

Externalities

Firms that make and sell paper also create, as a by-product of the manufacturing process, a chemical called dioxin. Scientists believe that once dioxin enters the environment, it raises the population's risk of cancer, birth defects, and other health problems.

Is the production and release of dioxin a problem for society? In Chapters 4 through 9, we examined how markets allocate scarce resources with the forces of supply and demand, and we saw that the equilibrium of supply and demand is typically an efficient allocation of resources. To use Adam Smith's famous metaphor, the "invisible hand" of the marketplace leads self-interested buyers and sellers in a market to maximize the total benefit that society derives from that market. This insight is the basis for one of the *Ten Principles of Economics* in Chapter 1: Markets are usually a good way to organize economic activity. Should we conclude, therefore, that the invisible hand prevents firms in the paper market from emitting too much dioxin?

Markets do many things well, but they do not do everything well. In this chapter, we begin our study of another of the *Ten Principles of Economics*: Government action can sometimes improve upon market outcomes. We examine why markets sometimes fail to allocate resources efficiently, how government policies can potentially improve the market's allocation, and what kinds of policies are likely to work best.

externality
the uncompensated
impact of one person's
actions on the well-being
of a bystander

The market failures examined in this chapter fall under a general category called *externalities*. An **externality** arises when a person engages in an activity that influences the well-being of a bystander and yet neither pays nor receives any compensation for that effect. If the impact on the bystander is adverse, it is called a *negative externality*. If it is beneficial, it is called a *positive externality*. In the presence of externalities, society's interest in a market outcome extends beyond the well-being of buyers and sellers who participate in the market to include the well-being of bystanders who are affected indirectly. Because buyers and sellers neglect the external effects of their actions when deciding how much to demand or supply, the market equilibrium is not efficient when there are externalities. That is, the equilibrium fails to maximize the total benefit to society as a whole. The release of dioxin into the environment, for instance, is a negative externality. Self-interested paper firms will not consider the full cost of the pollution they create in their production process, and consumers of paper will not consider the full cost of the pollution they contribute from their purchasing decisions. Therefore, the firms will emit too much pollution unless the government prevents or discourages them from doing so.

Externalities come in many varieties, as do the policy responses that try to deal with the market failure. Here are some examples:

- The exhaust from automobiles is a negative externality because it creates smog that other people have to breathe. As a result of this externality, drivers tend to pollute too much. The federal government attempts to solve this problem by setting emission standards for cars. It also taxes gasoline to reduce the amount that people drive.
- Restored historic buildings convey a positive externality because people who walk or ride by them can enjoy the beauty and the sense of history that these buildings provide. Building owners do not get the full benefit of restoration and, therefore, tend to discard older buildings too quickly. Many local governments respond to this problem by regulating the destruction of historic buildings and by providing tax breaks to owners who restore them.
- Barking dogs create a negative externality because neighbors are disturbed by the noise. Dog owners do not bear the full cost of the noise and, therefore, tend to take too few precautions to prevent their dogs from barking. Local governments address this problem by making it illegal to "disturb the peace."
- Research into new technologies provides a positive externality because it creates knowledge that other people can use. Because inventors cannot capture the full benefits of their inventions, they tend to devote too few resources to research. The federal government addresses this problem partially through the patent system, which gives inventors exclusive use of their inventions for a limited time.

In each of these cases, some decision maker fails to take account of the external effects of his or her behavior. The government responds by trying to influence this behavior to protect the interests of bystanders.

EXTERNALITIES AND MARKET INEFFICIENCY

In this section, we use the tools of welfare economics developed in Chapter 7 to examine how externalities affect economic well-being. The analysis shows precisely why externalities cause markets to allocate resources inefficiently. Later in

the chapter, we examine various ways in which private individuals and public policymakers may remedy this type of market failure.

WELFARE ECONOMICS: A RECAP

We begin by recalling the key lessons of welfare economics from Chapter 7. To make our analysis concrete, we consider a specific market—the market for aluminum. Figure 1 shows the supply and demand curves in the market for aluminum.

As you should recall from Chapter 7, the supply and demand curves contain important information about costs and benefits. The demand curve for aluminum reflects the value of aluminum to consumers, as measured by the prices they are willing to pay. At any given quantity, the height of the demand curve shows the willingness to pay of the marginal buyer. In other words, it shows the value to the consumer of the last unit of aluminum bought. Similarly, the supply curve reflects the costs of producing aluminum. At any given quantity, the height of the supply curve shows the cost of the marginal seller. In other words, it shows the cost to the producer of the last unit of aluminum sold.

In the absence of government intervention, the price adjusts to balance the supply and demand for aluminum. The quantity produced and consumed in the market equilibrium, shown as Q_{MARKET} in Figure 1, is efficient in the sense that it maximizes the sum of producer and consumer surplus. That is, the market allocates resources in a way that maximizes the total value to the consumers who buy and use aluminum minus the total costs to the producers who make and sell aluminum.

NEGATIVE EXTERNALITIES

Now let's suppose that aluminum factories emit pollution: For each unit of aluminum produced, a certain amount of smoke enters the atmosphere. Because this

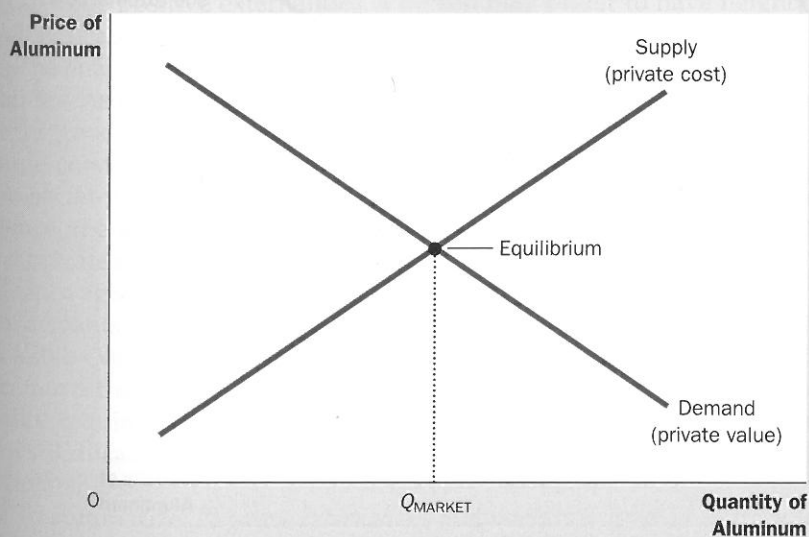


FIGURE 1

The Market for Aluminum

The demand curve reflects the value to buyers, and the supply curve reflects the costs of sellers. The equilibrium quantity, Q_{MARKET} , maximizes the total value to buyers minus the total costs of sellers. In the absence of externalities, therefore, the market equilibrium is efficient.



"ALL I CAN SAY IS THAT IF BEING A LEADING MANUFACTURER MEANS BEING A LEADING POLLUTER, SO BE IT."

smoke creates a health risk for those who breathe the air, it is a negative externality. How does this externality affect the efficiency of the market outcome?

Because of the externality, the cost to *society* of producing aluminum is larger than the cost to the aluminum producers. For each unit of aluminum produced, the *social cost* includes the private costs of the aluminum producers plus the costs to those bystanders affected adversely by the pollution. Figure 2 shows the social cost of producing aluminum. The social-cost curve is above the supply curve because it takes into account the external costs imposed on society by aluminum producers. The difference between these two curves reflects the cost of the pollution emitted.

What quantity of aluminum should be produced? To answer this question, we once again consider what a benevolent social planner would do. The planner wants to maximize the total surplus derived from the market—the value to consumers of aluminum minus the cost of producing aluminum. The planner understands, however, that the cost of producing aluminum includes the external costs of the pollution.

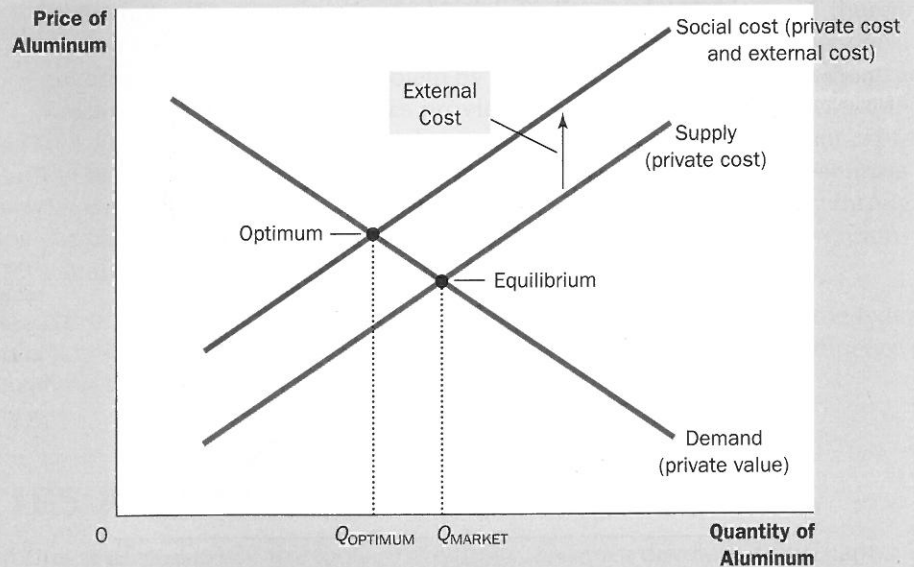
The planner would choose the level of aluminum production at which the demand curve crosses the social-cost curve. This intersection determines the optimal amount of aluminum from the standpoint of society as a whole. Below this level of production, the value of the aluminum to consumers (as measured by the height of the demand curve) exceeds the social cost of producing it (as measured by the height of the social-cost curve). The planner does not produce more than this level because the social cost of producing additional aluminum exceeds the value to consumers.

Note that the equilibrium quantity of aluminum, Q_{MARKET} , is larger than the socially optimal quantity, Q_{OPTIMUM} . This inefficiency occurs because the market equilibrium reflects only the private costs of production. In the market equilib-

2 FIGURE

Pollution and the Social Optimum

In the presence of a negative externality, such as pollution, the social cost of the good exceeds the private cost. The optimal quantity, Q_{OPTIMUM} , is therefore smaller than the equilibrium quantity, Q_{MARKET} .



rium, the marginal consumer values aluminum at less than the social cost of producing it. That is, at Q_{MARKET} , the demand curve lies below the social-cost curve. Thus, reducing aluminum production and consumption below the market equilibrium level raises total economic well-being.

How can the social planner achieve the optimal outcome? One way would be to tax aluminum producers for each ton of aluminum sold. The tax would shift the supply curve for aluminum upward by the size of the tax. If the tax accurately reflected the external cost of smoke released into the atmosphere, the new supply curve would coincide with the social-cost curve. In the new market equilibrium, aluminum producers would produce the socially optimal quantity of aluminum.

The use of such a tax is called **internalizing the externality** because it gives buyers and sellers in the market an incentive to take into account the external effects of their actions. Aluminum producers would, in essence, take the costs of pollution into account when deciding how much aluminum to supply because the tax would make them pay for these external costs. And, because the market price would reflect the tax on producers, consumers of aluminum would have an incentive to use a smaller quantity. The policy is based on one of the *Ten Principles of Economics*: People respond to incentives. Later in this chapter, we consider in more detail how policymakers can deal with externalities.

internalizing the externality
altering incentives so that people take account of the external effects of their actions

POSITIVE EXTERNALITIES

Although some activities impose costs on third parties, others yield benefits. For example, consider education. To a large extent, the benefit of education is private: The consumer of education becomes a more productive worker and thus reaps much of the benefit in the form of higher wages. Beyond these private benefits, however, education also yields positive externalities. One externality is that a more educated population leads to more informed voters, which means better government for everyone. Another externality is that a more educated population tends to mean lower crime rates. A third externality is that a more educated population may encourage the development and dissemination of technological advances, leading to higher productivity and wages for everyone. Because of these three positive externalities, a person may prefer to have neighbors who are well educated.

The analysis of positive externalities is similar to the analysis of negative externalities. As Figure 3 shows, the demand curve does not reflect the value to society of the good. Because the social value is greater than the private value, the social-value curve lies above the demand curve. The optimal quantity is found where the social-value curve and the supply curve (which represents costs) intersect. Hence, the socially optimal quantity is greater than the quantity determined by the private market.

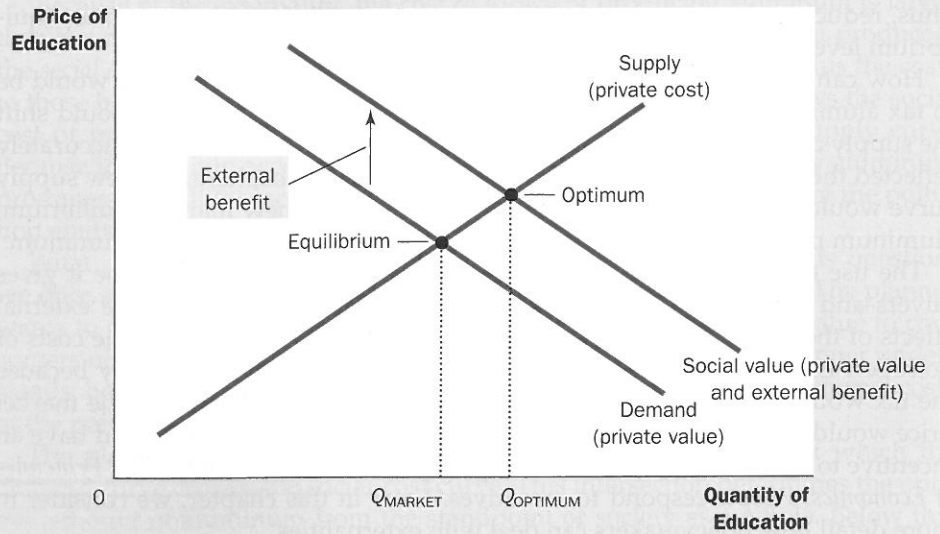
Once again, the government can correct the market failure by inducing market participants to internalize the externality. The appropriate response in the case of positive externalities is exactly the opposite to the case of negative externalities. To move the market equilibrium closer to the social optimum, a positive externality requires a subsidy. In fact, that is exactly the policy the government follows: Education is heavily subsidized through public schools and government scholarships.

To summarize: *Negative externalities lead markets to produce a larger quantity than is socially desirable. Positive externalities lead markets to produce a smaller quantity than*

3 FIGURE

Education and the Social Optimum

In the presence of a positive externality, the social value of the good exceeds the private value. The optimal quantity, Q_{OPTIMUM} , is therefore larger than the equilibrium quantity, Q_{MARKET} .



is socially desirable. To remedy the problem, the government can internalize the externality by taxing goods that have negative externalities and subsidizing goods that have positive externalities.

CASE STUDY TECHNOLOGY SPILLOVERS, INDUSTRIAL POLICY, AND PATENT PROTECTION

A potentially important type of positive externality is called a *technology spillover*—the impact of one firm's research and production efforts on other firms' access to technological advance. For example, consider the market for industrial robots. Robots are at the frontier of a rapidly changing technology. Whenever a firm builds a robot, there is some chance that it will discover a new and better design. This new design may benefit not only this firm but society as a whole because the design will enter society's pool of technological knowledge. That is, the new design may have positive externalities for other producers in the economy.

In this case, the government can internalize the externality by subsidizing the production of robots. If the government paid firms a subsidy for each robot produced, the supply curve would shift down by the amount of the subsidy, and this shift would increase the equilibrium quantity of robots. To ensure that the market equilibrium equals the social optimum, the subsidy should equal the value of the technology spillover.

How large are technology spillovers, and what do they imply for public policy? This is an important question because technological progress is the key to why living standards rise over time. Yet it is also a difficult question on which economists often disagree.

Some economists believe that technology spillovers are pervasive and that the government should encourage those industries that yield the largest spillovers.

For instance, these economists argue that if making computer chips yields greater spillovers than making potato chips, then the government should encourage the production of computer chips relative to the production of potato chips. The U.S. tax code does this in a limited way by offering special tax breaks for expenditures on research and development. Some other nations go further by subsidizing specific industries that supposedly offer large technology spillovers. Government intervention in the economy that aims to promote technology-enhancing industries is sometimes called *industrial policy*.

Other economists are skeptical about industrial policy. Even if technology spillovers are common, the success of an industrial policy requires that the government be able to measure the size of the spillovers from different markets. This measurement problem is difficult at best. Moreover, without precise measurements, the political system may end up subsidizing industries with the most political clout rather than those that yield the largest positive externalities.

Another way to deal with technology spillovers is patent protection. The patent laws protect the rights of inventors by giving them exclusive use of their inventions for a period of time. When a firm makes a technological breakthrough, it can patent the idea and capture much of the economic benefit for itself. The patent internalizes the externality by giving the firm a *property right* over its invention. If other firms want to use the new technology, they would have to obtain permission from the inventing firm and pay it some royalty. Thus, the patent system gives firms a greater incentive to engage in research and other activities that advance technology. ●

QUICK QUIZ Give an example of a negative externality and a positive externality. Explain why market outcomes are inefficient in the presence of these externalities.

PUBLIC POLICIES TOWARD EXTERNALITIES

We have discussed why externalities lead markets to allocate resources inefficiently but have mentioned only briefly how this inefficiency can be remedied. In practice, both public policymakers and private individuals respond to externalities in various ways. All of the remedies share the goal of moving the allocation of resources closer to the social optimum.

This section considers governmental solutions. As a general matter, the government can respond to externalities in one of two ways. *Command-and-control policies* regulate behavior directly. *Market-based policies* provide incentives so that private decision makers will choose to solve the problem on their own.

COMMAND-AND-CONTROL POLICIES: 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 entirely, 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.

MARKET-BASED POLICY 1: CORRECTIVE 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 deal with the effects of negative externalities are called **corrective taxes**. They are also called *Pigovian taxes* after economist Arthur Pigou (1877–1959), an early advocate of their use. An ideal corrective tax would equal the external cost from an activity with negative externalities, and an ideal corrective subsidy would equal the external benefit from an activity with positive externalities.

corrective tax
a tax designed to induce private decision makers to take account of the social costs that arise from a negative externality

Economists usually prefer corrective taxes to 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.
- Corrective 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 prefer the tax. To explain this preference, 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. If the tax is high enough, the factories will close down altogether, reducing pollution to zero.

Although regulation and corrective taxes are both capable of reducing pollution, the tax accomplishes this goal more efficiently. The regulation requires each factory to reduce pollution by the same amount. An equal reduction, however, 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.

In essence, the corrective tax places a price on the right to pollute. Just as markets allocate goods to those buyers who value them most highly, a corrective 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 corrective taxes are better for the environment. Under the command-and-control policy of regulation, the 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.

Corrective 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. Corrective taxes alter incentives to account for the presence of externalities and thereby move the allocation of resources closer to the social optimum. Thus, while corrective taxes raise revenue for the government, they also enhance economic efficiency.



WHY IS GASOLINE TAXED SO HEAVILY?

In many nations, gasoline is among the most heavily taxed goods. The gas tax can be viewed as a corrective tax aimed at 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, carpool more often, and live closer to work.
- *Accidents:* Whenever people buy large cars or sport-utility vehicles, they may make themselves safer but they certainly put their 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 this risk into account 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 threat 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.



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How high should the tax on gasoline be? Most European countries impose gasoline taxes that are much higher than those in the United States. Many observers have suggested that the United States also should tax gasoline more heavily. A 2007 study published in the *Journal of Economic Literature* summarized the research on the size of the various externalities associated with driving. It concluded that the optimal corrective tax on gasoline was \$2.10 per gallon, compared to the actual tax in the United States of 40 cents.

The tax revenue from a gasoline tax could be used to lower taxes that distort incentives and cause deadweight losses. In addition, some of the burdensome government regulations that require automakers to produce more fuel-efficient cars would prove unnecessary. This idea, however, has never proven politically popular. ●

MARKET-BASED POLICY 2: 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 pollution rights 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 allocates the right to pollute efficiently. That is, the permits will end up in the hands of those firms that value them most highly, as judged by their willingness to pay. A firm's willingness to pay, in turn, will depend on its cost of reducing pollution: The more costly it is for a firm to cut back on pollution, the more it will be willing to pay for a permit.

An 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. Those firms that can reduce pollution at a low cost will sell whatever permits they get, and firms that can reduce pollution only at a high cost will buy whatever permits they need. As long as there is a free market for the pollution rights, the final allocation will be efficient regardless of the initial allocation.

Although reducing pollution using pollution permits may seem very different from using corrective taxes, the two policies have much in common. In both cases, firms pay for their pollution. With corrective 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 corrective 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 4 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 corrective 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, the EPA can achieve any point on a given demand curve either by setting a price with a corrective tax or by setting a quantity with pollution permits.

In some circumstances, however, selling pollution permits may be better than levying a corrective tax. Suppose the EPA wants no more than 600 tons of glop 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 corrective tax.

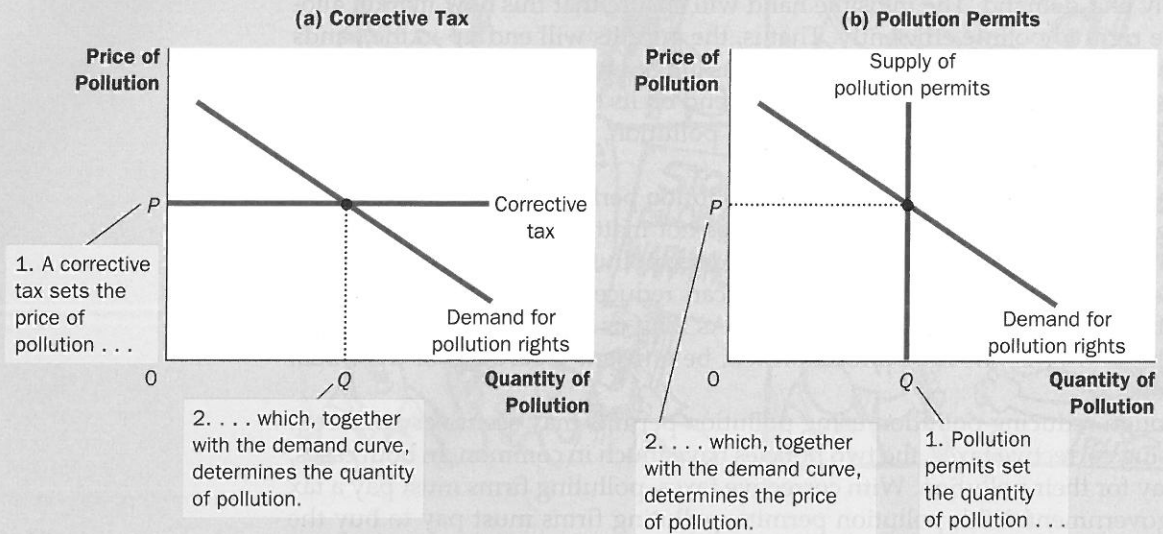
The idea of the government auctioning off the right to pollute may at first sound like a creature of some economist's imagination. And in fact, that is how the idea began. But increasingly, the EPA has used the system as a way to control pollution. A notable success story has been the case of sulfur dioxide (SO_2)—a

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4 FIGURE

The Equivalence of Corrective Taxes and Pollution Permits

In panel (a), the EPA sets a price on pollution by levying a corrective 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.



leading cause of acid rain. In 1990, amendments to the Clean Air Act required power plants to reduce SO_2 emissions substantially. At the same time, the amendments set up a system that allowed plants to trade their SO_2 allowances. Although initially both industry representatives and environmentalists were skeptical of the proposal, over time the system has proved that it can reduce pollution with minimal disruption. Pollution permits, like corrective 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 for 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 trade-offs. 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 clean 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 corrective 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 solution?

PRIVATE SOLUTIONS TO EXTERNALITIES

Although externalities tend to cause markets to be inefficient, government action is not always needed to solve the problem. In some circumstances, people can develop private solutions.

THE TYPES OF PRIVATE SOLUTIONS

Sometimes the problem of externalities is solved with moral codes and social sanctions. Consider, for instance, why most people do not litter. Although there are laws against littering, these laws are not vigorously enforced. Most people do not litter just because it is the wrong thing to do. The Golden Rule taught to most children says, "Do unto others as you would have them do unto you." This moral injunction tells us to take account of how our actions affect other people. In economic terms, it tells us to internalize externalities.

Another private solution to externalities is charities, many of which are established to deal with externalities. For example, the Sierra Club, whose goal is to protect the environment, is a nonprofit organization funded with private donations. As another example, colleges and universities receive gifts from alumni, corporations, and foundations in part because education has positive externalities for society. The government encourages this private solution to externalities through the tax system by allowing an income tax deduction for charitable donations.

The private market can often solve the problem of externalities by relying on the self-interest of the relevant parties. Sometimes the solution takes the form of integrating different types of businesses. For example, consider an apple grower and a beekeeper who are located next to each other. Each business confers a positive externality on the other: By pollinating the flowers on the trees, the bees help the orchard produce apples. At the same time, the bees use the nectar they get from the apple trees to produce honey. Nonetheless, when the apple grower is deciding how many trees to plant and the beekeeper is deciding how many bees to keep, they neglect the positive externality. As a result, the apple grower plants too few trees and the beekeeper keeps too few bees. These externalities could be internalized if the beekeeper bought the apple orchard or if the apple grower



In The News

The Case for Taxing Carbon

An obscure economist proposes a way to deal with global climate change.

One Answer to Global Warming: A New Tax

By N. Gregory Mankiw

In the debate over global climate change, there is a yawning gap that needs to be bridged. The gap is not between environmentalists and industrialists, or between Democrats and Republicans. It is between policy wonks and political consultants.

Among policy wonks like me, there is a broad consensus. The scientists tell us that world temperatures are rising because humans are emitting carbon into the atmosphere. Basic economics tells us that when you tax something, you normally get less of it. So if we want to reduce global emissions of carbon, we need a global carbon tax. QED.

The idea of using taxes to fix problems, rather than merely raise government revenue, has a long history. The British economist Arthur Pigou advocated such corrective taxes to deal with pollution in the early 20th

century. In his honor, economics textbooks now call them "Pigovian taxes."

Using a Pigovian tax to address global warming is also an old idea. It was proposed as far back as 1992 by Martin S. Feldstein on the editorial page of *The Wall Street Journal*. Once chief economist to Ronald Reagan, Mr. Feldstein has devoted much of his career to studying how high tax rates distort incentives and impede economic growth. But like most other policy wonks, he appreciates that some taxes align private incentives with social costs and move us toward better outcomes.

Those vying for elected office, however, are reluctant to sign on to this agenda. Their political consultants are no fans of taxes, Pigovian or otherwise. Republican consultants advise using the word "tax" only if followed immediately by the word "cut." Democratic consultants recommend the word "tax" be followed by "on the rich."

Yet this natural aversion to carbon taxes can be overcome if the revenue from the tax is used to reduce other taxes. By itself,

a carbon tax would raise the tax burden on anyone who drives a car or uses electricity produced with fossil fuels, which means just about everybody. Some might fear this would be particularly hard on the poor and middle class.

But Gilbert Metcalf, a professor of economics at Tufts, has shown how revenue from a carbon tax could be used to reduce payroll taxes in a way that would leave the distribution of total tax burden approximately unchanged. He proposes a tax of \$15 per metric ton of carbon dioxide, together with a rebate of the federal payroll tax on the first \$3,660 of earnings for each worker.

The case for a carbon tax looks even stronger after an examination of the other options on the table. Lawmakers in both political parties want to require carmakers to increase the fuel efficiency of the cars they sell. Passing the buck to auto companies has a lot of popular appeal.

Increased fuel efficiency, however, is not free. Like a tax, the cost of complying with

bought the beehives: Both activities would then take place within the same firm, and this single firm could choose the optimal number of trees and bees. Internalizing externalities is one reason that some firms are involved in different types of businesses.

Another way for the private market to deal with external effects is for the interested parties to enter into a contract. In the foregoing example, a contract between the apple grower and the beekeeper can solve the problem of too few trees and too few bees. The contract can specify the number of trees, the number of bees, and perhaps a payment from one party to the other. By setting the right number of trees and bees, the contract can solve the inefficiency that normally arises from these externalities and make both parties better off.

more stringent regulation will be passed on to consumers in the form of higher car prices. But the government will not raise any revenue that it can use to cut other taxes to compensate for these higher prices. (And don't expect savings on gas to compensate consumers in a meaningful way: Any truly cost-effective increase in fuel efficiency would already have been made.)

More important, enhancing fuel efficiency by itself is not the best way to reduce energy consumption. Fuel use depends not only on the efficiency of the car fleet but also on the daily decisions that people make—how far from work they choose to live and how often they carpool or use public transportation.

A carbon tax would provide incentives for people to use less fuel in a multitude of ways. By contrast, merely having more efficient cars encourages more driving. Increased driving not only produces more carbon but also exacerbates other problems, like accidents and road congestion.

Another popular proposal to limit carbon emissions is a cap-and-trade system, under which carbon emissions are limited and allowances are bought and sold in the marketplace. The effect of such a system depends on how the carbon allowances are

allocated. If the government auctions them off, then the price of a carbon allowance is effectively a carbon tax.

But the history of cap-and-trade systems suggests that the allowances would probably be handed out to power companies and other carbon emitters, which would then be free to use them or sell them at market prices. In this case, the prices of energy products would rise as they would under a carbon tax, but the government would collect no revenue to reduce other taxes and compensate consumers.

The international dimension of the problem also suggests the superiority of a carbon tax over cap-and-trade. Any long-term approach to global climate change will have to deal with the emerging economies of China and India. By some reports, China is now the world's leading emitter of carbon, in large part simply because it has so many people. The failure of the Kyoto treaty to include these emerging economies is one reason that, in 1997, the United States Senate passed a resolution rejecting the Kyoto approach by a vote of 95 to zero.

Agreement on a truly global cap-and-trade system, however, is hard to imagine. China is unlikely to be persuaded to accept fewer carbon allowances per person than

the United States. Using a historical baseline to allocate allowances, as is often proposed, would reward the United States for having been a leading cause of the problem.

But allocating carbon allowances based on population alone would create a system in which the United States, with its higher standard of living, would buy allowances from China. American voters are not going to embrace a system of higher energy prices, coupled with a large transfer of national income to the Chinese. It would amount to a massive foreign aid program to one of the world's most rapidly growing economies.

A global carbon tax would be easier to negotiate. All governments require revenue for public purposes. The world's nations could agree to use a carbon tax as one instrument to raise some of that revenue. No money needs to change hands across national borders. Each government could keep the revenue from its tax and use it to finance spending or whatever form of tax relief it considered best.

Convincing China of the virtues of a carbon tax, however, may prove to be the easy part. The first and more difficult step is to convince American voters, and therefore political consultants, that "tax" is not a four-letter word.

Source: *New York Times*, September 16, 2007.

THE COASE THEOREM

How effective is the private market in dealing with externalities? A famous result, called the **Coase theorem** after economist Ronald Coase, suggests that it can be very effective in some circumstances. According to the Coase theorem, if private parties can bargain over the allocation of resources at no cost, then the private market will always solve the problem of externalities and allocate resources efficiently.

To see how the Coase theorem works, consider an example. Suppose that Dick owns a dog named Spot. Spot barks and disturbs Jane, Dick's neighbor. Dick gets a benefit from owning the dog, but the dog confers a negative externality on Jane.

Coase theorem
the proposition that if private parties can bargain without cost over the allocation of resources, they can solve the problem of externalities on their own

Should Dick be forced to send Spot to the pound, or should Jane have to suffer sleepless nights because of Spot's barking?

Consider first what outcome is socially efficient. A social planner, considering the two alternatives, would compare the benefit that Dick gets from the dog to the cost that Jane bears from the barking. If the benefit exceeds the cost, it is efficient for Dick to keep the dog and for Jane to live with the barking. Yet if the cost exceeds the benefit, then Dick should get rid of the dog.

According to the Coase theorem, the private market will reach the efficient outcome on its own. How? Jane can simply offer to pay Dick to get rid of the dog. Dick will accept the deal if the amount of money Jane offers is greater than the benefit of keeping the dog.

By bargaining over the price, Dick and Jane can always reach the efficient outcome. For instance, suppose that Dick gets a \$500 benefit from the dog and Jane bears an \$800 cost from the barking. In this case, Jane can offer Dick \$600 to get rid of the dog, and Dick will gladly accept. Both parties are better off than they were before, and the efficient outcome is reached.

It is possible, of course, that Jane would not be willing to offer any price that Dick would accept. For instance, suppose that Dick gets a \$1,000 benefit from the dog and Jane bears an \$800 cost from the barking. In this case, Dick would turn down any offer below \$1,000, while Jane would not offer any amount above \$800. Therefore, Dick ends up keeping the dog. Given these costs and benefits, however, this outcome is efficient.

So far, we have assumed that Dick has the legal right to keep a barking dog. In other words, we have assumed that Dick can keep Spot unless Jane pays him enough to induce him to give up the dog voluntarily. But how different would the outcome be if Jane had the legal right to peace and quiet?

According to the Coase theorem, the initial distribution of rights does not matter for the market's ability to reach the efficient outcome. For instance, suppose that Jane can legally compel Dick to get rid of the dog. Although having this right works to Jane's advantage, it probably will not change the outcome. In this case, Dick can offer to pay Jane to allow him to keep the dog. If the benefit of the dog to Dick exceeds the cost of the barking to Jane, then Dick and Jane will strike a bargain in which Dick keeps the dog.

Although Dick and Jane can reach the efficient outcome regardless of how rights are initially distributed, the distribution of rights is not irrelevant: It determines the distribution of economic well-being. Whether Dick has the right to a barking dog or Jane the right to peace and quiet determines who pays whom in the final bargain. But in either case, the two parties can bargain with each other and solve the externality problem. Dick will end up keeping the dog only if the benefit exceeds the cost.

To sum up: *The Coase theorem says that private economic actors can solve the problem of externalities among themselves. Whatever the initial distribution of rights, the interested parties can always reach a bargain in which everyone is better off and the outcome is efficient.*

WHY PRIVATE SOLUTIONS DO NOT ALWAYS WORK

Despite the appealing logic of the Coase theorem, private individuals on their own often fail to resolve the problems caused by externalities. The Coase theorem applies only when the interested parties have no trouble reaching and enforcing

an agreement. In the real world, however, bargaining does not always work, even when a mutually beneficial agreement is possible.

Sometimes the interested parties fail to solve an externality problem because of **transaction costs**, the costs that parties incur in the process of agreeing to and following through on a bargain. In our example, imagine that Dick and Jane speak different languages so that, to reach an agreement, they 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.

At 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.

QUICK QUIZ Give an example of a private solution to an externality. • What is the Coase theorem? • Why are private economic participants sometimes unable to solve the problems caused by an externality?

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.

transaction costs
the costs that parties incur in the process of agreeing to and following through on a bargain