Module 74



# Introduction to Externalities

## What you will learn in this Module:

- What externalities are and why they can lead to inefficiency in a market economy
- Why externalities often require government intervention
- The difference between negative and positive externalities
- The importance of the Coase theorem, which explains how private individuals can sometimes remedy externalities

Module 74: Introduction to Externalities...

# 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 sullied by fertilizer runoff from farms that grow our food. Why shouldn'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 a framework to study the problem under the simplifying assumption that the amount of pollution emitted by a polluter is directly observable and controllable.

The Economics of Pollution

# Costs and Benefits of Pollution



How much pollution should society allow? We learned previously 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 harms fisheries, crops, and forests; and each additional ton of sulfur dioxide released into the atmosphere increases the harm.

The **marginal social benefit of pollution** is the additional benefit to society from an additional unit of pollution. This concept may seem counterintuitive—what's good about pollution? However, pollution avoidance requires the use of money and inputs that could otherwise be used for other purposes. 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 are these avoidance costs. If we calculated how much money the power industry would save if it were allowed to emit an additional ton of sulfur dioxide, that savings would be the marginal benefit to society of emitting that ton of sulfur dioxide.

Using hypothetical numbers, **Figure 74.1** shows how we can determine the **socially optimal quantity of pollution**—the quantity of pollution that makes society as well off as possible, taking all costs and benefits into account. The upward-sloping marginal social cost curve, labeled *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 harmed as pollution reaches high levels.) The marginal social benefit curve, labeled *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 savings to a polluter of being allowed to emit one more ton rises.

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

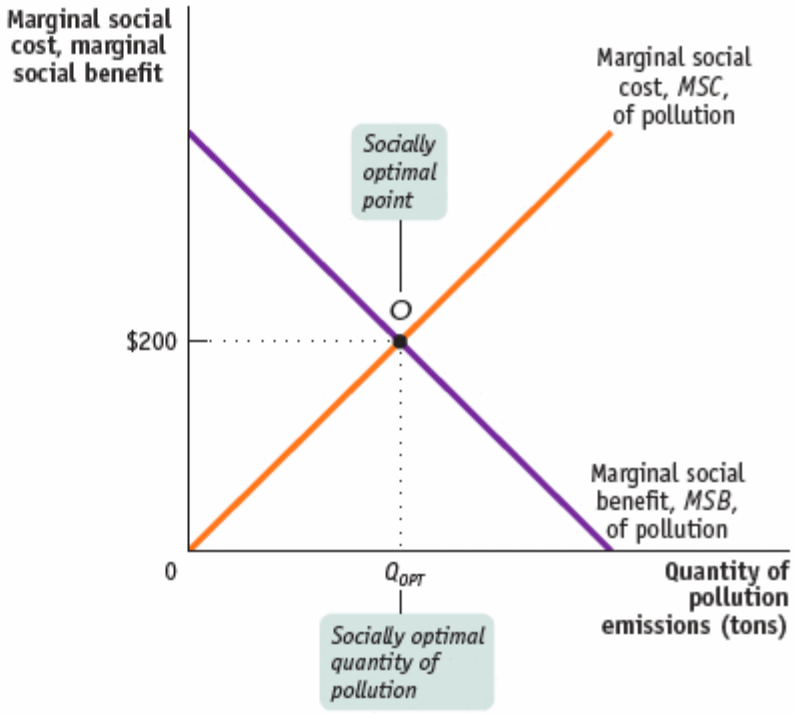
The **marginal social benefit of pollution** is the additional gain to society as a whole from an additional unit of pollution.

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.

figure 74.1

## 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.




The socially optimal quantity of pollution in this example isn't zero. It's $Q_{OPT}$, the quantity corresponding to point *O*, where the marginal social benefit curve crosses the marginal social cost curve. 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.

Costs and Benefits of Pollution

# 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: for example, people who fish in northeastern lakes do not control the decisions of power plants.

figure 74.2

**Why a Market Economy Produces Too Much Pollution**

In the absence of government intervention, the quantity of pollution will be $Q_{MKT}$, the quantity at which the marginal social benefit of pollution equals the price polluters pay for each unit of pollution they emit: $0. This is an inefficiently high quantity of pollution because the marginal social cost, $400, greatly exceeds the marginal social benefit, $0.

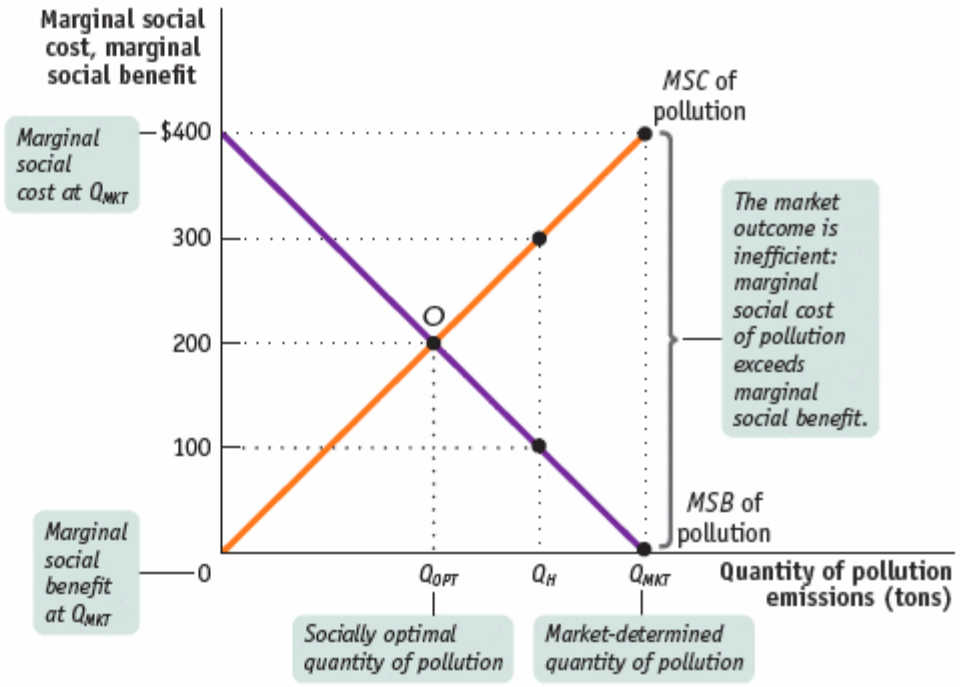



**Figure 74.2** shows the result of this asymmetry between who reaps the benefits and who pays the costs. In a market economy without government intervention to protect the environment, only the benefits of pollution are taken into account in choosing the quantity of pollution. So the quantity of emissions won't be 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 reason is that in the absence of government intervention, those who derive the benefit from pollution—the owners of polluting firms—don't have to compensate those who bear the cost. So the marginal cost of pollution to any given polluter is zero (the assumption being that the polluter isn't also

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

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

the pollution victim): 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, despite the fact that cheap coal generated more pollution, and they did nothing to scrub their emissions.

benefits are **positive externalities**.

The environmental cost of pollution is perhaps 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 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.

Traffic congestion is a negative externality. iStockphoto

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

fyi

### Talking and Driving

Why is that woman in the car in front of us driving so erratically? Is she drunk? No, she's talking on her cell phone.

Traffic safety experts take the risks posed by driving while talking very seriously. Using hands-free, voice-activated phones doesn't seem to help much because the main danger is distraction. As one traffic safety consultant put it, "It's not where your eyes are; it's where your head is." And we're not talking about a trivial problem. One estimate suggests that people who talk on their cell phones while driving may be responsible for 600 or more traffic deaths each year.

The National Safety Council urges people not to use phones while driving. But a growing number of people say that voluntary standards aren't enough; they want the use of cell phones while driving made illegal, as it already is in eight states and the District of Columbia, as well as in Japan, Israel, and many other countries.

Why not leave the decision up to the driver? Because the risk posed by driving while talking isn't just a risk to the driver; it's also a safety risk to others—especially people in other cars. Even if you decide that the benefit to you of taking that call is worth the cost, you aren't taking into account the cost to other people. Driving while talking, in other words, generates a serious—sometimes fatal—negative externality.

iStockphoto

Pollution: An External Cost

# 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 quantity $Q_{MKT}$ in **Figure 74.2**. Recall that an outcome is inefficient if some people could be made better off without making others worse off. We have already seen why the equilibrium quantity in a perfectly competitive market with no externalities 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 quantity of pollution by one ton would subtract very little from the total social benefit from pollution. In other words, the benefit to polluters from 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. In other words, by reducing the quantity of pollution at $Q_{MKT}$ by one ton, the total social cost of pollution falls by $400, but total social benefit falls 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 74.2**, the marginal social benefit of a ton of pollution is $100, but the marginal social cost is still much higher at $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. Thus $Q_H$ 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.

The Inefficiency of Excess Pollution

# 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, 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 reach an efficient solution, provided that the legal rights of the parties are clearly defined and the costs of making a deal are sufficiently low. In some cases it takes a lot of time, or even money, to bring the relevant parties together, negotiate a deal, and carry out the terms of the deal. The costs of making a deal are known as **transaction costs**.

To get a sense of Coase's argument, imagine two neighbors, Mick and Christina, 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 Christina, who can't stand that kind of music.

Who prevails? You might think 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, Christina just has to suffer; if the law says that Mick needs Christina'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 Christina and Mick can make a private deal as long as the legal rights are clearly defined. Even if Mick has the right to play his music, Christina could pay him not to. Even if Mick can't play the music without an OK from Christina, 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 Christina, the music will go on; if the benefit to Mick is less than the cost to Christina, 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 externalities**. If externalities are fully internalized, as when Mick must forgo a payment from Christina *equal to the external cost he imposes on her* in order to play music, the outcome is efficient even without government intervention.

Why can't individuals always internalize externalities? Our barbecue example implicitly assumes the transaction costs are low enough for Mick and Christina 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*. Such costs may be very high if many people are involved.

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

- *The costs of making legally binding agreements*. Such costs may be high if expensive legal services are 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.

fyi

### Thank You for Not Smoking

New Yorkers call them the "shiver-and-puff people"—the smokers who stand outside their workplaces, even in the depths of winter, to take a cigarette break. Over the past couple of decades, rules against smoking in spaces shared by others have become ever stricter. This is partly a matter of personal dislike—nonsmokers really don't like to smell other people's cigarette smoke—but it also reflects concerns over the health risks of second-hand smoke. As the Surgeon General's warning on many packs says, "Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy." And there's no question that being in the same room as someone who smokes exposes you to at least some health risk.

Second-hand smoke, then, is clearly an example of a negative externality. But how important is it? Putting a dollar-and-cents value on it—that is, measuring the marginal social cost of cigarette smoke—requires researchers to not only estimate the health effects but also put a value on these effects. Despite the difficulty, economists have tried. A paper published in 1993 in the Journal of Economic Perspectives surveyed the research on the external costs of both cigarette smoking and alcohol consumption.

According to this paper, conclusions regarding the health costs of cigarettes depend on whether the costs imposed on members of smokers' families, including unborn children, are counted along with the costs borne by smokers. If not, the external costs of secondhand smoke have been estimated at about $0.19 per pack smoked. (Using this method of calculation, $0.19 corresponds to the average social cost of smoking per pack at the current level of smoking in society.) A 2005 study raised this estimate to $0.52 per pack smoked. If the effects on smokers' families are included, the number rises considerably—family members who live with smokers are exposed to a lot more smoke. (They are also exposed to the risk of fire, which alone is estimated at $0.09 per pack.) If you include the effects of smoking by pregnant women on their unborn children's future health, the cost is immense—$4.80 per pack, which is more than twice the wholesale price charged by cigarette manufacturers.

In some cases, transaction costs are low enough to allow individuals to resolve externality problems. For example, while filming *A League of Their Own* on location in a neighborhood ballpark, director Penny Marshall paid a man $100 to stop using his noisy chainsaw nearby. 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—the subject of the next module.

**Private Solutions to Externalities**

# Module 74 AP Review

Solutions appear at the back of the book.



## Check Your Understanding

**1.** Wastewater runoff from large poultry farms adversely affects residents in neighboring homes. Explain the following:

**a.** why this is considered an externality problem

[Answer Field]

Hide Answer

**Correct Answer**

This is an externality problem because the cost of wastewater runoff is imposed on the farms' neighbors with no compensation and no other way for the farms to internalize the cost.

**b.** the efficiency of the outcome with neither government intervention nor a private deal

[Answer Field]

Hide Answer

**Correct Answer**

Since the large poultry farmers do not take the external cost of their actions into account when making decisions about how much wastewater to generate, they will create more runoff than is socially optimal. They will produce runoff up to the point at which the marginal social benefit of an additional unit of runoff is zero; however, their neighbors experience a high, positive level of marginal social cost of runoff from this output level. So the quantity of wastewater runoff is inefficient: reducing runoff by one unit would reduce total social benefit by less than it would reduce total social cost.

**c.** how the socially optimal outcome is determined and how it compares with the no-intervention, no-deal outcome

[Answer Field]

Hide Answer

**Correct Answer**

At the socially optimal quantity of wastewater runoff, the marginal social benefit is equal to the marginal social cost. This quantity is lower than the quantity of waste-water runoff that would be created in the absence of government intervention or a private deal.

**2.** According to Yasmin, any student who borrows a book from the university library and fails to return it on time imposes a negative externality on

other students. She claims that rather than charging a modest fine for late returns, the library should charge a huge fine, so that borrowers will never return a book late. Is Yasmin's economic reasoning correct?

**[Answer Field]**

Hide Answer

**Correct Answer**

Yasmin's reasoning is not correct: allowing some late returns of books is likely to be socially optimal. Although you impose a marginal social cost on others every day that you are late in returning a book, there is some positive marginal social benefit to you of returning a book late—you get a longer period during which to use it for education and pleasure. If you need it for a book report, the additional benefit from another day might be large indeed.

The socially optimal number of days that a book is returned late is the number at which the marginal social benefit equals the marginal social cost. A fine so stiff that it prevents any late returns is likely to result in a situation in which people return books although the marginal social benefit of keeping them another day is greater than the marginal social cost—an inefficient outcome. In that case, allowing an overdue patron another day would increase total social benefit more than it would increase total social cost. So charging a moderate fine that reduces the number of days that books are returned late to the socially optimal number of days is appropriate.

Check Your Understanding