Externalities and Public Goods

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Introduction (1/3)

17

Chapter Outline

17.1 Externalities
17.2 Correcting Externalities
17.3 The Coase Theorem: Free Markets Addressing Externalities on Their Own
17.4 Public Goods
17.5 Conclusion

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Introduction (2/3)

Pollution is a major fact of life around the world.

- The United States has areas (notably urban) struggling with air quality; the health costs are estimated at more than $100 billion per year.
- Much pollution is due to coal-fired power plants operating both domestically and abroad.

Other forms of pollution are also common.

- The noise of your neighbor's party
- The person smoking next to you
- The mess in someone's lawn

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Introduction (3/3)

These outcomes are evidence of a market failure.

- Markets are efficient when all transactions that positively benefit society take place.
- An efficient market takes all costs and benefits, both private and social, into account.
- Similarly, the smoker in the park is concerned only with his enjoyment, not the costs imposed on other people in the park.
- An efficient market takes these additional costs into account.

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Externalities (1/9)

17.1

Externalities: a cost or benefit that affects a party not directly involved in a transaction

- **Negative externality:** a cost imposed on a party not directly involved in a transaction
  - Example: air pollution from coal-fired power plants
- **Positive externality:** a benefit conferred on a party not directly involved in a transaction
  - Example: A beekeeper's bees not only produce honey but can help neighboring farmers by pollinating crops.

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Externalities (2/9)

Economic Inefficiencies from Externalities

When there are externalities, the **social costs** and **social benefits** will differ from the private costs and private benefits.

- **Social cost:** the cost of a transaction to society, equal to the private cost plus the external cost
- **Social benefit:** the benefit of a transaction to society, equal to the private benefit plus the external benefit

External marginal cost: the cost imposed on a third party when an additional unit of a good is produced or consumed

External marginal benefit: the benefit conferred on a third party when an additional unit of a good is produced or consumed

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Externalities (3/9)

17.1

Negative Externalities: Too much of a bad thing

Negative externalities occur when a market transaction imposes an external cost on society.

Consider the example of a coal-fired power plant.

- The power plant produces electricity, which is good, but in the process, it releases pollutants into the air: particulate matter, nitrogen oxides (NOx), and sulfur dioxide (SO_2).
- These pollutants both directly and indirectly damage human and environmental health, leading to welfare losses.

The costs of operating the plant are borne by the plant, *but* the health effects are external costs, borne by society.

Consider a competitive market for electricity.

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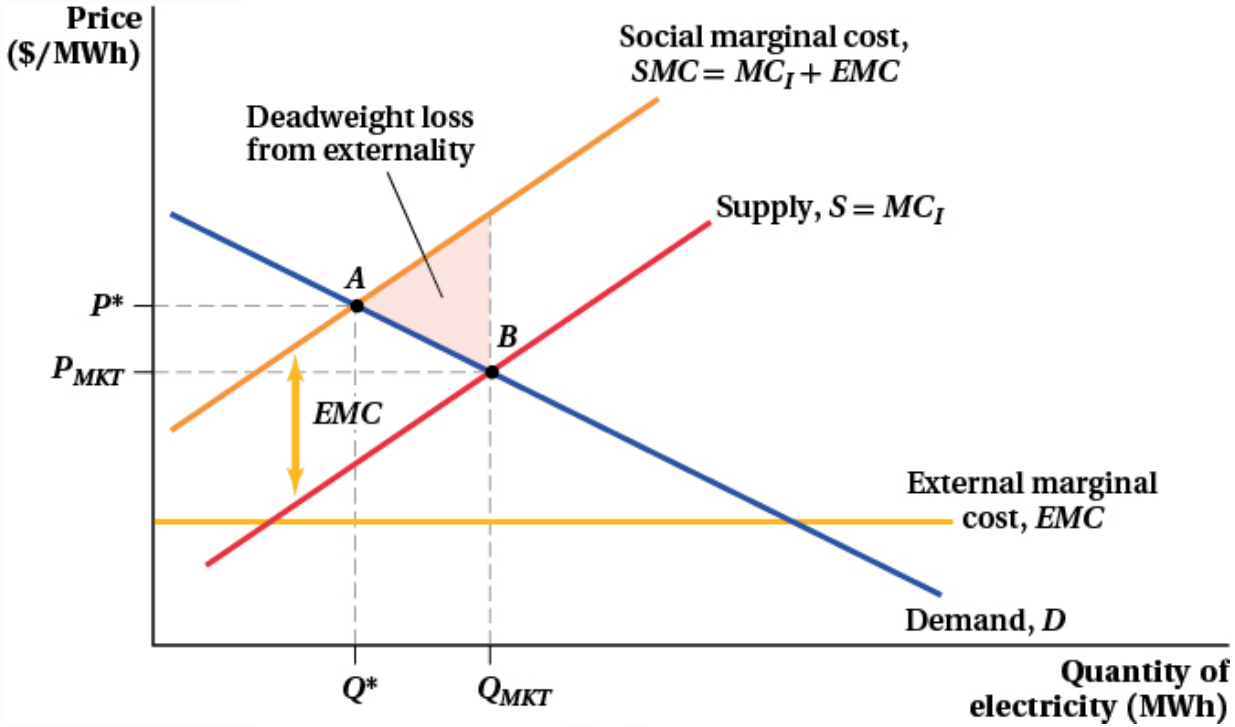
Externalities (4/9)

17.1

Figure 17.1 Negative Externalities in a Competitive Electricity Market



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Externalities (5/9)

17.1

Negative Externalities: Too much of a bad thing

The deadweight loss on the previous slide represents the social cost associated with the competitive outcome in the presence of an externality. The magnitude of the deadweight loss depends on two factors:

- The size of the externality
- Electricity that wouldn't be bought if the price reflected the true social cost

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Externalities (6/9)

17.1

Positive Externalities: Not enough of a good thing

Positive externalities exist when an economic activity has a spillover benefit enjoyed by third parties.

- Marginal social benefit of an economic activity higher than the private marginal benefit (i.e., the demand curve)

The classic example of a positive externality is education.

- Education is associated with private benefits, including higher lifetime earnings and many others.
- Education is also associated with broader social benefits, such as an increase in overall entrepreneurial activity, higher incomes, and a faster pace of technology growth.

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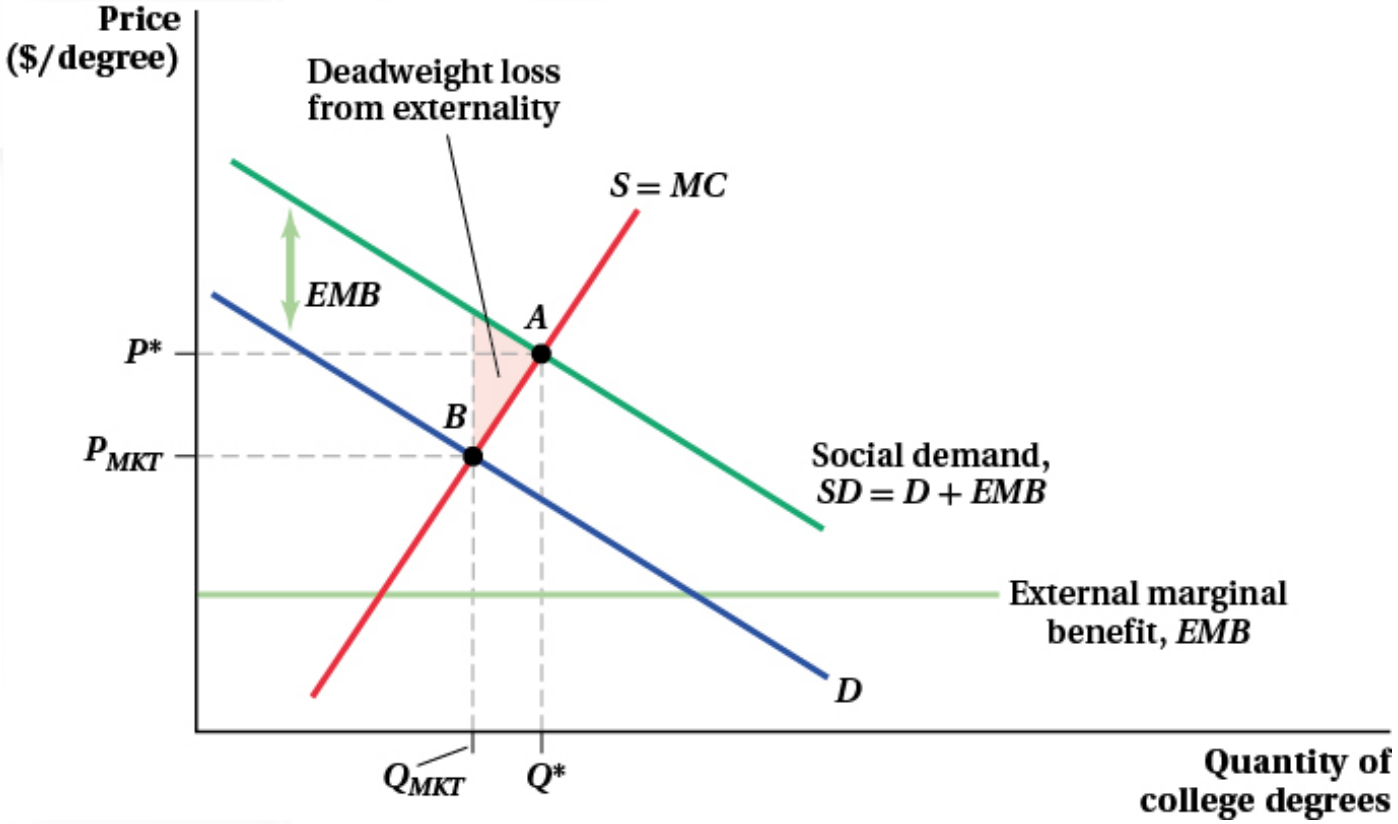
Externalities (7/9)

17.1

Figure 17.2 Positive Externalities in the Market for College Degrees



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Externalities (8/9): Question 1

17.1

Assume that boxes of pencils are sold in a perfectly competitive industry. The industry short-run supply curve (or marginal cost curve) is $P = MC = 0.4Q$ and the inverse demand for boxes of pencils in $P = 20 – 0.1Q$. Suppose that, in the production process, pencil manufacturers emit pollution into the air and the external marginal cost is estimated to be $0.50 for each box of pencils produced.

What is the social marginal cost (SMC) of pencil production?

A. $SMC = 0.9Q$
B. $SMC = 20 – 0.6Q$
C. $SMC = 0.4Q + 0.50$
D. $SMC = 20.5 – 0.1Q$

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Externalities (8/9): Question 1 – Correct Answer

17.1

Assume that boxes of pencils are sold in a perfectly competitive industry. The industry short-run supply curve (or marginal cost curve) is $P = MC = 0.4Q$ and the inverse demand for boxes of pencils in $P = 20 – 0.1Q$. Suppose that in the production process pencil manufacturers emit pollution into the air and the external marginal cost is estimated to be $0.50 for each box of pencils produced.

What is the social marginal cost (SMC) of pencil production?

A. $SMC = 0.9Q$
B. $SMC = 20 – 0.6Q$
C. $SMC = 0.4Q + 0.50$ (correct answer)
D. $SMC = 20.5 – 0.1Q$

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Externalities (9/9): Question 2

17.1

Assume that boxes of pencils are sold in a perfectly competitive industry. The industry short-run supply curve (or marginal cost curve) is $P = MC = 0.4Q$ and the inverse demand for boxes of pencils in $P = 20 - 0.1Q$. Suppose that, in the production process, pencil manufacturers emit pollution into the air and the external marginal cost is estimated to be $0.50 for each box of pencils produced.

What is the socially optimal level of pencil production?

A. 39 boxes
B. 40 boxes
C. 41 boxes
D. 42 boxes

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Externalities (9/9): Question 2 – Correct Answer

17.1

Assume that boxes of pencils are sold in a perfectly competitive industry. The industry short-run supply curve (or marginal cost curve) is $P = MC = 0.4Q$ and the inverse demand for boxes of pencils in $P = 20 - 0.1Q$. Suppose that, in the production process, pencil manufacturers emit pollution into the air and the external marginal cost is estimated to be $0.50 for each box of pencils produced.

What is the socially optimal level of pencil production?

A. 39 boxes (correct answer)
B. 40 boxes
C. 41 boxes
D. 42 boxes

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Correcting Externalities (1/16)

17.2

Competitive markets with externalities produce more or less than is socially efficient. A number of market interventions can help correct externalities.

- Some work through their effect on prices (e.g., taxes).
- Some target the quantity produced and consumed.

Example: The Efficient Level of Pollution

The goal is to determine the **efficient level of pollution**, or the level of emissions necessary to produce the efficient quantity of the good tied to the externality.

- This is the level resulting from the quantity where demand equals the marginal *social* cost.
- We can also think about the efficient amount of pollution as the level that balances its costs and benefits.

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Correcting Externalities (2/16)

17.2

The Efficient Level of Pollution

Why does the marginal cost of pollution (MCP) curve slope upward?

- At low levels of pollution, the damage associated with an additional unit of pollution is relatively low.
- At higher levels of pollution, health effects become more severe, and additional units of pollution are more costly to society.

Why does the marginal benefit of pollution (MBP) curve slope downward?

- High levels of pollution are associated with high levels of production, hence lower market prices. As pollution falls, so does production, and the forgone consumer and producer surplus is an opportunity cost.
- As pollution falls, the cost of further reducing pollution increases because easy methods are exhausted.

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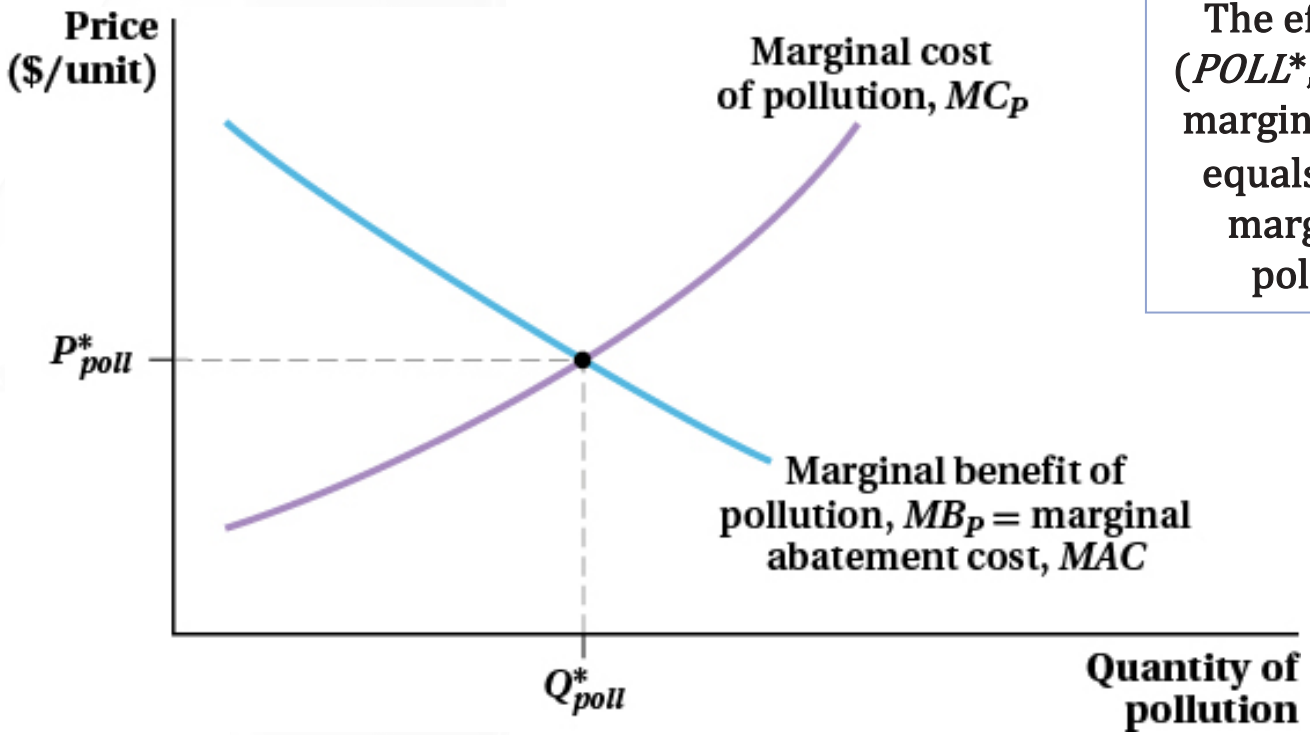
Correcting Externalities (3/16)

17.2

Figure 17.3 The Efficient Level of Pollution



The efficient level of pollution ($POLL^*$, $P_{POLL}{}^*$) occurs where the marginal cost of pollution, MCP, equals the marginal benefit or marginal abatement cost of pollution ($MBP = MAC$).

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Correcting Externalities (4/16)

17.2

The Efficient Level of Pollution

Marginal abatement cost: the cost of reducing emissions by one unit (includes technological costs and forgone production)

Figure 17.3 is very similar to the supply and demand figures we have been using throughout this class.

- *MBP* is demand for pollution; *MCP* is the marginal societal cost, or supply.
- This represents a hypothetical market for pollution, with a resulting optimal price and quantity placed on pollution.
- Since this market doesn't exist in the real world, what can be done to induce private parties to produce and consume at the socially efficient level?

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Correcting Externalities (5/16)

17.2

Using Prices to Correct Externalities

Consider changing the price of goods produced in the presence of externalities so that the social and private benefits and costs align.

- For a negative externality, levy a tax on production or consumption.
- For a positive externality, subsidize production or consumption.

In the presence of negative externalities, economists often advocate for the use of a **Pigouvian tax**.

- A tax on an activity that raises a good's price to take into account the external marginal costs imposed by a negative externality
- Designed to correct market failures and therefore improve societal welfare (rather than distorting markets like other taxes)

Consider the power plant.

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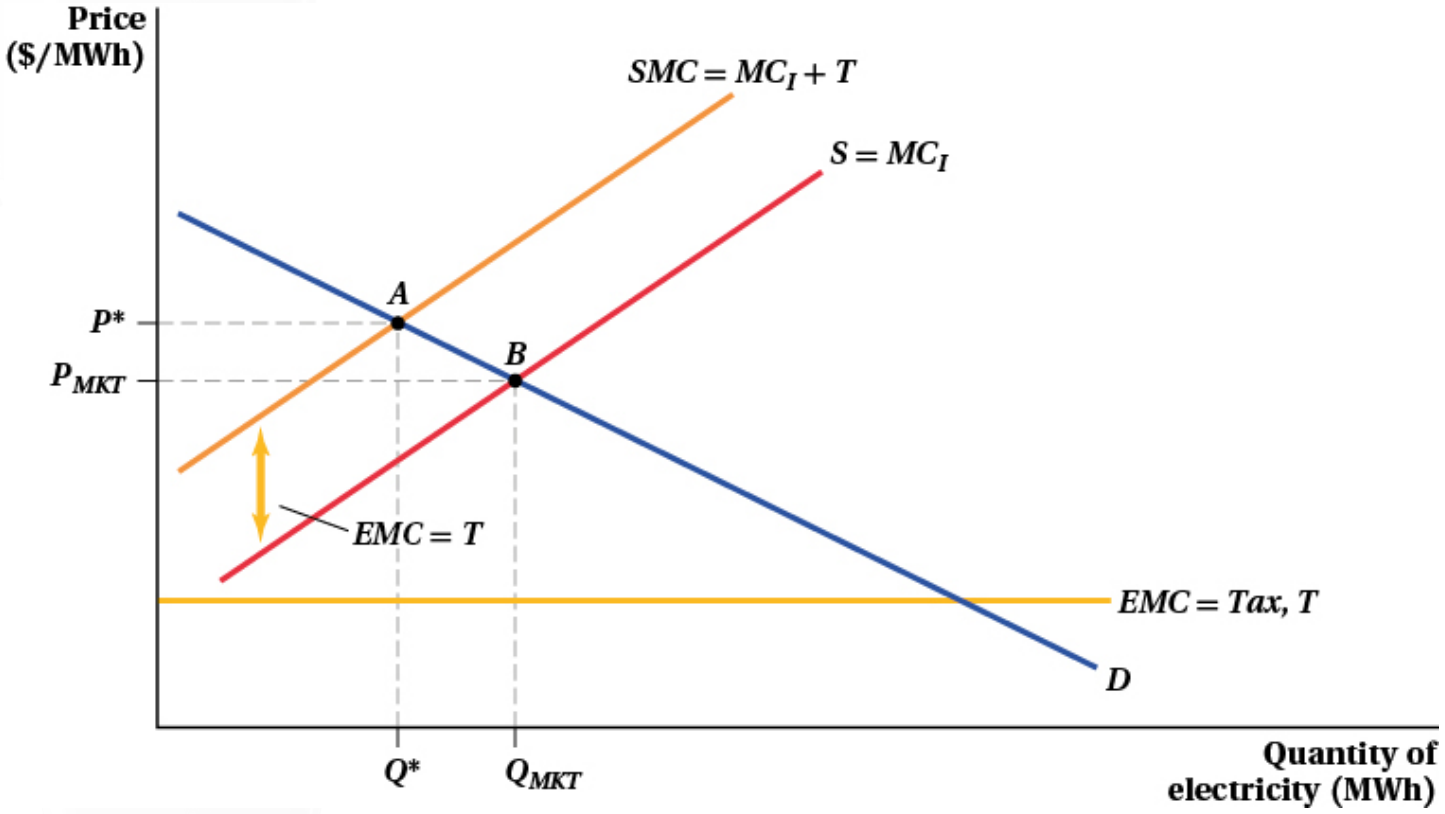
Correcting Externalities (6/16)

17.2

Figure 17.4 A Pigouvian Tax Corrects for a Negative Externality



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Correcting Externalities (7/16)

17.2

Using Prices to Correct Externalities

Similarly, in the presence of positive externalities, economists often advocate for the use of a **Pigouvian subsidy**.

- **A subsidy for an activity that produces a positive externality**
- Serves to equate the external marginal benefit imposed by an externality

Quantity Mechanisms to Correct Externalities

Quantity-based interventions have the same goal as taxes or subsidies—to move a market with externalities toward the efficient outcome.

Quota: a regulation mandating that the production or consumption of a certain quantity of a good or externality be limited (negative externality) or required (positive externality)

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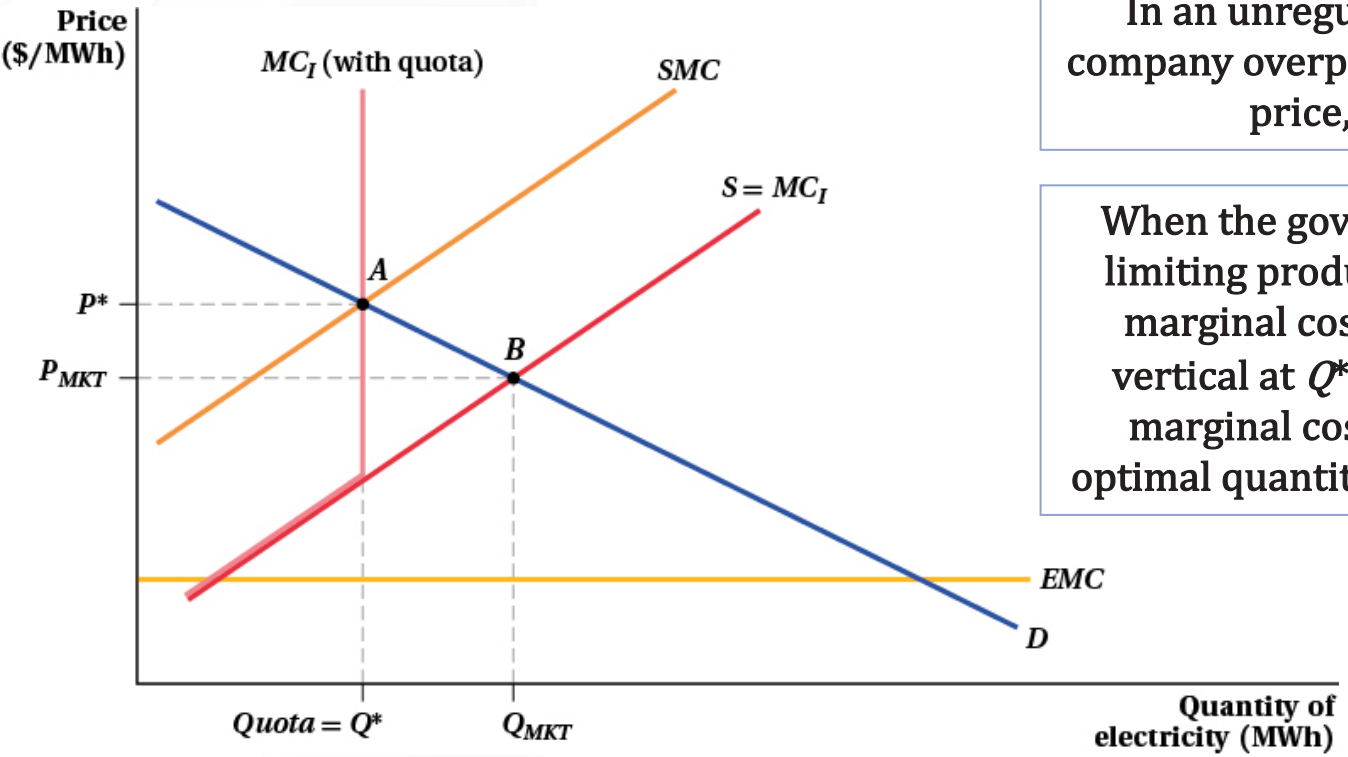
Correcting Externalities (8/16)

17.2

Figure 17.5 The Effects of a Quota on a Market with a Negative Externality



In an unregulated market, a power company overproduces quantity, Q_{MKT}, at price, P_{MKT} (point *B*).

When the government enacts a quota limiting production to Q^*, the private marginal cost curve, MC_I, becomes vertical at Q^*, intersecting the social marginal cost, *SMC*, at the socially optimal quantity, Q^*, and price, P^* (point *A*).

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Correcting Externalities (9/16)

17.2

Price-Based Versus Quantity-Based Interventions with Uncertainty

With perfect information, price and quantity instruments are equally effective in controlling externalities.

Without perfect information, significant problems face regulators.

- The costs of controlling externalities (marginal abatement costs) are often difficult to ascertain *ex ante.*
- The benefits of controlling externalities (marginal pollution costs) are similarly difficult to estimate—in the case of pollution, valuing changes to human health, ecosystems, and such.

When there is uncertainty in marginal abatement costs, price and quantity mechanisms are *not* equivalent.

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Correcting Externalities (10/16)

17.2

Price-Based Versus Quantity-Based Interventions with Uncertainty

The equivalence between price and quantity instruments breaks down under uncertainty because of a simple difference between the two.

- Price instruments correct the *price* of pollution; for example, a pollution tax imposes a fixed cost on polluters for each unit emitted.
- Quantity instruments fix the *quantity* of pollution.

Consider what happens when marginal abatement costs turn out to be larger than expected.

- Under a pollution permit system, firms are forced to abate a fixed amount of pollution.
- Under a pollution tax system, firms will abate *less* pollution.
  - They will limit pollution until the additional cost of reducing one more unit of pollution is equal to the tax, and then they will simply pay the tax.

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Correcting Externalities (11/16)

17.2

Price-Based Versus Quantity-Based Interventions with Uncertainty

What happens to the outcomes under taxes and permits when the marginal benefits of reducing pollution (MCP) are greater than expected?

- Nothing. Firms operating under a pollution tax system will not change their control efforts except in response to a change in the *private* costs of control (marginal abatement costs).
- The benefits of reducing pollution are in the form of reduced *external costs.* As these costs are not borne by polluting firms, the choice of how much pollution to emit is not affected.
- Uncertainty about benefits does not alter the equivalence between price and quantity interventions.

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Correcting Externalities (12/16)

17.2

Price-Based Versus Quantity-Based Interventions with Uncertainty

When are price-based interventions preferable to quantity-based interventions and vice versa?

- When the marginal abatement cost (*MAC*) and marginal cost of pollution (*MCP*) curves are linear, two factors determine the relative superiority of one intervention or the other.
    1. The slope of the *MAC* curve
    2. The slope of the *MCP* curve

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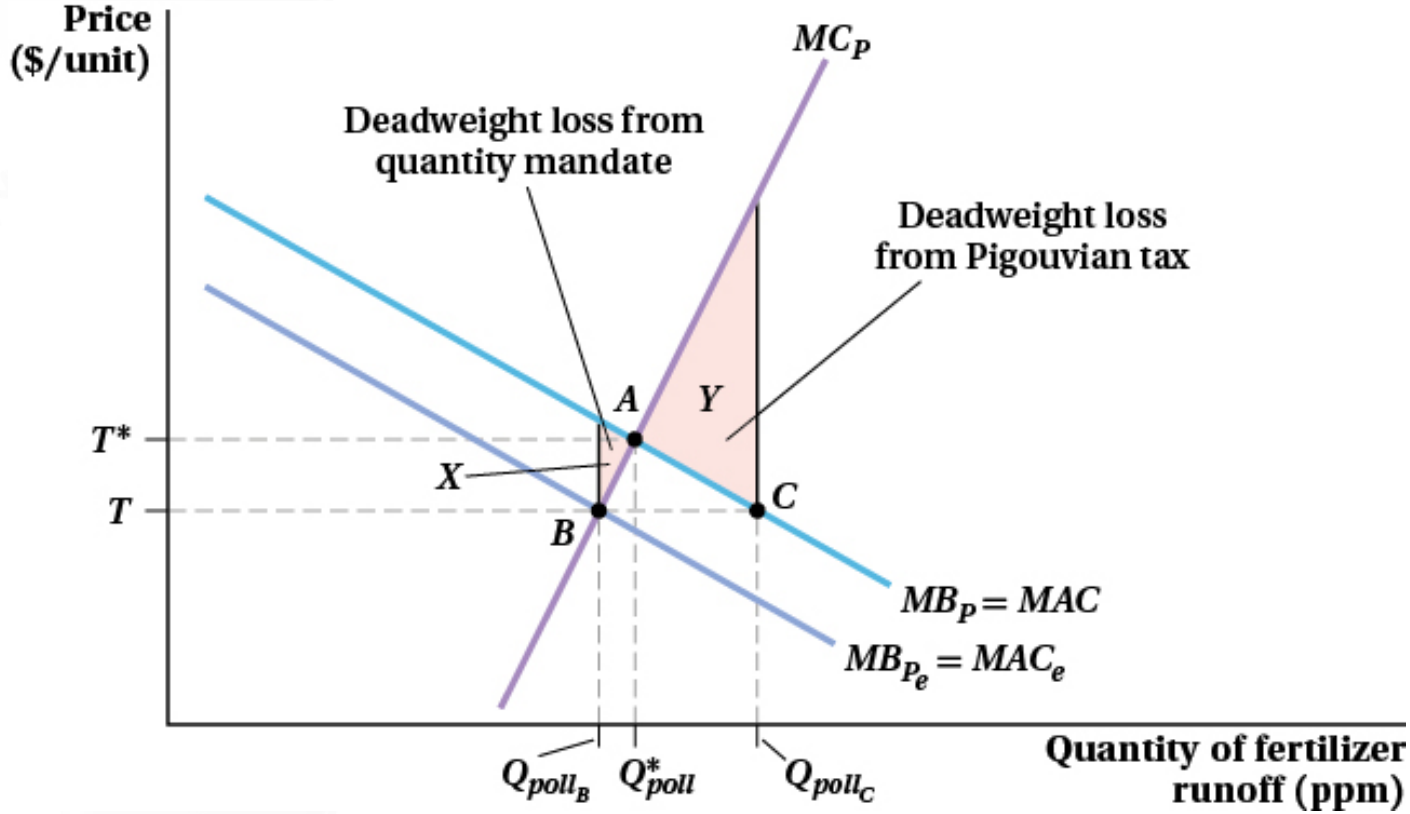
Correcting Externalities (13/16)

17.2

Figure 17.6 When Quantity Mechanisms Are Preferable to Price Mechanisms



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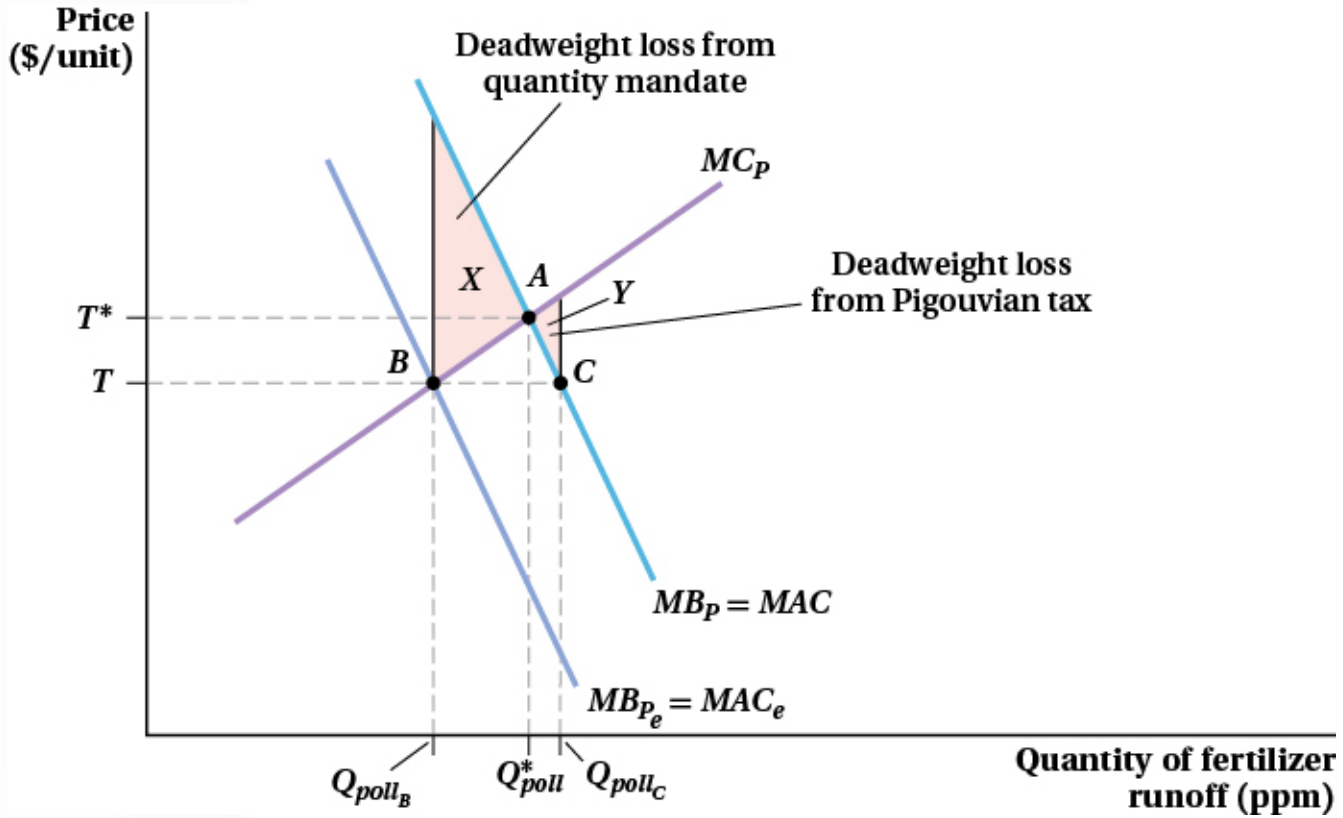
Correcting Externalities (14/16)

17.2

Figure 17.7 When Price Mechanisms Are Preferable to Quantity Mechanisms



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Correcting Externalities (15/16)

17.2

A Market-Oriented Approach to Reducing Externalities: Tradable permits markets

Using price or quantity interventions takes a lot of effort.

- Firms may differ dramatically in their abatement costs.
- Often, pollution control regulations require a fixed aggregate emissions reduction; it is difficult to enforce this with taxes.

In response to these challenges, many regulatory agencies issue **tradable permits** to control pollution.

- A government-issued permit that allows a firm to emit a certain amount of pollution and that can be traded to other firms
- In theory, these are effective in achieving allocative efficiency—when marginal abatement costs equalize across firms.

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Correcting Externalities (16/16)

17.2

Why do we need tradable permits?

- It is difficult for regulators to ascertain firms' costs of reducing pollution.
- Many firms do not perfectly understand the costs of reducing pollution.
- There is the problem of moral hazard; firms have an incentive to overstate costs to regulators, hoping to reduce their financial liability.

Tradable permits solve these problems.

- High-cost firms purchase permits from low-cost firms until no mutually beneficial trades remain.
- The market-clearing price of permits will be equal to *MAC* for each firm.
- This is exactly how any market works.

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The Coase Theorem: Free Markets Addressing Externalities on Their Own (1/2)

17.3

Under certain circumstances, it may be possible to reach the efficient market outcome through private negotiation.

The Coase theorem: if negotiation costs are low enough, negotiation among market participants will lead to the efficient market outcome regardless of who holds legal property rights.

- It does not matter who has property rights.
- If outcomes can be monitored and individuals can coordinate and negotiate at a low enough cost, parties should be able to reach the efficient outcome.
- Coordination is often very difficult, particularly with many participants and/or information problems.

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The Coase Theorem: Free Markets Addressing Externalities on Their Own (2/2)

17.3

The Coase Theorem and Tradable Permits Markets

The Coase theorem has been used to help inform the design of government regulations for controlling externalities.

- Consider discussion of the concept of tradable permits for pollution control.
  - The Coase theorem suggests it does not matter who is endowed with the rights or how they are distributed.
  - So long as there is monitoring and the ability to coordinate participants in a way that facilitates negotiation, the outcomes should be the same no matter the initial allocation.
  - This is one reason markets for tradable permits receive attention in the literature; markets make coordination easier.
  - When coordination is not easy, the Coase Theorem fails.

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Public Goods (1/10)

17.4

There is another type of good for which markets can fail to deliver the socially optimal level of output: **public goods**, which are accessible to anyone who wants to consume them.

- Good that benefits the individual consumer, even as others consume it
- These goods (e.g., national defense, a fireworks display, clean air) remain just as valuable to the consumer, even as other people consume them.
- Similar to positive externalities as they can provide external benefits to individuals other than those who purchase them

Public goods have two important properties:

1. They are **nonexcludable**, meaning that consumers cannot be prevented from consuming the good.

2. They are **nonrival**, meaning that one person's consumption of the good does not diminish another consumers enjoyment of the same good.

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Public Goods (2/10)

17.4

Using the definitions of **nonexcludable** and **nonrival**, we can define four categories of goods.

1. **Private goods**: Goods that are rival and excludable
2. **Common resource goods**: Goods that are rival, but nonexcludable
3. **Club goods**: Goods that are nonrival and excludable
4. **Pure public goods**: Goods that are nonrival and nonexcludable

Table 17.1 summarizes these four categories of goods.

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Public Goods (3/10)

17.4

Table 17.1: Examples of Goods by Characteristics

	Excludable ***Individuals can be kept from consuming.***	**Nonexcludable** ***Individuals cannot be kept from consuming.***
Rival ***One individual's consumption affects another's consumption.***	**Private good**: tacos, gasoline, paper	**Common resource**: shared property, fisheries, interstate highways
Nonrival ***One individual's consumption has no effect on another's consumption.***	**Club good**: satellite TV services, private parks, movies	**Public good**: fireworks display, mosquito abatement, national defense

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Public Goods (4/10): Question 1

17.4

A radio station available through an antenna is what kind of good?

A. A private good
B. A common resource good
C. A club good
D. A public good

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Public Goods (4/10): Question 1 – Correct Answer

17.4

A radio station available through an antenna is what kind of good?

A. A private good
B. A common resource good
C. A club good
D. A public good (correct answer)

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Public Goods (5/10)

17.4

The Optimal Level of Public Goods

Market efficiency requires that a good be produced until the marginal benefits of production are equal to the marginal costs.

- Since public goods are nonrival, the marginal benefit of a given level of provision is the vertical sum of all individuals' marginal benefit curves.
- Total marginal benefit is defined as the vertical sum of the marginal benefit curves of all of a public good's many customers.
- This is shown by the equation $MB_T = \sum MB_i$ where *i* indicates each individual.
- The cost side is the same as with any other good.

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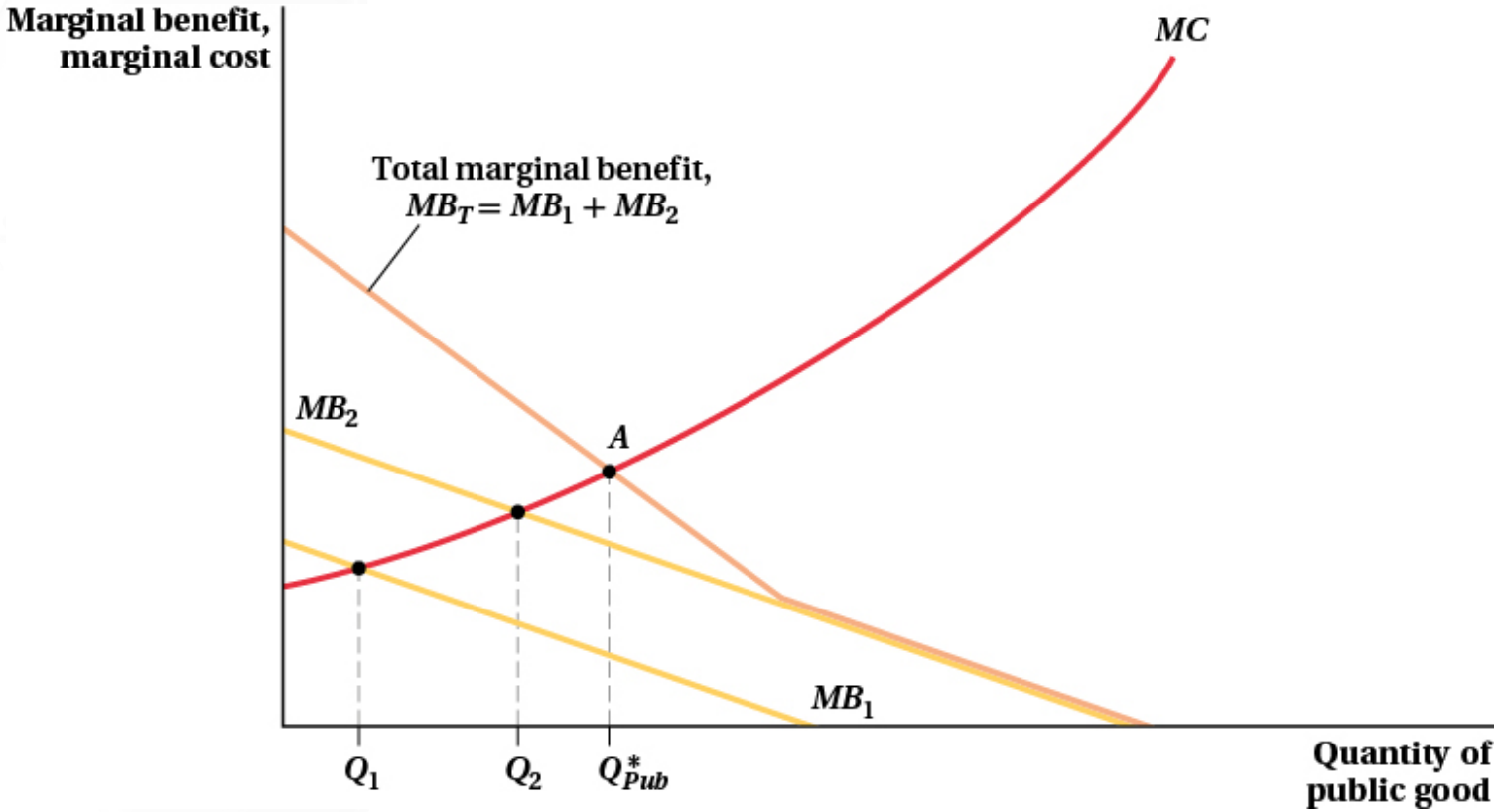
Public Goods (6/10)

17.4

Figure 17.8 Efficiency in the Market for a Public Good



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Public Goods (7/10)

17.4

The Optimal Level of Public Goods

There are two reasons markets will underprovide public goods.

The first is illustrated by the figure on the previous slide.

- If individuals purchase the goods themselves, they will do so only until private marginal benefit equals marginal cost.
- The efficient level occurs when the total marginal benefits equal marginal cost.

A second problem results from the nonexcludability of public goods.

- This is called the **free-rider problem**: a source of inefficiency resulting from individuals consuming a public good or service without paying for it.
- Why take on any private costs when you can simply benefit from it without paying anything?

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Public Goods (8/10)

17.4

Solving the Free-Rider Problem

The most common way that the free-rider problem is dealt with is by government.

- The power to tax is often used to provide public goods such as national defense, air traffic control, and weather forecasting.

There are other possible solutions.

- Groups of private citizens can form to provide public goods (e.g., homeowner associations).
- People do not always succumb to the free-rider problem. Often, private motivations are more complicated than assumed by the theory of rational agents.

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Public Goods (9/10)

17.4

The Tragedy of the Commons

A common resource good, isn't a pure public good, but it presents a similar kind of inefficiency.

- Reservoirs, public forests, public airwaves, and public restrooms are examples
- Key element is nonexcludability: consumers cannot be prevented from consuming the good once it is available

The **tragedy of the commons** is the dilemma that common resources create when everyone has free access and the resource is used more intensively than it would be if privately owned, leading to a decline in its value for everyone.

- Tragedy of the commons is a special form of a negative externality.
- Visitors of Plymouth Rock repeatedly chipped away at it until it was a fraction of the original size, and now it has to be closed off, which has affected the experience of other visitors.

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Public Goods (10/10)

17.4

The Tragedy of the Commons

Many of the solutions for negative externalities can serve as remedies for the tragedy of the commons:

- Pigouvian taxes: charge individuals for the external damage they do to the common resource
- Quotas: quantity restrictions on the rate at which common resources can be extracted (limits on the amount of fishing, hunting, logging, for example)
- Defining property rights and facilitating negotiation among those who share the common resource as laid out in the Coase theorem.

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Conclusion (1/1)

17.5

In this chapter, we delved into the issues that develop when markets are missing or otherwise incomplete.

- Externalities occur when costs and/or benefits are not completely captured by those making production and consumption decisions.
- Nonexcludable common resource goods are subject to overuse and/or underinvestment.
- Public goods are underprovided by private agents because of free riding and the misalignment of private and total marginal benefits.

In the final chapter, we examine situations in which consumers and producers may not appear to be the rational, utility- and profit-maximizing agents we have modeled throughout this text.

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