question in tort law is "Whose ox is being gored?" This is a shorthand way to say that the law cares who loses and who wins whenever there are losses and gains to be distributed. Posner's efficiency theory maintains to the contrary that the law's chief concern is only to minimize the number of gored oxen, without regard to who owns them. Or, if it is costly to prevent gorings, then the law is concerned with optimizing (not minimizing) their number; gorings should be prevented until the marginal benefit of preventing another is equal to the marginal cost of preventing it.

Posner and his disciples believe that the efficiency theory of the common law can be applied not only to the law of torts but to other areas of law such as the law of contracts and the law of property. We will consider just two of their many examples. One, the doctrine of *general average,* determines the distribution of losses from disasters at sea. The other, the doctrine of **respondeat superior,** determines an employer's liability for the conduct of his employees.

Respondeat superior

The liability of an employer for torts committed by his employees.

Example: General Average

When ships encounter peril at sea, cargo sometimes has to be quickly thrown overboard. If you are unlucky enough to own that cargo, should you bear the loss alone, or should you be partially reimbursed by the other cargo owners and the owners of the ship? The legal principle of **general average** dictates that losses should be divided proportionately according to each person's share in the venture. If the ship itself is worth $25,000 and the cargo is worth $75,000, then the entire venture is worth $100,000 and the shipowner pays for 25% of the losses. If $3,000 worth of the cargo belongs to you, then you pay for 3% of the losses, regardless of whose belongings are jettisoned.

General average

The rule of law that dictates the division of losses when cargo is jettisoned to prevent a disaster at sea.

It is easy to see how this arrangement promotes efficiency. If the owner of the jettisoned cargo bore all of the loss, the captain would simply toss the heaviest items, or those most conveniently at hand, without regard to their value (as long as they didn't belong to him). General average gives him an incentive to be more prudent, insofar as he acts as an agent for the owner of the ship. The captain is unlikely to discard a passenger's $60,000 gold bar if he knows that it will cost his own shipping company $15,000.

Not only does general average give the captain an incentive to behave responsibly; in many instances it gives exactly the *right* incentive. When the captain tosses out your $10,000 jeweled paperweight, he increases the probability of the ship's survival. That increased probability has some dollar value *V.* The social benefit from tossing the paperweight is *V,* and the social cost is $10,000. If the captain has a 25% stake in the venture, then his private benefit from tossing the paperweight is $V / 4$ (because $^1/_4$ of everything that is saved belongs to him) and his private cost is $2,500 (because of the law of general average). His self-interested calculation (toss the paperweight if and only if $V / 4 > \$2{,}500$) leads to the same outcome as if all social costs and benefits were accounted for (toss the paperweight if and only if $V > \$10{,}000$).

Example: Respondeat Superior

According to the legal doctrine of respondeat superior, employers are liable for torts committed by their employees. For example, if you get a job delivering pizza and you run down a pedestrian in the course of carrying out your duties, the pedestrian can successfully sue your employer. However, respondeat superior does not usually apply when the

victim is a fellow employee. If you run down one of your co-workers in the parking lot, he *cannot* successfully sue the employer. How do these rules help to promote economic efficiency?

The doctrine of respondeat superior creates an incentive for the employer to select employees whom he believes to be cautious and to oversee their activities. Although it might be more efficient for the burden of care to fall entirely on the employee, thus eliminating the costs of oversight, it is unfortunately the case that liability for accidents cannot deter an employee who has no money. Thus, in cases where the employer is much wealthier than the employee, respondeat superior at least ensures that someone will have an incentive to take appropriate safety precautions.

However, if respondeat superior applied to fellow workers as well, then workers would have no incentive to avoid the company of other workers whom they know to be habitually careless. Employees would be less likely to take extra precautions when the reckless drivers were working. They would also have no incentive to report the behavior of such employees to the employer. (Once the habitual carelessness has been reported, the employer does become liable.) The difference between the random pedestrian and the fellow employee is one of transactions costs. Because a pedestrian cannot be expected to know that a particular pizza truck driver is careless, he cannot negotiate with him to drive less recklessly. This high transactions cost makes it necessary to place liability in such a way as to create incentives to solve the problem, and respondeat superior can accomplish this. But fellow employees often have detailed information about each other's behavior, and this information may not be fully available to the employer. By eliminating the employer's liability in cases involving fellow employees, the law encourages workers to use this socially valuable information in an appropriate way.

Normative Theories of the Common Law

Posner's positive theory of the common law asserts that the law seeks economic efficiency. A closely related normative theory asserts that the law *should* seek economic efficiency.

A number of authors have proposed changes in the existing system of tort law, often arguing that goals other than economic efficiency should be given greater weight. One of the most eloquent of these is Professor Richard Epstein of the University of Chicago School of Law.[21] Epstein argues that the negligence system should be largely replaced by a system of strict liability. He argues, contrary to Coase, that it is indeed *possible* to develop a consistent set of criteria according to which we can say who is the "cause" of an injury and, contrary to Posner, that it is *desirable* to make this determination and to assign liability accordingly.

Good Samaritan rule

A bystander has no duty to rescue a stranger in distress.

As an example, Epstein considers the **Good Samaritan rule.** According to this rule, a bystander has no duty to rescue a stranger in trouble, even when he can do so at low cost to himself. If you are walking along the beach carrying a life preserver and see a man drowning, the law does not require you to save him. This rule seems not to conform to the logic of efficiency, since the benefits of the rescue would clearly exceed the costs. Epstein offers this rule as evidence that the common law is not so concerned with efficiency as Posner believes it to be. From a normative point of view, he believes

[21] R. Epstein, "A Theory of Strict Liability," *Journal of Legal Studies* 2 (1973): 151 and *A Theory of Strict Liability: Toward a Reformulation of Tort Law* (San Francisco: Cato Institute, 1980).

that the rule is a good one, because the bystander is not the cause of the drowning. He argues both that the principles embodied in the Good Samaritan rule are applied more widely than many scholars believe and that it would be a good thing if they were applied more widely still.

Optimal Systems of Law

An important role for the legal system is to maintain a system of well-defined property rights. We have seen that uncertainty about property rights can be an important source of inefficiency. For this reason courts are often well advised to adopt standards that are simple and well understood, even when more complicated rules appear to provide more appropriate incentives. The gain from clarity may suffice to justify a more straightforward legal standard.

Consider traffic lights, which constitute a method of allocating the property rights to an intersection. When you are stopped by a red light and there are obviously no cars coming in the opposite direction, property rights have been allocated inefficiently. You have an immediate use for the intersection, but the right has been granted to others who have no use for it. Nevertheless, the law does not allow you to enter the intersection. If it did, there would be ambiguity about when you could and could not take advantage of this exception, and that ambiguity could lead to an increase in the number of accidents. The law accepts inefficient outcomes in some cases in order to have the most efficient possible *system* of outcomes.

Another example is the "reasonable man" standard in tort law, where negligence is judged not by the actual costs of preventing a given accident, but by the typical costs of preventing similar accidents in similar circumstances. In individual cases this may lead to inefficient outcomes, but it has the salutary effect of making it easier to judge whether you or your neighbor is legally responsible for preventing his garage from catching fire. You may not be aware of his individual cost of fireproofing, but you are likely to be aware of the typical costs of fireproofing. The resulting clarification of property rights tends to ensure that at least *someone* will prevent fires, even if not always in the ideal way. Such approximations are often all that could be asked of the legal system by any reasonable man.

Summary

An external cost is a cost imposed on others, such as the damage to neighboring homes (or homeowners) from a polluting factory. External costs represent a gap between private and social costs, and hence lead to inefficiency. The reason for the inefficiency is that producers make decisions based on their private costs, whereas efficient decisions should be based on social costs.

A Pigou tax, which charges producers an amount equal to the externality they cause, forces producers to internalize the externality (i.e., they act as if they care about the consequences of their choices), which can lead to an efficient outcome.

A liability rule that requires producers to reimburse the victims of their externalities is equivalent to a Pigou tax, with the proceeds of the tax paid to the victims.

In the absence of transactions costs, a Pigou tax is unnecessary. All affected parties will agree to maximize social gain and split the proceeds via side payments.

The argument in favor of Pigou taxes ignores the possibility that the "victims" of an externality might be able to alleviate the problem at a relatively low cost. In that case, a Pigou tax might erase the incentive for those victims to implement that solution. So, in some cases, a Pigou tax actually reduces efficiency.

Transactions costs arise when behavior is not observable, when property rights are incomplete, when free ridership problems occur, and in many other situations. In all of these cases, the allocation of property rights has important implications for economic efficiency via its effects on the incentive structure.

A court can attempt to promote efficiency by assigning rights so as to create appropriate incentives. Unfortunately, the court may be unaware of the costs of various alternatives and hence unable to determine what incentives are appropriate. An alternative approach is for the court to attempt to reduce transactions costs. If transactions costs are sufficiently low, the Coase theorem guarantees an efficient outcome regardless of how rights are assigned. In some cases, the court's decision itself can affect transactions costs. For example, the unobservability of someone's behavior becomes a transactions cost when he is awarded a right that leads others to attempt to bribe him. (Giving miners the right to be compensated for injuries is an example.)

Posner argues that the law of torts, with its emphasis on the negligence standard, has evolved to promote economic efficiency.

Author Commentary www.cengage.com/economics/landsburg

AC1. Read this article for an application of the Coase theorem to marriage contracts.

AC2. Should the law encourage people to install burglar alarms and other crime prevention devices?

AC3. See this article for an application of economic reasoning to criminal law.

Review Questions

R1. What is a Pigou tax? Explain how it works.

R2. Under what circumstances and in what sense do assignments of property rights "not matter"?

R3. State the Coase theorem and explain what it means.

R4. Why might it be undesirable to make a railroad liable for the damage its trains cause to neighboring crops? Why might it be desirable? What sorts of information are necessary for determining the optimal liability rule?

R5. What is a principal–agent problem? Give some examples. How does the existence of a principal–agent problem affect the optimal choice of liability rule?

R6. How do incomplete property rights lead to inefficiency? In what way are many liability rules examples of this phenomenon?

R7. What is negligence? What is strict liability? What are some of the ways in which these standards can be conducive or nonconducive to economic efficiency?

Problem Set

1. A competitive beekeeper sells honey at $5 per pound. In the course of producing a pound of honey, the bees pollinate apple trees in neighboring orchards, thereby saving the orchard owners $1 worth of effort.

- **a.** Draw a graph showing the beekeeper's social and marginal cost curves. (Remember that this is one competitive firm, not an entire industry!) What quantity does the beekeeper produce? Illustrate his producer's surplus, the gain to the orchard owners, and the total social gain.
- **b.** What policy could lead to a higher social gain? If the new policy is implemented, illustrate the gains and losses to all relevant groups.
- **c.** In the absence of transactions costs, in what sense does it not matter whether your policy is implemented, and why?

2. The City of Rochester is thinking of expanding its airport. The expansion will increase travelers' consumers' surplus by $100 and airlines' producers' surplus by $200, while costing taxpayers only $50. However, the expanded airport will be much noisier. Hearing the noise would impose a $10 cost on each of the airport's 30 neighbors. Can you tell whether the expansion would improve social welfare? Why or why not?

3. **True or False:** If universities were made liable to their students for the effects of assaults that occur on campus, the number of such assaults might go up.

4. **True or False:** If a new law requires married men to do at least half the housework, then a lot of men will have to do more housework than they do today.

5. Farmer Jones keeps rabbits; Farmer Smith grows lettuce on adjoining land. The rabbits like to visit Farmer Smith. **True or False:** Farmer Jones should reimburse Farmer Smith for the damage, since it is caused by the rabbits.

6. **True or False:** In the absence of transactions costs, every monopolist would act like a competitor.

7. Suppose that you are the judge in the lawsuit described in the following article. Under various assumptions, discuss the senses in which your decision "matters" and the senses in which it might not. Which of your assumptions seems most reasonable to you?

Bee Trial Brings Up Sticky Mess

If you stay in this business long enough, sooner or later you deal with everything. This column, for example, is about insects depositing waste material—forgive the euphemism—on cars.

The issue comes up because in Macomb, Illinois, there is a lawsuit that charges that bees did $25,000 worth of damage to the paint on new cars by dropping their waste on them.

Anyway, the Macomb suit alleges that as much as 1.5 million bees were brought to a clover field across the road from a line of new car dealerships. The suit says the beekeeper and the landowner "should have known that said bees would rise up out of their hives and travel the short distance to the Mac Ford [or Kelly Pontiac] lot to deposit the fecal excrement upon said automobiles." Bee waste, it seems, contains acid that eats through automotive paint, right down to the bare metal, according to Bob Allen, a co-owner of Mac Ford.[22]

[22] *Chicago Tribune,* 1985.

Now suppose that the "victim" is not a car dealer but a large collection of motorists whose cars are attacked whenever they drive by the area. How would your answer change? What are some of the important factors that you would take into account in making your decision?

8. **True or False:** Monopolies lead to inefficient allocation of resources. Externalities lead to inefficient allocation of resources. Therefore, a firm that is both a monopoly *and* a source of negative externalities is an especially serious social problem.

9. Suppose that you are attempting to study for your economics final and are distracted by noise from your roommate's stereo. In some dormitories, there are rules allowing you to throw the stereo out the window under these circumstances. In other dormitories, roommates are allowed to play their stereos as much as they want to without punishment.

- **a.** In what sense does it not matter what the rules are in your particular dormitory? In what sense does it matter?
- **b.** Suppose that instead of just you and your roommate, there are many students making noise, and each of them disturbs many other students. In what sense do the rules now matter more than they used to?
- **c.** In case (b), what sorts of considerations would go into formulating the most efficient rule? Is it possible that the most efficient rule would lead to inefficient outcomes some of the time? Explain.

10. A factory is located next to a laundromat, and soot from the factory accumulates on the freshly washed clothes, significantly reducing demand for the laundromat's services. The owner of the laundromat asks the court to prevent the factory from emitting soot.

- **a.** Assuming that there are no transactions costs between the owners of the two business, which among the following are affected by the court's decision and which are not? (*i)* The number of goods produced at the factory. (*ii)* The prices at the laundromat. (*iii)* The wealth of the factory owner. (*iv*) The wealth of the laundromat owner. Explain *briefly.*
- **b.** Now suppose instead that transactions costs make it impossible for the owners of the two business to negotiate with each other. Assume that the court is interested in fostering efficiency. Give an example of a circumstance where it would be a mistake to rule *against* the laundromat. Give an example of a circumstance where it would be a mistake to rule *for* the laundromat.

11. The workers at a certain firm are exposed to radiation. This exposure can cause birth defects if the workers have children in future years. (If they don't have children, no health problems arise.) Some ex-workers have had children with birth defects and then sued the firm for large sums of money.

- **a.** Under what circumstances, and in what sense, does it not matter how the court rules in these lawsuits?
- **b.** Suppose that after an employee leaves the firm, all contracts between the employee and the firm become unenforceable. Now does it matter how the court rules?
- **c.** Suppose that the firm is considering a policy that requires all employees to be sterilized as a condition of employment. How does this possibility affect your analysis?
- **d.** Suppose that the firm is forbidden by law to adopt the policy described in part (c). How does this affect your analysis?

12. Suppose that Japanese cars and American cars are identical from the viewpoint of their owners, but that Japanese cars cause harmful pollution while American cars do not. Each American owner of a Japanese car imposes $1,000 worth of pollution costs on his neighbors. Suppose that the U.S. supply and demand curves for cars cross at a price of $10,000, but Americans can buy as many cars as they want to from Japan at $7,000 apiece.

a. Draw a diagram to illustrate the social gain from the market for cars. Be sure to show gains and losses to all relevant groups of Americans.

b. Now suppose that the government imposes a tariff of $1,000 on all Japanese cars sold in the United States. Once again illustrate the social gain, making sure to include all relevant groups of Americans.

c. Does the tariff increase or decrease social welfare? By how much?

13. In the preceding problem, suppose that instead of imposing a $1,000 tariff on Japanese cars, the government imposes a sales tax of $1,000 on *all* cars sold in the United States whether foreign or domestic.

a. Explain why U.S. producers must still receive $7,000 for every car they sell. How much must U.S. consumers now pay for a car?

b. Illustrate the social gain, including gains to all relevant groups of Americans.

c. Is the sales tax better or worse than the tariff of problem 3? Is it better or worse than doing nothing at all?

14. In problem 12, suppose that instead of imposing a tariff on Japanese cars, the government offers a $1,000 subsidy to each American who buys an American car. (To prevent abuse of the subsidy, U.S. consumers are not allowed to resell their cars abroad.) What price do U.S. producers receive for cars? What price do U.S. consumers pay? Does the subsidy increase social gain? By how much?

15. People who suffer from mange can purchase either of two cures: Mange-Away, which is made in the United States and sold by producers who have an upward-sloping supply curve, or Look-Ma-No-Mange, which is made in Mexico and available in any quantity at $5 per dose. The supply curve for Mange-Away crosses the (U.S.) demand curve for mange cures at a price of $8 per dose.

To the individual mange sufferer, Mange-Away and Look-Ma-No-Mange are interchangeable products. But although Mange-Away cures the disease, it also leaves the patient contagious to others. Look-Ma-No-Mange both cures the disease *and* renders the patient noncontagious; thus, every user of Look-Ma-No-Mange confers $1 worth of external benefits on his neighbors.

In order to encourage people to use more Mexican Look-Ma-No-Mange, the government has imposed a sales tax of $1 per dose on American Mange-Away.

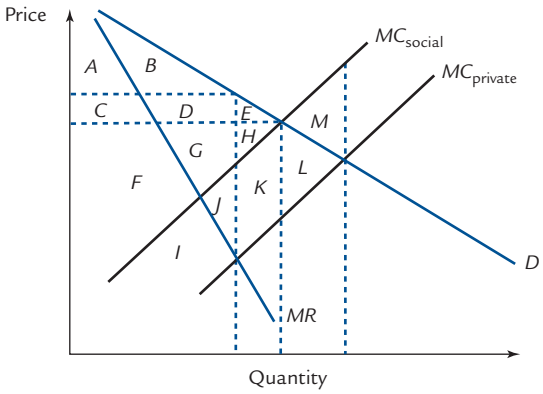
a. Before the tax is instituted, how much can U.S. producers charge for Mange-Away? After the tax is instituted, how much can U.S. producers charge for Mange-Away? Does the tax have any effect on the amount that U.S. consumers must pay for mange cures?

b. Use a graph to show the quantities of Mange-Away and Look-Ma-No-Mange that Americans buy both before and after the tax is instituted.

c. Use your graph to show how the tax on Mange-Away affects the welfare of all relevant groups of Americans, including the neighbors of potentially contagious mange sufferers and the recipients of tax revenue.

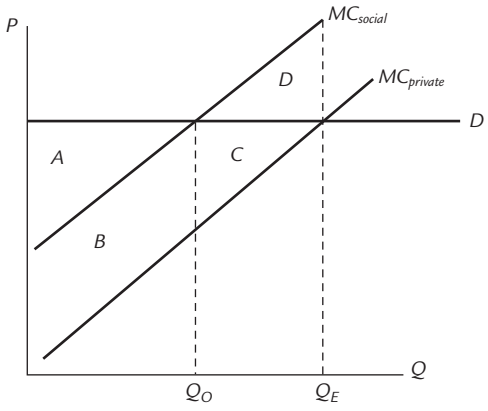
d. Does the tax on Mange-Away create a net social loss or a net social gain? Of how much?

16. Widgets are provided by a single monopolist, whose production process pollutes the surrounding environment. The U.S. government is thinking about breaking the monopoly up into a large number of small firms, who would then form a competitive industry. The small firms would use exactly the same production process as the large firm; thus, a breakup would not affect either the private or the social marginal cost curve. Conditions in the industry are summarized by the following graph.

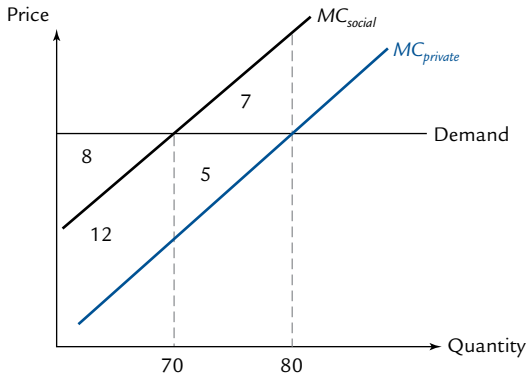


Suppose that you are called upon to advise the government as to whether breaking up the monopoly would improve social welfare. A magic oracle offers to reveal to you the exact numerical values of any *three* labeled areas in the graph. To help you give accurate advice, which three areas would you choose? Why?

17. A single competitive firm pollutes the air. There are no transactions costs between this firm and the neighbors who suffer from the pollution. In terms of the following diagram, what is the maximum amount that the neighbors would offer the firm in exchange for cutting its production back from Q_E to Q_O? What is the minimum amount the firm would accept? How do you know that the deal is certain to go through?



18. A competitive firm pollutes the air. The following graph shows the demand for the firm's product and the private and social marginal cost curves. The numbers in the graph represent areas.



a. Suppose there are no transaction costs, that there is no legal penalty for polluting, and that it is impossible for the neighbors to move. What quantity does the firm produce? Give a concrete description of a deal that might be struck between the firm and the neighbors (including the exact amount of money that changes hands). What is the social gain from this transaction? (Your answer should be a *number*.)

b. Suppose transaction costs are so high that negotiation is impossible, and that it would cost the neighbors $6 to move. Under each of the following scenarios, determine whether or not the neighbors move, determine how much the firm produces, and compute the social gain. Which policy or policies are most efficient?

Policy I: The firm faces no penalty for pollution.

Policy II: The firm pays an excise tax equal to the amount of the externality it causes; all tax revenue is paid to people who live 3,000 miles away.

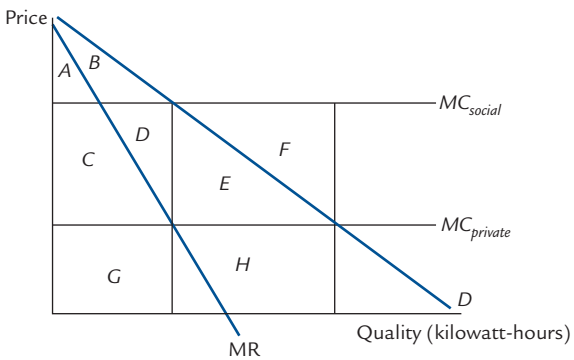
Policy III: The firm must reimburse the neighbors for all pollution damage.

c. Repeat part (b) on the assumption that it costs the neighbors $15 (instead of $6) to move.

d. Repeat part (b) on the assumption that it costs the neighbors $20 to move.

e. Repeat part (b) on the assumption that it costs the neighbors $25 to move.

19. Snidely Whiplash owns all the houses in the Yukon Territory, for which he charges the highest possible rent. He also owns the only electric company, which pollutes the territory's air. There is no way to negotiate with Snidely. It is costless for residents to leave the territory. The following graph shows the market for electricity:

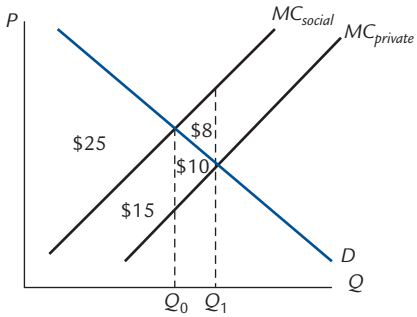


a. Snidely currently charges a monopoly price for electricity, but he is thinking of lowering the price to a competitive level. If he does so, how much does the price of housing change? Explain why. (*Hint:* Be sure to consider all the ways in which the electricity market affects the desirability of living in the Yukon Territory.)

b. Is it wise for Snidely to lower the price of electricity?

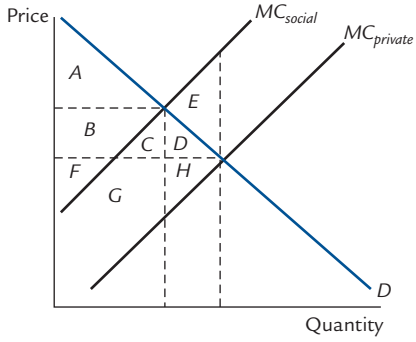
c. What is the combined deadweight loss due to Snidely's monopoly power and the pollution from the factory?

20. The widget industry is competitive. Widget factories pollute the neighborhoods where they are located. The following diagram shows the demand for widgets and the private and social marginal cost curves for the industry. There is no possibility of negotiation to reduce pollution. It would cost the neighbors $30 to move elsewhere.



To maximize social gain, should the firm be subject to a Pigou tax? (*Note:* Assume all tax revenue goes to someone other than the neighbors.)

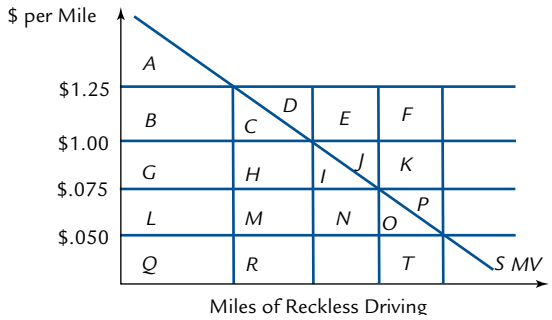
21. The widget industry is competitive and a source of localized air pollution (the pollution affects only people who live near widget factories). The following graph shows the demand for widgets and the private and social marginal cost curves.



a. Suppose there has always been a Pigou tax, and that people have always lived near widget factories. One day the Pigou tax is eliminated, and all these neighbors move away. Fill in these blanks: The cost of moving must be greater than _____ but less than _____.

b. *Instead of the assumptions in part (a),* assume that there has never been a Pigou tax and that the factories still have neighbors. Assume also that if there *were* a Pigou tax, all of the revenue would be spent on entirely worthless projects. Which areas would you want to measure in order to determine whether a Pigou tax is an efficient policy?

22. Suppose that reckless driving imposes costs (in the form of medical bills) on both the drivers themselves and on pedestrians. Each mile of reckless driving costs drivers $1 and pedestrians $0.25. The marginal value to drivers of their reckless driving is indicated by the downward-sloping curve in the following figure:



a. In terms of labeled areas on the graph, what is the social gain from reckless driving?

b. Suppose that you could require drivers to pay all the pedestrians' medical bills. According to the graph, how much would social gain increase?

c. Explain why, from the viewpoint of economic efficiency, requiring drivers to pay for pedestrians' medical bills might nevertheless be a mistake.

In the remainder of this problem, suppose that drivers can acquire air bags that reduce the cost (to them) of their reckless driving from $1 per mile to $0.50 per mile. The cost to pedestrians remains $0.25 per mile, regardless of whether drivers use air bags, and pedestrians pay their own medical bills.

d. Suppose you want to predict whether having air bags will increase or decrease drivers' medical costs. Which areas would you want to measure and compare?

e. Suppose you want to know whether air bags will increase or decrease the social gains from reckless driving. Which areas would you want to measure and compare?

f. Suppose you want to know how much drivers would be willing to pay for air bags. Which areas would you want to measure?

g. Suppose you are interested in maximizing social gain, so that you want drivers to buy air bags if and only if the social benefits of the air bags exceed their cost. You cannot tax reckless driving, but you can tax air bags. How much should you tax them?

23. **True or False:** If the courts enforce a negligence standard in determining liability for auto accidents, then people will take too many car trips.

24. A radical revision of accident law has been proposed. The proposal is that every individual who is within 1 mile of an auto accident when it occurs must pay a fine equal to the sum of all of the damages. No attempt will be made to determine who was responsible for the accident; everyone who was in the vicinity must pay the full amount. However, anyone who bears any personal costs as a result of the accident is permitted to deduct those costs from his fine. Evaluate the efficiency aspects of this proposal.

25. Betty hires Veronica to build an addition to Betty's house. They agree on a price and Veronica begins the job. After the work is partially completed, Betty changes her mind and decides that the addition is worth less than the price she has

agreed to and announces that she will not pay for the job. Veronica then sues Betty for breach of contract.

Under these circumstances, a court can order Betty to pay either *reliance damages* or *expectation damages.* "Reliance damages" means a sum of money sufficient to make Veronica as well off as if she had never signed the contract. "Expectation damages" means a sum of money sufficient to make Veronica as well off as if the contract has been fulfilled.

Let A stand for the costs that Veronica has incurred so far, let *B* stand for the total cost of building an addition, let *C* stand for the amount Betty originally promised to pay, and let *D* stand for the value that Betty places on having the job completed now that she has changed her mind about its worth.

a. How much will Betty have to pay Veronica under a rule of reliance damages? How much will Betty have to pay Veronica under a rule of expectation damages?

b. How much does Betty lose if she fulfills the contract?

c. Assuming that courts assess reliance damages, write down an inequality that expresses the condition under which Betty will break the contract. Do the same for expectation damages.

d. Write down an inequality that expresses the condition under which it is efficient for Betty to break the contract.

e. Which rule induces Betty to behave efficiently: reliance damages or expectation damages?

26. In the situation of the preceding problem, suppose that courts want to choose a standard (either reliance damages or expectation damages) that induces efficient behavior. Having worked the preceding problem, judges are aware that one of these standards results in contracts being broken when and only when it is efficient for them to be broken. (And, having worked the problem, they know *which* standard has this property.) Does it follow that this is the standard they should adopt?