section 14

Market Failure and the Role of Government

For many people in the northeastern United States, there is no better way to relax than to fish in one of the region's thousands of lakes. But in the 1960s, avid fishermen noticed something alarming: lakes that had formerly teemed with fish were now almost empty. What had happened?

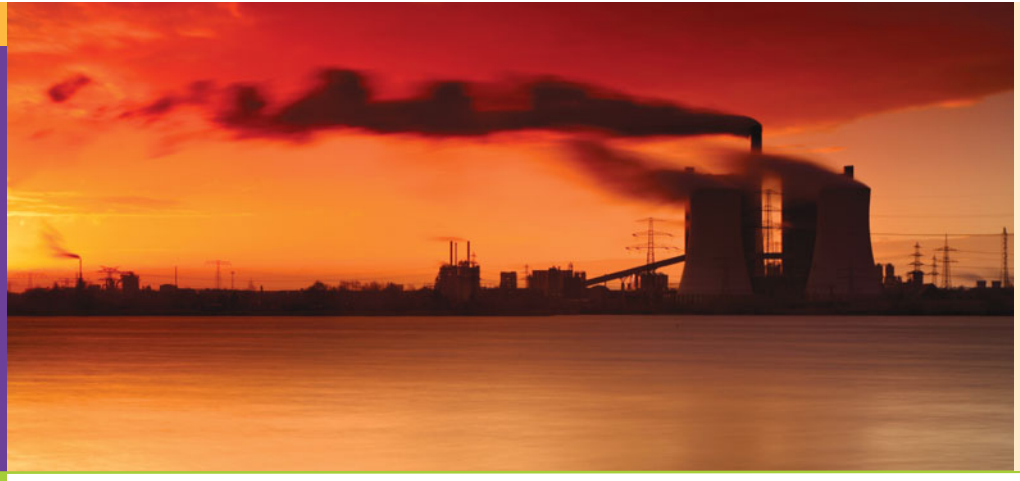
The answer was acid rain, caused mainly by coal-burning power plants. When coal is burned, it releases sulfur dioxide and nitric oxide into the atmosphere; these gases react with water, producing sulfuric acid and nitric acid. The result in the Northeast, downwind from the nation's industrial heartland, was rain sometimes as acidic as lemon juice. Acid rain didn't just kill fish; it also damaged trees and crops, and in time even began to dissolve limestone buildings.

You'll be glad to hear that the acid rain problem today is much less serious than it was in the 1960s. Power plants have reduced their emissions by switching to low-sulfur coal and installing scrubbers in their smokestacks. But they didn't do this out of the goodness of their hearts; they did it in response to government policy. Without such government intervention, power companies would have had no incentive to take the environmental effects of their actions into account.

AP/Wide World Photos

For many polluters, acid rain is someone else's problem.

The Gulf of Mexico oil spill of 2010 is among the reminders that environmental problems persist. Neglected pollution is one of several reasons why markets sometimes fail to deliver efficient quantities of goods and services. We've already seen that inefficiency can arise from market power, which allows monopolists and colluding oligopolists to charge prices above marginal cost, thereby preventing mutually beneficial transactions from occurring. In this section we will consider other reasons for market failure. In Modules 74 and 75, we will see that inefficiency can arise from *externalities,* which create a conflict between the best interests of an individual or a firm and the best interests of society as a whole. In Module 76, we will focus on how the characteristics of goods often determine whether markets can deliver them efficiently. In Modules 77 and 78, we look at the role of government in addressing market failures. The investigation of sources of inefficiency will deepen our understanding of the types of policy that can make society better off.



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 **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.

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.

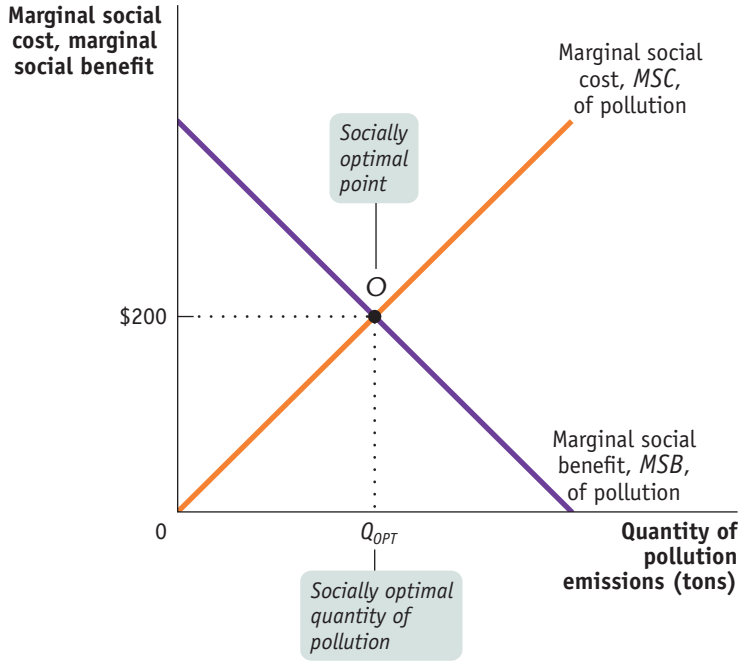
The **socially optimal quantity of pollution** is the quantity of pollution that society would choose if all the costs and benefits of pollution were fully accounted for.

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.

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.

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

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 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.

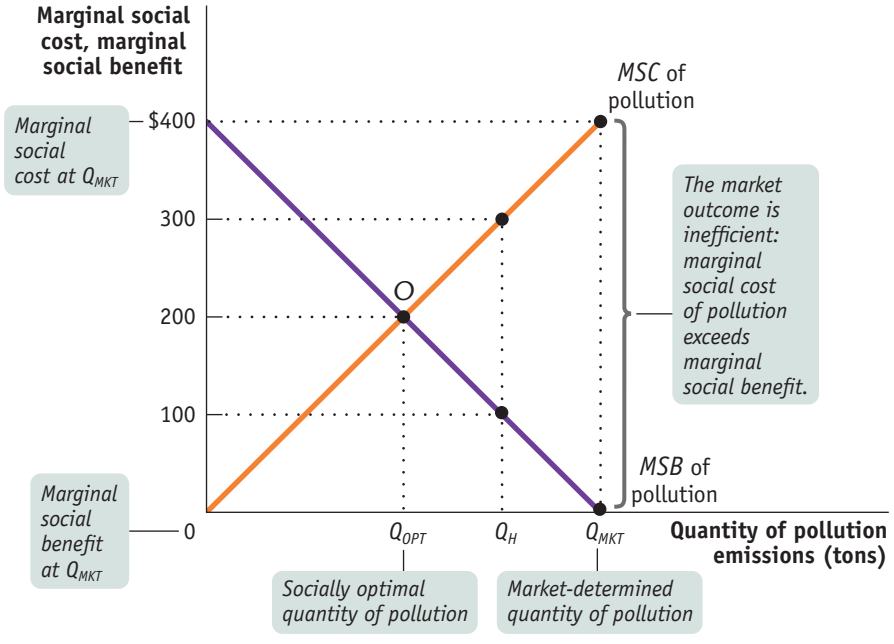
The reason is that in the absence of government intervention, those who derive the benefit from pollution—the owners of polluting firms—don't have to compensate those who bear the cost. So the marginal cost of pollution to any given polluter is zero (the assumption being that the polluter isn't also 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.

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

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.



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.

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.**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Traffic congestion is a negative externality.

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.

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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.


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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

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.**

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 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.

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

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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 second-hand 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.

- *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, 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.

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
   b. the efficiency of the outcome with neither government intervention nor a private deal
   c. how the socially optimal outcome is determined and how it compares with the no-intervention, no-deal outcome
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?

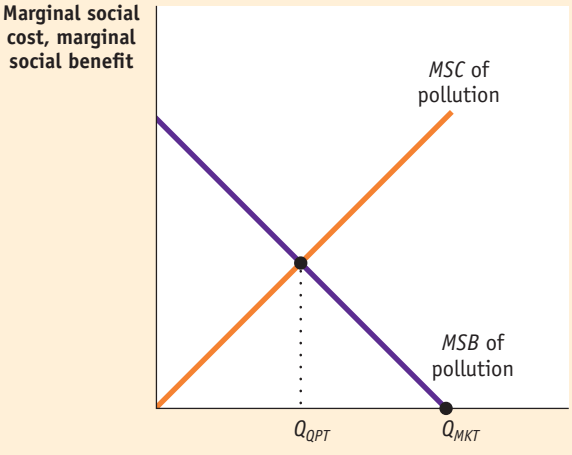
Tackle the Test: Multiple-Choice Questions

1. The socially optimal level of pollution is
   a. less than that created by the market, but not zero.
   b. more than that created by the market.
   c. whatever the market creates.
   d. determined by firms.
   e. zero.
2. Which of the following is a source of negative externalities?
   a. loud conversations in a library
   b. smokestack scrubbers
   c. a beautiful view
   d. national defense
   e. a decision to purchase dressy but uncomfortable shoes.
3. Inefficiencies created by externalities can be dealt with through
   a. government actions only.
   b. private actions only.
   c. market outcomes only.
   d. either private or government actions.
   e. neither private nor government actions.
4. The Coase theorem asserts that, under the right circumstances, inefficiencies created by externalities can be dealt with through
   a. lawsuits.
   b. private bargaining.
   c. vigilante actions.
   d. government policies.
   e. mediation.
5. Which of the following makes it more likely that private solutions to externality problems will succeed?
   a. high transaction costs
   b. high prices for legal services
   c. delays in the bargaining process
   d. a small number of affected parties
   e. loosely defined legal rights

Tackle the Test: Free-Response Questions

1. Draw a correctly labeled graph showing the market-determined quantity of pollution, and explain why that quantity will be chosen in the absence of intervention and private deals. On the same graph, show the socially optimal level of pollution.

Answer (6 points)



1 point: The vertical axis is labeled "Marginal social cost, marginal social benefit" or "Dollars per unit" and the horizontal axis is labeled "Quantity of pollution" or "Q."

1 point: The marginal social cost curve is labeled and upward sloping.

1 point: The marginal social benefit curve is labeled and downward sloping.

1 point: The market-determined level of pollution is shown on the horizontal axis where the marginal social benefit curve reaches the horizontal axis.

1 point: In the absence of intervention and private deals, the marginal cost to a polluter of polluting is zero. Thus, pollution will continue until the marginal social benefit (all of which goes to the polluter) equals the polluter's marginal cost of zero, which occurs at the horizontal intercept of the marginal social cost curve.

1 point: The socially optimal level of pollution is shown on the horizontal axis below the intersection of *MSC* and *MSB*.

2. a. Define the marginal social cost of pollution.
   b. Define the marginal social benefit of pollution, and explain why polluting more can provide benefits to a firm even when it could produce the same quantity of output without polluting as much.
   c. Define the socially optimal level of pollution.

Module 75 Externalities and Public Policy

What you will learn in this Module:

- How external benefits and costs cause inefficiency in the markets for goods
- Why some government policies to deal with externalities, such as emissions taxes, tradable emissions permits, and Pigouvian subsidies, are efficient, although others, including environmental standards, are not

Policies Toward Pollution

Before 1970 there were no rules governing the amount of sulfur dioxide that power plants in the United States could emit—which is why acid rain got to be such a problem. In 1970, the Clean Air Act set rules about sulfur dioxide emissions; thereafter, the acidity of rainfall declined significantly. Economists argued, however, that a more flexible system of rules that exploited the effectiveness of markets could achieve lower pollution levels at a lower cost. In 1990 this theory was put into effect with a modified version of the Clean Air Act. And guess what? The economists were right!

In this section we'll look at the policies governments use to deal with pollution and at how economic analysis has been used to improve those policies.

Environmental Standards

Because the economy, and life itself, depend on a viable environment, external costs that threaten the environment—air pollution, water pollution, habitat destruction, and so on, are worthy of attention. Protection of the environment has become a major focus of government in every advanced nation. In the United States, the Environmental Protection Agency is the principal enforcer of environmental policies at the national level and is supported by the actions of state and local governments.

How does a country protect its environment? At present the main policy tools are **environmental standards,** rules that protect the environment by specifying actions by producers and consumers. A familiar example is the law that requires almost all vehicles to have catalytic converters, which reduce the emission of chemicals that can cause smog and lead to health problems. Other rules require communities to treat their sewage, factories to limit their pollution emissions, and homes to be painted with lead-free paint, among many other examples.

Environmental standards came into widespread use in the 1960s and 1970s with considerable success. Since the United States passed the Clean Air Act in 1970, for example, the emission of air pollutants has fallen by more than a third, even though the

Environmental standards are rules that protect the environment by specifying limits or actions for producers and consumers.

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Environmental standards are helping to erase the Los Angeles smog.

population has grown by a third and the size of the economy has more than doubled. Even in Los Angeles, still famous for its smog, the air has improved dramatically: in 1988 ozone levels in the surrounding South Coast Air Basin exceeded federal standards on 178 days; in 2008, on only 28 days.

Despite these successes, economists believe that when regulators can control a polluter's emissions directly, there are more efficient ways than environmental standards to deal with pollution. By using methods grounded in economic analysis, society can achieve a cleaner environment at lower cost. Most current environmental standards are inflexible and don't allow reductions in pollution to be achieved at the lowest possible cost. For example, two power plants—plant A and plant B—might be ordered to reduce pollution by the same percentage, even if their costs of achieving that objective are very different.

How does economic theory suggest that pollution should be controlled? We'll examine two approaches: taxes and tradable permits. As we'll see, either approach can achieve the efficient outcome at the minimum feasible cost.

Emissions Taxes

One way to deal with pollution directly is to charge polluters an **emissions tax.** Emissions taxes are taxes that depend on the amount of pollution a firm produces. For example, power plants might be charged $200 for every ton of sulfur dioxide they emit.

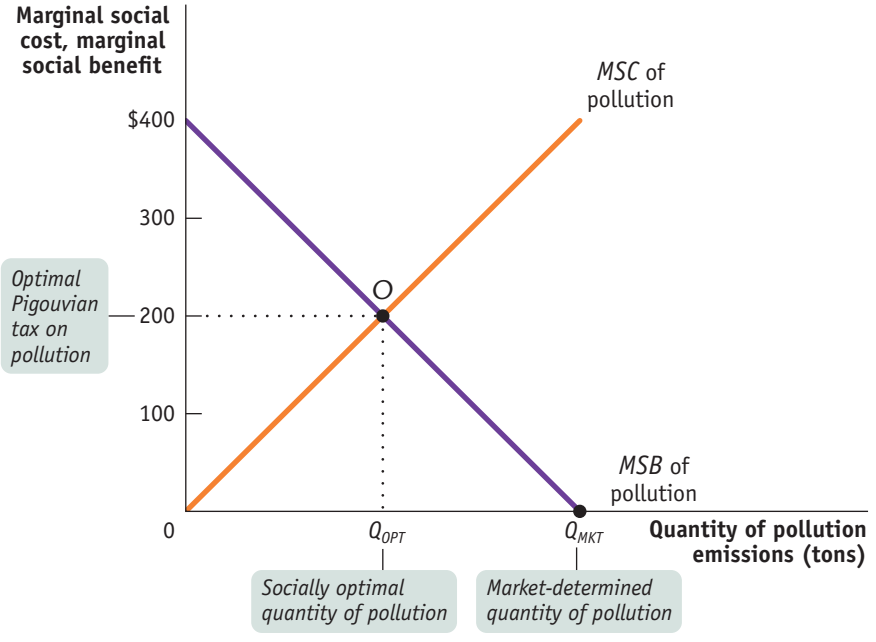
An **emissions tax** is a tax that depends on the amount of pollution a firm produces.

Consider the socially optimal quantity of pollution, Q_{OPT}, shown in Figure 75.1. At that quantity of pollution, the marginal social benefit and the marginal social cost of an additional ton of emissions are equal at $200. But in the absence of government intervention, power companies have no incentive to limit pollution to the socially optimal quantity Q_{OPT}; instead, they will push pollution up to the quantity Q_{MKT}, at which the marginal social benefit is zero.

figure 75.1

In Pursuit of the Efficient Quantity of Pollution

The market determined quantity of pollution, Q_{MKT}, is too high because polluters don't pay the marginal social cost, and thus pollute beyond the socially optimal quantity, Q_{OPT}, at which marginal social cost equals marginal social benefit. A Pigouvian tax of $200—the value of the marginal social cost of pollution when it equals the marginal social benefit of pollution—gives polluters the incentive to emit only the socially optimal quantity of pollution. Another solution is to provide permits for only the socially optimal quantity of pollution.

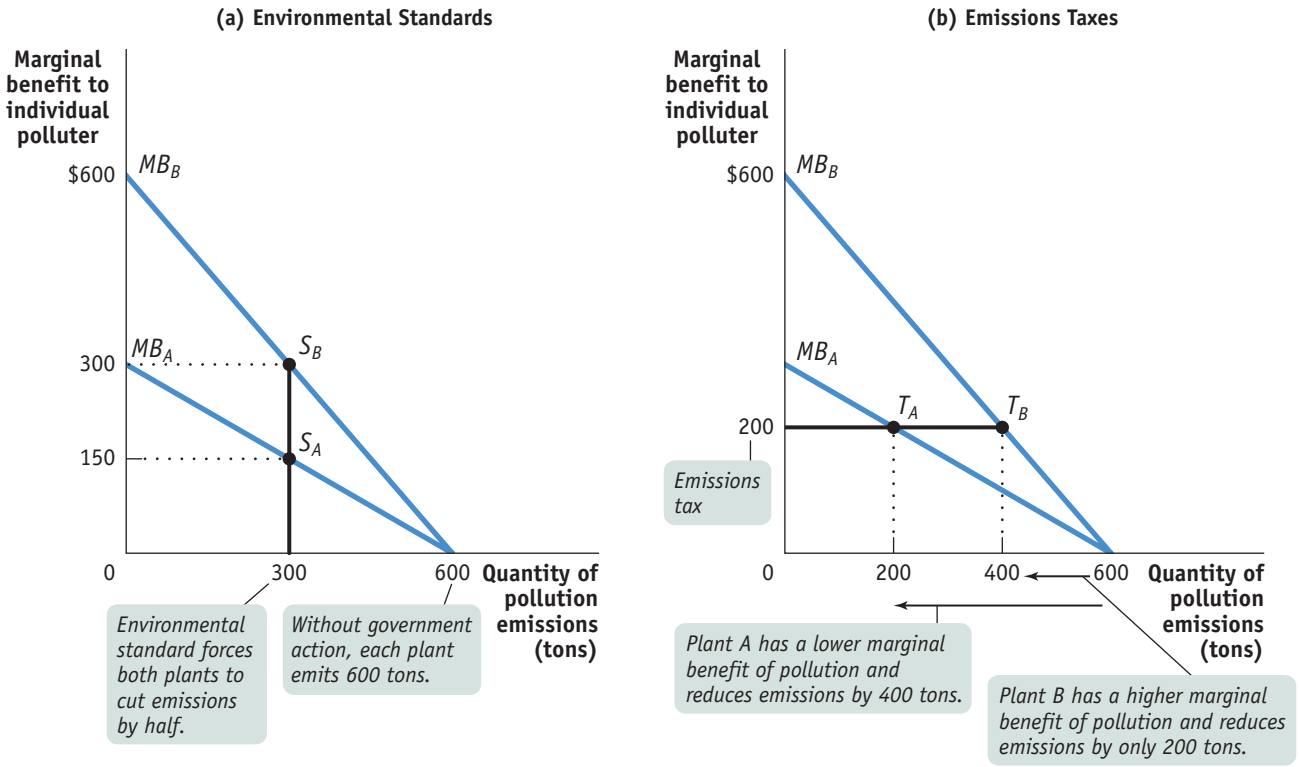


It's now easy to see how an emissions tax can solve the problem. If power companies are required to pay a tax of $200 per ton of emissions, they face a marginal cost of $200 per ton and have an incentive to reduce emissions to Q_{OPT}, the socially optimal quantity. This illustrates a general result: an emissions tax equal to the marginal social cost at the socially optimal quantity of pollution induces polluters to internalize the externality—to take into account the true cost to society of their actions.

Why is an emissions tax an efficient way (that is, a cost-minimizing way) to reduce pollution but environmental standards generally are not? Because an emissions tax ensures that the marginal benefit of pollution is equal for all sources of pollution, but an environmental standard does not. Figure 75.2 shows a hypothetical industry consisting of only two plants, plant A and plant B. We'll assume that plant A uses newer technology than plant B and so has a lower cost of reducing pollution. Reflecting this difference in costs, plant A's marginal benefit of pollution curve, MB_A, lies below plant B's marginal benefit of pollution curve, MB_B. Because it is more costly for plant B to reduce its pollution at any output quantity, an additional ton of pollution is worth more to plant B than to plant A.

In the absence of government action, polluters will pollute until the marginal social benefit of an additional unit of emissions is equal to zero. Recall that the marginal

figure 75.2 Environmental Standards versus Emissions Taxes



In both panels, MB_A shows the marginal benefit of pollution to plant A and MB_B shows the marginal benefit of pollution to plant B. In the absence of government intervention, each plant would emit 600 tons. However, the cost of reducing emissions is lower for plant A, as shown by the fact that MB_A lies below MB_B. Panel (a) shows the result of an environmental standard that requires both plants to cut emissions in half; this is inefficient, because it leaves the marginal benefit of pollution higher for plant B than for plant A. Panel (b) shows that an emissions tax achieves the same quantity of overall pollution efficiently: faced with an emissions tax of $200 per ton, both plants reduce pollution to the point where its marginal benefit is $200.

social benefit of pollution is the cost savings, at the margin, to polluters of an additional unit of pollution. As a result, without government intervention each plant will pollute until its own marginal benefit of pollution is equal to zero. This corresponds to an emissions quantity of 600 tons each for plants A and B—the quantity of pollution at which MB_A and MB_B are each equal to zero. So although plant A and plant B value a ton of emissions differently, without government action they will each choose to emit the same amount of pollution.

Now suppose that the government decides that overall pollution from this industry should be cut in half, from 1,200 tons to 600 tons. Panel (a) of Figure 75.2 shows how this might be achieved with an environmental standard that requires each plant to cut its emissions in half, from 600 to 300 tons. The standard has the desired effect of reducing overall emissions from 1,200 to 600 tons but accomplishes it in an inefficient way. As you can see from panel (a), the environmental standard leads plant A to produce at point S_A, where its marginal benefit of pollution is \$150, but plant B produces at point S_B, where its marginal benefit of pollution is twice as high, \$300.

This difference in marginal benefits between the two plants tells us that the same quantity of pollution can be achieved at lower total cost by allowing plant B to pollute more than 300 tons but inducing plant A to pollute less. In fact, the efficient way to reduce pollution is to ensure that at the industry-wide outcome, the marginal benefit of pollution is the same for all plants. When each plant values a unit of pollution equally, there is no way to rearrange pollution reduction among the various plants that achieves the optimal quantity of pollution at a lower total cost.

We can see from panel (b) how an emissions tax achieves exactly that result. Suppose both plant A and plant B pay an emissions tax of \$200 per ton so that the marginal cost of an additional ton of emissions to each plant is now \$200 rather than zero. As a result, plant A produces at T_A and plant B produces at T_B. So plant A reduces its pollution more than it would under an inflexible environmental standard, cutting its emissions from 600 to 200 tons; meanwhile, plant B reduces its pollution less, going from 600 to 400 tons. In the end, total pollution—600 tons—is the same as under the environmental standard, but total surplus is higher. That's because the reduction in pollution has been achieved efficiently, allocating most of the reduction to plant A, the plant that can reduce emissions at lower cost.

The term *emissions tax* may convey the misleading impression that taxes are a solution to only one kind of external cost, pollution. In fact, taxes can be used to discourage any activity that generates negative externalities, such as driving during rush hour or operating a noisy bar in a residential area. In general, taxes designed to reduce external costs are known as **Pigouvian taxes,** after the economist A.C. Pigou, who emphasized their usefulness in a classic 1920 book, *The Economics of Welfare.* Look again at Figure 75.1. In our example, the optimal Pigouvian tax is \$200; as you can see from Figure 75.1, this corresponds to the marginal social cost of pollution at the optimal output quantity, Q_{OPT}.

Are there any problems with emissions taxes? The main concern is that in practice government officials usually aren't sure at what level the tax should be set. If they set the tax too low, there will be too little improvement in the environment; if they set it too high, emissions will be reduced by more than is efficient. This uncertainty cannot be eliminated, but the nature of the risks can be changed by using an alternative strategy, issuing tradable emissions permits.

Tradable Emissions Permits

Taxes designed to reduce external costs are known as **Pigouvian taxes.**

Tradable emissions permits are licenses to emit limited quantities of pollutants that can be bought and sold by polluters.

Tradable emissions permits are licenses to emit limited quantities of pollutants that can be bought and sold by polluters. They are usually issued to polluting firms according to some formula reflecting their history. For example, each power plant might be issued permits equal to 50% of its emissions before the system went into

effect. The more important point, however, is that these permits are *tradable*. Firms with differing costs of reducing pollution can now engage in mutually beneficial transactions: those that find it easier to reduce pollution will sell some of their permits to those that find it more difficult. In other words, firms will use transactions in permits to reallocate pollution reduction among themselves, so that in the end those with the lowest cost will reduce their pollution the most and those with the highest cost will reduce their pollution the least. Assume that the government issues 300 permits each to plant A and plant B, where one permit allows the emission of one ton of pollution. Under a system of tradable emissions permits, commonly known as a *cap-and-trade program,* plant A will find it profitable to sell 100 of its 300 government-issued permits to plant B. The effect of a cap-and-trade program is to create a market in rights to pollute.

Just like emissions taxes, tradable permits provide polluters with an incentive to take the marginal social cost of pollution into account. To see why, suppose that the market price of a permit to emit one ton of sulfur dioxide is $200. Then every plant has an incentive to limit its emissions of sulfur dioxide to the point where its marginal benefit of emitting another ton of pollution is $200. This is obvious for plants that buy rights to pollute: if a plant must pay $200 for the right to emit an additional ton of sulfur dioxide, it faces the same incentives as a plant facing an emissions tax of $200 per ton. But it's equally true for plants that have more permits than they plan to use: by *not* emitting a ton of sulfur dioxide, a plant frees up a permit that it can sell for $200, so the opportunity cost of a ton of emissions to the plant's owner is $200.

In short, tradable emissions permits have the same cost-minimizing advantage as emissions taxes over environmental standards: either system ensures that those who can reduce pollution most cheaply are the ones who do so. The socially optimal quantity of pollution shown in Figure 75.1 could be efficiently achieved either way: by imposing an emissions tax of $200 per ton of pollution or by issuing tradable permits to emit Q_{OPT} tons of pollution. If regulators choose to issue Q_{OPT} permits, where one permit allows the release of one ton of emissions, then the equilibrium market price of a permit among polluters will indeed be $200. Why? You can see from Figure 75.1 that at Q_{OPT}, only polluters with a marginal benefit of pollution of $200 or more will buy a permit. And the last polluter who buys—who has a marginal benefit of exactly $200—sets the market price.

It's important to realize that emissions taxes and tradable permits do more than induce polluting industries to reduce their output. Unlike rigid environmental standards, emissions taxes and tradable permits provide incentives to create and use technology that emits less pollution—new technology that lowers the socially optimal level of pollution. The main effect of the permit system for sulfur dioxide has been to change *how* electricity is produced rather than to reduce the nation's electricity output. For example, power companies have shifted to the use of alternative fuels such as low-sulfur coal and natural gas; they have also installed scrubbers that take much of the sulfur dioxide out of a power plant's emissions.

The main problem with tradable emissions permits is the flip-side of the problem with emissions taxes: because it is difficult to determine the optimal quantity of pollution, governments can find themselves either issuing too many permits (that is, they don't reduce pollution enough) or issuing too few (that is, they reduce pollution too much).

After first relying on environmental standards, the U.S. government has turned to a system of tradable permits to control acid rain. Current proposals would extend the system to other major sources of pollution. And in 2005 the European Union created an emissions-trading scheme with the purpose of controlling emissions of carbon dioxide, a greenhouse gas. The European Union scheme is part of a larger global market for the trading of greenhouse gas permits. The FYI that follows describes these two systems in greater detail.

fyi

Cap and Trade

The tradable emissions permit systems for both acid rain in the United States and greenhouse gases in the European Union are examples of *cap and trade programs:* the government sets a *cap* (a total amount of pollution that can be emitted), issues tradable emissions permits, and enforces a yearly rule that a polluter must hold a number of permits equal to the amount of pollution emitted. The goal is to set the cap low enough to generate environmental benefits and, at the same time, to give polluters flexibility in meeting environmental standards and motivate them to adopt new technologies that will lower the cost of reducing pollution.

In 1994 the United States began a cap and trade system for the sulfur dioxide emissions that cause acid rain by issuing permits to power plants based on their historical consumption of coal. The cap of 8.95 million tons set for 2010 was about half the level of sulfur dioxide emissions in 1980. Economists who have analyzed the sulfur dioxide cap and trade system point to another reason for its success: it would have been a lot more expensive—80% more to be exact—to reduce emissions by this much using a non-market-based regulatory policy.

The European Union cap and trade scheme is the world's only mandatory trading scheme for greenhouse gases and covers all 27 member nations of the European Union. Available data indicate that within the system, 3,093 metric tons of emissions were transacted in 2008 and 6,326 metric tons in 2009, an astonishing increase of 105%. Although it is still too early to evaluate the system's performance, at the time of this writing the U.S. Senate was impressed enough with the preliminary results to consider proposing an American cap and trade system for greenhouse gases.

Despite all this good news, however, cap and trade systems are not silver bullets for the world's pollution problems. Although they are appropriate for pollution that's geographically dispersed, like sulfur dioxide and greenhouse gases, they don't work for pollution that's localized, like mercury or lead contamination. In addition, the amount of overall reduction in pollution depends on the level of the cap. Under industry pressure, regulators run the risk of issuing too many permits, effectively eliminating the cap. Finally, there must be vigilant monitoring of compliance if the system is to work. Without oversight of how much a polluter is actually emitting, there is no way to know for sure that the rules are being followed.

Production, Consumption, and Externalities

Nobody imposes external costs like pollution out of malice. Pollution, traffic congestion, and other negative externalities are side effects of activities, like electricity generation, manufacturing, or driving, that are otherwise desirable. We've just learned how government regulators can move the market to the socially optimal quantity when the side effects can be directly controlled. But as we cautioned earlier, in some cases it's not possible to directly control the side effects, only the activities that cause them can be influenced. As we'll see shortly, government policies in these situations must instead be geared to changing the levels of production and consumption that create externalities, which in turn changes the levels of the externalities themselves.

This approach, although slightly more complicated, has several advantages. First, for activities that generate external *costs,* it gives us a clear understanding of how the desirable activity is affected by policies designed to manage its side effects. Second, it helps us think about a question that is different but related to the problem of external costs: what should be done when an activity generates external *benefits.* It's important to realize that not all externalities are negative. There are, in fact, many positive externalities that we encounter every day; for example, a neighbor's bird-feeder has the side effect of maintaining the local wild bird population for everyone's enjoyment. And a beautiful flower garden in front of a neighbor's house can be enjoyed by many passersby.

Using the approach of targeting the activity behind the externalities, we'll now turn our attention to the topic of positive externalities.

Private versus Social Benefits

Earlier, we pointed out that getting a flu shot has benefits to people beyond the person getting the shot. Under some conditions, getting a flu vaccination reduces the expected number of *other* people who get the flu by as much as 1.5. This prompted one

economist to suggest a new T-shirt slogan, one particularly suited for the winter months: "Kiss Me, I'm Vaccinated!" When you get vaccinated against the flu, it's likely that you're conferring a substantial benefit on those around you—a benefit for others that you are not compensated for. In other words, getting a flu shot generates a positive externality.

The government can directly control the external costs of pollution because it can measure emissions. In contrast, it can't observe the reduction in flu cases caused by you getting a flu shot, so it can't directly control the external benefits—say, by rewarding you based on how many fewer people caught the flu because of your actions. So if the government wants to influence the level of external benefits from flu vaccinations, it must target the original activity—getting a flu shot.

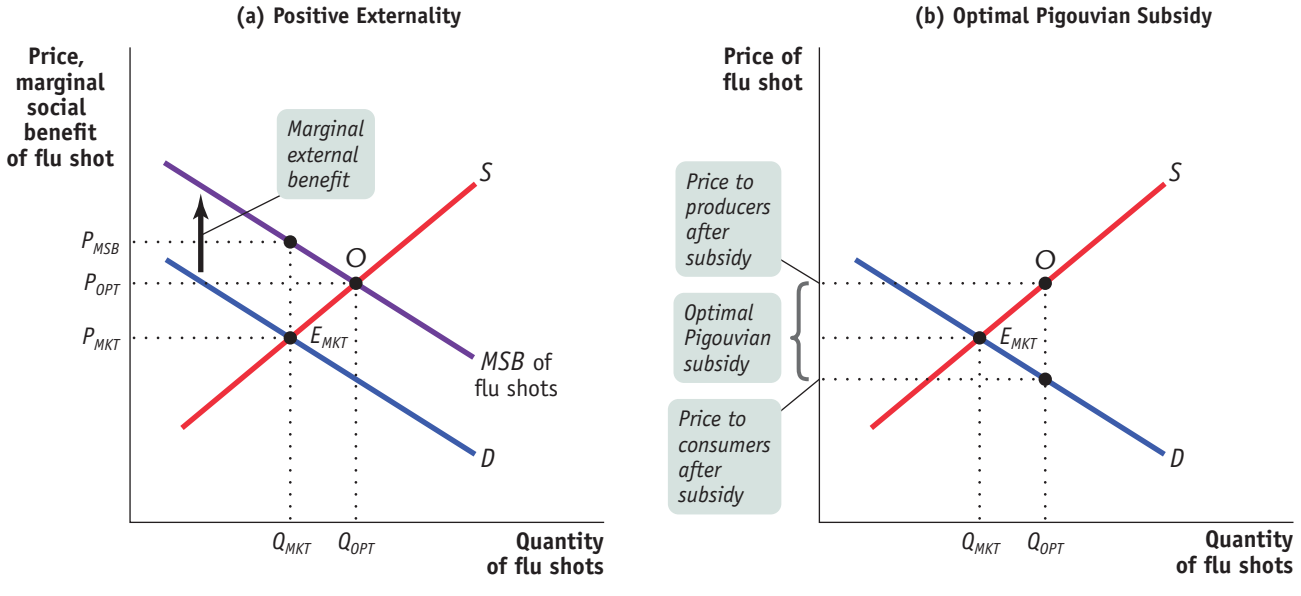
From the point of view of society as a whole, a flu shot carries both costs (the price you pay for the shot, which compensates the vaccine maker and your health care provider for the inputs and factors of production necessary to grow the vaccine and deliver it to your bloodstream) and benefits. Those benefits are the private benefit that accrues to you from not getting the flu yourself, but they also include the external benefits that accrue to others from a lower likelihood of catching the flu. However, you have no incentive to take into account the beneficial side effects that are generated by your actions. As a result, in the absence of government intervention, too few people will choose to be vaccinated.

Panel (a) of Figure 75.3 illustrates this point. The market demand curve for flu shots is represented by the curve *D;* the market, or industry, supply curve is given by the curve *S*. In the absence of government intervention, market equilibrium will be at point E_{MKT}, with Q_{MKT} flu shots being bought and sold at the market price of P_{MKT}.

iStockphoto

Your flu shot provides positive externalities to those whom you would otherwise make sick.

figure 75.3 Positive Externalities and Consumption



Consumption of flu shots generates external benefits, so the marginal social benefit curve, *MSB,* of flu shots, corresponds to the demand curve, *D,* shifted upward by the marginal external benefit. Panel (a) shows that without government action, the market produces Q_{MKT}. It is lower than the socially optimal quantity of consumption, Q_{OPT}, the quantity at which *MSB* crosses the supply curve, *S*. At Q_{MKT}, the marginal social benefit of another flu shot, P_{MSB}, is greater than the marginal private benefit to consumers of another flu shot, P_{MKT}. Panel (b) shows how an optimal Pigouvian subsidy to consumers, equal to the marginal external benefit, moves consumption to Q_{OPT} by lowering the price paid by consumers.

The **marginal private benefit** of a good is the marginal benefit that accrues to consumers of a good, not including any external benefits.

The **marginal social benefit of a good** is the marginal private benefit plus the marginal external benefit.

The **marginal external benefit** of a good is the addition to external benefits created by one more unit of the good.

A **Pigouvian subsidy** is a payment designed to encourage purchases and activities that yield external benefits.

A **technology spillover** is an external benefit that results when knowledge spreads among individuals and firms.

At that point, the marginal cost to society of another flu shot is equal to the marginal benefit *gained by the individual consumer who purchases that flu shot,* measured by the market price.

So far we have studied goods in the absence of external benefits, so the marginal benefit to the consumer has been no different from the marginal benefit to society. When a good like flu shots creates positive externalities, there is a difference between the marginal benefit to the consumer, which we'll distinguish by calling it the **marginal private benefit,** and the marginal benefit to society, called the **marginal social benefit of a good** (or similarly, of a service or activity). The difference between the marginal private benefit (*MPB*) and the marginal social benefit (*MSB*) is the **marginal external benefit** (*MEB*) that indicates the increase in external benefits to society from an additional unit of the good:

(75-1) $MSB = MPB + MEB$

The demand curve represents the marginal benefit that accrues to *consumers of the good:* the marginal private benefit. It does not incorporate the benefits to society as a whole from consuming the good—in this case, the reduction in the number of flu cases. As you can see from panel (a) of Figure 75.3, the marginal social benefit curve, *MSB,* corresponds to the demand curve, *D, shifted upward* by the amount of the marginal external benefit.

With the marginal social benefit curve and the supply curve, we can find the socially optimal quantity of a good or activity that generates external benefits: it is the quantity Q_{OPT}, the quantity that corresponds to point *O* at which *MSB* and *S* cross. Because the external benefit is not accounted for in market decisions, Q_{OPT} is greater than Q_{MKT}; it's the quantity at which the marginal cost of a good (measured by *S*) is equal to the marginal social benefit (measured by *MSB*).

So left to its own, a market will bring about too little production and consumption of a good or activity that generates external benefits. Correspondingly, without government action, the price to consumers of such a good or activity is too high: at the market output level Q_{MKT}, the unregulated market price is P_{MKT} and the marginal benefit to consumers of an additional flu shot is lower than P_{MSB}, the true marginal benefit to society of an additional flu shot.

How can the economy be induced to produce Q_{OPT}, the socially optimal level of flu shots shown in Figure 75.3? The answer is by a **Pigouvian subsidy:** a payment designed to encourage activities that yield external benefits. The optimal Pigouvian subsidy, shown in panel (b) of Figure 75.3, is equal to the marginal external benefit of consuming another unit of flu shots. In this example, a Pigouvian subsidy works by lowering the price of consuming the good: consumers pay a price for a flu shot that is equal to the market price *minus* the subsidy. In 2001, Japan began a program of subsidizing 71% of the cost of flu shots for the elderly in large cities. A 2005 study found that the subsidy significantly reduced the incidence of pneumonia, and influenza-caused mortality, at a net benefit to Japanese society of $1.08 billion dollars.

The most important single source of external benefits in the modern economy is the creation of knowledge. In high-tech industries such as the semiconductor, software design, and bioengineering industries, innovations by one firm are quickly emulated by rival firms and put to use in the development of further advancements in related industries. This spreading of cutting-edge information among high-tech firms is known as **technology spillover.** Such spillovers often take place through face-to-face contact. For example, bars and restaurants in California's Silicon Valley are famed for their technical chitchat. Workers know that the best way to keep up with the latest technological innovations is to hang around in the right places, have a drink, and gossip. Such informal contact helps to spread useful knowledge, which may also explain why so many high-tech firms are clustered close to one another.

Private versus Social Costs

Now let's turn briefly to consider a case in which production of a good creates external costs—namely, the livestock industry. Whatever it is—cows, pigs, chicken, sheep, or salmon—livestock farming produces prodigious amounts of what is euphemistically known as "muck." But that's not all: scientists estimate that the amount of methane gas produced by livestock currently rivals the amount caused by the burning of fossil fuels in the creation of greenhouse gases. From the point of view of society as a whole, then, the cost of livestock farming includes both direct production costs (payments for factors of production and inputs) and the external environmental costs imposed as a by-product of farming.


Photodisc

The social cost of livestock production is felt beyond the farm.

When a good like pork involves negative externalities, there is a difference between the marginal cost to the *firm,* which we distinguish as the **marginal private cost,** and the marginal cost to *society,* the **marginal social cost of a good** (or likewise of a service or activity). The difference between the marginal private cost (*MPC*) and the marginal social cost (*MSC*) is the **marginal external cost** (*MEC*)—the increase in external costs to society from an additional unit of the good:

(75-2) $MSC = MPC + MEC$

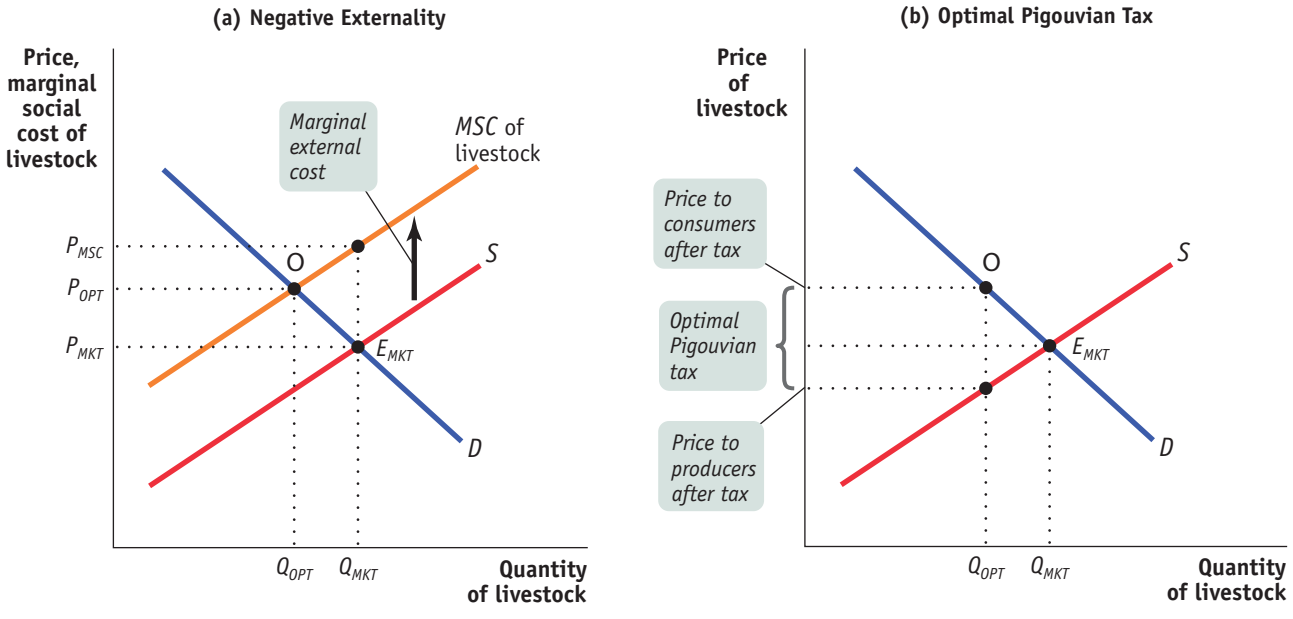
The **marginal private cost** of a good is the marginal cost of producing that good, not including any external costs.

The **marginal social cost of a good** is equal to the marginal private cost of production plus its marginal external cost.

The **marginal external cost** of a good is the increase in external costs created by one more unit of the good.

Panel (a) in Figure 75.4 shows the marginal social cost curve, *MSC,* of livestock; it corresponds to the industry supply curve, *S, shifted upward* by the amount of the marginal external cost. (Recall that in a competitive industry, the industry supply curve is the horizontal sum of the individual firms' supply curves, which are the same as their

figure 75.4 Negative Externalities and Production



Livestock production generates external costs, so the marginal social cost curve, *MSC,* of livestock, corresponds to the supply curve, *S,* shifted upward by the marginal external cost. Panel (a) shows that without government action, the market produces the quantity Q_{MKT}. It is greater than the socially optimal quantity of livestock production, Q_{OPT}, the quantity at which *MSC* crosses the demand curve, *D.* At Q_{MKT}, the market price, P_{MKT}, is less than P_{MSC}, the true marginal cost to society of livestock production. Panel (b) shows how an optimal Pigouvian tax on livestock production, equal to its marginal external cost, moves the production to Q_{OPT}, resulting in lower output and a higher price to consumers.

marginal cost curves.) In the absence of government intervention, the market equilibrium will be at point E_{MKT}, yielding an equilibrium quantity of Q_{MKT} and an equilibrium price of P_{MKT}.

The ever-important socially optimal quantity of a good is the quantity at which *marginal social benefit equals marginal social cost.* In the livestock example, this criterion is met at point *O,* where the *MSC* and *D* curves cross. Why can we substitute the demand curve for marginal social benefit in this case? Because although the demand curve represents the marginal benefit to consumers—the marginal private benefit—there are no external benefits to separate the marginal private benefit from the marginal social benefit. That means that when $MSC = D$ and there are no external benefits, it is also true that $MSC = MPB = MSB$.

Unfortunately, the market equilibrium quantity Q_{MKT} is greater than Q_{OPT}, the socially optimal quantity of livestock. So left to its own, the market produces too much of a good that generates an external cost in production, and the price to consumers of such a good is too low: P_{MKT} is less than P_{MSC}, the true marginal cost to society of another unit of livestock. As panel (b) of Figure 75.4 shows, an optimal Pigouvian tax on livestock production, equal to the marginal external cost, moves the market to the socially optimal level of production, Q_{OPT}.

In the flu shot example, we explained that the socially optimal quantity was found where the *MSB* and *S* curves crossed. That point met the $MSB = MSC$ criterion for the socially optimal quantity as well because in the absence of external costs, marginal social cost equals marginal private cost, which is indicated by the supply curve. That is, when $MSB = S$ and there are no external costs, it is also true that $MSB = MPC = MSC$.

At this point, you might ask whether a regulator would choose a method of control that targets pollution directly, such as a cap and trade program, or control the production of the associated good with a Pigouvian tax. Generally, it is a good idea to target the pollution directly whenever feasible. The main reason is that this method creates incentives for the invention and adoption of production methods that create less pollution. For example, the AgCert company has found a way to capture greenhouse gases emitted from animal waste for use as tradable emissions reductions in a cap and trade program.

Network Externalities

There is one type of externality that has no inherently favorable or adverse effect on society at large, but it does affect other users of the associated good or service. Suppose you were the only user of Twitter in the world. What would it be worth to you? The answer, of course, is nothing. Twitter derives its value only from the fact that other people also use Twitter and you can send or receive tweets. In general, the more people who use Twitter, the more valuable it is to you.

A **network externality** exists when the value to an individual of a good or service depends on how many other people use the same good or service. Sometimes referred to as the "fax machine effect," the phenomenon of network externalities is so named because the classic examples involve networks of telephones, computers, and transportation systems. When it comes to sharing digital information, it helps to have more users of the same software, hardware, and online networking services. In other contexts, it's better to have more users of the same stock exchanges, gauges of railroad line, and sizes of electrical plugs, among many examples. Congestion creates a form of negative network externality: it can make things worse for you when more people use the same highway, elevator, or swimming pool.

A good is subject to a **network externality** when the value of the good to an individual is greater when more other people also use the good.

Module 75 AP Review

Solutions appear at the back of the book.

Check Your Understanding

1. Some opponents of tradable emissions permits object to them on the grounds that polluters that sell their permits benefit monetarily from their involvement in polluting the environment. Assess this argument.
2. For each of the following cases, explain whether an external cost or an external benefit is created and identify an appropriate policy response.
   a. Trees planted in urban areas improve air quality and lower summer temperatures.
   b. Water-saving toilets reduce the need to pump water from rivers and aquifers. The cost of a gallon of water to homeowners is virtually zero.
   c. Old computer monitors contain toxic materials that pollute the environment when improperly disposed of.

Tackle the Test: Multiple-Choice Questions

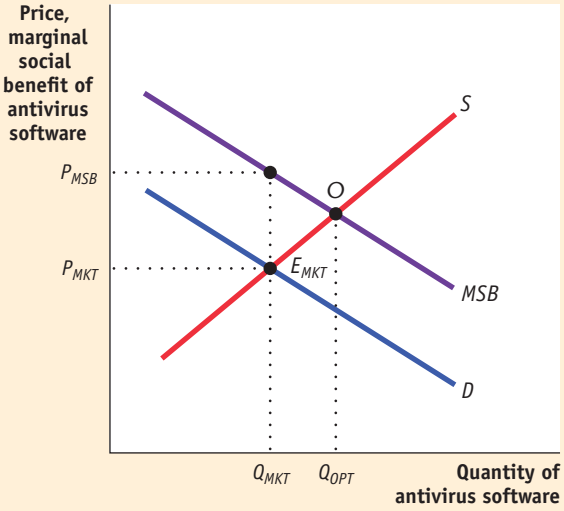
1. Which of the following policy tools is inefficient even when correctly administered?
   a. environmental standards
   b. emissions taxes
   c. tradable emissions permits
   d. Pigouvian taxes
   e. cap and trade programs
2. An efficient Pigouvian subsidy for a good is set equal to the good's
   a. external cost.
   b. marginal social benefit.
   c. marginal external cost.
   d. marginal external benefit.
   e. price at which $MSC = MSB$.
3. Which of the following is true in the case of a positive externality?
   a. $MSC > MSB$
   b. $MPB > MSC$
   c. $MSB > MPB$
   d. $MPB > MSB$
   e. $MSC > MPC$
4. One example of a source of external benefits is
   a. technology spillover.
   b. traffic congestion.
   c. pollution.
   d. subsidies for polluters.
   e. taxes on environmental conservation.
5. Marginal social benefit equals marginal private benefit plus
   a. marginal external benefit.
   b. marginal private cost.
   c. total external benefit.
   d. total external cost.
   e. marginal social cost.

Tackle the Test: Free-Response Questions

1. The purchase of antivirus software by one person provides benefits to other people because they are less likely to receive a virus from the software purchaser. Draw a correctly labeled graph showing how the market will determine the quantity of antivirus software purchased. On the same graph, show the socially optimal quantity of antivirus software. List two different government policies that could be used to achieve the optimal quantity of antivirus software.

2. The use of plastic water bottles creates external costs as the result of plastic production, bottle transportation, litter, and waste disposal. Draw a correctly labeled graph showing how the market will determine the quantity of water bottles purchased. On the same graph, show the marginal external cost, the socially optimal quantity of water bottles, and the size of a Pigouvian tax that could be used to achieve the socially optimal quantity of water bottles.

Answer (8 points)



1 point: Vertical axis labeled "Price, marginal social benefit" or "Dollars per unit," horizontal axis labeled "Quantity of antivirus software" or "Q"

1 point: Upward-sloping supply (or equivalently, marginal cost) curve. (Note that with no external costs, marginal private cost equals marginal social cost.)

1 point: Downward-sloping demand (or equivalently, marginal private benefit) curve

1 point: The market quantity of antivirus software is found at the intersection of supply and demand and shown on the horizontal axis.

1 point: Downward-sloping marginal social benefit curve drawn above demand curve

1 point: The optimal quantity of antivirus software is found at the intersection of supply and marginal social benefit and shown on the horizontal axis.

1 point: A Pigouvian subsidy equal to the marginal external benefit at the socially optimal quantity

1 point: A government regulation requiring the optimal quantity of antivirus software

Module 76 Public Goods

What you will learn in this Module:

- How public goods are characterized and why markets fail to supply efficient quantities of public goods
- What common resources are and why they are overused
- What artificially scarce goods are and why they are underconsumed
- How government intervention in the production and consumption of these types of goods can make society better off
- Why finding the right level of government intervention is often difficult

In this module, we take a somewhat different approach to the question of why markets sometimes fail. Here we focus on how the characteristics of goods often determine whether markets can deliver them efficiently. When goods have the "wrong" characteristics, the resulting market failures resemble those associated with externalities or market power. This alternative way of looking at sources of inefficiency deepens our understanding of why markets sometimes don't work well and how government can take actions that improve the welfare of society.

Private Goods—And Others

What's the difference between installing a new bathroom in a house and building a municipal sewage system? What's the difference between growing wheat and fishing in the open ocean?

These aren't trick questions. In each case there is a basic difference in the characteristics of the goods involved. Bathroom appliances and wheat have the characteristics necessary to allow markets to work efficiently. Public sewage systems and fish in the sea do not.

Let's look at these crucial characteristics and why they matter.

Characteristics of Goods

Goods like bathroom fixtures and wheat have two characteristics that are essential if a good is to be provided in efficient quantities by a market economy.

- They are **excludable:** suppliers of the good can prevent people who don't pay from consuming it.
- They are **rival in consumption:** the same unit of the good cannot be consumed by more than one person at the same time.

When a good is both excludable and rival in consumption, it is called a **private good.** Wheat is an example of a private good. It is *excludable:* the farmer can sell a bushel to one consumer without having to provide wheat to everyone in the county. And it is *rival in consumption:* if I eat bread baked with a farmer's wheat, that wheat cannot be consumed by someone else.

But not all goods possess these two characteristics. Some goods are **nonexcludable**—the supplier cannot prevent consumption of the good by people who do not pay for it.

A good is **excludable** if the supplier of that good can prevent people who do not pay from consuming it.

A good is **rival in consumption** if the same unit of the good cannot be consumed by more than one person at the same time.

A good that is both excludable and rival in consumption is a **private good.**

When a good is **nonexcludable,** the supplier cannot prevent consumption by people who do not pay for it.

A good is **nonrival in consumption** if more than one person can consume the same unit of the good at the same time.

Fire protection is one example: a fire department that puts out fires before they spread protects the whole city, not just people who have made contributions to the Firemen's Benevolent Association. An improved environment is another: pollution can't be ended for some users of a river while leaving the river foul for others.

Nor are all goods rival in consumption. Goods are **nonrival in consumption** if more than one person can consume the same unit of the good at the same time. TV programs are nonrival in consumption: your decision to watch a show does not prevent other people from watching the same show.

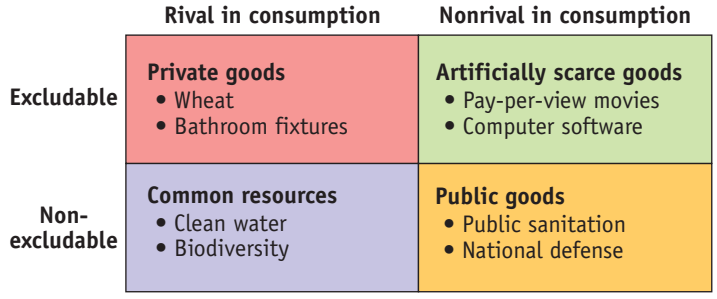
Because goods can be either excludable or nonexcludable, and either rival or nonrival in consumption, there are four types of goods, illustrated by the matrix in Figure 76.1:

- *Private goods,* which are excludable and rival in consumption, like wheat
- *Public goods,* which are nonexcludable and nonrival in consumption, like a public sewer system
- *Common resources,* which are nonexcludable but rival in consumption, like clean water in a river
- *Artificially scarce goods,* which are excludable but nonrival in consumption, like pay-per-view movies on cable TV

figure 76.1

Four Types of Goods

There are four types of goods. The type of a good depends on (1) whether or not it is excludable—whether a producer can prevent someone from consuming it; and (2) whether or not it is rival in consumption—whether it is impossible for the same unit of a good to be consumed by more than one person at the same time.



There are, of course, many other characteristics that distinguish between types of goods—necessities versus luxuries, normal versus inferior, and so on. Why focus on whether goods are excludable and rival in consumption?

Why Markets Can Supply Only Private Goods Efficiently

As we learned in earlier modules, markets are typically the best means for a society to deliver goods and services to its members; that is, markets are efficient except in the case of market power, externalities, or other instances of market failure. One source of market failure is rooted in the nature of the good itself: markets cannot supply goods and services efficiently unless they are private goods—excludable and rival in consumption.

To see why excludability is crucial, suppose that a farmer had only two choices: either produce no wheat or provide a bushel of wheat to every resident of the county who wants it, whether or not that resident pays for it. It seems unlikely that anyone would grow wheat under those conditions.

Yet the operator of a public sewage system consisting of pipes that anyone can dump sewage into faces pretty much the same problem as our hypothetical farmer.

A sewage system makes the whole city cleaner and healthier—but that benefit accrues to all the city's residents, whether or not they pay the system operator. The general point is that if a good is nonexcludable, rational consumers won't be willing to pay for it—they will take a "free ride" on anyone who *does* pay. So there is a **free-rider problem.** Examples of the free-rider problem are familiar from daily life. One example you may have encountered happens when students are required to do a group project. There is often a tendency of some group members to shirk their responsibilities, relying on others in the group to get the work done. The shirkers *free-ride* on someone else's effort.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When the benefits from a group project are nonexcludable, there is a temptation to free-ride on the efforts of others.

Because of the free-rider problem, the forces of self-interest alone do not lead to an efficient level of production for a nonexcludable good. Even though consumers would benefit from increased production of the good, no one individual is willing to pay for more, and so no producer is willing to supply it. The result is that nonexcludable goods suffer from *inefficiently low production* in a market economy. In fact, in the face of the free-rider problem, self-interest may not ensure that any amount of the good—let alone the efficient quantity—is produced.

Goods that are excludable and nonrival in consumption, like pay-per-view movies, suffer from a different kind of inefficiency. As long as a good is excludable, it is possible to earn a profit by making it available only to those who pay. Therefore, producers are willing to supply an excludable good. But the marginal cost of letting an additional viewer watch a pay-per-view movie is zero because it is nonrival in consumption. So the efficient price to the consumer is also zero—or, to put it another way, individuals should watch TV movies up to the point where their marginal benefit is zero. But if the cable company actually charges viewers $4, viewers will consume the good only up to the point where their marginal benefit is $4. When consumers must pay a price greater than zero for a good that is nonrival in consumption, the price they pay is higher than the marginal cost of allowing them to consume that good, which is zero. So in a market economy goods that are nonrival in consumption suffer from *inefficiently low consumption.*

Now we can see why private goods are the only goods that will be produced and consumed in efficient quantities in a competitive market. (That is, a private good will be produced and consumed in efficient quantities in a market free of market power, externalities, and other sources of market failure.) Because private goods are excludable, producers can charge for them and so have an incentive to produce them. And because they are also rival in consumption, it is efficient for consumers to pay a positive price—a price equal to the marginal cost of production. If one or both of these characteristics are lacking, a market economy will lack the incentives to bring about efficient quantities of the good.

Yet there are crucial goods that don't meet these criteria—and in these cases, the government can offer assistance.

Public Goods

A **public good** is the exact opposite of a private good: it is both nonexcludable and nonrival in consumption. A public sewage system is an example of a public good: you can't keep a river clean without making it clean for everyone who lives near its banks, and my protection from sewage contamination does not prevent my neighbor from being protected as well.

Here are some other examples of public goods:

- *Disease prevention.* When a disease is stamped out, no one can be excluded from the benefit, and one person's health doesn't prevent others from being healthy.

Goods that are nonexcludable suffer from the **free-rider problem:** individuals have no incentive to pay for their own consumption and instead will take a "free ride" on anyone who does pay.

A **public good** is both nonexcludable and nonrival in consumption.

- *National defense.* A strong military protects all citizens.
- *Scientific research.* In many cases new findings provide widespread benefits that are not excludable or rival.

Because these goods are nonexcludable, they suffer from the free-rider problem, so private firms would produce inefficiently low quantities of them. And because they are nonrival in consumption, it would be inefficient to charge people for consuming them. As a result, society must find nonmarket methods for providing these goods.

Providing Public Goods

Public goods are provided in a variety of ways. The government doesn't always get involved—in many cases a non-governmental solution has been found for the free-rider problem. But these solutions are usually imperfect in some way.

Some public goods are supplied through voluntary contributions. For example, private donations help support public radio and a considerable amount of scientific research. But private donations are insufficient to finance large programs of great importance, such as the Centers for Disease Control and national defense.

Some public goods are supplied by self-interested individuals or firms because those who produce them are able to make money in an indirect way. The classic example is broadcast television, which in the United States is supported entirely by advertising. The downside of such indirect funding is that it skews the nature and quantity of the public goods that are supplied, while imposing additional costs on consumers. TV stations show the programs that yield the most advertising revenue (that is, programs best suited for selling antacids, hair-loss remedies, antihistamines, and the like to the segment of the population that buys them), which are not necessarily the programs people most want to see. And viewers must endure many commercials.

Some potentially public goods are deliberately made excludable and therefore subject to charge, like pay-per-view movies. In the United Kingdom, where most television programming is paid for by a yearly license fee assessed on every television owner (£145.50, or about $229 in 2010), television viewing is made artificially excludable by the use of "television detection vans": vans that roam neighborhoods in an attempt to detect televisions in non-licensed households and fine them. However, as noted earlier, when suppliers charge a price greater than zero for a nonrival good, consumers will consume an inefficiently low quantity of that good.

Touhig Sion/Corbis Sygma

On the prowl: a British TV detection van at work.

In small communities, a high level of social encouragement or pressure can be brought to bear on people to contribute money or time to provide the efficient level of a public good. Volunteer fire departments, which depend both on the volunteered services of the firefighters themselves and on contributions from local residents, are a good example. But as communities grow larger and more anonymous, social pressure is increasingly difficult to apply, compelling larger towns and cities to tax residents and depend on salaried firefighters for fire protection services.

As this last example suggests, when other solutions fail, it is up to the government to provide public goods. Indeed, the most important public goods—national defense, the legal system, disease control, fire protection in large cities, and so on—are provided by government and paid for by taxes. Economic theory tells us that the provision of public goods is one of the crucial roles of government.

How Much of a Public Good Should Be Provided?

In some cases, the provision of a public good is an "either–or" decision: a city can either have a sewage system—or not. But in most cases, governments must decide not only whether to provide a public good but also *how much* of that public good to provide. For example, street cleaning is a public good—but how often should the streets be cleaned? Once a month? Twice a month? Every other day?

Imagine a city with only two residents, Ted and Alice. Assume that the public good in question is street cleaning and that Ted and Alice truthfully tell the government how much they value a unit of the public good, one unit being one street cleaning per month. Specifically, each of them tells the government his or her *willingness to pay* for another unit of the public good supplied—an amount that corresponds to that individual's *marginal private benefit* from another unit of the public good.

Using this information along with information on the cost of providing the good, the government can use marginal analysis to find the efficient level of providing the public good: the level at which the *marginal social benefit* of the public good is equal to the marginal social cost of producing it. Recall that the marginal social benefit of a good is the benefit that accrues to society as a whole from the consumption of one additional unit of the good.

But what is the marginal social benefit of another unit of a public good—a unit that generates utility for *all* consumers, not just one consumer, because it is nonexcludable and nonrival in consumption? This question leads us to an important principle: *In the special case of a public good, the marginal social benefit of a unit of the good is equal to the sum of the marginal private benefits enjoyed by all consumers of that unit.* Or to consider it from a slightly different angle, if a consumer could be compelled to pay for a unit before consuming it (the good is made excludable), then the marginal social benefit of a unit is equal to the *sum* of each consumer's willingness to pay for that unit. Using this principle, the marginal social benefit of an additional street cleaning per month is equal to Ted's marginal private benefit from that additional cleaning *plus* Alice's marginal private benefit.

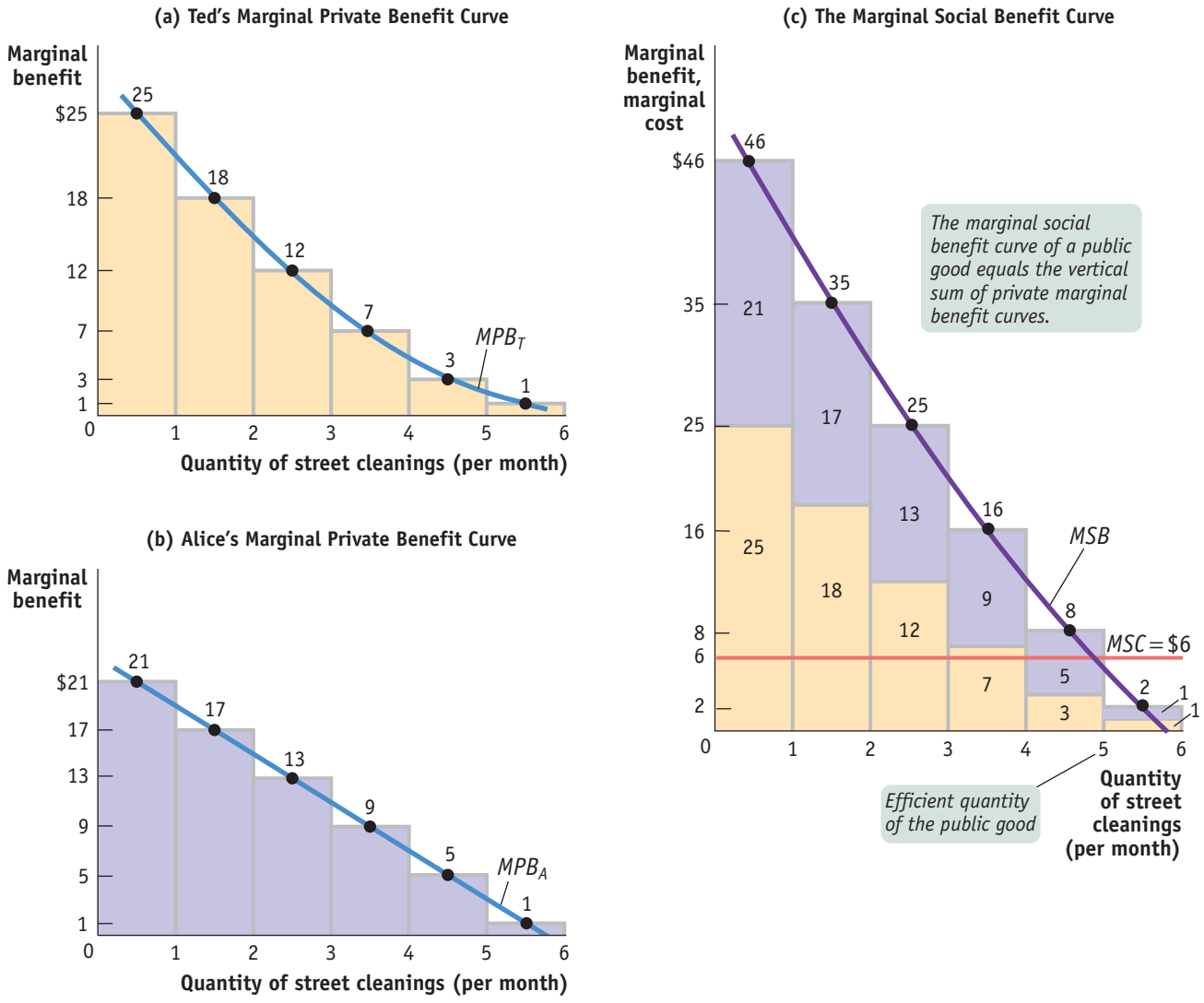
Why? Because a public good is nonrival in consumption—Ted's benefit from a cleaner street does not diminish Alice's benefit from that same clean street, and vice versa. Because Ted and Alice can simultaneously "consume" the same unit of street cleaning, the marginal social benefit is the *sum* of their marginal private benefits. And the efficient quantity of a public good is the quantity at which the marginal social benefit is equal to the marginal social cost of providing it.

Figure 76.2 on the next page illustrates the efficient provision of a public good, showing three marginal benefit curves. Panel (a) shows Ted's marginal private benefit curve from street cleaning, MPB_T: he would be willing to pay \$25 for the city to clean its streets once a month, an additional \$18 to have it done a second time, and so on. Panel (b) shows Alice's marginal private benefit curve from street cleaning, MPB_A. Panel (c) shows the marginal social benefit curve from street cleaning, *MSB:* it is the vertical sum of Ted's and Alice's marginal private benefit curves, MPB_T and MPB_A.

To maximize society's welfare, the government should increase the quantity of street cleanings until the marginal social benefit of an additional cleaning would fall below the marginal social cost. Suppose that the marginal social cost is \$6 per cleaning. Then the city should clean its streets 5 times per month, because the marginal social benefit of each of the first 5 cleanings is more than \$6, but going from 5 to 6 cleanings would yield a marginal social benefit of only \$2, which is less than the marginal social cost.

One fundamental rationale for the existence of government is that it provides a way for citizens to tax themselves in order to provide public goods—particularly a vital public good like national defense.

figure 76.2 A Public Good



Panel (a) shows Ted's marginal private benefit curve, MPB_T, and panel (b) shows Alice's marginal private benefit curve, MPB_A. Panel (c) shows the marginal social benefit of the public good, equal to the *sum* of the marginal private benefits to all consumers (in this case, Ted and Alice). The marginal social benefit curve, *MSB,* is the vertical sum of the marginal private benefit curves MPB_T and MPB_A. At a constant marginal social cost of $6, there should be 5 street cleanings per month, because the marginal social benefit of going from 4 to 5 cleanings is $8 ($3 for Ted plus $5 for Alice), but the marginal social benefit of going from 5 to 6 cleanings is only $2.

Of course, if society really consisted of only two individuals, they would probably manage to strike a deal to provide the good. But imagine a city with a million residents, each of whose marginal private benefit from a good is only a tiny fraction of the marginal social benefit. It would be impossible for people to reach a voluntary agreement to pay for the efficient level of a good like street cleaning—the potential for free-riding would make it too difficult to make and enforce an agreement among so many people. But they could and would vote to tax themselves to pay for a city-wide sanitation department.

fyi

Voting as a Public Good

It's a sad fact that many Americans who are eligible to vote don't bother to. As a result, their interests tend to be ignored by politicians. But what's even sadder is that this self-defeating behavior may be completely rational.

As the economist Mancur Olson pointed out in a famous book titled *The Logic of Collective Action,* voting is a public good, one that suffers from severe free-rider problems.

Imagine that you are one of a million people who would stand to gain the equivalent of $100 each if some plan is passed in a statewide referendum—say, a plan to improve public schools. And suppose that the opportunity cost of the time it would take you to vote is $10. Will you be sure to go to the polls and vote for the referendum? If you are rational, the answer is no! The reason is that it is very unlikely that your vote will decide the issue, either way. If the measure passes, you benefit, even if you didn't bother to vote—the benefits are nonexcludable. If the measure doesn't pass, your vote would not have changed the outcome. Either way, by not voting—by free-riding on those who do vote—you save $10.

Of course, many people do vote out of a sense of civic duty. But because political action is a public good, in general people devote too little effort to defending their own interests.

The result, Olson pointed out, is that when a large group of people share a common political interest, they are likely to exert too little effort promoting their cause and so will be ignored. Conversely, small, well-organized interest groups that act on issues narrowly targeted in their favor tend to have disproportionate power.

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Is this a reason to distrust democracy? Winston Churchill said it best: "Democracy is the worst form of government, except for all the other forms that have been tried."

Common Resources

A **common resource** is a good that is nonexcludable but is rival in consumption. An example is the stock of fish in a fishing area, like the fisheries off the coast of New England. Traditionally, anyone who had a boat could go out to sea and catch fish—fish in the sea were a nonexcludable good. Yet the total number of fish is limited: the fish that one person catches are no longer available to be caught by someone else. So fish in the sea are rival in consumption.

Other examples of common resources include clean air, water, and the diversity of animal and plant species on the planet (biodiversity). In each of these cases the fact that the good is rival in consumption, and yet nonexcludable, poses a serious problem.

The Problem of Overuse

Because common resources are nonexcludable, individuals cannot be charged for their use. But the resources are rival in consumption, so an individual who uses a unit depletes the resource by making that unit unavailable to others. As a result, a common resource is subject to **overuse:** an individual will continue to use it until his or her marginal private benefit is equal to his or her marginal private cost, ignoring the cost that this action inflicts on society as a whole.

Fish are a classic example of a common resource. Particularly in heavily fished waters, my fishing imposes a cost on others by reducing the fish population and making it harder for others to catch fish. But I have no personal incentive to take this cost into account, since I cannot be charged for fishing. As a result, from society's point of view, I catch too many fish. Traffic congestion is another example of overuse of a common resource. A major highway during rush hour can accommodate only a certain number of vehicles per hour. If I decide to drive to work alone rather than carpool or work at home, I cause many other people to have a longer commute; but I have no incentive to take these consequences into account.

A **common resource** is nonexcludable and rival in consumption: you can't stop me from consuming the good, and more consumption by me means less of the good available for you.

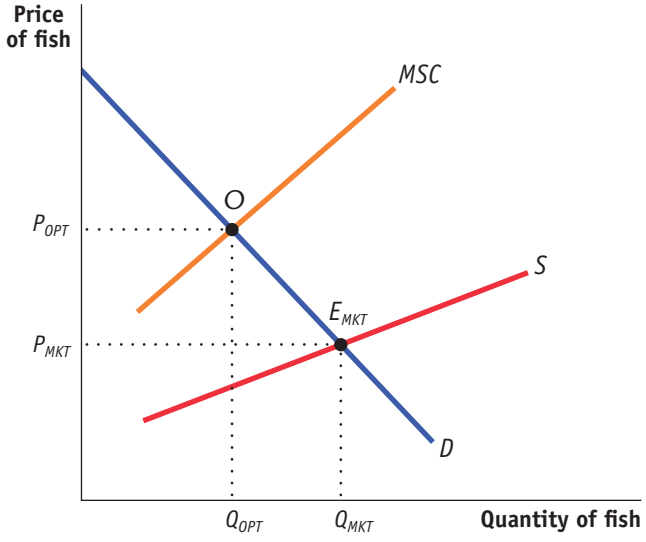
Overuse is the depletion of a common resource that occurs when individuals ignore the fact that their use depletes the amount of the resource remaining for others.

In the case of a common resource, as in the earlier examples involving marginal external costs, the *marginal social cost* of my use of that resource is higher than my *marginal private cost,* the cost to me of using an additional unit of the good. Figure 76.3 illustrates this point. It shows the demand curve for fish, which measures the marginal private benefit of fish (as well as the marginal social benefit because there are no external benefits from catching and consuming fish). The figure also shows the supply curve for fish, which measures the marginal private cost of production of the fishing industry. We know that the industry supply curve is the horizontal sum of each individual fisherman's supply curve—equivalent to his or her marginal private cost curve. The fishing industry supplies the quantity Q_{MKT} at which its marginal private cost equals the price. But the efficient quantity is Q_{OPT}, the quantity of fish that equates the marginal social benefit (as reflected by the demand curve) to the marginal social cost, not to the fishing industry's marginal private cost of production. Thus, the market outcome results in overuse of the common resource.

figure 76.3

A Common Resource

The supply curve *S,* which shows the marginal private cost of production of the fishing industry, is composed of the individual supply curves of the individual fishermen. But each fisherman's marginal private cost does not include the cost that his or her actions impose on others: the depletion of the common resource. As a result, the marginal social cost curve, *MSC,* lies above the supply curve; in an unregulated market, the quantity of the common resource used, Q_{MKT}, exceeds the efficient quantity of use, Q_{OPT}.



As we noted, there is a close parallel between the problem of managing a common resource and the problem posed by negative externalities. In the case of an activity that generates a negative externality, the marginal social cost of production is greater than the marginal private cost of production, the difference being the marginal external cost imposed on society. Here, the loss to society arising from a fisher's depletion of the common resource plays the same role as the external cost when there is a negative externality. In fact, many negative externalities (such as pollution) can be thought of as involving common resources (such as clean air).

The Efficient Use and Maintenance of a Common Resource

Because common resources pose problems similar to those created by negative externalities, the solutions are also similar. To ensure efficient use of a common resource, society must find a way to get individual users of the resource to take into account the costs they impose on others. This is the same principle as that of getting individuals to internalize a negative externality that arises from their actions.

There are three principal ways to induce people who use common resources to internalize the costs they impose on others:

- Tax or otherwise regulate the use of the common resource
- Create a system of tradable licenses for the right to use the common resource
- Make the common resource excludable and assign property rights to some individuals

The first two solutions overlap with the approaches to private goods with negative externalities. Just as governments use Pigouvian excise taxes to temper the consumption of alcohol, they use alternative forms of Pigouvian taxes to reduce the use of common resources. For example, in some countries there are "congestion charges" on those who drive during rush hour, in effect charging them for the use of highway space, a common resource. Likewise, visitors to national parks in the United States must pay an entry fee that is essentially a Pigouvian tax.

A second way to correct the problem of overuse is to create a system of tradable licenses for the use of the common resource, much like the systems designed to address negative externalities. The policy maker issues the number of licenses that corresponds to the efficient level of use of the good. Making the licenses tradable ensures that the right to use the good is allocated efficiently—that is, those who end up using the good (those willing to pay the most for a license) are those who gain the most from its use.

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If it weren't for fees and restrictions, some common resources would be overrun.

But when it comes to common resources, often the most natural solution is simply to assign property rights. At a fundamental level, common resources are subject to overuse because *nobody owns them.* The essence of ownership of a good—the *property right* over the good—is that you can limit who can and cannot use the good as well as how much of it can be used. When a good is nonexcludable, in a very real sense no one owns it because a property right cannot be enforced—and consequently no one has an incentive to use it efficiently. So one way to correct the problem of overuse is to make the good excludable and assign property rights over it to someone. The good now has an owner who has an incentive to protect the value of the good—to use it efficiently rather than overuse it. This solution is applicable when currently nonexcludable goods can be made excludable, as with the privatization of parks and even roads, but it cannot be applied to resources that are inherently nonexcludable, including the air and flowing water.

Artificially Scarce Goods

An **artificially scarce good** is a good that is excludable but nonrival in consumption. As we've already seen, pay-per-view movies are a familiar example. The marginal cost to society of allowing an individual to watch a movie is zero because one person's viewing doesn't interfere with other people's viewing. Yet cable companies prevent an individual from seeing a movie if he or she hasn't paid. Goods like computer software and audio files, which are valued for the information they embody (and are sometimes called "information goods"), are also artificially scarce.

Markets will supply artificially scarce goods because their excludability allows firms to charge people for them. However, since the efficient price is equal to the marginal cost of zero and the actual price is something higher than that, the good is "artificially scarce" and consumption is inefficiently low. The problem is that, unless the producer can somehow earn revenue from producing and selling the good, none will be produced, which is likely to be worse than a positive but inefficiently low quantity.

Artificially scarce good is a good that is excludable but nonrival in consumption.

We have seen that, in the cases of public goods, common resources, and artificially scarce goods, a market economy will not provide adequate incentives for efficient levels of production and consumption. Fortunately for the sake of market efficiency, most goods are private goods. Food, clothing, shelter, and most other desirable things in life are excludable and rival in consumption, so the types of market failure discussed in this module are important exceptions rather than the norm.

Module 76 AP Review

Solutions appear at the back of the book.

Check Your Understanding

1. For each of the following goods, indicate whether it is excludable, whether it is rival in consumption, and what kind of good it is.
   a. a public space such as a park
   b. a cheese burrito
   c. information from a website that is password-protected
   d. publicly announced information about the path of an incoming hurricane
2. Which of the goods in Question 1 will be provided by a private producer without government intervention? Which will not be? Explain your answer.

Tackle the Test: Multiple-Choice Questions

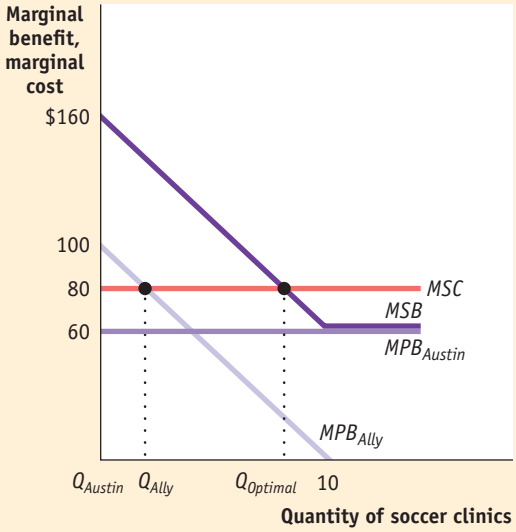
1. Which of the following types of goods are always nonrival in consumption?
   a. public goods
   b. private goods
   c. common resources
   d. inferior goods
   e. goods provided by the government
2. The free-rider problem occurs in the case of
   a. private goods.
   b. common resources.
   c. artificially scarce goods.
   d. motorcycles.
   e. all of the above.
3. Public goods are sometimes provided through which of the following means?
   I. voluntary contributions
   II. individual self-interest
   III. the government
   a. I only
   b. II only
   c. III only
   d. I and III only
   e. I, II, and III
4. Market provision of a public good will lead to
   a. the efficient quantity.
   b. the efficient price.
   c. inefficiently high production of the good.
   d. inefficiently low production of the good.
   e. none of the good being provided.
5. The overuse of a common resource can be reduced by which of the following?
   a. a Pigouvian tax
   b. government regulations
   c. tradable licenses
   d. the assignment of property rights
   e. all of the above

Tackle the Test: Free-Response Questions

1. Suppose Austin and Ally are the only soccer enthusiasts in a village where any number of public soccer clinics could be put on by visiting experts for $80 each. There are no external costs involved. Austin's marginal private benefit curve for soccer clinics is horizontal at $60. Ally's marginal private benefit curve is a straight line starting at $100 on the vertical axis and ending at 10 clinics on the horizontal axis. Draw a correctly labeled graph for soccer clinics showing the marginal social cost, the marginal social benefit, and each resident's marginal private benefit. Label the quantity of clinics that Austin would purchase if he were the only resident as Q_{Austin}. Label the quantity of clinics that Ally would purchase if she were the only resident as Q_{Ally}. Label the optimal quantity of clinics for society as $Q_{Optimal}$.

2. a. Identify and explain the two characteristics shared by every public good.
   b. Suppose a new resident moves to a community that purchases a public good for the benefit of every member of the community. What is the additional cost of providing the public good to the new community member? Explain.

Answer (6 points):



1 point: Correct axis labels ("Marginal benefit, marginal cost" or "Dollars per unit" on the vertical axis, "Quantity of soccer clinics" or "Q" on the horizontal axis)

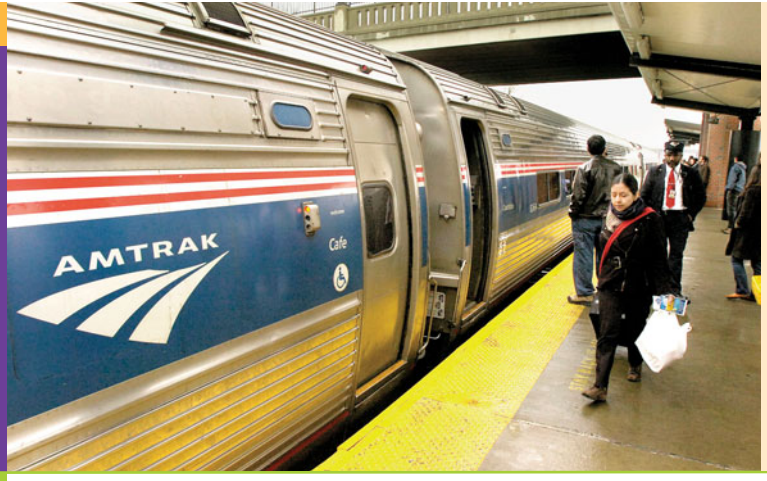
1 point: *MSC* curve horizontal at a height of $80

1 point: *MSB* curve starts at a height of $160 where the quantity is zero, slopes downward to a height of $60 where the quantity is 10, and then coincides with MPB_{Austin}

1 point: Q_{Austin} labeled at a quantity of zero (because *MSC* exceeds MPB_{Austin} for every clinic)

1 point: Q_{Ally} found at the intersection of *MSC* and MPB_{Ally} and shown on the horizontal axis

1 point: $Q_{Optimal}$ found at the intersection of *MSC* and *MSB* and shown on the horizontal axis



What you will learn in this **Module:**

- The three major antitrust laws and how they are used to promote competition
- How government regulation is used to prevent inefficiency in the case of natural monopoly
- The pros and cons of using marginal cost pricing and average cost pricing to regulate prices in natural monopolies

Module 77 Public Policy to Promote Competition

Promoting Competition

We have seen that, in general, equilibrium in a competitive market with no externalities is efficient. On the other hand, imperfectly competitive markets—for example, those with a monopoly or an oligopoly—generally create inefficient outcomes. Concern about the higher prices, lower quantities, and lower quality of goods that can result from imperfect competition has led to public policies to promote competition. These policies include antitrust laws and direct government regulation.

As we discussed in Module 62, public policy toward monopoly depends crucially on whether or not the industry in question is a natural monopoly. The most common approach to a natural monopoly is for the government to allow one firm to exist but to regulate that firm to increase the quantity and lower the price relative to the monopoly outcome.

In this module, we first focus on ways to promote competition in cases that don't involve natural monopolies. If the industry is *not* a natural monopoly, the best policy is to prevent monopoly from arising or break it up if it already exists. These policies are carried out through antitrust laws. Later in this module we will turn to the more difficult problem of dealing with natural monopoly.

Antitrust Policy

As we discussed in Module 66, imperfect competition first became an issue in the United States during the second half of the nineteenth century when industrialists formed trusts to facilitate monopoly pricing. By having shareholders place their shares in the hands of a board of trustees, major companies in effect merged into a single firm. That is, they created monopolies.

Eventually, there was a public backlash, driven partly by concern about the economic effects of the trust movement, partly by fear that the owners of the trusts were simply becoming too powerful. The result was the Sherman Antitrust Act of 1890,

which was intended both to prevent the creation of more monopolies and to break up existing ones. Following the Sherman Act, government passed several other acts intended to clarify antitrust policy.

The Sherman Antitrust Act of 1890

When Microsoft Corporation bundled its Internet Explorer web browser software with its Windows operating system, the makers of competing Netscape Navigator cried foul. Netscape advocates claimed the immediate availability of Internet Explorer to Windows users would create unfair competition. The plaintiffs sought protection under the cornerstone of U.S. antitrust policy (known in many other countries as "competition policy"), the Sherman Antitrust Act. This Act was the first of three major federal antitrust laws in the United States, followed by the Clayton Antitrust Act and the Federal Trade Commission Act, both passed in 1914. The Department of Justice, which has an Antitrust Division charged with enforcing antitrust laws, describes the goals of antitrust laws as protecting competition, ensuring lower prices, and promoting the development of new and better products. It emphasizes that firms in competitive markets attract consumers by cutting prices and increasing the quality of products or services. Competition and profit opportunities also stimulate businesses to find new and more efficient production methods.

The Sherman Antitrust Act of 1890 has two important provisions, each of which outlaws a particular type of activity. The first provision makes it illegal to create a contract, combination, or conspiracy that unreasonably restrains interstate trade. The second provision outlaws the monopolization of any part of interstate commerce. In addition, under the law, the Department of Justice is empowered to bring civil claims and criminal prosecutions when the law is violated. Indeed, it was the Department of Justice that filed suit against Microsoft in the web browser case. The initial court ruling, by the way, was that Microsoft should be broken up into one company that sold Windows and another that sold other software components. After that ruling was overturned on appeal, a final settlement kept Microsoft intact, but prohibited various forms of predatory behavior and practices that could create barriers to entry.

As the ambiguities of the Microsoft case suggest, the law provides little detail regarding what constitutes "restraining trade." And the law does not make it illegal to *be* a monopoly but to "monopolize," that is, to take illegal actions to become a monopoly. If you are the only firm in an industry because no other firm chooses to enter the market, you are not in violation of the Sherman Act.

The two provisions of the Sherman Act give very broad, general descriptions of the activities it makes illegal. The act does not provide details regarding specific actions or activities that it prohibits. The vague nature of the Sherman Act led to the subsequent passage of two additional major antitrust laws.

The Clayton Antitrust Act of 1914

The Clayton Antitrust Act of 1914 was intended to clarify the Sherman Act, which did not identify specific firm behaviors that were illegal. The Clayton Act outlaws four specific firm behaviors; price discrimination, anticompetitive practices (exclusive dealing and tying arrangements), anticompetitive mergers and acquisitions, and interlocking directorates (two corporate boards of directors that share at least one director in common).

You are already familiar with the topic of price discrimination from our discussion of market structures. The Clayton Act makes it illegal to charge different prices to different customers for the same product. Obviously, there are exceptions to this rule that allow the price discrimination we see in practice, for example, at movie theaters where children pay a different price from adults.

By prohibiting exclusive dealing, the Clayton Act makes it illegal for a firm to refuse to do business with you just because you also do business with its competitors. If a firm

had the dominant product in a given market, exclusive dealing could allow it to gain monopoly power in other markets. For example, a company that sells an extremely popular felt-tip marker—the only one of its kind—could set a condition that customers who want to purchase the marker must purchase all of their office supplies from the company. This would allow the marker company to expand its existing market power into the market for other office supplies.

The Clayton Act outlaws tying arrangements because, otherwise, a firm could expand its monopoly power for a dominant product by "tying" the purchase of one product to the purchase of a dominant product in another market. Tying arrangements occur when a firm stipulates that it will sell you a specific product, say a printer, only if you buy something else, such as printer paper, at the same time. In this case, tying the printer and paper together expands the firm's printer market power into the market for paper. In this way, as with exclusive dealing, tying arrangements can lessen competition by allowing a firm to expand its market power from one market into another.

Mergers and acquisitions happen fairly often in the U.S. economy; most are not illegal despite the Clayton Act stipulations. The Justice Department regularly reviews proposed mergers between companies in the same industry and, under the Clayton Act, bars any that they determine would significantly reduce competition. To evaluate proposed mergers, they often use the measures we discussed in the oligopoly modules: *concentration ratios* and the *Herfindahl-Hirschman Index*. But the Justice Department is not the only agency responsible for enforcing antitrust laws. Another of our major antitrust laws created and empowers the Federal Trade Commission to enforce antitrust laws.

The Federal Trade Commission Act of 1914

Passed in 1914, the Federal Trade Commission Act prohibits unfair methods of competition in interstate commerce and created the Federal Trade Commission (FTC) to enforce the Act. The FTC Act outlaws unfair competition, including "unfair or deceptive acts." The FTC Act also outlaws some of the same practices included in the Sherman and Clayton Acts. In addition, it specifically outlaws price fixing (including the setting of minimum resale prices), output restrictions, and actions that prevent the entry of new firms. The FTC's goal is to promote lower prices, higher output, and free entry—all characteristics of competitive markets (as opposed to monopolies and oligopolies).

The Federal Trade Commission promotes fair practices, free entry by firms, and the virtues of competitive markets.

Dealing with Natural Monopoly

Antitrust laws are designed to promote competition by preventing business behaviors that concentrate market power. But what if a market is a natural monopoly? As you will recall, a natural monopoly occurs when economies of scale make it efficient to have only one firm in a market. Now we turn from promoting competition to establishing a monopoly, but seeking a public policy to prevent the relatively high prices and low quantities that result when there is only one firm.

Breaking up a monopoly that isn't natural is clearly a good idea: the gains to consumers outweigh the loss to the firm. But what about the situation in which a large firm has a lower average total cost than many small firms—the case of natural monopoly we discussed in Section 9? The goal in these circumstances is to retain the advantage of lower average total cost that results from a single producer and still curb the inefficiency associated with a monopoly. In Module 62, we presented two ways to do this—public ownership and price regulation.

While there are a few examples of public ownership in the United States, such as Amtrak, a provider of passenger rail service, the more common answer has been to leave the industry in private hands but subject it to regulation.

Price Regulation Most local utilities are natural monopolies with regulated prices. By having only one firm produce in the market, society benefits from increased efficiency. That is, the average cost of production is lower due to economies of scale. But without price regulation, these firms would be tempted to restrict output and raise price. How, then, do regulators determine an appropriate price?

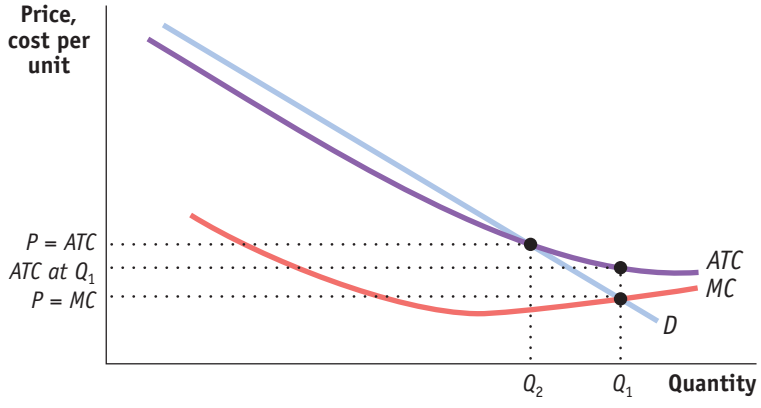
Since the purpose of regulation is to achieve efficiency in the market, a logical place to set price is at the level at which the marginal cost curve intersects the demand curve. This is called **marginal cost pricing.** (Because we are no longer discussing situations with externalities, we will refer to a single marginal cost that is both marginal social cost and marginal private cost.) We have seen that it is efficient for a competitive firm to set price equal to marginal cost. So should regulators require marginal cost pricing?

Figure 77.1 illustrates this situation. In the case of a natural monopoly, the firm is operating on the downward-sloping portion of its average total cost curve (it is experiencing economies of scale). When average total cost is falling, it must be that marginal cost is below average total cost, pulling it down. If the firm had to set price equal to marginal cost and sell Q_1 units (the quantity demanded when price equals marginal cost), price would be below average total cost and the firm would incur a loss: for each unit sold, the firm would lose the difference between average total cost and price. The firm would not continue to operate at a loss in the long run unless it received a subsidy equal to the amount of the loss. Government could require the efficient price and subsidize the firm, resulting in an overall increase in efficiency for society. But firm subsidies funded from tax revenues are often politically unpopular. What other options do regulators have?

figure 77.1

Price Setting for a Regulated Monopoly

This figure shows the marginal cost curve, *MC,* and the average total cost curve, *ATC.* When price is set equal to marginal cost (where the *MC* curve crosses the demand curve), the firm incurs a loss. When price is set equal to average total cost (where *ATC* crosses the demand curve) the firm breaks even, but price and quantity are not at the efficient level.



If regulators want to set the price so that the firm does not require a subsidy, they can set the price at which the demand curve intersects the average total cost curve and the firm breaks even. This is called **average cost pricing.** As Figure 77.1 illustrates, average cost pricing results in output level Q_2. The result, a lower quantity at a higher price than with marginal cost pricing, seems to fly in the face of what antitrust regulation is all about. But remember that there are always trade-offs, and it may be best to avoid subsidizing a loss even if it results in less than the efficient quantity.

Allowing a natural monopoly to exist permits the firm to produce at a lower average total cost than if multiple firms produced in the same market. And price regulation seeks to prevent the inefficiency that results when an unregulated monopoly limits output and raises price. This all looks terrific: consumers are better off, monopoly

Marginal cost pricing occurs when regulators set a monopoly's price equal to its marginal cost to achieve efficiency.

Average cost pricing occurs when regulators set a monopoly's price equal to its average cost to prevent the firm from incurring a loss.

profits are avoided, and overall welfare increases. Unfortunately, things are rarely that easy in practice. The main problem is that regulators don't always have the information required to set the price exactly at the level at which the demand curve crosses the average total cost curve. Sometimes they set it too low, creating shortages; at other times they set it too high, increasing inefficiency. Also, regulated monopolies, like publicly owned firms, tend to exaggerate their costs to regulators and to provide inferior quality to consumers.

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The Regulated Price of Power

Power doesn't come cheap, and we're not just talking about the nearly $2 billion spent on congressional races in 2010. By 2017, Georgia Power plans to add two 1,100-megawatt nuclear reactors to its Vogtle Electric Generating Plant in eastern Georgia at an estimated cost of $14 billion. In Kentucky, Louisville Gas and Electric will spend $1.2 billion to add a 750-megawatt coal-fired generating unit. With high start-up costs like these, power plants are natural monopolies. If many plants competed for customers in the same region, none would sell enough energy to warrant the cost of each plant. Here we see the spreading effect from Module 55 in action—having just one plant allows the production level to be relatively high and the average fixed cost to be tolerably low.

On October 6, 2010, U.S. Interior Secretary Ken Salazar and representatives from Cape Wind Associates signed the lease for a wind farm off the coast of Massachusetts. The $2.5 billion project will generate 468 megawatts of electricity. With lower output and higher start-up costs than the coal-fired power plant, the spreading effect is smaller, making the average fixed cost and the average total cost relatively high. If regulators set prices for this natural monopoly in accordance with average total cost, we would expect coal-fired plants to be held to a lower price per kilowatt-hour (kWh) than the relatively expensive wind power plants. Indeed, Cape Wind plans to charge 19 cents per kWh, more than twice the 8 cents per kWh allowed for electricity from coal-fired plants in Kentucky and Massachusetts.

Why the interest in generating energy from wind when energy from coal is cheaper for the consumer? The dynamics of supply and demand provide one reason: as supplies of coal decrease and energy demand increases, the equilibrium price for coal energy will rise, helping investments in wind energy to pay off. Another reason relates to the external costs discussed in Module 75: wind turbines create no emissions. The U.S. Department of Energy reports that if 20 percent of the nation's energy needs were satisfied with wind, carbon dioxide emissions would fall by 825 million metric tons annually. Like coal-fired power plants, wind farms do create some negative externalities. The potential for noise and obstructed views elicit cries of "not in my back yard (or even five miles off my coast)!" As with lunches, there's no such thing as a free kWh, which highlights the importance of cost-benefit analysis.

Module 77 AP Review

Solutions appear at the back of the book.

Check Your Understanding

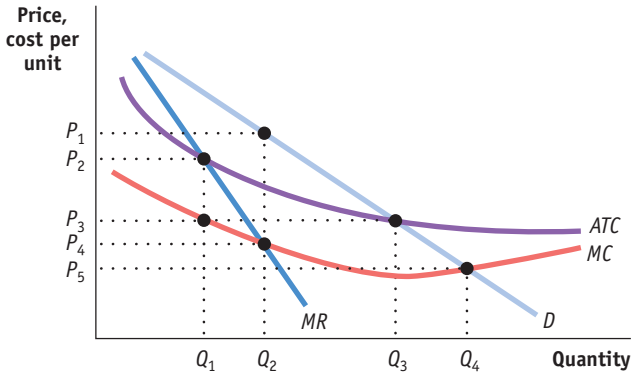
1. Would each of the following business practices be legal under antitrust law? Explain.
   a. You have a patent for a superior fax machine and therefore are the only person able to sell that type of fax machine. In order to buy your fax machine, you require the purchaser to buy a service contract from you (even though other firms provide excellent service for your machine).
   b. You have invented a new type of correction fluid that does an amazing job covering up mistakes made on paper forms. In order to buy your correction fluid, you require purchasers to buy all of their office supplies from you.
   c. You own a car dealership and plan to buy the dealership across the street and merge the two companies. There are several other car dealerships in town.
   d. You and your only other competitor in the state have an agreement that, any time a new firm tries to enter the market, you will drop your prices for long enough to run the new entrant out of business before returning to your previous prices.

2. The FYI in this module discusses the possibility that regulators set prices for wind energy on the basis of average total cost. Explain why policymakers who don't want to pay subsidies would choose average cost pricing over marginal cost pricing in the market for wind energy.

Tackle the Test: Multiple-Choice Questions

1. The Sherman Antitrust Act of 1890 sought to do which of the following?
   a. break up existing monopolies
   b. prevent the creation of new monopolies
   c. stop monopoly behavior engaged in by trusts
   d. respond to the increasing power of trusts in the economy
   e. all of the above
2. A natural monopoly exists when, over the relevant range, increasing the output level results in a lower
   a. total cost.
   b. average total cost.
   c. average variable cost.
   d. average fixed cost.
   e. marginal cost.
3. Which of the following is the most common policy approach to a natural monopoly?
   a. public ownership
   b. price regulation
   c. quantity regulation
   d. quality regulation
   e. a breakup of the monopoly into smaller firms

For questions 4 and 5, refer to the graph provided.

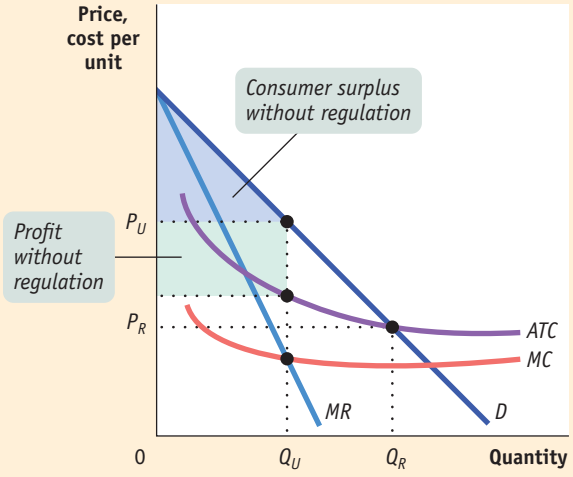


4. Without government intervention, a monopolist will produce _____ and charge _____.
   a. Q_3, P_3
   b. Q_2, P_4
   c. Q_2, P_1
   d. Q_1, P_3
   e. Q_1, P_2
5. The lowest regulated price the government could expect this monopolist to maintain in the long run is
   a. P_1.
   b. P_2.
   c. P_3.
   d. P_4.
   e. P_5.

Tackle the Test: Free-Response Questions

1. a. Draw a correctly labeled graph showing a natural monopoly. On your graph, label the price and quantity the monopoly will choose if unregulated as P_U and Q_U.
   b. On the same graph, shade in and label consumer surplus and the firm's profit in the absence of regulation.
   c. On the same graph, label the lowest price that regulators could expect the monopoly to maintain in the long run as P_R and the resulting quantity as Q_R.
   d. What happens to the size of consumer surplus when the firm is required to charge P_R rather than P_U? What happens to the firm's profit?

Answer (10 points)



1 point: Correctly labeled axes ("Price, cost per unit" or "Dollars per unit" on the vertical axis, "Quantity" or "Q" on the horizontal axis)

1 point: Downward-sloping *ATC* curve

1 point: Downward-sloping *MC* curve below the *ATC* curve

1 point: Unregulated quantity Q_U shown on the horizontal axis where $MC = MR$

1 point: Unregulated price P_U found on a downward-sloping demand curve above Q_U and shown on the vertical axis

1 point: Correct profit rectangle

1 point: Consumer surplus triangle shown below the demand curve and above the price

1 point: Regulated price and quantity P_R and Q_R shown on the appropriate axes, corresponding to where the demand curve crosses the average total cost curve.

1 point: Consumer surplus will increase

1 point: Profit will decrease to zero

2. List and describe three different public policy approaches to monopoly.

Module 78
Income Inequality and Income Distribution

What you will learn in this Module:

- What defines poverty, what causes poverty, and the consequences of poverty
- How income inequality in America has changed over time
- How programs like Social Security affect poverty and income inequality

For at least the past 70 years, every U.S. president has promised to do his best to reduce poverty. In 1964 President Lyndon Johnson went so far as to declare a "war on poverty," creating a number of new programs to aid the poor. Antipoverty programs account for a significant part of the U.S. *welfare state*—the system whereby the government takes responsibility for the welfare of its citizens—although social insurance programs are an even larger part. In this module, we look at the problem of poverty and the issue of income distribution, and learn how public policy can affect them.

The Problem of Poverty

What, exactly, do we mean by poverty? Any definition is somewhat arbitrary. Since 1965, however, the U.S. government has maintained an official definition of the **poverty threshold,** a minimum annual income that is considered adequate to purchase the necessities of life. Families whose incomes fall below the poverty threshold are considered poor.

The official poverty threshold depends on the size and composition of a family. In 2009 the poverty threshold for an adult living alone was $10,956; for a household consisting of two adults and two children, it was $21,756.

Trends in Poverty

Contrary to popular misconceptions, although the official poverty threshold is adjusted each year to reflect changes in the cost of living, it has *not* been adjusted upward over time to reflect the long-term rise in the standard of living of the average American family. As a result, as the economy grows and becomes more prosperous, and average incomes rise, you might expect the percentage of the population living below the poverty threshold to steadily decline.

Somewhat surprisingly, however, this hasn't happened. Figure 78.1 on the next page shows the U.S. **poverty rate**—the percentage of the population living below the poverty

The **poverty threshold** is the annual income below which a family is officially considered poor.

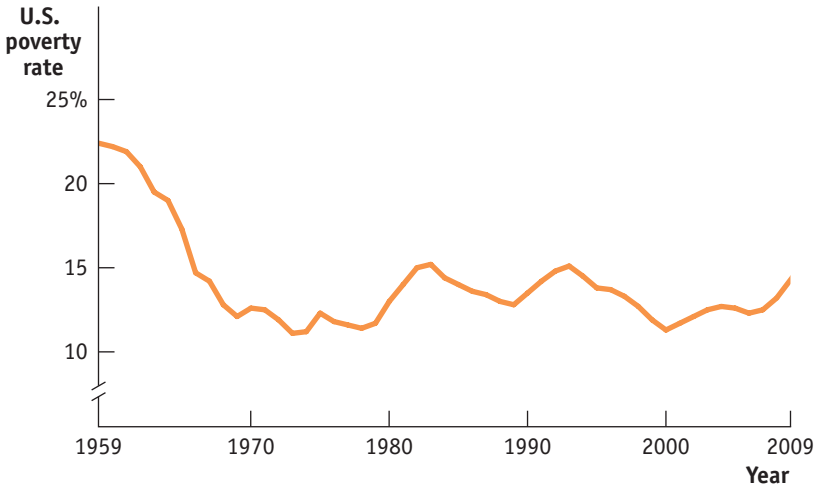
The **poverty rate** is the percentage of the population with incomes below the poverty threshold.

figure 78.1

Trends in the U.S Poverty Rate, 1959–2009

The poverty rate fell sharply from the 1960s to the early 1970s but has not shown a clear trend since then.

Source: U.S. Census Bureau



threshold—from 1959 to 2009. As you can see, the poverty rate fell steeply during the 1960s and early 1970s. Since then, however, it has fluctuated up and down, with no clear trend. In fact, in 2009 the poverty rate was higher than it had been in 1973.

Who Are the Poor?

Many Americans probably hold a stereotyped image of poverty: an African-American or Hispanic family with no husband present and the female head of the household unemployed at least part of the time. This picture isn't completely off-base: poverty is disproportionately high among African-Americans and Hispanics as well as among female-headed households. But a majority of the poor don't fit the stereotype.

In 2009, about 43.5 million Americans were in poverty—14.3% of the population, or about one in seven persons. About one-quarter of the poor were African-American and a roughly equal number, Hispanic. Within these two groups, poverty rates were well above the national average: 25.9% of African-Americans and 25.3% of Hispanics. But there was also widespread poverty among non-Hispanic whites, who had a poverty rate of 9.4%.

There is also a correlation between family makeup and poverty. Female-headed families with no husband present had a very high poverty rate: 32.5%. Married couples were much less likely to be poor, with a poverty rate of only 5.8%; still, about 39% of poor families were married couples.

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What really stands out from the data, however, is the association between poverty and lack of adequate employment. Adults who work full time are very unlikely to be poor: only 3.6% of full-time workers were poor in 2008. Adults who worked part time or not at all during the year made up 87.3% of the poor in 2008. Many industries, particularly in the retail and service sectors, now rely primarily on part-time workers. Part-time work typically lacks benefits such as health plans, paid vacation days, and retirement benefits, and it also usually pays a lower hourly wage than comparable full-time work. As a result, many of the poor are members of what analysts call the *working poor:* workers whose income falls at or below the poverty threshold.

What Causes Poverty?

Poverty is often blamed on lack of education, and educational attainment clearly has a strong positive effect on income level—those with more education earn, on average, higher incomes than those with less education. For example, in 1979 the average hourly wage of men with a college degree was 36% higher than that of men with only a high school diploma; by 2009 the "college premium" had increased to 81%. Lack of proficiency in English is also a barrier to higher income. For example, Mexican-born male workers in the United States—two-thirds of whom have not graduated from high school and many of whom have poor English skills—earn less than half of what native-born men earn. And it's important not to overlook the role of racial and gender discrimination; although less pervasive today than 50 years ago, discrimination still erects formidable barriers to advancement for many Americans. Non-whites earn less and are less likely to be employed than whites with comparable levels of education. Studies find that African-American males suffer persistent discrimination by employers in favor of whites, African-American women, and Hispanic immigrants. Women earn lower incomes than men with similar qualifications.

In addition, one important source of poverty that should not be overlooked is bad luck. Many families find themselves impoverished when a wage-earner loses a job or a family member falls seriously ill.

Consequences of Poverty

The consequences of poverty are often severe, particularly for children. Currently, more than 17.4% of children in the United States live in poverty. Poverty is often associated with a lack of access to health care, which can lead to further health problems that erode the ability to attend school and work later in life. Affordable housing is also frequently a problem, leading poor families to move often and disrupting school and work schedules. Recent medical studies have shown that children raised in severe poverty tend to suffer from lifelong learning disabilities. As a result, American children growing up in or near poverty don't have an equal chance at the starting line: they tend to be at a disadvantage throughout their lives. For example, even talented children who come from poor families are unlikely to finish college.

Table 78.1 shows the results of a long-term survey conducted by the U.S. Department of Education, which tracked a group of students who were in eighth grade in 1988. That year, the students took a mathematics test that the study used as an indicator of their innate ability; the study also scored students by the socioeconomic status of their families, a measure that took into account their parents' income and employment. As you can see, the results were disturbing: only 29% of students who were in the highest-scoring 25% on the test but whose parents were of low status finished college. By contrast, the equally talented children of high-status parents had a 74% chance of finishing college—and children of high-status parents had a 30% chance of finishing college even if they had low test scores. What this tells us is that

table **78.1**

Percent of Eighth-Graders Finishing College, 1988

	Mathematics test score in bottom quartile	Mathematics test score in top quartile
Parents in bottom quartile	3%	29%
Parents in top quartile	30	74

Source: National Center for Education Statistics, *The Condition of Education 2003*, p. 47.

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The Impeccable Economic Logic of Early Childhood Intervention Programs

One of the most vexing problems facing any society is how to break what researchers call the "cycle of poverty": children who grow up with disadvantaged socioeconomic backgrounds are far more likely to remain trapped in poverty as adults, even after we account for differences in ability. They are more likely to be unemployed or underemployed, to engage in crime, and to suffer chronic health problems.

Early childhood intervention has offered some hope of breaking the cycle. A 2006 study by the RAND Corporation found that high-quality early-childhood programs that focus on education and health care lead to significant social, intellectual, and financial advantages for kids who would otherwise be at risk of dropping out of high school and of engaging in criminal behavior. Children in programs like Head Start were less likely to engage in such destructive behaviors and more likely to end up with a job and to earn a high salary later in life. Another study by researchers at the University of Pittsburgh in 2003 looked at early-childhood intervention programs from a dollars-and-cents perspective, finding from $4 to $7 in benefits for every $1 spent on early-childhood intervention programs. The study also pointed to one program whose participants, by age 20, were 26% more likely to have finished high school, 35% less likely to have been charged in juvenile court, and 40% less likely to have repeated a grade compared to individuals of similar socioeconomic background who did not attend preschool. The observed external benefits to society of these programs are so large that the Brookings Institution predicts that providing high-quality preschool education to every American child would result in an increase in GDP, the total value of a country's domestic output, by almost 2%, representing over 3 million more jobs.

poverty is, to an important degree, self-perpetuating: the children of the poor start at such a disadvantage relative to other Americans that it's very hard for them to achieve a better life.

Economic Inequality

The United States is a rich country. In 2008, the average U.S. household had an income of more than $68,000, far exceeding the poverty threshold. How is it possible, then, that so many Americans still live in poverty? The answer is that income is unequally distributed, with many households earning much less than the average and others earning much more.

Table 78.2 shows the distribution of pre-tax income among U.S. families in 2008—income before federal income taxes are paid—as estimated by the Census Bureau. Households are grouped into *quintiles,* each containing 20% or one-fifth of the popula-

table **78.2**

U.S. Income Distribution in 2008

Income group	Income range	Average income	Percent of total income
Bottom quintile	Less than $20,712	$11,656	3.4%
Second quintile	$20,712 to $39,000	29,517	8.6
Third quintile	$39,000 to $62,725	50,132	14.7
Fourth quintile	$62,725 to $100,240	79,760	23.3
Top quintile	More than $100,240	171,057	50.0
Top 5%	More than $180,000	294,709	21.5
Mean Income = $68,424		Median Income = $50,303	

Source: U.S. Census Bureau.

tion. The first, or bottom, quintile contains households whose income put them below the 20th percentile in income, the second quintile contains households whose income put them between the 20th and 40th percentiles, and so on. The Census Bureau also provides data on the 5% of families with the highest incomes.

For each group, Table 78.2 shows three numbers. The second column shows the range of incomes that define the group. For example, in 2008, the bottom quintile consisted of households with annual incomes of less than $20,712; the next quintile of households with incomes between $20,712 and $39,000; and so on. The third column shows the average income in each group, ranging from $11,656 for the bottom fifth to $294,709 for the top 5 percent. The fourth column shows the percentage of total U.S. income received by each group.

At the bottom of Table 78.2 are two useful numbers for thinking about the incomes of American households. **Mean household income,** also called average household income, is the total income of all U.S. households divided by the number of households. **Median household income** is the income of a household in the exact middle of the income distribution—the level of income at which half of all households have lower income and half have higher income. It's very important to realize that these two numbers do not measure the same thing. Economists often illustrate the difference by asking people first to imagine a room containing several dozen more or less ordinary wage-earners and then to think about what happens to the mean and median incomes of the people in the room if a billionaire Wall Street tycoon walks in. The mean income soars, because the tycoon's income pulls up the average, but median income hardly rises at all. This example helps explain why economists generally regard median income as a better guide to the economic status of typical American families than mean income: mean income is strongly affected by the incomes of a relatively small number of very-high-income Americans, who are not representative of the population as a whole; median income is not.

Mean household income is the average income across all households.

Median household income is the income of the household lying in the middle of the income distribution.

The **Gini coefficient** is a number that summarizes a country's level of income inequality based on how unequally income is distributed across the quintiles.

What we learn from Table 78.2 is that income in the United States is quite unequally distributed. The average income of the poorest fifth of families is less than a quarter of the average income of families in the middle, and the richest fifth have an average income more than three times that of families in the middle. The incomes of the richest fifth of the population are, on average, about 15 times as high as those of the poorest fifth. In fact, the distribution of income in America has become more unequal since 1980, rising to a level that has made it a significant political issue. The FYI at the end of this section discusses long-term trends in U.S. income inequality, which declined in the 1930s and 1940s, was stable for more than 30 years after World War II, but began rising again in the late 1970s.

It's often convenient to have a single number that summarizes a country's level of income inequality. The **Gini coefficient,** the most widely used measure of inequality, is based on how disparately income is distributed across the quintiles. A country with a perfectly equal distribution of income—that is, one in which the bottom 20% of the population received 20% of the income, the bottom 40% of the population received 40% of the income, and so on—would have a Gini coefficient of 0. At the other extreme, the highest possible value for the Gini coefficient is 1—the level it would attain if all of a country's income went to just one person.

One way to get a sense of what Gini coefficients mean in practice is to look at international comparisons. Figure 78.2 on page 767 shows the most recent estimates of the Gini coefficient for many of the world's countries. Aside from a few countries in Africa, the highest levels of income inequality are found in Latin America; countries with a high degree of inequality, such as Brazil, have Gini coefficients close to 0.6. The most equal distributions of income are in Europe, especially in Scandinavia; countries with very equal income distributions, such as Sweden, have Gini coefficients around 0.25. Compared to other wealthy countries, the United States, with a Gini coefficient of 0.468 in 2009, has unusually high inequality, though it isn't as unequal as in Latin America.

How serious an issue is income inequality? In a direct sense, high income inequality means that some people don't share in a nation's overall prosperity. As we've seen, rising inequality explains how it's possible that the U.S. poverty rate has failed to fall for the

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Long-Term Trends in Income Inequality in the United States

Does inequality tend to rise, fall, or stay the same over time? The answer is yes—all three. Over the course of the past century, the United States has gone through periods characterized by all three trends: an era of falling inequality during the 1930s and 1940s, an era of stable inequality for about 35 years after World War II, and an era of rising inequality over the past generation.

Detailed U.S. data on income by quintiles, as shown in Table 78.2, are only available starting in 1947. The figure shows the annual rate of growth of income, adjusted for inflation, for each quintile over two periods: from 1947 to 1980, and from 1980 to 2008. There's a clear difference between the two periods. In the first period, income within each group grew at about the same rate—that is, there wasn't much change in the inequality of income, just growing incomes across the board. After 1980, however, incomes grew much more quickly at the top than in the middle, and more quickly in the middle than at the bottom. So inequality has increased substantially since 1980. Overall, inflation-adjusted income for the top quintile rose 48% between 1980 and 2008, but it rose only 8.7% for the bottom quintile.

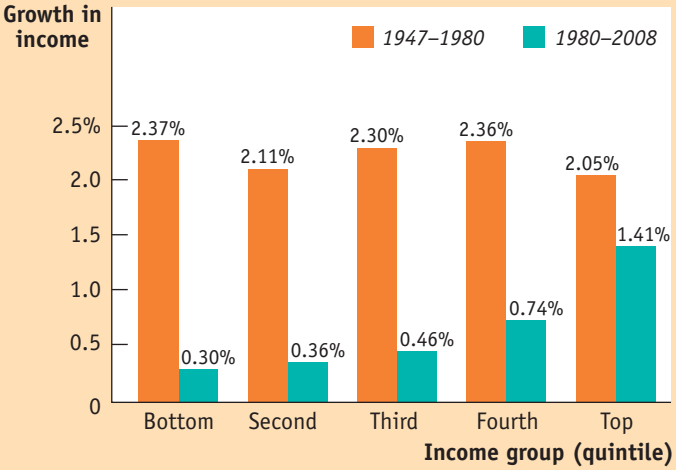
Although detailed data on income distribution aren't available before 1947, economists have instead used other information including income tax data to estimate the share of income going to the top 10% of the population all the way back to 1917. Panel (b) of the figure shows this measure from 1917 to 2008. These data, like the more detailed data available since 1947, show that American inequality was more or less stable between 1947 and the late 1970s but has risen substantially since. The longer-term data also show, however, that the relatively equal distribution of 1947 was something new. In the late nineteenth century, often referred to as the Gilded Age, American income was very unequally distributed; this high level of inequality persisted into the 1930s. But inequality declined sharply between the late 1930s and the end of World War II. In a famous paper, Claudia Goldin and Robert Margo, two economic historians, dubbed this narrowing of income inequality "the Great Compression."

The Great Compression roughly coincided with World War II, a period during which the U.S. government imposed special controls on wages and prices. Evidence indicates that these controls were applied in ways that reduced inequality—for example, it was much easier for employers to get approval to increase the wages of their lowest-paid employees than to increase executive salaries. What remains puzzling is that the equality imposed by wartime controls lasted for decades after those controls were lifted in 1946.

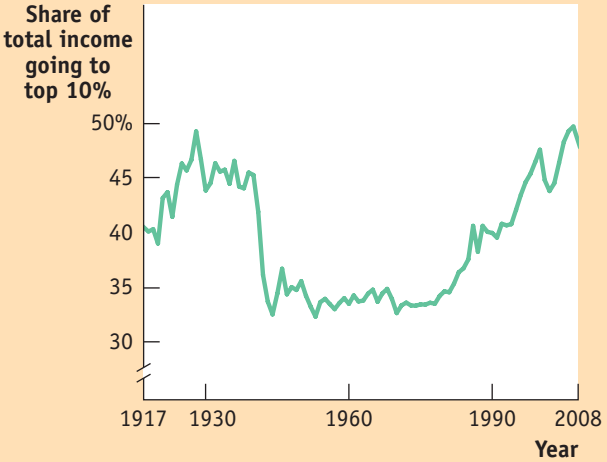
Since the 1970s, as we've already seen, inequality has increased substantially. In fact, pretax income appears to be as unequally distributed in America today as it was in the 1920s, prompting many commentators to describe the current state of the nation as a new Gilded Age—albeit one in which the effects of inequality are moderated by taxes and the existence of the welfare state. There is intense debate among economists about the causes of this widening inequality. The most popular explanation is rapid technological change, which has increased the demand for highly skilled or talented workers more rapidly than the demand for other workers, leading to a rise in the wage gap between the highly skilled and other workers. Growing international trade may also have contributed by allowing the United States to import labor-intensive products from low-wage countries rather than making them domestically, reducing the demand for less skilled American workers and depressing their wages. Rising immigration may be yet another source. On average, immigrants have lower education levels than native-born workers and increase the supply of low-skilled labor while depressing low-skilled wages.

All of these explanations, however, fail to account for one key feature: much of the rise in inequality doesn't reflect a rising gap between highly educated workers and those with less education, but rather growing differences among highly educated workers themselves. For example, schoolteachers and top business executives have similarly high levels

(a) Rates of Income Growth Since 1947



(b) The Richest 10% of Americans, 1917–2008



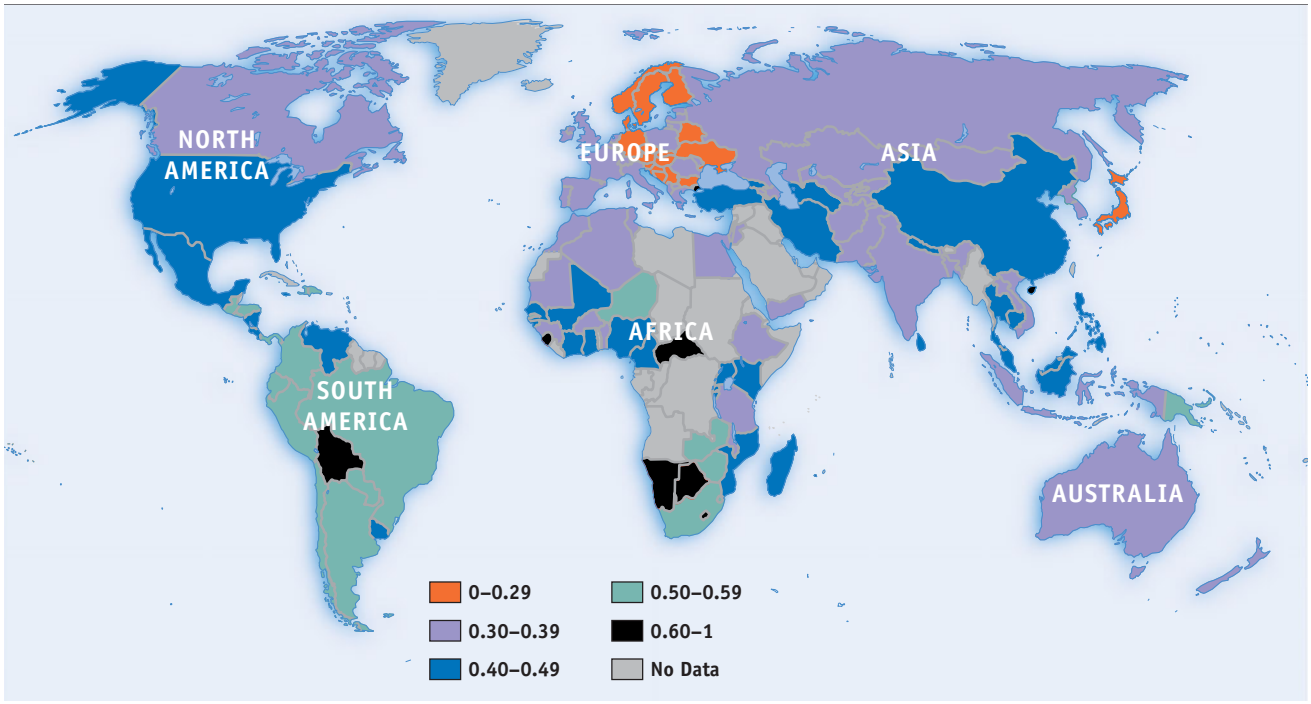
of education, but executive paychecks have risen dramatically and teachers' salaries have not. For some reason, the economy now pays a few "superstars"—a group that includes literal superstars in the entertainment world but also such groups as Wall Street traders and top corporate executives—much higher incomes than it did a generation ago. It's still not entirely clear what caused the change.

past 35 years even though the country as a whole has become considerably richer. Also, extreme inequality, as found in Latin America, is often associated with political instability, because of tension between a wealthy minority and the rest of the population.

It's important to realize, however, that the data shown in Table 78.2 overstate the true degree of inequality in America, for several reasons. One is that the data represent a snapshot for a single year, whereas the incomes of many individual families fluctuate over time. That is, many of those near the bottom in any given year are having an unusually bad year and many of those at the top are having an unusually good one. Over time, their incomes will revert to a more normal level. So a table showing average incomes within quintiles over a longer period, such as a decade, would not show as much inequality. Furthermore, a family's income tends to vary over its life cycle: most people earn considerably less in their early working years than they will later in life, and then experience a considerable drop in income when they retire. Consequently, the numbers in Table 78.2, which combine young workers, mature workers, and retirees, show more inequality than would a table that compares families of similar ages.

Despite these qualifications, there is a considerable amount of genuine inequality in the United States. Moreover, the fact that families' incomes fluctuate from year to year

figure 78.2 Income Inequality Around the World



The highest levels of income inequality are found in Africa and Latin America. The most equal distributions of income are in Europe, especially in Scandinavia. Compared to other wealthy countries, the United States, with a Gini coefficient of 0.468 in 2009, has unusually high inequality.

Source: World Bank, *Human Development Report 2007–2008*

isn't entirely good news. Measures of inequality in a given year *do* overstate true inequality. But those year-to-year fluctuations are part of a problem that worries even affluent families—economic insecurity.

Economic Insecurity

The rationale for the welfare state rests in part on the benefits of reducing economic insecurity, which afflicts even relatively well-off families. One source of economic insecurity is the risk of a sudden loss of income, as occurs when a family member loses a job and either spends an extended period without work or is forced to take a new job that pays considerably less. In a given year, according to recent estimates, about one in six American families will see their income cut in half. Related estimates show that the percentage of people who find themselves below the poverty threshold for at least one year over the course of a decade is several times higher than the percentage of people below the poverty threshold in any given year.

Even if a family doesn't face a loss in income, it can face a surge in expenses. The most common reason for such surges is a medical problem that requires expensive treatment, such as heart disease or cancer. Many Americans have health insurance that covers a large share of their expenses in such cases, but a substantial number either do not have health insurance or rely on insurance provided by the government.

U.S. Antipoverty Programs

U.S. antipoverty programs include three huge programs—Social Security, Medicare, and Medicaid—several other fairly big programs, including Temporary Assistance for Needy Families, food stamps, the Earned Income Tax Credit, and a number of smaller programs. Table 78.3 shows one useful way to categorize these programs, along with the amount spent on each listed program in 2009.

First, the table distinguishes between programs that are **means-tested** and those that are not. In means-tested programs, benefits are available only to families or individuals whose income and/or wealth falls below some minimum. Basically, means-tested programs are poverty programs designed to help only those with low incomes. By contrast, non-means-tested programs provide their benefits to everyone, although, as we'll see, they tend in practice to reduce income inequality by increasing the incomes of the poor by a larger proportion than the incomes of the rich.

Second, the table distinguishes between programs that provide monetary transfers that beneficiaries can spend as they choose and those that provide **in-kind benefits,** which are given in the form of goods or services rather than money. As the numbers suggest, in-kind benefits are dominated by Medicare and Medicaid, which pay for health care.

table **78.3**

Major U.S. Welfare State Programs, 2009

	Monetary transfers	In-kind
Means-tested	Temporary Assistance for Needy Families: $20.1 billion	Food stamps: $54.6 billion
	Supplemental Security Income: $42.4 billion	Medicaid: $369.3 billion
	Earned Income Tax Credit: $66.6 billion	
Not means-tested	Social Security: $664 billion	Medicare: $500.3 billion
	Unemployment insurance: $129.4 billion	

A **means-tested** program is available only to individuals or families whose incomes fall below a certain level.

An **in-kind benefit** is a benefit given in the form of goods or services.

Means-Tested Programs

A **negative income tax** is a program that supplements the income of low-income workers.

When people use the term *welfare,* they're often referring to monetary aid to poor families. The main source of such monetary aid in the United States is Temporary Assistance for Needy Families, or TANF. This program does not aid everyone who is poor; it is available only to poor families with children and only for a limited period of time.

TANF was introduced in the 1990s to replace a highly controversial program known as Aid to Families with Dependent Children, or AFDC. The older program was widely accused of creating perverse incentives for the poor, including encouraging family breakup. Partly as a result of the change in programs, the benefits of modern "welfare" are considerably less generous than those available a generation ago, once the data are adjusted for inflation. Also, TANF contains time limits, so welfare recipients—even single parents—must eventually seek work. As you can see from Table 78.3, TANF is a relatively small part of the modern U.S. welfare state.

Other means-tested programs, though more expensive, are less controversial. The Supplemental Security Income program aids disabled Americans who are unable to work and have no other source of income. The Supplemental Nutrition Assistance Program (formerly known as the Food Stamp Program) helps low-income families and individuals to buy food staples.

AP Photo/Rich Pedroncelli

The Supplemental Nutrition Assistance Program helps those with low-incomes put food on the table. Purchases are made using an electronic benefits transfer card that works like a debit card but can be used only to purchase food.

Finally, economists use the term **negative income tax** for a program that supplements the earnings of low-income workers. For example, in the United States, the Earned Income Tax Credit (EITC) provides additional income to millions of workers. It has become more generous as traditional welfare has become less generous. As an incentive to work, only workers who earn income are eligible for the EITC. And as an incentive to work more, over a certain range of incomes, the more a worker earns, the higher the amount of EITC received. That is, the EITC acts as a negative income tax for low-wage workers. In 2009, married couples with two children earning less than $12,570 per year received EITC payments equal to 40% of their earnings. Payments were slightly lower for single-parent families or workers without children. At higher incomes, the EITC is phased out, disappearing at an income of $40,295 in 2009.

Social Security and Unemployment Insurance

Social Security, the largest program in the U.S. welfare state, is a non-means-tested program that guarantees retirement income to qualifying older Americans. It also provides benefits to workers who become disabled and "survivor benefits" to family members of workers who die. Social Security is supported by a dedicated tax on wages: the Social Security portion of the payroll tax pays for Social Security benefits. The benefits workers receive on retirement depend on their taxable earnings during their working years: the more you earn up to the maximum amount subject to Social Security taxes ($106,800 in 2010), the more you receive in retirement. Benefits are not, however, strictly proportional to earnings. Instead, they're determined by a formula that gives high earners more than low earners, but with a sliding scale that makes the program relatively more generous for low earners.

Because most senior citizens don't receive pensions from their former employers, and most don't own enough assets to live off the income from their assets, Social Security benefits are an enormously important source of income for them. Fully 60% of Americans 65 and older rely on Social Security for more than half their income, and 20% have no income at all except for Social Security.

Unemployment insurance, although a much smaller amount of government transfers than Social Security, is another key social insurance program. It provides workers who lose their jobs with about 35% of their previous salary until they find a new job or until 26 weeks have passed. (This period is sometimes extended when the economy is in a slump.) Unemployment insurance is financed by a tax on employers.

The Effects of Programs on Poverty and Inequality

Because the people who receive government transfers tend to be different from those who are taxed to pay for those transfers, the U.S. welfare state has the effect of redistributing income from some people to others. Each year the Census Bureau estimates the effect of this redistribution in a report titled "The Effects of Government Taxes and Transfers on Income and Poverty." The report calculates only the *direct* effects of taxes and transfers, without taking into account changes in behavior that the taxes and transfers might cause. For example, the report doesn't try to estimate how many older Americans who are now retired would still be working if they weren't receiving Social Security checks. As a result, the estimates are only a partial indicator of the true effects of the welfare state. Nonetheless, the results are striking.

Table 78.4 shows how taxes and government transfers affected the poverty threshold for the population as a whole and for different age groups in 2008. It shows two numbers for each group: the percentage of the group that *would have had* incomes below the poverty threshold if the government neither collected taxes nor made transfers, and the percentage that actually fell below the poverty threshold once taxes and transfers were taken into account. (For technical reasons, the second number is somewhat lower than the standard measure of the poverty rate.) Overall, the combined effect of taxes and transfers is to cut the U.S. poverty rate nearly in half. The elderly derived the greatest benefits from redistribution, which reduced their potential poverty rate of 47.4% to an actual poverty rate of 9.7%.

table **78.4**

Effects of Taxes and Transfers on the Poverty Rate, 2008

Group (by age)	Poverty rate without taxes and transfers	Poverty rate with taxes and transfers
All	21.4%	12.1%
Under 18	22.0	15.9
18 to 64	15.9	11.1
65 and over	47.4	9.7

Source: Census.gov, ASEC: Table 2. Percent of Persons in Poverty, by Definition of Income and Selected Characteristics: 2008

Table 78.5 shows the effects of taxes and transfers on the share of aggregate income going to each quintile of the income distribution in 2005. Like Table 78.4, it shows both what the distribution of income *would have been* if there were no taxes or government transfers and the actual distribution of income taking into account both

table **78.5**

Effects of Taxes and Transfers on the Income Distribution, 2005

Quintiles	Share of aggregate income without taxes and transfers	Share of aggregate income with taxes and transfers
Bottom quintile	1.5%	4.4%
Second quintile	7.3	9.9
Third quintile	14.0	15.3
Fourth quintile	23.4	23.1
Top quintile	53.8	47.3

Source: U.S. Census Bureau.

taxes and transfers. The effect of government programs was to increase the share of income going to the poorest 60% of the population, especially the share going to the poorest 20%, while reducing the share of income going to the richest 20%.

The Debate Over Income Redistribution

The goals of income redistribution seem laudable: to help the poor, protect everyone from financial risk, and ensure that people can afford essential health care. But good intentions don't always make for good policy. There is an intense debate about how large the antipoverty programs should be, a debate that partly reflects differences in philosophy but also reflects concern about the possibly counterproductive effects of antipoverty programs. Disputes about the role of government in income redistribution are also one of the defining issues of modern politics.

Problems with Income Redistribution

There are two different lines of argument against antipoverty programs. One is based on philosophical concerns about the proper role of government. Some political theorists believe that redistributing income is not a legitimate role of government—that government's role should be limited to maintaining the rule of law, providing public goods, and managing externalities.

The more conventional argument against income redistribution involves the trade-off between efficiency and equity. A government with extensive antipoverty programs requires more revenue, and thus higher marginal tax rates, than one that limits itself mainly to the provision of public goods such as national defense. Table 78.6 shows "social expenditure," a measure that roughly corresponds to welfare state spending, as a percentage of GDP in the United States, Britain, and France; it also compares this with an estimate of the marginal tax rate faced by an average wage-earner, including payroll taxes paid by employers and state and local taxes. As you can see, France's large welfare state goes along with a high marginal rate of taxation. Some, but not all, economists believe that this high rate of taxation is a major reason the French work substantially fewer hours per year than Americans.

table **78.6**

Social Expenditure and Marginal Tax Rates

	Social expenditure in 2005 (% of GDP)	Marginal tax rate in 2008
US	16.3%	34.4%
UK	22.1	38.8
France	29.5	52.0

Sources: OECD Social Expenditure Database; OECD Taxing Wages Database.

The trade-off between antipoverty programs and high marginal tax rates seems to suggest that we should try to hold down the cost of these programs. One way to do this is to means-test benefits: make them available only to those who need them. But means-testing, it turns out, creates a different kind of trade-off between equity and efficiency. Consider the following example: Suppose there is some means-tested benefit, worth $2,000 per year that is available only to families with incomes of less than $20,000 per year. Now suppose that a family currently has an income of $19,500 but that one family member is deciding whether to take a new job that will raise the family's income to $20,500. Well, taking that job will actually make the family worse off because it will gain $1,000 in earnings but lose the $2,000 government benefit.

This situation, in which earning more actually leaves a family worse off through lost benefits, is known as a *notch*. It is a well-known problem with programs that aid the poor and behaves much like a high marginal tax rate on income. Most welfare state programs are designed to avoid creating a notch. This is typically done by setting a sliding scale for benefits such that they fall off gradually as the recipient's income rises. As long as benefits are reduced by less than a dollar for every additional dollar earned, there is an incentive to work more if possible. Current programs are not always successful in providing incentives for work. The combined effects of the major means-tested programs shown in Table 78.3, plus additional means-tested programs such as housing aid that are offered by some state and local governments, can be to create very high effective marginal tax rates. For example, one 2005 study found that a family consisting of two adults and two children that raised its annual income from $20,000—just above the poverty threshold in 2005—to $35,000 would find almost all of its increase in after-tax income offset by the loss of benefits such as food stamps, the Earned Income Tax Credit, and Medicaid.

The Politics of Income Redistribution

In 1791, in the early phase of the French Revolution, France had a sort of congress, the National Assembly, in which representatives were seated according to social class: nobles, who pretty much liked the way things were, sat on the right; commoners, who wanted big changes, sat on the left. Ever since, it has been common in political discourse to talk about politicians as being on the "right" (more conservative) or on the "left" (more liberal).

But what do modern politicians on the left and right disagree about? In the modern United States, they mainly disagree about the appropriate size of antipoverty programs.

You might think that saying that political debate is really about just one thing—how big should government's involvement in income redistribution be—is a huge oversimplification. But political scientists have found that once you carefully rank members of Congress from right to left, a congressperson's position in that ranking does a very good job of predicting his or her votes on proposed legislation. Modern politics isn't completely one-dimensional—but it comes pretty close.

The same studies that show a strong left–right spectrum in U.S. politics also show strong polarization between the major parties on this spectrum. Thirty years ago there was a substantial overlap between the parties: some Democrats were to the right of some Republicans, or, if you prefer, some Republicans were to the left of some Democrats. Today, however, the rightmost Democrats appear to be to the left of the leftmost Republicans. There's nothing necessarily wrong with this. Although it's common to decry "partisanship," it's hard to see why members of different political parties shouldn't have different views about policy.

Can economic analysis help resolve this political conflict? Only up to a point.

Some of the political controversy over the welfare state involves differences in opinion about the trade-offs we have just discussed: if you believe that the disincentive effects of generous benefits and high taxes are very large, you're likely to look less favorably on welfare state programs than if you believe they're fairly small. Economic analysis, by improving our knowledge of the facts, can help resolve some of these differences.

To an important extent, however, differences of opinion on income redistribution reflect differences in values and philosophy. And those are differences economics can't resolve.

Module 78 AP Review

Solutions appear at the back of the book.

Check Your Understanding

1. Recall that the poverty threshold is not adjusted to reflect changes in the standard of living. As a result, is the poverty threshold a relative or an absolute measure of poverty? That is, does it define poverty according to how poor someone is relative to others or according to some fixed measure that doesn't change over time? Explain.

Tackle the Test: Multiple-Choice Questions

1. Which of the following is true of the U.S. poverty rate?
   a. It fell in the 1960s.
   b. There has been a clear upward trend since 1973.
   c. It was lower in 2009 than in 1973.
   d. It has remained unchanged since the mid 1970s.
   e. It has been steadily decreasing since 1959.
2. In 2009, approximately what percentage of the U.S. population lived in poverty?
   a. 2%
   b. 12%
   c. 20%
   d. 26%
   e. 32%
3. Average household income in the United States in 2008 was approximately
   a. $12,000.
   b. $22,000.
   c. $33,000.
   d. $48,201.
   e. $68,000.
4. Programs designed to help only those with low incomes are called
   a. welfare programs.
   b. in-kind programs.
   c. means-tested programs.
   d. income maintenance programs.
   e. social programs.
5. If a country has a perfectly equal distribution of income, its Gini coefficient equals
   a. 0.
   b. 1.
   c. 10.
   d. 50.
   e. 100.

Tackle the Test: Free-Response Questions

1. There are 100 households in the economy of Equalor. Initially, 99 of them have an income of $10,000 each, and one household has an income of $1,010,000.
   a. What is the median income in this economy? What is the mean income?

   Through its poverty programs, the government of Equalor now redistributes income: it takes $990,000 away from the richest household and distributes it equally among the remaining 99 households.
   b. What is the median income in this economy now? What is the mean income? Which indicator (mean or median household income) is a better indicator of the typical Equalorian household's income?

Answer (5 points)

1 point: median income = $10,000

1 point: mean income = $20,000

1 point: median income = $20,000

1 point: mean income = $20,000

1 point: median

2. In your opinion, what is the strongest argument for and against government programs to redistribute income? To what extent can economics be used to resolve the debate?

Section 14 Review

Summary

1. When pollution can be directly observed and controlled, government policies should be geared directly to producing the **socially optimal quantity of pollution,** the quantity at which the **marginal social cost of pollution** is equal to the **marginal social benefit of pollution.** In the absence of government intervention, a market produces too much pollution because polluters take only their benefit from polluting into account, not the costs imposed on others.

2. The cost to society of pollution from a power plant is an example of an **external cost;** the benefit to neighbors of beautiful flowers planted in your yard is an example of an **external benefit.** External costs and benefits are jointly known as **externalities,** with external costs called **negative externalities** and external benefits called **positive externalities.**

3. According to the **Coase theorem,** when externalities exist, bargaining will cause individuals to **internalize the externalities,** making government intervention unnecessary, as long as property rights are clearly defined and **transaction costs**—the costs of making a deal—are sufficiently low. However, in many cases transaction costs are too high to permit such deals.
4. Governments often deal with pollution by imposing **environmental standards,** an approach, economists argue, that is usually inefficient. Two efficient (cost-minimizing) methods for reducing pollution are **emissions taxes,** a form of **Pigouvian tax,** and **tradable emissions permits.** The optimal Pigouvian tax on pollution is equal to its marginal social cost at the socially optimal quantity of pollution. These methods also provide incentives for the creation and adoption of production technologies that cause less pollution.
5. When a good yields external benefits, such as **technology spillovers,** the **marginal social benefit of the good** is equal to the **marginal private benefit** accruing to consumers plus its **marginal external benefit.** Without government intervention, the market produces too little of the good. An optimal **Pigouvian subsidy** to producers, equal to the marginal external benefit, moves the market to the socially optimal quantity of production. This yields higher output and a higher price to producers.
6. When there are external costs from production, the **marginal social cost of a good** exceeds its **marginal private cost** to producers, the difference being the **marginal external cost.** Without government action, the market produces too much of the good. The optimal Pigouvian tax on production of the good is equal to its marginal external cost, yielding lower output and a higher price to consumers. A system of tradable production permits for the right to produce the good can also achieve efficiency at minimum cost.
7. Communications, transportation, and high-technology goods are frequently subject to **network externalities,** which arise when the value of the good to an individual is greater when more people use the good.
8. Goods may be classified according to whether or not they are **excludable,** meaning that people can be prevented from consuming them, and whether or not they are **rival in consumption,** meaning that one person's consumption of them affects another person's consumption of them.
9. Free markets can deliver efficient levels of production and consumption for **private goods,** which are both excludable and rival in consumption. When goods are nonexcludable, nonrival in consumption, or both, free markets cannot achieve efficient outcomes.
10. When goods are **nonexcludable,** there is a **free-rider problem:** consumers will not pay for the good, leading to inefficiently low production. When goods are **nonrival in consumption,** any positive price leads to inefficiently low consumption.
11. A **public good** is nonexcludable and nonrival in consumption. In most cases a public good must be supplied by the government. The marginal social benefit of a public good is equal to the sum of the marginal private benefits to each consumer. The efficient quantity of a public good is the quantity at which marginal social benefit equals the marginal social cost of providing the good. As with a positive externality, the marginal social benefit is greater than any one individual's marginal private benefit, so no individual is willing to provide the efficient quantity.
12. One rationale for the presence of government is that it allows citizens to tax themselves in order to provide public goods. Governments use cost-benefit analysis to determine the efficient provision of a public good. Such analysis is difficult, however, because individuals have an incentive to overstate the good's value to them.
13. A **common resource** is rival in consumption but nonexcludable. It is subject to **overuse,** because an individual does not take into account the fact that his or her use depletes the amount available for others. This is similar to the problem with a negative externality: the marginal social cost of an individual's use of a common resource is always higher than his or her marginal private cost. Pigouvian taxes, the creation of a system of tradable licenses, and the assignment of property rights are possible solutions.
14. **Artificially scarce goods** are excludable but nonrival in consumption. Because no marginal cost arises from allowing another individual to consume the good, the efficient price is zero. A positive price compensates the producer for the cost of production but leads to inefficiently low consumption.
15. Antitrust laws and regulation are used to promote competition. When the industry in question is a natural monopoly, price regulation is used.
16. The Sherman Act, the Clayton Act, and the Federal Trade Commission Act were the first major antitrust laws.
17. **Marginal cost pricing** and **average cost pricing** are examples of price regulation used in the case of natural monopoly to allow efficiencies from large scale production without allowing the deadweight loss that results from unregulated monopoly.
18. Despite the fact that the **poverty threshold** is adjusted according to the cost of living but not according to the standard of living, and that the average income in the United States has risen substantially over the last 30 years, the **poverty rate,** the percentage of the population with an income below the poverty threshold, is no

lower than it was 30 years ago. There are various causes of poverty: lack of education, the legacy of discrimination, and bad luck. The consequences of poverty are particularly harmful for children.

19. **Median household income,** the income of a family at the center of the income distribution, is a better indicator of the income of the typical household than **mean household income** because it is not distorted by the inclusion of a small number of very wealthy households. The **Gini coefficient,** a number that summarizes a country's level of income inequality based on how unequally income is distributed across quintiles, is used to compare income inequality across countries.
20. **Means-tested** programs target aid to people whose income falls below a certain level. The major **in-kind benefits** programs are Medicare and Medicaid, which pay for medical care. Due to concerns about the effects on incentives to work and on family cohesion, aid to poor families has become significantly less generous even as the **negative income tax** has become more generous. Social Security, the largest U.S. welfare program, has significantly reduced poverty among the elderly. Unemployment insurance is another key social insurance program.

Key Terms

Marginal social cost of pollution, p. 724
Marginal social benefit of pollution, p. 724
Socially optimal quantity of pollution, p. 725
External cost, p. 726
External benefit, p. 727
Externalities, p. 727
Negative externalities, p. 727
Positive externalities, p. 727
Coase theorem, p. 728
Transaction costs, p. 728
Internalize the externalities, p. 728
Environmental standards, p. 731
Emissions taxes, p. 732
Pigouvian taxes, p. 734
Tradable emissions permits, p. 734
Marginal private benefit, p. 738
Marginal social benefit of a good, p. 738
Marginal external benefit, p. 738
Pigouvian subsidy, p. 738
Technology spillover, p. 738
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Network externality, p. 740
Excludable, p. 743
Rival in consumption, p. 743
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Nonrival in consumption, p. 744
Free-rider problem, p. 745
Public good, p. 745
Common resource, p. 749
Overuse, p. 749
Artificially scarce good, p. 751
Marginal cost pricing, p. 757
Average cost pricing, p. 757
Poverty threshold, p. 761
Poverty rate, p. 761
Mean household income, p. 765
Median household income, p. 765
Gini coefficient, p. 765
Means-tested, p. 768
In-kind benefits, p. 768
Negative income tax, p. 769

Problems

1. What type of externality (positive or negative) is present in each of the following examples? Is the marginal social benefit of the activity greater than or equal to the marginal benefit to the individual? Is the marginal social cost of the activity greater than or equal to the marginal cost to the individual? Without intervention, will there be too little or too much (relative to what would be socially optimal) of this activity?
   a. Mr. Chau plants lots of colorful flowers in his front yard.
   b. Your next-door neighbor likes to build bonfires in his backyard, and sparks often drift onto your house.
   c. Maija, who lives next to an apple orchard, decides to keep bees to produce honey.
   d. Justine buys a large SUV that consumes a lot of gasoline.
2. The loud music coming from the sorority next to your dorm is a negative externality that can be directly quantified. The accompanying table shows the marginal social benefit and the marginal social cost per decibel (dB, a measure of volume) of music.

Volume of music (dB)	Marginal social benefit of dB	Marginal social cost of dB
90		
	$36	$0
91		
	30	2
92		
	24	4
93		
	18	6
94		
	12	8
95		
	6	10
96		
	0	12
97		

a. Draw the marginal social benefit curve and the marginal social cost curve. Use your diagram to determine the socially optimal volume of music.

b. Only the members of the sorority benefit from the music and they bear none of the cost. Which volume of music will they choose?

c. The college imposes a Pigouvian tax of $3 per decibel of music played. From your diagram, determine the volume of music the sorority will now choose.

3. Many dairy farmers in California are adopting a new technology that allows them to produce their own electricity from methane gas captured from animal wastes. (One cow can produce up to 2 kilowatts a day.) This practice reduces the amount of methane gas released into the atmosphere. In addition to reducing their own utility bills, the farmers are allowed to sell any electricity they produce at favorable rates.

a. Explain how the ability to earn money from capturing and transforming methane gas behaves like a Pigouvian tax on methane gas pollution and can lead dairy farmers to emit the efficient amount of methane gas pollution.

b. Suppose some dairy farmers have lower costs of transforming methane into electricity than others. Explain how this system leads to an efficient allocation of emissions reduction among farmers.

4. The accompanying table shows the total revenue and the total cost that accrue to steel producers from producing steel. Producing a ton of steel imposes a marginal external cost of $60 per ton.

Quantity of steel (tons)	Total revenue	Total cost to producers
1	$115	$ 10
2	210	30
3	285	60
4	340	100
5	375	150

a. Calculate the marginal revenue per ton of steel and the marginal cost per ton of steel to steel producers. Then calculate the marginal social cost per ton of steel.

b. What is the market equilibrium quantity of steel production?

c. What is the socially optimal quantity of steel production?

d. What is the optimal Pigouvian tax to remedy the problem created by the negative externality?

5. Voluntary environmental programs were extremely popular in the United States, Europe, and Japan in the 1990s. Part of their popularity stems from the fact that these programs do not require legislative authority, which is often hard to obtain. The 33/50 program started by the Environmental Protection Agency (EPA) is an example of such a program. With this program, the EPA attempted to reduce industrial emissions of 17 toxic chemicals by providing information on relatively inexpensive methods of pollution control. Companies were asked to voluntarily commit to reducing emissions from their 1988 levels by 33% by 1992 and by 50% by 1995. The program actually met its second target by 1994.

a. As in Figure 75.2 draw marginal benefit curves for pollution generated by two plants, A and B, in 1988. Assume that without government intervention, each plant emits the same amount of pollution, but that at all levels of pollution less than this amount, plant A's marginal benefit of polluting is less than that of plant B. Label the vertical axis "Marginal benefit to individual polluter" and the horizontal axis "Quantity of pollution emissions." Mark the quantity of pollution each plant produces without government action.

b. Do you expect the total quantity of pollution before the program was put in place to have been less than or more than the optimal quantity of pollution? Why?

c. Suppose the plants whose marginal benefit curves you depicted in part a were participants in the 33/50 program. In a replica of your graph from part a, mark targeted levels of pollution in 1995 for the two plants. Compare the amounts by which the two plants reduced emissions. Was this solution necessarily efficient?

d. What kind of environmental policy does the 33/50 program most closely resemble? What is the main shortcoming of such a policy? Compare it to two other types of environmental policy discussed.

6. Smoking produces a negative externality because it imposes a health risk on others who inhale second-hand smoke. Cigarette smoking also causes productivity losses to the economy due to the shorter expected life span of a smoker. The U.S. Centers for Disease Control (CDC) has estimated the average social cost of smoking a single pack of cigarettes for different states by taking these negative externalities into account. The accompanying table provides the price of cigarettes and the estimated average social cost of smoking in five states.

State	Cigarette retail price with taxes (per pack)	CDC estimate of smoking cost in 2006 (per pack)
California	$4.40	$15.10
New York	5.82	21.91
Florida	3.80	10.14
Texas	4.76	9.94
Ohio	4.60	9.19

a. At the current level of consumption, what is the optimal retail price of a pack of cigarettes in the different states? Is the current price below or above this optimal price? Does this suggest that the current level of consumption is too high or too low? Explain your answer.

b. In order to deal with negative externalities, state governments currently impose excise taxes on cigarettes. Are current taxes set at the optimal level? Justify your answer.

c. What is the correct size of an additional Pigouvian tax on cigarette sales in the different states if the CDC's estimate for smoking cost does not change with an increase in the retail price of cigarettes?

7. Education is an example of an activity that generates a positive externality: acquiring more education benefits the individual student and having a more highly educated workforce is good for the economy as a whole. The accompanying table illustrates the marginal benefit to Sian per year of education and the marginal cost per year of education. Each year of education has a marginal external benefit to society equal to $8,000. Assume that the marginal social cost is the same as the marginal cost paid by an individual student.

Quantity of education (years)	Sian's marginal benefit per year	Sian's marginal cost per year
9		
	$20,000	$15,000
10		
	19,000	16,000
11		
	18,000	17,000
12		
	17,000	18,000
13		
	16,000	19,000
14		
	15,000	20,000
15		
	14,000	21,000
16		
	13,000	22,000
17		

a. Find Sian's market equilibrium number of years of education.

b. Calculate the marginal social benefit schedule. What is the socially optimal number of years of education?

c. You are in charge of education funding. Would you use a Pigouvian tax or a Pigouvian subsidy to induce Sian to choose the socially optimal amount of education? How high would you set this tax or subsidy per year of education?

8. Planting a tree improves the environment: trees transform greenhouse gases into oxygen, improve water retention in the soil, and improve soil quality. Assume that the value of this environmental improvement to society is $10 for the expected lifetime of the tree. The following table contains a hypothetical demand schedule for trees to be planted.

Price of tree	Quantity of trees demanded (thousands)
$30	0
25	6
20	12
15	18
10	24
5	30
0	36

a. Assume that the marginal cost of producing a tree for planting is constant at $20. Draw a diagram that shows the market equilibrium quantity and price for trees to be planted.

b. What type of externality is generated by planting a tree? Draw a diagram that shows the optimal number of trees planted. How does this differ from the market outcome?

c. On your diagram from part b, indicate the optimal Pigouvian tax/subsidy (as the case may be). Explain how this moves the market to the optimal outcome.

9. The government is involved in providing many goods and services. For each of the goods or services listed, determine whether it is rival or nonrival in consumption and whether it is excludable or nonexcludable. What type of good is it? Without government involvement, would the quantity provided be efficient, inefficiently low, or inefficiently high?

a. street signs

b. Amtrak rail service

c. regulations limiting pollution

d. an interstate highway without tolls

e. a lighthouse on the coast

10. An economist gives the following advice to a museum director: "You should introduce 'peak pricing': at times when the museum has few visitors, you should admit visitors for free. And at times when the museum has many visitors, you should charge a higher admission fee."

a. When the museum is quiet, is it rival or nonrival in consumption? Is it excludable or nonexcludable? What type of good is the museum at those times? What would be the efficient price to charge visitors during that time, and why?

b. When the museum is busy, is it rival or nonrival in consumption? Is it excludable or nonexcludable? What type of good is the museum at those times? What would be the efficient price to charge visitors during that time, and why?

11. In many planned communities, various aspects of community living are subject to regulation by a homeowners' association. These rules can regulate house architecture; require snow removal from sidewalks; exclude outdoor equipment, such as backyard swimming pools; require appropriate conduct in shared spaces such as the community clubhouse; and so on. Suppose there has been some conflict in one such community because some homeowners feel that some of the regulations mentioned above are overly intrusive. You have been called in to mediate. Using what you have learned about public goods and common resources, how would you decide what types of regulations are warranted and what types are not?

12. A residential community has 100 residents who are concerned about security. The accompanying table gives the total cost of hiring a 24-hour security service as well as each individual resident's total benefit.

Quantity of security guards	Total cost	Total individual benefit to each resident
0	$ 0	$ 0
1	150	10
2	300	16
3	450	18
4	600	19

a. Explain why the security service is a public good for the residents of the community.

b. Calculate the marginal cost, the individual marginal benefit for each resident, and the marginal social benefit.

c. If an individual resident were to decide about hiring and paying for security guards on his or her own, how many guards would that resident hire?

d. If the residents act together, how many security guards will they hire?

13. The accompanying table shows Tanisha's and Ari's individual marginal benefit of different numbers of street cleanings per month. Suppose that the marginal cost of street cleanings is constant at $9 each.

Quantity of street cleanings per month	Tanisha's individual marginal benefit	Ari's individual marginal benefit
0		
	$10	$8
1		
	6	4
2		
	2	1
3		

a. If Tanisha had to pay for street cleaning on her own, how many street cleanings would there be?

b. Calculate the marginal social benefit of street cleaning. What is the optimal number of street cleanings?

c. Consider the optimal number of street cleanings. The last street cleaning of that number costs $9. Is Tanisha willing to pay for that last cleaning on her own? Is Ari willing to pay for that last cleaning on his own?

14. Anyone with a radio receiver can listen to public radio, which is funded largely by donations.

a. Is public radio excludable or nonexcludable? Is it rival in consumption or nonrival? What type of good is it?

b. Should the government support public radio? Explain your reasoning.

c. In order to finance itself, public radio decides to transmit only to satellite radios, for which users have to pay a fee. What type of good is public radio then? Will the quantity of radio listening be efficient? Why or why not?

15. Your economics teacher assigns a group project for the course. Describe the free-rider problem that can lead to a suboptimal outcome for your group. To combat this problem, the instructor asks you to evaluate the contribution of your peers in a confidential report. Will this evaluation have the desired effects?

16. The accompanying table shows six consumers' willingness to pay (his or her individual marginal benefit) for one MP3 file copy of a Dr. Dre album. The marginal cost of making the file accessible to one additional consumer is constant, at zero.

Consumer	Individual marginal benefit
Adriana	$ 2
Bhagesh	15
Chizuko	1
Denzel	10
Emma	5
Frank	4

a. What would be the efficient price to charge for a download of the file?

b. All six consumers are able to download the file for free from a file-sharing service, Pantster. Which consumers will download the file? What will be the total consumer surplus to those consumers?

c. Pantster is shut down for copyright law infringement. In order to download the file, consumers now have to pay $4.99 at a commercial music site. Which consumers will download the file? What will be the total consumer surplus to those consumers? How much producer surplus accrues to the commercial music site? What is the total surplus? What is the deadweight loss from the new pricing policy?

17. Software has historically been an artificially scarce good—it is nonrival because the cost of replication is negligible once the investment to write the code is made, but software companies make it excludable by charging for user licenses. Recently, however, open-source software has emerged, most of which is free to download and can be modified and maintained by anyone.

a. Discuss the free-rider problem that might exist in the development of open-source software. What effect might this have on quality? Why does this problem not exist for proprietary software, such as the products of a company like Microsoft or Adobe?

b. Some argue that open-source software serves an unsatisfied market demand that proprietary software ignores. Draw a typical diagram that illustrates how proprietary software may be underproduced. Put the price and marginal cost of software on the vertical axis and the quantity of software on the horizontal axis. Draw a typical demand curve and a marginal cost curve (*MC*) that is always equal to zero. Assume that the software company charges a positive price, *P*, for the software. Label the equilibrium point and the efficient point.

18. In developing a vaccine for the H1N1 virus, a pharmaceutical company incurs a very high fixed cost. The marginal cost of delivering the vaccine to patients, however, is negligible (consider it to be equal to zero). The pharmaceutical company holds the exclusive patent to the vaccine. You are a regulator who must decide what price the pharmaceutical company is allowed to charge.

a. Draw a diagram that shows the price for the vaccine that would arise if the company is unregulated, and label it P_M. What is the efficient price for the vaccine? Show the deadweight loss that arises from the price P_M.

b. On another diagram, show the lowest price that the regulator can enforce that would still induce the pharmaceutical company to develop the vaccine. Label it P^*. Show the deadweight loss that arises from this price. How does it compare to the deadweight loss that arises from the price P_M?

c. Suppose you have accurate information about the pharmaceutical company's fixed cost. How could you use price regulation of the pharmaceutical company, combined with a subsidy to the company, to have the efficient quantity of the vaccine provided at the lowest cost to the government?

19. According to a report from the U.S. Census Bureau, "the average [lifetime] earnings of a full-time, year-round worker with a high school education are about $1.2 million compared with $2.1 million for a college graduate." This indicates that there is a considerable benefit to a graduate from investing in his or her own education. Tuition at most state universities covers only about two-thirds to three-quarters of the cost, so the state applies a Pigouvian subsidy to college education. If a Pigouvian subsidy is appropriate, is the externality created by a college education a positive or a negative externality? What does this imply about the differences between the costs and benefits to students compared to social costs and benefits? What are some reasons for the differences?

20. Fishing for sablefish has been so intensive that sablefish were threatened with extinction. After several years of banning such fishing, the government is now proposing to introduce tradable vouchers, each of which entitles its holder to a catch of a certain size. Explain how fishing generates a negative externality and how the voucher scheme may overcome the inefficiency created by this externality.

21. The two dry-cleaning companies in Collegetown, College Cleaners and Big Green Cleaners, are a major source of air pollution. Together they currently produce 350 units of air pollution, which the town wants to reduce to 200 units. The accompanying table shows the current pollution level produced by each company and each company's marginal cost of reducing its pollution. The marginal cost is constant.

Companies	Initial pollution level (units)	Marginal cost of reducing pollution (per unit)
College Cleaners	230	$5
Big Green Cleaners	120	2

a. Suppose that Collegetown passes an environmental standards law that limits each company to 100 units of pollution. What would be the total cost to the two companies of each reducing its pollution emissions to 100 units?

Suppose instead that Collegetown issues 100 pollution vouchers to each company, each entitling the company to one unit of pollution, and that these vouchers can be traded.

b. How much is each pollution voucher worth to College Cleaners? to Big Green Cleaners? (That is, how much would each company, at most, be willing to pay for one more voucher?)

c. Who will sell vouchers and who will buy them? How many vouchers will be traded?

d. What is the total cost to the two companies of the pollution controls under this voucher system?

22. Ronald owns a cattle farm at the source of a long river. His cattle's waste flows into the river and down many miles to where Carla lives. Carla gets her drinking water from the river. By allowing his cattle's waste to flow into the river, Ronald imposes a negative externality on Carla. In each of the two following cases, do you think that through negotiation, Ronald and Carla can find an efficient solution? What might this solution look like?

a. There are no telephones, and for Carla to talk to Ronald, she has to travel for two days on a rocky road.

b. Carla and Ronald both have e-mail access, making it costless for them to communicate.

23. a. EAuction and EMarketplace are two competing Internet auction sites, where buyers and sellers transact goods. Each auction site earns money by charging sellers for listing their goods. EAuction has decided to eliminate fees for the first transaction for sellers that are new to their site. Explain why this is likely to be a good strategy for EAuction in its competition with EMarketplace.

b. EMarketplace complained to the Justice Department that EAuction's practice of eliminating fees for new sellers was anticompetitive and would lead to monopolization of the Internet auction industry. Is EMarketplace correct? How should the Justice Department respond?

c. EAuction stopped its practice of eliminating fees for new sellers. But since it provided much better technical service than its rival, EMarketplace, buyers and sellers came to prefer EAuction. Eventually, EMarketplace closed down, leaving EAuction as a monopolist. Should the Justice Department intervene to break EAuction into two companies? Explain.

d. EAuction is now a monopolist in the Internet auction industry. It also owns a site that handles payments over the Internet, called PayForIt. It is competing with another Internet payment site, called PayBuddy. EAuction has now stipulated that any transaction on its auction site must use PayForIt, rather than PayBuddy, for the payment. Should the Justice Department intervene? Explain.