chapter 20

>> Public Goods and Common Resources

THE GREAT STINK

By the middle of the nineteenth century, London had become the world's largest city, with close to 2.5 million inhabitants. Unfortunately, all those people produced a lot of waste—and there was no place for the stuff to go except the Thames, the river flowing through the city. Nobody with a working nose could ignore the results. And the river didn't just smell bad—it carried waterborne diseases like cholera and typhoid. London neighborhoods close to the Thames had death rates from cholera more than six times greater than the neighborhoods farthest away. And the great majority of Londoners drew their drinking water from the Thames.

What the city needed, said reformers, was a sewage system that would carry waste away from the river. Yet no private individual was willing to build such a system, and influential people were opposed to the idea that the government should take responsibility for the problem. For example, the magazine *The Economist* weighed in against proposals for a government-built sewage system, declaring that "suffering and evil are nature's admonitions—they cannot be got rid of."

But the hot summer of 1858 brought what came to be known as the Great Stink, which was so bad that one health journal reported "men struck down with the stench." Even the privileged and powerful suffered: Parliament met in a building next to the river. After unsuccessful efforts to stop the smell by covering the windows with chemical-soaked curtains,

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London's River Thames then . . .

Corbis

. . . and the same river now, thanks to government intervention.

What you will learn in this chapter:

- A way to classify goods that predicts whether a good can be efficiently provided by free markets
- What **public goods** are, and why markets fail to supply them
- 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 difficult

Parliament finally approved a plan for an immense system of sewers and pumping stations to direct sewage away from the city. The system, completed in 1870, brought dramatic improvement in the city's quality of life; cholera and typhoid epidemics, which had been regular occurrences, completely disappeared. The Thames was turned from the filthiest to the cleanest metropolitan river in the world, and the sewage system's principal engineer, Sir Joseph Bazalgette, was lauded as having "saved more lives than any single Victorian public official." It was estimated at the time that Bazalgette's sewer system added 20 years onto the life span of the average Londoner.

The story of the Great Stink and the policy response that followed illustrate two important reasons for government intervention in the economy. London's new sewage system was a clear example of a *public good*—a good that benefits many people, whether or not they have paid for it, and whose benefits to any one individual do not depend on how many others also benefit. As we will see shortly, public goods differ in important ways from the *private goods* we have studied so far—and these differences mean that public goods cannot be efficiently supplied by the market.

In addition, clean water in the Thames is an example of a *common resource*, a good that many people can consume whether or not they have paid for it but whose consumption by each person reduces the amount available to others. Such goods tend to be overused by individuals in a market system unless the government takes action.

In earlier chapters, we saw that markets sometimes fail to deliver efficient levels of production and consumption. We also saw how inefficiency can arise from market power, which leads producers to charge prices that are higher than marginal cost, thereby impeding mutually beneficial transactions. And we saw how inefficiency can arise from externalities, which cause a divergence between the private costs and benefits of an individual's actions and the costs and benefits of those actions borne by society as a whole.

In this chapter, we will 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 serve a useful purpose.

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 needed to allow markets to work efficiently; 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 or wheat have two characteristics that, as we'll soon see, are essential if a good is to be efficiently provided 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 bread can no longer be eaten by someone else.

But not all goods have these two characteristics. Some goods are **nonexcludable**—the supplier cannot prevent consumption of the good by people who do not pay for it. 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: the city of London couldn't have ended the Great Stink for some residents while leaving the River Thames 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, rival or nonrival in consumption, there are four types of goods, illustrated by the matrix in Figure 20-1:

- *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

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?

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.

Figure 20-1

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.

	Rival in consumption	Nonrival in consumption
Excludable	**Private goods** • Wheat • Bathroom fixtures	**Artificially scarce goods** • Pay-per-view movies • Computer software
Non-excludable	**Common resources** • Clean water • Biodiversity	**Public goods** • Public sanitation • National defense

Why Markets Can Supply Only Private Goods Efficiently

A market economy, as we learned in earlier chapters, is an amazing system for delivering goods and services. But it 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 municipal sewage system 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. That's why no private entrepreneur came forward with a plan to end London's Great Stink.

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.**

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.

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 members of the group to shirk, relying on others in the group to get the work done. The shirkers *free-ride* on someone else's effort.

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 nonrival in consumption, like pay-per-view movies, suffer from a different kind of inefficiency. As long as these goods are excludable, it is possible to earn a profit by making the goods available only to those who pay. But the marginal cost of letting an additional viewer watch a pay-per-view movie is zero. 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 can be efficiently produced and consumed in a competitive market. 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 not lead to the efficient production and consumption of the good.

Fortunately for the market system, most goods are private goods. Food, clothing, shelter, and most other desirable things in life are excludable and rival in consumption, so we can rely on free markets to provide us with most things. Yet there are crucial goods that don't meet these criteria—and in most cases, that means that the government must step in.

PITFALLS

MARGINAL COST OF WHAT EXACTLY?

In the case of a good that is nonrival in consumption, it's easy to confuse the marginal cost of *producing* a unit of the good with the marginal cost of *allowing* a unit of the good *to be consumed*. For example, your local cable company incurs a marginal cost in making a movie available to its subscribers that is equal to the cost of the resources it uses to produce and broadcast that movie. However, *once that movie is being broadcast,* no marginal cost is incurred by letting an additional family watch it. In other words, no costly resources are "used up" when one more family consumes a movie that has already been produced and is being broadcast.

This complication does not arise, however, when a good is rival in consumption. In that case, the resources used to produce a unit of the good are "used up" by a person's consumption of it—they are no longer available to satisfy someone else's consumption. So when a good is rival in consumption the marginal cost to society of allowing an individual to consume a unit is equal to the resource cost of producing that unit—that is, equal to the marginal cost of producing it.

economics in action

What (Kind of) Good Is Education?

On the face of it, education seems to meet the definition of a private good. It is excludable—a private school can turn away students whose parents don't pay tuition. And it's rival in consumption—each student requires space, school supplies, and teacher attention that are therefore not available to other students.

But if education is a private good, and private goods can be efficiently supplied by markets, why don't we leave education up to the market? Why does every modern nation treat basic education as a government responsibility?

One possible answer is that governments may be buying "having an educated population," not the education of individuals. All of us gain many advantages from living in a society where almost everyone has a basic education. For example, aren't you glad that other drivers can read traffic signs?

The good "having an educated population" is neither excludable nor rival in consumption. I can't enjoy the benefits of living in a literate society while excluding you from also enjoying those same benefits, and my gain from living in a literate society does not come at your expense. ■

>>QUICK REVIEW

- Goods can be classified according to two attributes: whether they are *excludable* and whether they are *rival in consumption*
- Goods that are both excludable and rival in consumption are *private goods.* Private goods can be efficiently produced and consumed in a competitive market.
- When goods are *nonexcludable,* there is a *free-rider problem:* consumers will not pay producers, leading to inefficiently low production.
- When goods are *nonrival in consumption,* the efficient price for consumption is zero. But if a positive price is charged to compensate producers for the cost of production, the result is inefficiently low consumption.

>>CHECK YOUR UNDERSTANDING 20-1

1. Classify each of the following goods according to whether they are excludable and whether they are rival in consumption. What kind of good is each?
   a. Use of a public space such as a park
   b. A cheese burrito
   c. Information from a website that is password-protected
   d. Publicly announced information on the path of an incoming hurricane
2. Which of the goods in Question 1 will be provided by a competitive market? Which will not be? Explain.

Solutions appear at back of book.

Public Goods

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

A **public good** is the exact opposite of a private good: it is a good that is both nonexcludable and nonrival in consumption. A 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 great stinks does not come at my neighbor's expense.

Here are some other examples of public goods:

- *Disease prevention.* When doctors act to stamp out the beginnings of an epidemic before it can spread, they protect people around the world.
- *National defense.* A strong military protects all citizens.
- *Scientific research.* More knowledge benefits everyone.

Because these goods are nonexcludable, they suffer from the free-rider problem, so no private firm would be willing to produce 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 through a variety of means. The government doesn't always get involved—in many cases a nongovernmental 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 support a considerable amount of scientific research. But private donations are insufficient to finance huge, socially important projects like basic medical research.

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 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, as well as 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 also endure many commercials.

Touhig Sion/Corbis Sygma

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

Some potentially public goods are deliberately made excludable and therefore subject to charge, like pay-per-view movies. In the U.K., where most television programming is paid for by a yearly license fee assessed against every television owner, television viewing is made artificially excludable by the use of "television detection vans": vans that roam neighborhoods in an attempt to detect televisions in nonlicensed 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.

In small communities, a high level of social encouragement or pressure can be brought to bear on people to contribute 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, so that larger towns and cities must depend on salaried firefighters.

As this last example suggests, when these 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, provision of a public good is an "either–or" decision: London would either have a sewage system—or not. But in most cases, government 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 in which there are 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, where a unit is equal to 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 benefit* of another unit of the public good.

Using this information plus 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 cost of producing it. Recall from Chapter 19 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 individual marginal benefits that are 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 individual marginal benefit from that additional cleaning *plus* Alice's individual marginal 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 people can all simultaneously consume a public good, the marginal social benefit of an additional unit of that good is the *sum* of the individual marginal benefits of all who enjoy the public good. And the efficient quantity of a public good is the quantity at which the marginal social benefit is equal to the marginal cost of providing it.

Figure 20-2 on page 482 illustrates the efficient provision of a public good, showing three marginal benefit curves. Panel (a) shows Ted's individual marginal benefit curve from street cleaning, MB_T: he would be willing to pay \$25 for the city to clean its streets once per month, an additional \$18 to have it done a second time, and so on. Panel (b) shows Alice's individual marginal benefit curve from street cleaning, MB_A. Panel (c) shows the marginal social benefit curve from street cleaning, *MSB*: it is the vertical sum of Ted's and Alice's individual marginal benefit curves, MB_T and MB_A.

To maximize society's welfare, the government should clean the street up to the level at which the marginal social benefit of an additional cleaning is no longer greater than the marginal cost. Suppose that the marginal cost of street cleaning is \$5 per cleaning. Then the city should clean its streets 5 times per month, because the marginal social benefit of going from 4 to 5 cleanings is \$7, but going from 5 to 6 cleanings would yield a marginal social benefit of only \$1.

Figure 20-2 can help reinforce our understanding of why we cannot rely on individual self-interest to yield provision of an efficient quantity of public goods. Suppose that the city did one fewer street cleaning than the efficient quantity and that either Ted or Alice was asked to pay for the last cleaning. Neither one would be willing to pay for it! Ted would personally gain only the equivalent of \$3 in utility from adding one more street cleaning—so he wouldn't be willing to pay the \$5 marginal cost of another cleaning. Alice would personally gain the equivalent of \$4 in utility—so she wouldn't be willing to pay either. The point is that the marginal social benefit of one more unit of a public good is always greater than the individual marginal benefit to any one individual. That is why no individual is willing to pay for the efficient quantity of the good.

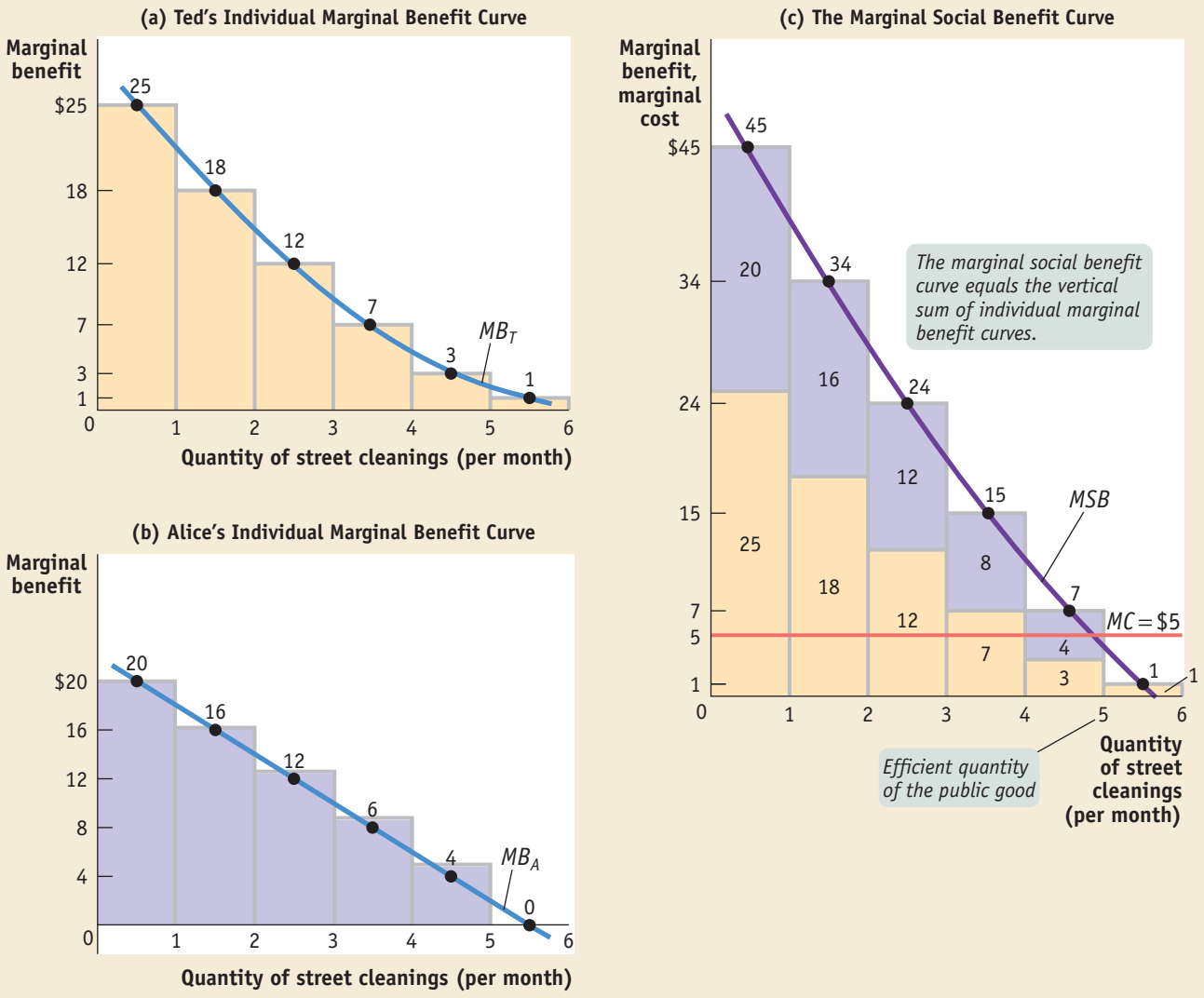
Does this description of the public good problem, in which the marginal social benefit of an additional unit of the public good is greater than any individual's marginal benefit, sound a bit familiar? It should: we encountered a somewhat similar situation in our discussion of *positive externalities*. Remember that in the case of a positive externality, the marginal social benefit accruing to all consumers of another unit of the good is greater than the producer's marginal benefit of producing that unit. In the case of a public good, the individual marginal benefit of a consumer plays the same role that the producer's marginal benefit plays in the case of positive externalities. So the problem of providing public goods is very similar to the problem of dealing with positive externalities; in both cases there is a market failure that calls for government intervention. One basic 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.

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 individual marginal benefit from provision of the good is only a tiny fraction of the marginal social benefit. It would be impossible for people to reach a voluntary

AP/Wide World Photos

We all benefit when someone does the cleaning up.

Figure 20-2 A Public Good



Panel (a) shows Ted's individual marginal benefit curve of street cleanings per month, MB_T, and panel (b) shows Alice's individual marginal benefit curve, MB_A. Panel (c) shows the marginal *social* benefit of the public good, equal to the *sum* of the individual marginal benefits to all consumers (in this case, Ted and Alice). The marginal social benefit curve, *MSB*, is the vertical sum of the individual marginal benefit curves MB_T and MB_A. At a constant marginal cost of $5, there should be 5 street cleanings per month, because the marginal social benefit of the fifth cleaning is $7 ($3 for Ted plus $4 for Alice), but the marginal social benefit of a sixth cleaning is only $1. >web...

agreement to pay for the efficient level of street cleaning—the potential for free-riding makes 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 citywide sanitation department.

Cost-Benefit Analysis

Governments engage in **cost-benefit analysis** when they estimate the social costs and social benefits of providing a public good.

How do governments decide in practice how much of a public good to provide? Sometimes policy makers just guess—or do whatever they think will get them reelected. However, responsible governments try to estimate both the social benefits and the social costs of providing a public good, a process known as **cost-benefit analysis.**

FOR INQUIRING MINDS

VOTING AS A PUBLIC GOOD

It's a sad fact that many Americans who could vote don't bother to. This means that 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 don'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.

Because political action is a public good, people in general devote too little effort to voting and defending their interests. 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."

It's straightforward to estimate the cost of supplying a public good. Estimating the benefit is harder. In fact, it is a very difficult problem.

Now you might wonder why governments can't figure out the marginal social benefit of a public good just by asking people their willingness to pay for it (their individual marginal benefit). But it turns out that it's hard to get an honest answer.

This is not a problem with private goods: we can determine how much an individual is willing to pay for one more unit of a private good by looking at his or her actual choices. But because people don't actually pay for public goods, the question of willingness to pay is always hypothetical.

Worse yet, it's a question that people have an incentive not to answer truthfully. People naturally want more rather than less. Because they cannot be made to pay for whatever quantity of the public good they use, when asked how much they desire a public good people are apt to overstate their true feelings. For example, if street cleaning were scheduled according to the stated wishes of homeowners alone, the streets would be cleaned every day—an inefficient level of provision. So governments must be aware that they cannot simply rely on the public's statements when deciding how much of a public good to provide—if they do, they are likely to provide too much. In contrast, as the following For Inquiring Minds indicates, relying on the public to indicate how much of the public good they want through voting has problems as well—and is likely to lead to too little of the public good being provided.

economics in action

Old Man River

It just keeps rolling along—but now and then it decides to roll in a different direction. In fact, the Mississippi River changes its course every few hundred years. Sediment carried downstream gradually clogs the river's route to the sea, and eventually the river breaches its banks and opens a new channel. Over the millennia the mouth of the Mississippi has swung back and forth along an arc some 200 miles wide.

So when is the Mississisippi due to change course again? Oh, about 35 years ago.

The Mississippi currently runs to the sea past New Orleans; but by 1950 it was apparent that the river was about to shift course, taking a new route to the sea. If the Army Corps of Engineers hadn't gotten involved, the shift would probably have happened by 1970.

A shift in the Mississippi would have severely damaged the Louisiana economy. A major industrial area would have lost good access to the ocean, and salt water would have contaminated much of its water supply.

So the Army Corps of Engineers has kept the Mississippi in its place with a huge complex of dams, walls, and gates known as the Old River Control Structure. At times the amount of water released by this control structure is five times the flow at Niagara Falls.

The Old River Control Structure is a dramatic example of a public good. No individual would have had an incentive to build it, yet it protects many billions of dollars' worth of private property.

The history of the Army Corps of Engineers, which handles water-control projects across the United States, illustrates the problems with government provision of public goods. Everyone wants a project that benefits his or her own property—if other people are going to pay for it. So there is a systematic tendency for potential beneficiaries of Corps projects to overstate the benefits. And the Corps has become notorious for undertaking expensive projects that cannot be justified with any reasonable cost-benefit analysis.

In other countries the counterparts of the Army Corps of Engineers are even more prone to overspending. In Japan, almost every river now runs through a concrete channel, and an amazing 60 percent of the coastline is now "armored" with concrete barriers. ■

>>QUICK REVIEW

- A *public good* is both nonexcludable and nonrival in consumption.
- Because most forms of public good provision by the private sector have serious defects, they must be provided by the government and paid for with taxes.
- The marginal social benefit of an additional unit of a public good is equal to the *sum* of each consumer's individual marginal benefit from that unit. At the efficient quantity, the marginal social benefit equals the marginal cost.
- No individual has an incentive to pay for providing the efficient quantity of a public good because each individual's marginal benefit is less than the marginal social benefit. This is a primary justification for the existence of government.
- Although governments should rely on *cost-benefit analysis* to determine how much of a public good to supply, doing so is problematic because individuals tend to overstate the good's value to them.

>>CHECK YOUR UNDERSTANDING 20-2

1. The town of Centreville, population 16, has two types of residents, Homebodies and Revelers. Using the accompanying table, the town must decide how much to spend on its New Year's Eve party.

Money spent on party	Individual marginal benefit of additional $1 spent on party	
	Homebody	Reveler
$0		
	$0.05	$0.13
1		
	0.04	0.11
2		
	0.03	0.09
3		
	0.02	0.07
4		

a. Suppose there are 10 Homebodies and 6 Revelers. Determine the marginal social benefit schedule of money spent on the party. What is the efficient level of spending?

b. Suppose there are 6 Homebodies and 10 Revelers. How do your answers to part a change? Explain.

c. Suppose no one knows the true numbers of Homebodies and Revelers, but individuals are asked their preferences. What is the likely outcome? Why is it likely to result in an inefficiently high level of spending? Explain.

Solutions appear at back of book.

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.

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 limited 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 because 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 are clean air and water as well as the diversity of animal and plant species on the planet (biodiversity).

In each of these cases the fact that the good, though rival in consumption, is nonexcludable poses a serious problem.

The Problem of Overuse

Because common resources are nonexcludable, individuals cannot be charged for their use. Yet, because they are rival in consumption, 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 benefit of its use is equal to zero, ignoring the cost that this action inflicts on society as a whole. As we will see shortly, the problem of overuse of a common resource is similar to a problem we studied in Chapter 19: the problem of a good that generates a negative externality, such as pollution-creating electricity generation or livestock farming.

Common resources left to the free market suffer from **overuse:** individuals ignore the fact that their use depletes the amount of the resource remaining for others.

Fishing is a classic example of a common resource. 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 alone to work rather than carpooling or working at home, I make the commute of many other people a bit longer; but I have no incentive to take these consequences into account.

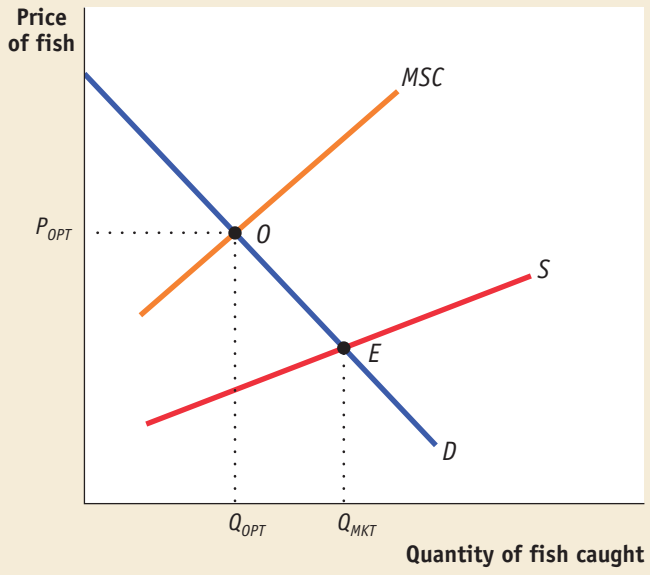
In the case of a common resource, the *marginal social cost* of my use of that resource is higher than my individual *marginal cost*, the cost to me of using an additional unit of the good.

Figure 20-3 illustrates the point. It shows the demand curve for fish, which measures the marginal benefit of fish—the benefit to consumers when an additional unit of fish is caught and consumed. It also shows the supply curve for fish, which

Figure 20-3

A Common Resource

The supply curve *S*, which shows the marginal cost of production of the entire fishing industry, is composed of the individual supply curves of the individual fishermen. But each fisherman's individual marginal 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}.



measures the marginal cost of production of the fishing industry. We know from Chapter 9 that the industry supply curve is the horizontal sum of each individual fisherman's supply curve—equivalent to his or her individual marginal cost curve. The fishing industry is willing to supply fish up to the point where its marginal cost is equal to the price, the quantity Q_{MKT}. But the efficient outcome is to catch the quantity Q_{OPT}, the quantity of output that equates the marginal benefit to the marginal social cost, not to the fishing industry's marginal cost of production.

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 industry's marginal cost of production, the difference being the marginal external cost imposed on society by pollution. Here, the loss to society arising from a fisherman's depletion of the common resource plays the same role as the external cost plays 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 of getting individual users of the resource to take into account the costs they impose on other users. This is basically the same principle as that of getting individuals to internalize a negative externality that arises from their actions.

And just as in the case of a negative externality, there are two fundamental ways to induce individuals to internalize the costs they impose on others:

- Tax or otherwise regulate the use of the common resource
- Make the common resource excludable and assign property rights to some individuals

Like activities that generate negative externalities, use of a common resource can be reduced to the efficient level by imposing a Pigouvian tax. For example, some countries have imposed "congestion charges" on those who drive during rush hour, in effect charging them for use of the common resource of highway space. Likewise, visitors to national parks must pay a fee and the number of visitors to any one park is restricted.

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, and 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.

A third 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 assures 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.

As the Economics in Action that follows shows, creation of property rights through a system of tradable licenses has been a successful strategy in some fisheries.

economics in action

A Tale of Two Fisheries

On August 27, 2000, the *New York Times Magazine* carried a story titled "A Tale of Two Fisheries," which compared the lives of lobstermen in two places: Port Judith, Rhode Island, and Port Lincoln, Australia.

Port Judith used to call itself the "tuna capital of the world," but tuna—along with swordfish, cod, halibut, and other species that used to be plentiful offshore—are now hard to find anywhere in the vicinity. Fishermen in the United States have been free to catch as many fish as they like; as a result of overfishing, the once-great fisheries of New England have largely collapsed. This includes lobsters, except for some areas of Maine where "lobster gangs" (who would sometimes sabotage the boats of outsiders) have protected the common resource. As lobster stocks have plunged, life for the lobstermen of Port Judith has gotten increasingly difficult.

In Australia, however, a different system prevails. To set a lobster trap, you must have a license, and only a limited number of licenses have been issued. A license now sells for about $21,000. At first Australian lobstermen were skeptical of a system that limited their fishing. But they now support the system enthusiastically, because it sustains the value of their licenses—and also sustains their livelihood.

The system is popular because it works: an Australian lobster trap typically comes up with more and bigger lobsters than its American counterpart. As a result, the lobstermen of Port Lincoln, Australia, are far more prosperous than those of Port Judith, Rhode Island.

By the way, we don't want to give the impression that establishing property rights over common resources is un-American. The New Jersey clam fishery, which was in serious trouble in the late 1980s, now operates under a license system similar to that of the Australian lobster fishery. And both the clams and the New Jersey clam industry have staged a spectacular comeback. ■

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>>QUICK REVIEW

- A *common resource* is rival in consumption but nonexcludable.
- The problem with common resources is *overuse:* a user depletes the amount of the common resource available to others but does not take this cost into account when deciding how much to use the common resource.
- Like negative externalities, a common resource can be efficiently managed by Pigouvian taxes, by making it excludable and assigning property rights, or by the creation of a system of tradable licenses for its use.

>>CHECK YOUR UNDERSTANDING 20-3

1. Rocky Mountain Forest is a government-owned forest in which private citizens were allowed in the past to harvest as much timber as they wanted free of charge. State in economic terms why this is problematic from society's point of view.
2. You are the new Forest Service Commissioner and have been instructed to come up with ways to preserve the forest for the general public. Name three different methods you could use to maintain the efficient level of tree harvesting and explain how each would work. For each method, what information would you need to know in order to achieve an efficient outcome?

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 the 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. Many "information" goods like computer software are also artificially scarce; we will discuss the economics of information technology at greater length in Chapter 22.

An **artificially scarce good** is excludable but nonrival in consumption.

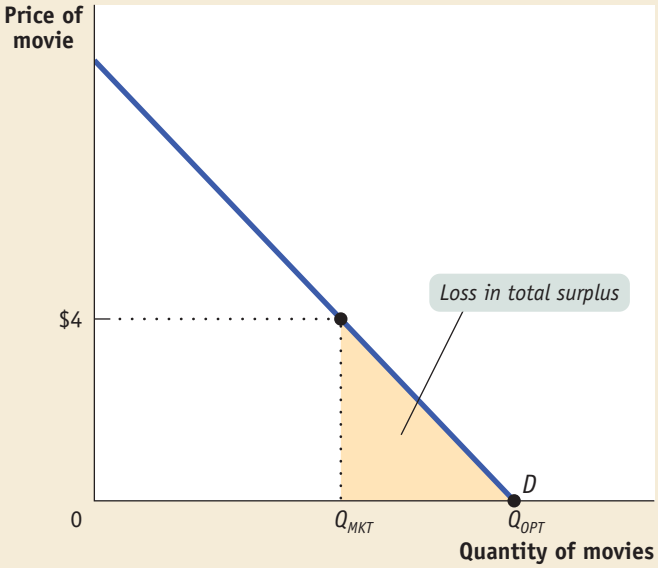
As we've already seen, markets will supply artificially scarce goods: because they are excludable, the producers can charge people for consuming them.

But artificially scarce goods are nonrival in consumption, which means that the marginal cost of an individual's consumption is zero. So the price that the supplier of an artificially scarce good charges exceeds marginal cost. Because the efficient price

Figure 20-4

An Artificially Scarce Good

An artificially scarce good is excludable and nonrival in consumption. It is made artificially scarce because producers charge a positive price but the marginal cost of allowing one more person to consume the good is zero. In this example the market price is $4 and the quantity demanded in an unregulated market is Q_{MKT}. But the efficient level of consumption is Q_{OPT}, the quantity demanded when the price is zero. The efficient quantity, Q_{OPT}, exceeds the quantity demanded in an unregulated market, Q_{MKT}. The shaded area represents the loss in total surplus from charging a price of $4. >web...



is equal to the marginal cost of zero, the good is "artificially scarce," and consumption of the good is inefficiently low. However, unless the producer can somehow earn revenue for producing and selling the good, he or she will be unwilling to produce at all—an outcome that leaves society even worse off than positive but inefficiently low consumption.

Figure 20-4 illustrates the loss in total surplus caused by artificial scarcity. The demand curve shows the number of people who would want to watch a pay-per-view movie at any given price. The marginal cost of allowing an additional person to watch the movie is zero; so the efficient number of viewers is Q_{OPT}. The cable company charges a positive price, in this case $4, to unscramble the signal, and as a result only Q_{MKT} people will actually watch. This leads to a loss in total surplus equal to the area of the shaded triangle.

Does this look familiar? Like the problems that arise with public goods and common resources, the problem created by artificially scarce goods is similar to something we have already seen: in this case, it is the problem of *natural monopoly*. A natural monopoly, you will recall, is an industry in which average total cost is above marginal cost for the relevant output range. In order to be willing to produce output, the producer must charge a price at least as high as average total cost—that is, a price above marginal cost. But a price above marginal cost leads to inefficiently low consumption.

economics in action

Blacked-Out Games

It's the night of the big game for your local team—a game that is being nationally televised by one of the major networks. So you flip to the local channel that is an affiliate of that network—but the game isn't on. Instead, you get some other show with a message scrolling across the bottom of the screen that this game has been blacked out in your area. What the message probably doesn't say, though you understand quite well, is that this blackout is at the insistence of the team's owners, who don't want people who might have paid for tickets staying home and watching on TV instead.

So the good in question—seeing the game—has been made artificially scarce. Because the game is being broadcast anyway, no scarce resources would be used to make it available in its immediate locality as well. But it isn't available—which means a loss in welfare to those who would have watched the game on TV but are not willing to pay the price, in time and money, to go to the stadium. ■

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>>QUICK REVIEW

- An *artificially scarce good* is excludable but nonrival in consumption.
- Because the good is nonrival in consumption, the efficient price to consumers is zero. However, because it is excludable, sellers charge a positive price, which leads to inefficiently low consumption.
- The problems of artificially scarce goods are similar to those posed by a natural monopoly.

>>CHECK YOUR UNDERSTANDING 20-4

1. Xena is a software program produced by Xenoid. Each year Xenoid produces an upgrade that costs $300,000 to produce. It costs nothing to allow customers to download it from the company's website. The demand schedule for the upgrade is shown in the accompanying table.

a. What is the efficient price to a consumer of this upgrade? Explain.

b. What is the lowest price at which Xenoid is willing to produce and sell the upgrade? Draw the demand curve and show the loss of total surplus that occurs when Xenoid charges this price compared to the efficient price.

Price of upgrade	Quantity of upgrades demanded
$180	1,700
150	2,000
120	2,300
90	2,600
0	3,500

Solutions appear at back of book.

• A LOOK AHEAD •

In 2003 the various levels of U.S. government—federal, state, and local—spent about $3 trillion. Where did the money go?

The answer, in large part, is that it went to provide public goods. National defense and homeland security took a big chunk; so did education, which is widely regarded as a public good. Then there was spending on highways, public health, fire prevention, and so on.

Not all government spending is on items that can easily be described as public goods. As we'll see in Chapter 21, much spending at the federal level goes for *social insurance*, programs intended to help individuals and families in trouble. But providing public goods is still a central feature of government budgets.

And that brings us to the next question: where does the money that pays for public goods come from? The answer, of course, is that it comes from tax revenue. But taxes, in turn, have economic effects, because they change incentives.

In the next chapter we'll take a deeper look at how taxes affect a market economy. We'll also look at the related effects of social insurance.

SUMMARY

1. Goods may be classified according to whether or not they are **excludable** and whether or not they are **rival in consumption.**

2. 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.

3. 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,** they should be free, and any positive price leads to inefficiently low consumption.

4. A **public good** is nonexcludable and nonrival in consumption. In many 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 individual marginal benefits to each consumer. The efficient quantity of a public good is the quantity at which marginal social benefit is equal to marginal cost. Like a positive externality, marginal social benefit is greater than any one individual's marginal benefit, so no individual is willing to provide the efficient quantity.

5. 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.
6. 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 of a negative externality: the marginal social cost of use of the common resource is always higher than any individual's marginal cost. Pigouvian taxes, the assignment of property rights, or the creation of a system of tradable licenses are possible solutions.
7. **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 leads to inefficiently low consumption. The problem of an artificially scarce good is similar to that of a natural monopoly.

KEY TERMS

Excludable, p. 477
Rival in consumption, p. 477
Private good, p. 477
Nonexcludable, p. 477
Nonrival in consumption, p. 477
Free-rider problem, p. 478
Public good, p. 479
Cost-benefit analysis, p. 482
Common resource, p. 484
Overuse, p. 485
Artificially scarce good, p. 487

PROBLEMS

1. 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 cleaning
   b. Amtrak rail service
   c. Regulations limiting pollution
   d. An interstate highway without tolls
   e. A lighthouse on the coast
2. 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?
3. In many newly created planned communities, various aspects of community living are subject to regulation by a homeowners' association. These rules can regulate house architecture; required snow removal from sidewalks; exclusion of outdoor equipment, such as backyard swimming pools; appropriate conduct in shared spaces such as the community clubhouse; and so on. There has been some conflict, as some homeowners feel that some of the regulations are overly intrusive. You have been called in to mediate. Using economics, how would you decide what types of regulations are warranted and what ones are not?
4. 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 social 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?

5. The accompanying table shows Tanisha's and Ari's individual marginal benefit of different amounts 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?

6. 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?

7. The village of Upper Bigglesworth has a village "commons," a piece of land on which each villager, by law, is free to graze his or her cows. Use of the commons is measured in units of the number of cows grazing on it. Assume that each resident has a constant marginal cost of sending cows to graze (that is, the cost of a cowherd is the same, whether he or she is herding 1 or 10 cows). But the damage done by overgrazing of the commons increases as the number of cows grazing increases. Finally, assume that the benefit to the villagers of each additional cow grazing on the commons declines as more cows graze, since each additional cow has less grass to eat than the previous one.

a. Is the commons excludable or nonexcludable? Is it rival in consumption or nonrival? What kind of good is the commons?

b. Draw a diagram, with the quantity of cows that graze on the commons on the horizontal axis, showing how much the commons will be used in the absence of government intervention and what the efficient outcome would be.

c. How does the quantity of cows grazing in the absence of government intervention compare to the efficient quantity? Show both in your diagram.

d. The villagers hire you to tell them how to achieve an efficient use of the commons. You tell them that there are three possibilities: a Pigouvian tax, the assignment of property rights over the commons, and a system of tradable licenses for the right to graze a cow. Explain how each one of these options would lead to an efficient se of the commons. Draw a diagram that shows the Pigouvian tax.

8. 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? How much surplus is lost, relative to the surplus you found in your answer to part b?

9. Butchart Gardens is a very large garden in Victoria, British Columbia, renowned for its beautiful plants. It is so large that it could hold many times more visitors than currently visit it. The garden charges an admission fee of $10. At this price, 1,000 visitors visit the garden each day. If admission were free, 2,000 visitors would be visiting the garden each day.

a. Are visits to Butchart Gardens excludable or nonexcludable? Are they rival in consumption or nonrival? What type of good is it?

b. In a diagram, illustrate the demand curve for visits to Butchart Gardens. Indicate the situation when Butchart Gardens charges an admission fee of $10. Also indicate the situation when Butchart Gardens charges no admission fee.

c. Illustrate the loss in total surplus from charging a $10 admission fee. Explain why charging a $10 admission fee is inefficient.

10. In developing a vaccine for a new virus called SARS, a pharmaceutical company incurs a very high fixed cost. The marginal cost of delivering the vaccine to patients, however, is negligible (consider is 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 loss in consumer surplus 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 loss in consumer surplus that arises from this price. How does it compare to the loss in consumer surplus 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?

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