

different languages so that, to reach an agreement, they will need to hire a translator. If the benefit of solving the barking problem is less than the cost of the translator, Dick and Jane might choose to leave the problem unsolved. In more realistic examples, the transaction costs are the expenses not of translators but of the lawyers required to draft and enforce contracts.

Other times bargaining simply breaks down. The recurrence of wars and labor strikes shows that reaching agreement can be difficult and that failing to reach agreement can be costly. The problem is often that each party tries to hold out for a better deal. For example, suppose that Dick gets a \$500 benefit from the dog, and Jane bears an \$800 cost from the barking. Although it is efficient for Jane to pay Dick to get rid of the dog, there are many prices that could lead to this outcome. Dick might demand \$750, and Jane might offer only \$550. As they haggle over the price, the inefficient outcome with the barking dog persists.

Reaching an efficient bargain is especially difficult when the number of interested parties is large because coordinating everyone is costly. For example, consider a factory that pollutes the water of a nearby lake. The pollution confers a negative externality on the local fishermen. According to the Coase theorem, if the pollution is inefficient, then the factory and the fishermen could reach a bargain in which the fishermen pay the factory not to pollute. If there are many fishermen, however, trying to coordinate them all to bargain with the factory may be almost impossible.

When private bargaining does not work, the government can sometimes play a role. The government is an institution designed for collective action. In this example, the government can act on behalf of the fishermen, even when it is impractical for the fishermen to act for themselves. In the next section, we examine how the government can try to remedy the problem of externalities.

**QUICK QUIZ:** Give an example of a private solution to an externality.

- ◆ What is the Coase theorem? ◆ Why are private economic actors sometimes unable to solve the problems caused by an externality?

## PUBLIC POLICIES TOWARD EXTERNALITIES

When an externality causes a market to reach an inefficient allocation of resources, the government can respond in one of two ways. *Command-and-control policies* regulate behavior directly. *Market-based policies* provide incentives so that private decisionmakers will choose to solve the problem on their own.

### REGULATION

The government can remedy an externality by making certain behaviors either required or forbidden. For example, it is a crime to dump poisonous chemicals into the water supply. In this case, the external costs to society far exceed the benefits to the polluter. The government therefore institutes a command-and-control policy that prohibits this act altogether.

In most cases of pollution, however, the situation is not this simple. Despite the stated goals of some environmentalists, it would be impossible to prohibit all

polluting activity. For example, virtually all forms of transportation—even the horse—produce some undesirable polluting by-products. But it would not be sensible for the government to ban all transportation. Thus, instead of trying to eradicate pollution altogether, society has to weigh the costs and benefits to decide the kinds and quantities of pollution it will allow. In the United States, the Environmental Protection Agency (EPA) is the government agency with the task of developing and enforcing regulations aimed at protecting the environment.

Environmental regulations can take many forms. Sometimes the EPA dictates a maximum level of pollution that a factory may emit. Other times the EPA requires that firms adopt a particular technology to reduce emissions. In all cases, to design good rules, the government regulators need to know the details about specific industries and about the alternative technologies that those industries could adopt. This information is often difficult for government regulators to obtain.

### PIGOVIAN TAXES AND SUBSIDIES

Instead of regulating behavior in response to an externality, the government can use market-based policies to align private incentives with social efficiency. For instance, as we saw earlier, the government can internalize the externality by taxing activities that have negative externalities and subsidizing activities that have positive externalities. Taxes enacted to correct the effects of negative externalities are called **Pigovian taxes**, after economist Arthur Pigou (1877–1959), an early advocate of their use.

Economists usually prefer Pigovian taxes over regulations as a way to deal with pollution because they can reduce pollution at a lower cost to society. To see why, let us consider an example.

Suppose that two factories—a paper mill and a steel mill—are each dumping 500 tons of glop into a river each year. The EPA decides that it wants to reduce the amount of pollution. It considers two solutions:

- ◆ *Regulation:* The EPA could tell each factory to reduce its pollution to 300 tons of glop per year.
- ◆ *Pigovian tax:* The EPA could levy a tax on each factory of \$50,000 for each ton of glop it emits.

The regulation would dictate a level of pollution, whereas the tax would give factory owners an economic incentive to reduce pollution. Which solution do you think is better?

Most economists would prefer the tax. They would first point out that a tax is just as effective as a regulation in reducing the overall level of pollution. The EPA can achieve whatever level of pollution it wants by setting the tax at the appropriate level. The higher the tax, the larger the reduction in pollution. Indeed, if the tax is high enough, the factories will close down altogether, reducing pollution to zero.

The reason why economists would prefer the tax is that it reduces pollution more efficiently. The regulation requires each factory to reduce pollution by the same amount, but an equal reduction is not necessarily the least expensive way to clean up the water. It is possible that the paper mill can reduce pollution at lower cost than the steel mill. If so, the paper mill would respond to the tax by reducing pollution substantially to avoid the tax, whereas the steel mill would respond by reducing pollution less and paying the tax.

#### Pigovian tax

*a tax enacted to correct the effects of a negative externality*

In essence, the Pigovian tax places a price on the right to pollute. Just as markets allocate goods to those buyers who value them most highly, a Pigovian tax allocates pollution to those factories that face the highest cost of reducing it. Whatever the level of pollution the EPA chooses, it can achieve this goal at the lowest total cost using a tax.

Economists also argue that Pigovian taxes are better for the environment. Under the command-and-control policy of regulation, factories have no reason to reduce emission further once they have reached the target of 300 tons of glop. By contrast, the tax gives the factories an incentive to develop cleaner technologies, because a cleaner technology would reduce the amount of tax the factory has to pay.

Pigovian taxes are unlike most other taxes. As we discussed in Chapter 8, most taxes distort incentives and move the allocation of resources away from the social optimum. The reduction in economic well-being—that is, in consumer and producer surplus—exceeds the amount of revenue the government raises, resulting in a deadweight loss. By contrast, when externalities are present, society also cares about the well-being of the bystanders who are affected. Pigovian taxes correct incentives for the presence of externalities and thereby move the allocation of resources closer to the social optimum. Thus, while Pigovian taxes raise revenue for the government, they enhance economic efficiency.

### CASE STUDY WHY IS GASOLINE TAXED SO HEAVILY?

In many countries, gasoline is among the most heavily taxed goods in the economy. In the United States, for instance, almost half of what drivers pay for gasoline goes to the gas tax. In many European countries, the tax is even larger and the price of gasoline is three or four times the U.S. price.

Why is this tax so common? One answer is that the gas tax is a Pigovian tax aimed at correcting three negative externalities associated with driving:

- ◆ *Congestion:* If you have ever been stuck in bumper-to-bumper traffic, you have probably wished that there were fewer cars on the road. A gasoline tax keeps congestion down by encouraging people to take public transportation, car pool more often, and live closer to work.
- ◆ *Accidents:* Whenever a person buys a large car or a sport utility vehicle, he makes himself safer, but he puts his neighbors at risk. According to the National Highway Traffic Safety Administration, a person driving a typical car is five times as likely to die if hit by a sport utility vehicle than if hit by another car. The gas tax is an indirect way of making people pay when their large, gas-guzzling vehicles impose risk on others, which in turn makes them take account of this risk when choosing what vehicle to purchase.
- ◆ *Pollution:* The burning of fossil fuels such as gasoline is widely believed to be the cause of global warming. Experts disagree about how dangerous this threat is, but there is no doubt that the gas tax reduces the risk by reducing the use of gasoline.

So the gas tax, rather than causing deadweight losses like most taxes, actually makes the economy work better. It means less traffic congestion, safer roads, and a cleaner environment.



"If the gas tax were any larger, I'd take the bus."

### TRADABLE POLLUTION PERMITS

Returning to our example of the paper mill and the steel mill, let us suppose that, despite the advice of its economists, the EPA adopts the regulation and requires each factory to reduce its pollution to 300 tons of glop per year. Then one day, after the regulation is in place and both mills have complied, the two firms go to the EPA with a proposal. The steel mill wants to increase its emission of glop by 100 tons. The paper mill has agreed to reduce its emission by the same amount if the steel mill pays it \$5 million. Should the EPA allow the two factories to make this deal?

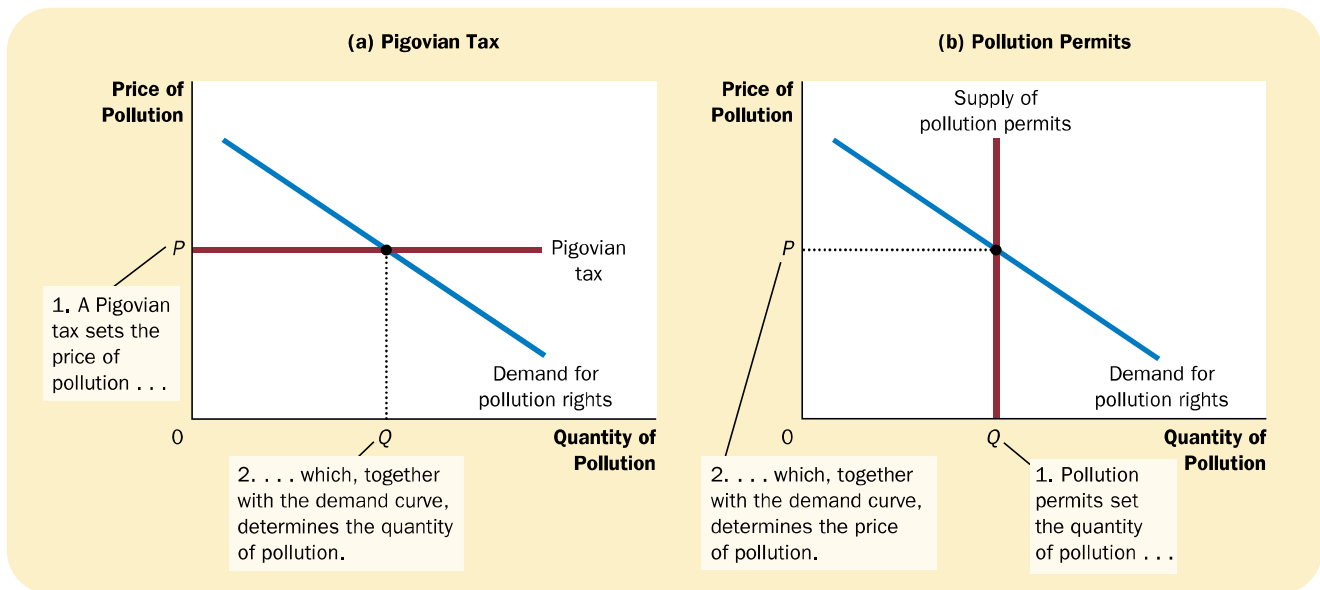
From the standpoint of economic efficiency, allowing the deal is good policy. The deal must make the owners of the two factories better off, because they are voluntarily agreeing to it. Moreover, the deal does not have any external effects because the total amount of pollution remains the same. Thus, social welfare is enhanced by allowing the paper mill to sell its right to pollute to the steel mill.

The same logic applies to any voluntary transfer of the right to pollute from one firm to another. If the EPA allows firms to make these deals, it will, in essence, have created a new scarce resource: pollution permits. A market to trade these permits will eventually develop, and that market will be governed by the forces of supply and demand. The invisible hand will ensure that this new market efficiently allocates the right to pollute. The firms that can reduce pollution only at high cost will be willing to pay the most for the pollution permits. The firms that can reduce pollution at low cost will prefer to sell whatever permits they have.

One advantage of allowing a market for pollution permits is that the initial allocation of pollution permits among firms does not matter from the standpoint of economic efficiency. The logic behind this conclusion is similar to that behind the Coase theorem. Those firms that can reduce pollution most easily would be willing to sell whatever permits they get, and those firms that can reduce pollution only at high cost would be willing to buy whatever permits they need. As long as there is a free market for the pollution rights, the final allocation will be efficient whatever the initial allocation.

Although reducing pollution using pollution permits may seem quite different from using Pigovian taxes, in fact the two policies have much in common. In both cases, firms pay for their pollution. With Pigovian taxes, polluting firms must pay a tax to the government. With pollution permits, polluting firms must pay to buy the permit. (Even firms that already own permits must pay to pollute: The opportunity cost of polluting is what they could have received by selling their permits on the open market.) Both Pigovian taxes and pollution permits internalize the externality of pollution by making it costly for firms to pollute.

The similarity of the two policies can be seen by considering the market for pollution. Both panels in Figure 10-5 show the demand curve for the right to pollute. This curve shows that the lower the price of polluting, the more firms will choose to pollute. In panel (a), the EPA uses a Pigovian tax to set a price for pollution. In this case, the supply curve for pollution rights is perfectly elastic (because firms can pollute as much as they want by paying the tax), and the position of the demand curve determines the quantity of pollution. In panel (b), the EPA sets a quantity of pollution by issuing pollution permits. In this case, the supply curve for pollution rights is perfectly inelastic (because the quantity of pollution is fixed by the number of permits), and the position of the demand curve determines the price of pollution. Hence, for any given demand curve for pollution, the EPA can



**THE EQUIVALENCE OF PIGOVIAN TAXES AND POLLUTION PERMITS.** In panel (a), the EPA sets a price on pollution by levying a Pigovian tax, and the demand curve determines the quantity of pollution. In panel (b), the EPA limits the quantity of pollution by limiting the number of pollution permits, and the demand curve determines the price of pollution. The price and quantity of pollution are the same in the two cases.

**Figure 10-5**

achieve any point on the demand curve either by setting a price with a Pigovian tax or by setting a quantity with pollution permits.

In some circumstances, however, selling pollution permits may be better than levying a Pigovian tax. Suppose the EPA wants no more than 600 tons of glop to be dumped into the river. But, because the EPA does not know the demand curve for pollution, it is not sure what size tax would achieve that goal. In this case, it can simply auction off 600 pollution permits. The auction price would yield the appropriate size of the Pigovian tax.

The idea of the government auctioning off the right to pollute may at first sound like a creature of some economist's imagination. And, in fact, that is how the idea began. But increasingly the EPA has used the system as a way to control pollution. Pollution permits, like Pigovian taxes, are now widely viewed as a cost-effective way to keep the environment clean.

## OBJECTIONS TO THE ECONOMIC ANALYSIS OF POLLUTION

"We cannot give anyone the option of polluting for a fee." This comment by former Senator Edmund Muskie reflects the view of some environmentalists. Clean air and clean water, they argue, are fundamental human rights that should not be debased by considering them in economic terms. How can you put a price on clean air and clean water? The environment is so important, they claim, that we should protect it as much as possible, regardless of the cost.





Economists have little sympathy with this type of argument. To economists, good environmental policy begins by acknowledging the first of the *Ten Principles of Economics* in Chapter 1: People face tradeoffs. Certainly, clean air and clean water have value. But their value must be compared to their opportunity cost—that is, to what one must give up to obtain them. Eliminating all pollution is impossible. Trying to eliminate all pollution would reverse many of the technological advances that allow us to enjoy a high standard of living. Few people would be willing to accept poor nutrition, inadequate medical care, or shoddy housing to make the environment as clean as possible.

Economists argue that some environmental activists hurt their own cause by not thinking in economic terms. A clean environment is a good like other goods. Like all normal goods, it has a positive income elasticity: Rich countries can afford a cleaner environment than poor ones and, therefore, usually have more rigorous environmental protection. In addition, like most other goods, clean air and water obey the law of demand: The lower the price of environmental protection, the more the public will want. The economic approach of using pollution permits and Pigovian taxes reduces the cost of environmental protection and should, therefore, increase the public's demand for a clean environment.

**QUICK QUIZ:** A glue factory and a steel mill emit smoke containing a chemical that is harmful if inhaled in large amounts. Describe three ways the town government might respond to this externality. What are the pros and cons of each of your solutions?

## CONCLUSION

The invisible hand is powerful but not omnipotent. A market's equilibrium maximizes the sum of producer and consumer surplus. When the buyers and sellers in the market are the only interested parties, this outcome is efficient from the standpoint of society as a whole. But when there are external effects, such as pollution, evaluating a market outcome requires taking into account the well-being of third parties as well. In this case, the invisible hand of the marketplace may fail to allocate resources efficiently.

In some cases, people can solve the problem of externalities on their own. The Coase theorem suggests that the interested parties can bargain among themselves and agree on an efficient solution. Sometimes, however, an efficient outcome cannot be reached, perhaps because the large number of interested parties makes bargaining difficult.

When people cannot solve the problem of externalities privately, the government often steps in. Yet, even now, society should not abandon market forces entirely. Rather, the government can address the problem by requiring decision-makers to bear the full costs of their actions. Pigovian taxes on emissions and pollution permits, for instance, are designed to internalize the externality of pollution. More and more, they are the policy of choice for those interested in protecting the environment. Market forces, properly redirected, are often the best remedy for market failure.