chapter 19

>> Externalities

Section 1: The Economics of Pollution

Pollution is a bad thing. Yet most pollution is a side effect of activities that provide us with good things: our air is polluted by power plants generating the electricity that lights our cities, and our rivers are damaged by fertilizer runoff from farms that grow our food. Why don't we accept a certain amount of pollution as the cost of a good life?

Actually, we do. Even highly committed environmentalists don't think that we can or should completely eliminate pollution—even an environmentally conscious society would accept *some* pollution as the cost of producing useful goods and services. What environmentalists argue is that unless there is a strong and effective environmental policy, our society will generate *too much* pollution—too much of a bad thing. And the great majority of economists agree.

To see why, we need a framework that lets us think about how much pollution a society *should* have. We'll then be able to see why a market economy, left to itself, will produce more pollution than it should. We'll start by adopting the simplest framework to study the problem—assuming that the amount of pollution emitted by a polluter is directly observable and controllable.

The **marginal social cost of pollution** is the additional cost imposed on society as a whole by an additional unit of pollution.

The **marginal social benefit of pollution** is the additional gain to society as a whole from an additional unit of pollution.

The **socially optimal quantity of pollution** is the quantity of pollution that society would choose if all the costs and benefits of pollution were fully accounted for.

Costs and Benefits of Pollution

How much pollution should society allow? We learned in Chapter 7 that "how much" decisions always involve comparing the marginal benefit from an additional unit of something with the marginal cost of that additional unit. The same is true of pollution.

The **marginal social cost of pollution** is the additional cost imposed on society as a whole by an additional unit of pollution. For example, acid rain damages fisheries, crops, and forests, and each additional ton of sulfur dioxide released into the atmosphere increases the damage.

The **marginal social benefit of pollution**—the additional gain to society from an additional unit of pollution—may seem like a confusing concept. What's good about pollution? However, avoiding pollution requires using scarce resources that could have been used to produce other goods and services. For example, to reduce the quantity of sulfur dioxide they emit, power companies must either buy expensive low-sulfur coal or install special scrubbers to remove sulfur from their emissions. The more sulfur dioxide they are allowed to emit, the lower these extra costs. Suppose that we can calculate how much money the power industry would save if it were allowed to emit an additional ton of sulfur dioxide. That saving is the marginal benefit to society of emitting an extra ton of sulfur dioxide.

Using hypothetical numbers, Figure 19-1 shows how we can determine the **socially optimal quantity of pollution**—the quantity of pollution society would choose if all its costs and benefits were fully accounted for. The upward-sloping marginal social cost curve, *MSC*, shows how the marginal cost to society of an additional ton of pollution emissions varies with the quantity of emissions. (An upward slope is likely because nature can often safely handle low levels of pollution but is increasingly

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SO HOW DO YOU MEASURE THE MARGINAL SOCIAL COST OF POLLUTION?

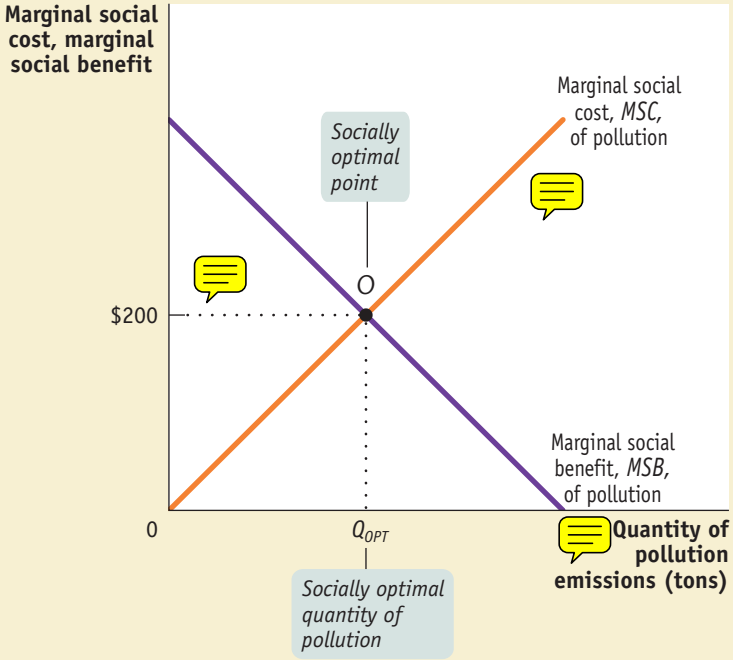
It might be confusing to think of marginal *social* cost—after all, we have up to this point always defined marginal cost as being incurred by an individual or a firm, not society as a whole. But it is easily understandable once we link it to the familiar concept of willingness to pay: the marginal social cost of a unit of pollution is equal to the *highest willingness to pay among all members of society* to avoid that unit of pollution. But calculating the true cost to society of pollution—marginal or average—is a difficult matter, requiring a great deal of scientific knowledge. As a result, society often underestimates the true marginal social cost of pollution.

harmed as pollution reaches high levels.) The marginal social benefit curve, *MSB*, is downward sloping because it is progressively harder, and therefore more expensive, to achieve a further reduction in pollution as the total amount of pollution falls—increasingly more expensive technology must be used. As a result, as pollution falls, the cost

Figure 19-1

The Socially Optimal Quantity of Pollution

Pollution yields both costs and benefits. Here the curve *MSC* shows how the marginal cost to society as a whole from emitting one more ton of pollution emissions depends on the quantity of emissions. The curve *MSB* shows how the marginal benefit to society as a whole of emitting an additional ton of pollution emissions depends on the quantity of pollution emissions. The socially optimal quantity of pollution is Q_{OPT}; at that quantity, the marginal social benefit of pollution is equal to the marginal social cost, corresponding to $200.



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SO HOW DO YOU MEASURE THE MARGINAL SOCIAL BENEFIT OF POLLUTION?

Similar to the problem of measuring the marginal social cost of pollution, the concept of willingness to pay helps us understand the marginal social benefit of pollution in contrast to the marginal benefit to an individual or firm. The marginal social benefit of a unit of pollution is simply equal to the highest willingness to pay for the right to emit that unit across all polluters. But unlike the marginal social cost of pollution, the value of the marginal social benefit of pollution is a number likely to be known—to polluters, that is.

savings to a polluter of being allowed to emit one more ton rises.

The socially optimal quantity of pollution in this example isn't zero. It's Q_{OPT}, the quantity corresponding to point *O*, where *MSB* crosses *MSC*. At Q_{OPT}, the marginal social benefit from an additional ton of emissions and its marginal social cost are equalized at $200.

But will a market economy, left to itself, arrive at the socially optimal quantity of pollution? No, it won't.

Pollution: An External Cost

Pollution yields both benefits and costs to society. But in a market economy without government intervention, those who benefit from pollution—like the owners of power companies—decide how much pollution occurs. They have no incentive to take into account the costs of pollution that they impose on others.

To see why, remember the nature of the benefits and costs from pollution. For polluters, the benefits take the form of monetary savings: by emitting an extra ton of sulfur dioxide, any given polluter saves the cost of buying expensive, low-sulfur coal or installing pollution-control equipment. So the benefits of pollution accrue directly to the polluters.

The costs of pollution, though, fall on people who have no say in the decision about how much pollution takes place: people who fish in northeastern lakes do not control the decisions of power plants.

Figure 19-2 shows the result of this asymmetry between who reaps the benefits and who pays the costs. In a market economy without government intervention to protect the environment, only the benefits of pollution are taken into account in choosing the quantity of pollution. So the quantity of emissions won't be at the socially optimal quantity Q_{OPT}; it will be Q_{MKT}, the quantity at which the marginal social benefit of an additional ton of pollution is zero, but the marginal social cost of that additional ton is much larger—$400. The quantity of pollution in a market economy

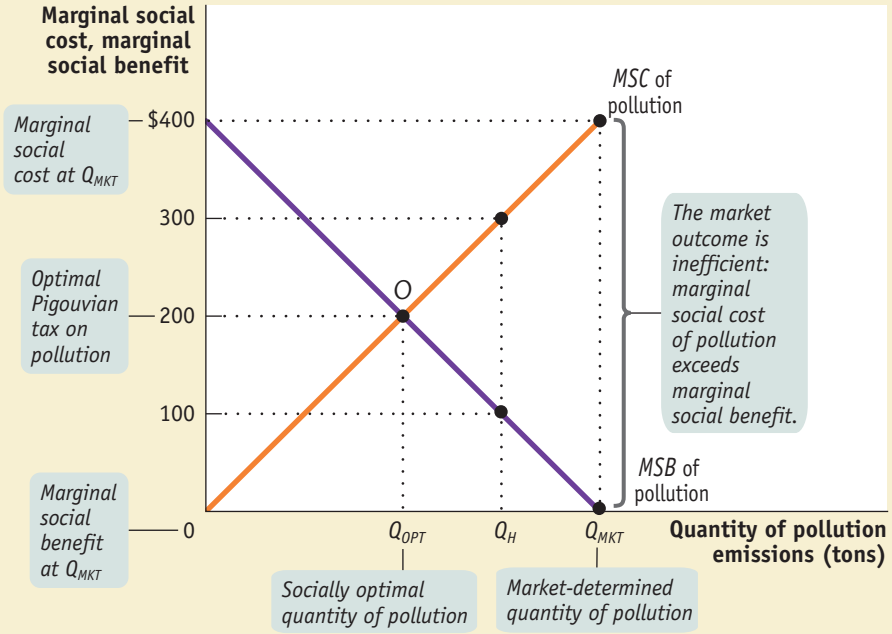
without government intervention will be higher than its socially optimal quantity. (The Pigouvian tax noted in Figure 19-2 will be explained shortly.)

The reason is that in the absence of government intervention, those who derive the benefits from pollution—in this case, the owners of power plants—don't have to compensate those who bear the costs. So the marginal cost of pollution to any given

Figure 19-2

Why a Market Economy Produces Too Much Pollution

In the absence of government intervention, the quantity of pollution will be Q_{MKT}, the level at which the marginal social benefit of pollution to polluters is zero. This is an inefficiently high quantity of pollution: the marginal social cost, $400, greatly exceeds the marginal social benefit, $0. An optimal Pigouvian tax of $200, the value of the marginal social cost of pollution when it equals the marginal social benefit of pollution, can move the market to the socially optimal quantity of pollution, Q_{OPT}. >web...



polluter is zero: polluters have no incentive to limit the amount of emissions. For example, before the Clean Air Act of 1970, midwestern power plants used the cheapest type of coal available, regardless of how much pollution it caused, and did nothing to scrub their emissions.

The environmental costs of pollution are the best-known and most important example of an **external cost**—an uncompensated cost that an individual or firm imposes on others. There are many other examples of external costs besides pollution. Another important, and certainly very familiar, external cost is traffic congestion—an individual who chooses to drive during rush hour increases congestion and so increases the travel time of other drivers.

An **external cost** is an uncompensated cost that an individual or firm imposes on others.

We'll see later in this chapter that there are also important examples of **external benefits,** benefits that individuals or firms confer on others without receiving compensation. External costs and benefits are jointly known as **externalities,** with external costs called **negative externalities** and external benefits called **positive externalities.**

An **external benefit** is a benefit that an individual or firm confers on others without receiving compensation.

External costs and benefits are known as **externalities;** external costs are **negative externalities,** and external benefits are **positive externalities.**

As we've already suggested, externalities can lead to individual decisions that are not optimal for society as a whole. Let's take a closer look at why, focusing on the case of pollution.

The Inefficiency of Excess Pollution

We have just shown that in the absence of government action, the quantity of pollution will be *inefficient:* polluters will pollute up to the point at which the marginal social benefit of pollution is zero, as shown by the pollution quantity Q_{MKT} in Figure 19-2. Recall that an outcome is inefficient if some people could be made better off without making others worse off. In Chapter 6 we showed why the market equilibrium quantity in a perfectly competitive market is the efficient quantity of the good, the quantity that maximizes total surplus. Here, we can use a variation of that analysis to show how the presence of a negative externality upsets that result.

Because the marginal social benefit of pollution is zero at Q_{MKT}, reducing the quan-

tity of pollution by one ton would subtract very little from the total social benefit from pollution. In other words, the benefit to polluters to that last unit of pollution is very low—virtually zero. Meanwhile, the marginal social cost imposed on the rest of society of that last ton of pollution at Q_{MKT} is quite high—$400. This means that by reducing the quantity of pollution at Q_{MKT} by one ton, the total social cost of pollution falls by $400, while total social benefits fall by virtually zero. So total surplus rises by approximately $400 if the quantity of pollution at Q_{MKT} is reduced by one ton.

If the quantity of pollution is reduced further, there will be more gains in total surplus, though they will be smaller. For example, if the quantity of pollution is Q_H in Figure 19-2, the marginal social benefit of a ton of pollution is $100, but the marginal social cost is still $300. This means that reducing the quantity of pollution by one ton leads to a net gain in total surplus of approximately $300 – $100 = $200. This tells us that Q_H is still an inefficiently high quantity of pollution. Only if the quantity of pollution is reduced to Q_{OPT}, where the marginal social cost and the marginal social benefit of an additional ton of pollution are both $200, is the outcome efficient.

Private Solutions to Externalities

Can the private sector solve the problem of externalities without government intervention? Bear in mind that when an outcome is inefficient, there is potentially a deal that makes people better off. Why don't individuals find a way to make that deal?

In an influential 1960 article, the economist and Nobel laureate Ronald Coase pointed out that in an ideal world the private sector could indeed deal with all externalities. According to the **Coase theorem,** even in the presence of externalities an economy can always reach an efficient solution provided that the costs of making a deal are sufficiently low. The costs of making a deal are known as **transaction costs.**

According to the **Coase theorem,** even in the presence of externalities an economy can always reach an efficient solution as long as **transaction costs**—the costs to individuals of making a deal—are sufficiently low.

To get a sense of Coase's argument, imagine two neighbors, Mick and Britney, who both like to barbecue in their backyards on summer afternoons. Mick likes to play golden oldies on his boombox while barbecuing; but this annoys Britney, who can't

stand that kind of music.

Who prevails? You might think that it depends on the legal rights involved in the case: if the law says that Mick has the right to play whatever music he wants, Britney just has to suffer; if the law says that Mick needs Britney's consent to play music in his backyard, Mick has to live without his favorite music while barbecuing.

But as Coase pointed out, the outcome need not be determined by legal rights, because Britney and Mick can make a private deal. Even if Mick has the right to play his music, Britney could pay him not to. Even if Mick can't play the music without an OK from Britney, he can offer to pay her to give that OK. These payments allow them to reach an efficient solution, regardless of who has the legal upper hand. If the benefit of the music to Mick exceeds its cost to Britney, the music will go on; if the benefit to Mick is less than the cost to Britney, there will be silence.

The implication of Coase's analysis is that externalities need not lead to inefficiency because individuals have an incentive to make mutually beneficial deals—deals that lead them to take externalities into account when making decisions. When individuals *do* take externalities into account when making decisions, economists say that they **internalize the externality.** If externalities are fully internalized, the outcome is efficient even without government intervention.

When individuals take external costs or benefits into account, they **internalize the externality.**

Why can't individuals always internalize externalities? Our barbecue example implicitly assumes the transaction costs are low enough for Mick and Britney to be able to make a deal. In many situations involving externalities, however, transaction costs prevent individuals from making efficient deals. Examples of transaction costs include the following:

- The costs of communication among the interested parties—costs that may be very high if many people are involved
- The costs of making legally binding agreements—costs that may be high if the employment of expensive lawyers is required

- Costly delays involved in bargaining—even if there is a potentially beneficial deal, both sides may hold out in an effort to extract more favorable terms, leading to increased effort and forgone utility

In some cases, people do find ways to reduce transaction costs, allowing them to internalize externalities. For example, many people live in private communities that set rules for home maintenance and behavior, making bargaining between neighbors unnecessary. But in many other cases, transaction costs are too high to make it possible to deal with externalities through private action. For example, tens of millions of people are adversely affected by acid rain. It would be prohibitively expensive to try to make a deal among all those people and all those power companies.

When transaction costs prevent the private sector from dealing with externalities, it is time to look for government solutions. We turn to public policy in the next section. ■