The Overuse of a Common Resource

Why might a fish stock be overused? Why might overfishing occur? The answer is that fishers face only their own private cost and don't face the cost they impose on others—external cost. The *social* cost of fishing combines the *private* cost and *external* cost. Let's examine the costs of catching fish to see how the presence of external cost brings overfishing.

Marginal Private Cost You can think of the *marginal private cost* of catching fish as the additional cost incurred by keeping a boat and crew at sea for long enough to increase the catch by one ton. Keeping a fishing boat at sea for an additional amount of time eventually runs into *diminishing marginal returns* (see p. 255). As the crew gets tired, the storage facilities get overfull, and boat's speed is cut to conserve fuel, the catch per hour decreases. The cost of keeping the boat at sea for an additional hour is constant so the marginal cost of catching fish increases as the quantity caught increases.

You've just seen that the *principle of increasing marginal cost* applies to catching fish just as it applies to other production activities: Marginal private cost increases as the quantity of fish caught increases.

The marginal private cost of catching fish determines an indiviual fisher's supply of fish. A profit-maximizing fisher is willing to supply the quantity at which the market price of fish covers the marginal private cost. And the market supply is the sum of the quantities supplied by each individual fisher.

Marginal External Cost The marginal exernal cost of catching fish is the cost per additional ton that one fisher's production imposes on all other fishers. This additional cost arises because one fisher's catch decreases the remaining stock, which in turn decreases the renewal rate of the stock and makes it harder for others to find and catch fish.

Marginal external cost also increases as the quantity of fish caught increases. If the quantity of fish caught is so large that it drives the species to near extinction, the marginal external cost becomes infinitely large.

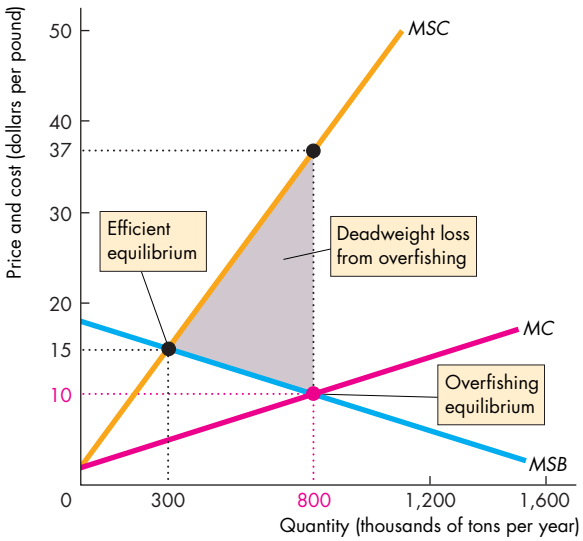
Marginal Social Cost The *marginal social cost* of catching fish is the marginal private cost plus the marginal external cost. Because both of its components increase as the quantity caught increases, marginal social cost also increases with the quantity of fish caught.

Marginal Social Benefit and Demand The marginal social benefit from fish is the price that consumers are willing to pay for an additional pound of fish. Marginal social benefit decreases as the quantity of fish consumed increases, so the demand curve, which is also the marginal social benefit curve, slopes downward.

Overfishing Equilibrium Figure 17.6 illustrates overfishing and how it arises. The market demand curve for fish is the marginal social benefit curve, *MSB*. The market supply curve is the marginal *private* cost curve, *MC*. Market equilibrium occurs at the intersection point of these two curves. The equilibrium quantity is 800 thousand tons per year and the equilibrium price is $10 per pound.

At this market equilibrium, overfishing is running down the fish stock. Figure. 17.6 illustrates why

FIGURE 17.6 Why Overfishing Occurs



The supply curve is the marginal private cost curve, *MC*. The demand curve is the marginal social benefit curve *MSB*. Market equilibrium occurs at a quantity of 800 thousand tons and a price of $10 per pound.

The marginal social cost curve is *MSC* and at the market equilibrium there is overfishing—marginal social cost exceeds marginal social benefit.

The quantity at which *MSC* equals *MSB* is the efficient quantity, 300 thousand tons per year. The gray triangle shows the deadweight loss from overfishing.

myeconlab animation

overfishing occurs. At the market equilibrium quantity, marginal social benefit (and willingness to pay) is $10 per pound, but the marginal social cost exceeds this amount. The marginal external cost is the cost of running down the fish stock.

Efficient Equilibrium What is the efficient use of a common resource? It is the use of the resource that makes the marginal social benefit from the resource equal to the marginal social cost of using it.

In Fig. 17.6, the efficient quantity of fish is 300 thousand tons per year—the quantity that makes marginal social cost (on the *MSC* curve) equal to marginal social benefit (on the *MSB* curve). At this quantity, the marginal catch of each individual fisher costs society what people are willing to pay for it.

Deadweight Loss from Overfishing Deadweight loss measures the cost of overfishing. The gray triangle in Fig. 17.6 illustrates this loss. It is the marginal social cost minus the marginal social benefit from all the fish caught in excess of the efficient quantity.

Achieving an Efficient Outcome

Defining the conditions under which a common resource is used efficiently is easier than delivering those conditions. To use a common resource efficiently, it is necessary to design an incentive mechanism that confronts the users of the resource with the marginal *social* consequences of their actions. The same principles apply to common resources as those that you met earlier in this chapter when you studied the external cost of pollution.

The three main methods that might be used to achieve the efficient use of a common resource are

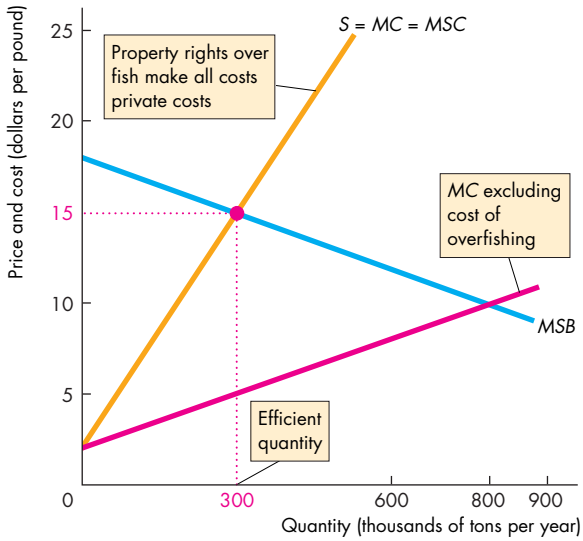
- Property rights
- Production quotas
- Individual transferable quotas (ITQs)

Property Rights A common resource that no one owns and that anyone is free to use contrasts with *private property*, which is a resource that *someone* owns and has an incentive to use in the way that maximizes its value. One way of overcoming the tragedy of the commons is to convert a common resource to private property. By assigning private property rights to what was previously a common resource, its owner faces the same conditions as society faces. It doesn't matter who owns the resource. The users of the resource will be confronted with the full cost of using it because they either own it or pay a fee to the owner for permission to use it.

When private property rights over a resource are established and enforced, the *MSC* curve becomes the marginal *private* cost curve, and the use of the resource is efficient.

Figure 17.7 illustrate an efficient outcome with property rights. The supply curve $S = MC = MSC$ and the demand curve $D = MSB$ determine the equilibrium price and quantity. The price equals both marginal social benefit and marginal social cost and the quantity is efficient.

FIGURE 17.7 Property Rights Achieve an Efficient Outcome



With private property rights, fishers pay the owner of the fish stock for permission to fish and face the full social cost of their actions. The marginal cost curve includes the external cost, so the supply curve is the marginal private cost curve and the marginal social cost curve, $S = MC = MSC$.

Market equilibrium occurs at $15 per pound and at that price, the quantity is 300 thousand tons per year. At this quantity, marginal social cost equals marginal social benefit, and the quantity of fish caught is efficient.

The property rights convert the fish stock from a common resource to a private resource and it is used efficiently.

myeconlab animation

The private property solution to the tragedy of the commons *is* available in some cases. It was the solution to the original tragedy of the commons in England's Middle Ages. It is also a solution that has been used to prevent overuse of the airwaves that carry cell-phone services. The right to use this space (called the frequency spectrum) has been auctioned by governments to the highest bidders. The owner of each part of the spectrum is the only one permitted to use it (or to license someone else to use it).

But assigning private property rights is not always feasible. It would be difficult, for example, to assign private property rights to the oceans. It would not be impossible, but the cost of enforcing private property rights over thousands of square miles of ocean would be high. It would be even more difficult to assign and protect private property rights to the atmosphere.

In some cases, there is an emotional objection to assigning private property rights. Critics of it have a moral objection to someone owning a resource that they regard as public. In the absence of property rights, some form of government intervention is used, one of which is a production quota.

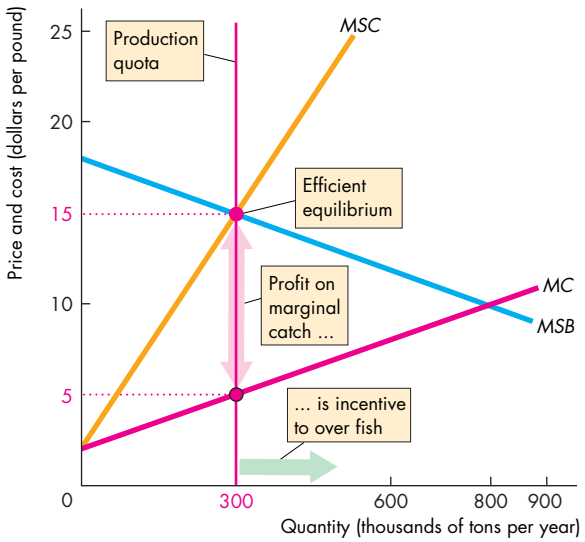
Production Quota A *production quota* is an upper limit to the quantity of a good that may be produced in a specified period. The quota is allocated to individual producers, so each producer has its own quota.

You studied the effects of a production quota in Chapter 6 (pp. 139–140) and learned that a quota can drive a wedge between marginal social benefit and marginal social cost and create deadweight loss. In that earlier example, the market was efficient without a quota. But in the case of common resources, the market overuses the resource and produces an inefficient quantity. A production quota in this market brings a move toward a more efficient outcome.

Figure 17.8 shows a quota that achieves an efficient outcome. The quota limits the catch (production) to 300 thousand tons, the efficient quantity at which marginal social benefit, *MSB*, equals marginal social cost, *MSC*. If everyone sticks to their own quota, the outcome is efficient. But implementing a production quota has two problems.

First, it is in every fisher's self-interest to catch more fish than the quantity permitted under the quota. The reason is that price exceeds marginal private cost, so by catching more fish, a fisher gets a higher income. If enough fishers break the quota, overfishing and the tragedy of the commons remain.

FIGURE 17.8 A Production Quota to Use a Common Resource Efficiently



A quota of 300 thousand tons that limits production to this quantity, raises the price to $15 per pound, and lowers marginal cost to $5 per pound. A fisher who cheats and produces more that the alloted quota increases his profit by $10 per pound. If all (or most) fishers cheat, production exceeds the quota and there is a return to overfishing.

myeconlab animation

Second, marginal cost is not, in general, the same for all producers—as we're assuming here. Efficiency requires that the quota be allocated to the producers with the lowest marginal cost. But bureaucrats who allocate quotas do not have information about the marginal cost of individual producers. Even if they tried to get this information, producers would have an incentive to lie about their costs so as to get a bigger quota.

So where producers are difficult, or very costly, to monitor or where marginal cost varies across producers, a production quota cannot achieve an efficient outcome.

Individual Transferable Quotas Where producers are difficult to monitor or where marginal cost varies across producers, a more sophisticated quota system can be effective. It is an **individual transferable quota (ITQ)**, which is a production limit that is assigned to an individual who is then free to transfer (sell) the quota to someone else. A market in ITQs emerges and ITQs are traded at their market price.

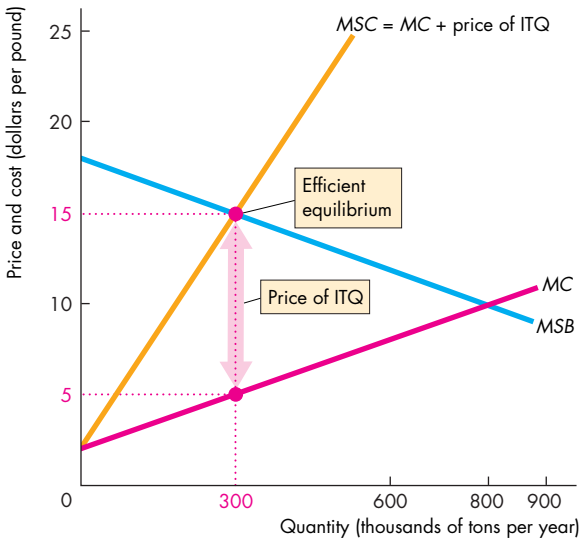
The market price of an ITQ is the highest price that someone is willing to pay for one. That price is

marginal social benefit minus marginal cost. The price of an ITQ will rise to this level because fishers who don't have a quota would be willing to pay this amount to get one.

A fisher with an ITQ could sell it for the market price, so by not selling the ITQ the fisher incurs an opportunity cost. The marginal cost of fishing, which now includes the opportunity cost of the ITQ, equals the marginal social benefit from the efficient quantity.

Figure 17.9 illustrates how ITQs work. Each fisher receives an allocation of ITQs and the total catch permited by the ITQs is 300 thousand tons per year. Fishers trade ITQs: Those with low marginal cost buy ITQs from those with high marginal cost and the market price of an ITQ settles at $10 per pound of fish. The marginal private cost of fishing now becomes the original marginal private cost, *MC* plus the cost of the ITQ. The marginal private cost curve shifts upward from *MC* to *MC* + *price of ITQ* and each fisher is confronted with the marginal *social* cost of fishing. No one has an incentive to exceed the quota because to do so would send marginal cost above price and result in a loss on the marginal catch. The outcome is efficient.

FIGURE 17.9 ITQs to Use a Common Resource Efficiently



ITQs are issued on a scale that keeps output at the efficient level. The market price of an ITQ equals the marginal social benefit minus marginal cost. Because each user of the common resource faces the opportunity cost of using the resource, self-interest achieves the social interest.

myeconlab animation

Economics in Action

ITQs Work

Iceland introduced the first ITQs in 1984 to conserve its stocks of lobster. In 1986, New Zealand and a bit later Australia introduced ITQs to conserve fish stocks in the South Pacific and Southern Oceans. The evidence from these countries suggests that ITQs work well.

ITQs help maintain fish stocks, but they also reduce the size of the fishing industry. This consequence of ITQs puts them against the self-interest of fishers. In all countries, the fishing industry opposes restrictions on its activities, but in Australia and New Zealand, the opposition is not strong enough to block ITQs.

In the United States the opposition has been harder to overcome and in 1996, Congress passed the Sustainable Fishing Act that put a moratorium on ITQs. This moratorium was lifted in 2004 and since then, ITQs have been applied to 28 fisheries from the Gulf of Alaska to the Gulf of Mexico. Economists have studied the effects of ITQs extensively and agree that they work. ITQs offer an effective tool for achieving an efficient use of the stock of ocean fish.

REVIEW QUIZ

1. What is the tragedy of the commons? Give two examples, including one from your state.
2. Describe the conditions under which a common resource is used efficiently.
3. Review three methods that might achieve the efficient use of a common resource and explain the obstacles to efficiency.

You can work these questions in Study Plan 17.2 and get instant feedback. myeconlab

Reading Between the Lines on pp. 406–407 looks at the use of a tax versus cap-and-trade to lower carbon emissions.

The next two chapters examine the third big question of economics: For whom are goods and services produced? We examine the markets for factors of production and discover how factor incomes and the distribution of income are determined.

Tax Versus Cap-and-Trade

Oil Spill Pushes Carbon Tax Back into Spotlight

http://www.SFGate.com
June 22, 2010

… Oil's true cost also includes the well-known litany of other hidden burdens: military spending to protect Middle East oil, the $1 billion of U.S. wealth and jobs sent overseas each day to buy oil, and pollution of all sorts, including carbon dioxide emissions. None of these costs is included in the price of the fossil fuels Americans use.

"There has to be a price, and a reward for moving to low-carbon fuels," said Rep. Pete Stark, D-Fremont. Stark may be the only one in Congress who has the temerity to propose a direct tax on carbon. …

Congress instead is considering cap-and-trade systems for carbon emissions that do the same thing as a carbon tax, …

The leading Senate plan … would set an increasingly stricter limit on carbon emissions and auction emissions permits. Revenue would go to alternative energy investments and utility rebates to help low-income consumers burdened by rising energy costs. …

Europeans pay $7 to $8 for a gallon of gas, mostly in taxes, and "they still drive," said Severin Borenstein, co-director of the UC Energy Institute. "They use much less oil per capita than we do, but they still use more than we need to get to." …

Borenstein called for a big increase in federal funding for basic research into alternatives. "When you take a realistic look at the economic side, without major technological breakthroughs at a much faster pace than we've seen over the last couple of decades, it doesn't look very doable," he said. …

ESSENCE OF THE STORY

- The cost of oil includes external costs that include military spending to protect Middle East oil, pollution, and carbon dioxide emissions.
- Representative Pete Stark, D-Fremont, says that there has to be a price, and a reward for moving to low-carbon fuels, so he proposes a tax on carbon.
- Congress is considering cap-and-trade systems for carbon emissions.
- The leading Senate plan puts a limit on carbon emissions and auctions emissions permits.
- Revenue from the sale of permits would be spent on developing clean alternative energy and utility rebates to help low-income consumers.
- Europeans pay $7 to $8 for a gallon of gasoline and use less than Americans but more than the required target.
- Without a technological breakthrough to make clean energy cheap, it will be hard to reach a low carbon emission target.

ECONOMIC ANALYSIS

- The news article lists some external costs of using oil. One of them, "sending jobs overseas," isn't such a cost. International trade brings gains for all, not external costs—see Chapter 7, pp. 155–156.
- The price of gasoline might be raised to incude marginal external cost with a carbon tax or a cap-and-trade carbon permit system.
- The news article says that using either of these measures would do little to curb gas consumption and Fig. 1 illustrates why.
- In the short run, the demand for gasoline, D_{SR}, is inelastic. If the U.S. gas price was raised to the European level, gas consumption would decrease by very little.
- In the long run, the demand for gasoline, D_{LR}, is elastic. Raising the U.S. gas price to the European level might eventually cut U.S. consumption to the European level.
- Figure 2 illustrates how a technological breakthrough that results in a low-cost clean fuel would work (suggests in the news article by Severin Borenstein).
- Figure 2(a) shows the short-run effects. Taxing carbon emissions or putting a price on them raises the marginal cost of gasoline to the marginal social cost, and the supply curve becomes the *MSC* curve. The price of gasoline rises, but the quantity consumed barely changes. The government collects the revenue shown by the purple rectangle.
- Figure 2(b) shows the long-run effect when a new technology is developed.
- The availablity of a low-cost clean fuel decreases the demand for gasoline from D_0 to D_1. The price of gasoline falls and the quantity consumed decreases.
- In the new equilibrium, the price of gasoline is lower, and so is the carbon tax or carbon price.
- Technological change is a crucial source of eventually curbing carbon emissions.

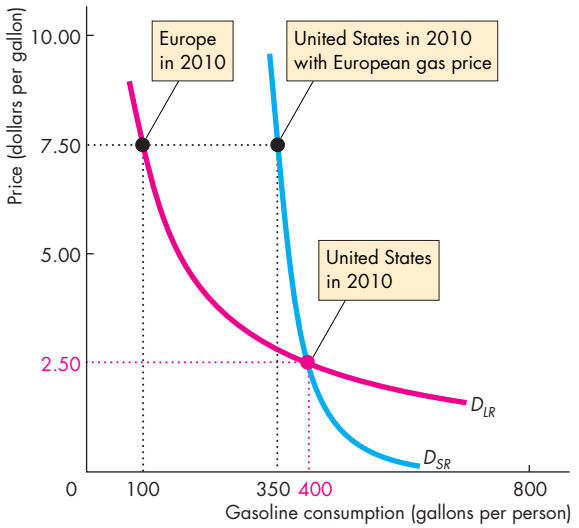
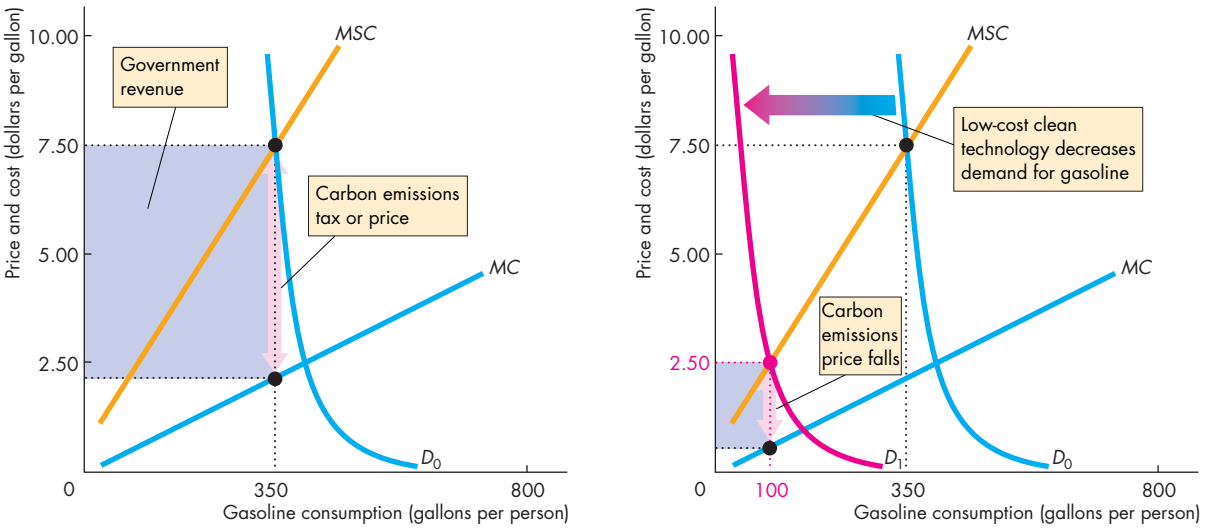


Figure 1 Inelastic demand for gasoline



(a) In the short run **(b) In the long run**

Figure 2 Short-run and long-run effects of tax and technological change

SUMMARY

Key Points

Negative Externality: Pollution (pp. 394–399)

- A competitive market would produce too much of a good that has external production costs.
- External costs are costs of production that fall on people other than the producer of a good or service. Marginal social cost equals marginal private cost plus marginal external cost.
- Producers take account only of marginal private cost and produce more than the efficient quantity when there is a marginal external cost.
- Sometimes it is possible to overcome a negative externality by assigning a property right.
- When property rights cannot be assigned, governments might overcome externalities by using taxes, emission charges, or marketable permits.

Working Problems 1 to 12 will give you a better understanding of the external costs of pollution.

The Tragedy of the Commons (pp. 400–405)

- Common resources create a problem that is called the tragedy of the commons—no one has a private incentive to conserve the resources and use them at an efficient rate.
- A common resource is used to the point at which the marginal private benefit equals the marginal cost.
- A common resource might be used efficiently by creating a private property right, setting a quota, or issuing individual transferable quotas.

Working Problems 13 to 19 will give you a better understanding of the tragedy of the commons.

Key Terms

Coase theorem, 397
Individual transferable quota (ITQ), 404
Marginal external cost, 395
Marginal private cost, 395
Marginal social cost, 395
Pigovian taxes, 398
Property rights, 396
Tragedy of the commons, 400
Transactions costs, 397

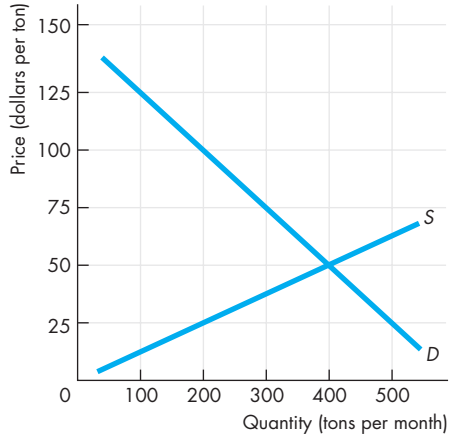
STUDY PLAN PROBLEMS AND APPLICATIONS

myeconlab You can work Problems 1 to 19 in MyEconLab Chapter 17 Study Plan and get instant feedback.

Negative Externality: Pollution (Study Plan 17.1)

Use the following figure to work Problems 1 to 5.

The figure illustrates the market for cotton. Consider a small town surrounded by a large cotton farm. Suppose that the cotton grower sprays the plants with chemicals to control insects and the chemical waste flows into the river passing through the town. The marginal external cost of the chemical waste is equal to the marginal private cost of producing the cotton (that is, the marginal social cost of producing the cotton is double the marginal private cost).



1. If no one owns the river and the town takes no action to control the waste, what is the quantity of cotton, and the deadweight loss created?
2. a. Suppose that the town owns the river and makes the cotton grower pay the cost of pollution. How much cotton is produced and what does the farmer pay the town per ton of cotton produced?
   b. Suppose that the cotton grower owns the river and rents it to the town. How much cotton is produced and how is the rent paid by the town to the grower (per ton of cotton produced) influenced by cotton growing?
   c. Compare the quantities of cotton produced in parts (a) and (b) and explain the relationship between these quantities.
3. Suppose that no one owns the river and that the city introduces a pollution tax. What is the tax per ton of cotton produced that achieves an efficient outcome?
4. Compare the outcomes when property rights exist and when the pollution tax achieves the efficient amount of waste.
5. Suppose that no one owns the river and that the government issues two marketable pollution permits: one to the cotton grower and one to the city. Each permit allows the same amount of pollution of the river, and the total pollution created is the efficient amount.

   What is the quantity of cotton produced and what is the market price of a pollution permit? Who buys and who sells a permit?

Use the following news clip to work Problems 6 to 8.

Bag Revolution

Thin plastic shopping bags aren't biodegradable and often end up in the ocean or in trees. Americans use about 110 billion bags a year. In 2007, San Francisco required all retailers with revenue over $2 million to offer only compostable or reusable bags. In all, 28 U.S. cities have proposed laws restricting the use of plastic bags.

Source: *Fortune*, May 12, 2008

6. a. Describe the externality that arises from plastic bags.
   b. Draw a graph to illustrate how plastic bags create deadweight loss.
7. a. With 70 percent of all plastic bags coming from grocery, drug and convenience stores, in July 2008, Seattle imposed a tax of 20¢ per bag from these outlets. Explain the effects of Seattle's policy on the use of plastic bags.
   b. Draw a graph to illustrate Seattle's policy and show the change in the deadweight loss that arises from this policy.
8. In 2010, the Governor of California supported a move to make California the first state in the nation to ban plastic shopping bags. He said that the bill "will be a great victory for our environment." Explain why a complete ban on plastic bags might be inefficient.

Use the following news clip to work Problems 9 to 11.

The Year in Medicine: Cell Phones

Talking on a hands-free cell phone while driving might seem safe, but think again. People who used

hands-free cell phones in simulation trials exhibited slower reaction times and took longer to hit the brakes than drivers who weren't otherwise distracted. Data from real-life driving tests show that cell-phone use rivals drowsy driving as a major cause of accidents.

Source: *Time*, December 4, 2006

9. a. Explain the external costs that arise from using a cell phone while driving.
   b. Explain why the market for cell-phone service creates a deadweight loss.
10. Draw a graph to illustrate how a deadweight loss arises from the use of cell phones.
11. Explain how government intervention might improve the efficiency of cell-phone use.
12. **Pollution Rules Squeeze Strawberry Crop**

    Last year, Ventura County farmers harvested nearly 12,000 acres of strawberries valued at more than $323 million. To comply with the federal Clean Air Act, growers must use 50 percent less pesticide. It is estimated that strawberry output will fall by 60 percent.

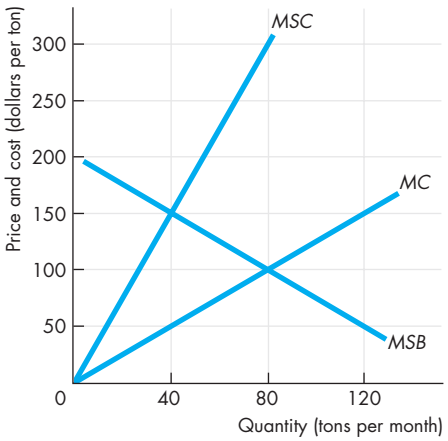
    Source: *USA Today*, February 29, 2008

    Explain how a limit on pesticide will change the efficiency of the strawberry industry. Would a cap-and-trade scheme be more efficient?

Tragedy of the Commons (Study Plan 17.2)

Use the following figure to work Problems 13 to 15.

The figure shows the market for North Atlantic tuna.



13. a. What is the quantity of tuna that fishers catch and the price of tuna? Is the tuna stock being used efficiently? Explain why or why not.
    b. What would be the price of tuna, if the stock of tuna is used efficiently?
14. a. With a quota of 40 tons a month for the tuna fishing industry, what is the equilibrium price of tuna and the quantity of tuna that fishers catch?
    b. Is the equilibrium an overfishing equilibrium?
15. If the government issues ITQs to individual fishers that limit the total catch to the efficient quantity, what is the market price of an ITQ?
16. **Whaling "Hurts Tourist Industry"**

    Leah Garces, the director of programs at the World Society for the Protection of Animals, reported that whale watching is more economically significant and sustainable to people and communities than whaling. The global whale-watching industry is estimated to be a $1.25 billion business enjoyed by over 10 million people in more than 90 countries each year.

    Source: BBC, June 2, 2009

    Describe the tradeoff facing communities that live near whaling areas. How might a thriving whale-watching industry avoid the tragedy of the commons?

Use the following information to work Problems 17 to 19.

A natural spring runs under land owned by ten people. Each person has the right to sink a well and can take water from the spring at a constant marginal cost of $5 a gallon. The table sets out the external cost and the social benefit of water.

Quantity of water (gallons per day)	Marginal external cost (dollars per gallon)	Marginal social benefits (dollars per gallon)
10	1	10
20	2	9
30	3	8
40	4	7
50	5	6
60	6	5
70	7	4

17. Draw a graph to illustrate the market equilibrium. On your graph, show the efficient quantity of water taken.
18. If the government sets a quota on the total amount of water such that the spring is used efficiently, what would that quota be?
19. If the government issues ITQs to land owners that limit the total amount of water taken to the efficient quantity, what is the market price of an ITQ?

ADDITIONAL PROBLEMS AND APPLICATIONS

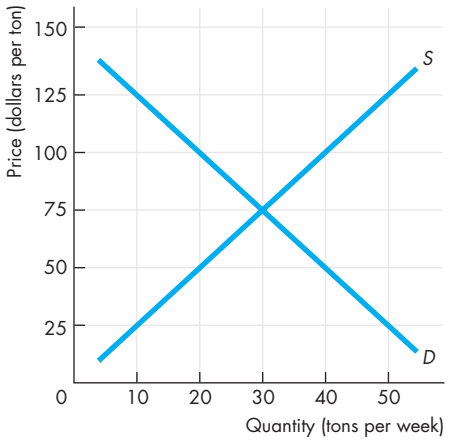
myeconlab You can work these problems in MyEconLab if assigned by your instructor.

Negative Externality: Pollution

20. Betty and Anna work at the same office in Philadelphia. They both must attend a meeting in Pittsburgh, so they decide to drive to the meeting together. Betty is a cigarette smoker and her marginal benefit from smoking a package of cigarettes a day is $40. Cigarettes are $6 a pack. Anna dislikes cigarette smoke, and her marginal benefit from a smoke-free environment is $50 a day. What is the outcome if
    a. Betty drives her car with Anna as a passenger?
    b. Anna drives her car with Betty as a passenger?

Use the following information and the figure, which illustrates the market for a pesticide with no government intervention, to work Problems 21 to 24.

When factories produce pesticide, they also create waste, which they dump into a lake on the outskirts of the town. The marginal external cost of the waste is equal to the marginal private cost of producing the pesticide (that is, the marginal social cost of producing the pesticide is double the marginal private cost).



21. What is the quantity of pesticide produced if no one owns the lake and what is the efficient quantity of pesticide?
22. If the residents of the town own the lake, what is the quantity of pesticide produced and how much do residents of the town charge the factories to dump waste?
23. If the pesticide factories own the lake, how much pesticide is produced?
24. If no one owns the lake and the government levies a pollution tax, what is the tax that achieves the efficient outcome?

Use the following table to work Problems 25 to 27.

The first two columns of the table show the demand schedule for electricity from a coal burning utility; the second and third columns show the utility's cost of producing electricity. The marginal external cost of the pollution created is equal to the marginal cost.

Price (cents per kilowatt)	Quantity (kilowatts per day)	Marginal cost (cents per kilowatt)
4	500	10
8	400	8
12	300	6
16	200	4
20	100	2

25. With no government action to control pollution, what is the quantity of electricity produced, the price of electricity, and the marginal external cost of the pollution generated?
26. With no government action to control pollution, what is the marginal social cost of the electricity generated and the deadweight loss created?
27. Suppose that the government levies a pollution tax, such that the utility produces the efficient quantity. What is the price of electricity? What is the tax levied, and the government's tax revenue per day?
28. **EPA Pushes to have Companies Track Greenhouse Gases**

    Congress plans to make large polluters, such as oil refiners and automobile manufacturers, and makers of cement, aluminum, glass and paper, start tracking their emissions next year. The EPA's climate change division noted that this is an important step. A cap-and-trade scheme will be introduced for factories that emit 90 percent of U.S. greenhouse gases.

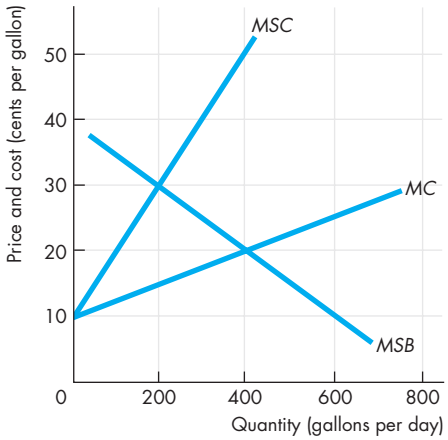
    Source: *USA Today*, March 11, 2009

    The monitoring cost of the scheme is expected to be about $127 million a year. Who will benefit from the scheme? Who will bear the burden of this scheme?

The Tragedy if the Commons

29. If hikers and other visitors were required to pay a fee to use the Appalachian Trail,
    a. Would the use of this common resource be more efficient?
    b. Would it be even more efficient if the most popular spots along the trail had the highest prices?
    c. Why do you think we don't see more market solutions to the tragedy of the commons?

Use the following figure to work Problems 30 to 32.



A spring runs under a village. Everyone can sink a well on her or his land and take water from the spring. The figure shows the marginal social benefit from and the marginal cost of taking water.

30. What is the quantity of water taken and what is the private cost of the water taken?
31. What is the efficient quantity of water taken and the marginal social cost at the efficient quantity?
32. If the village council sets a quota on the total amount of water such that the spring is used efficiently, what would be the quota and the market value of the water taken per day?
33. **Polar Ice Cap Shrinks Further and Thins**
    With the warming of the planet, the polar ice cap is shrinking and the Arctic Sea is expanding. As the ice cap shrinks further, more and more underwater mineral resources will become accessible. Many countries are staking out territorial claims to parts of the polar region.

    Source: *The Wall Street Journal*, April 7, 2009

    Explain how ownership of these mineral resources will influence the amount of damage done to the Arctic Sea and its wildlife.

Economics in the News

34. After you have studied *Reading Between the Lines* on pp. 406–407 answer the following questions:
    a. Why is it difficult to decrease carbon emissions in the short run?
    b. Which holds the greater promise as a method of lowering carbon emissions: actions that decrease the demand for gasoline or actions that decrease the supply of gasoline? Explain.
    c. Why might a carbon cap-and-trade program be preferred to a carbon tax?

Use the following information to work Problems 35 and 36.

Where the Tuna Roam

To the first settlers, the Great Plains posed the same problem as the oceans today: a vast, open area where there seemed to be no way to protect animals. But animals thrived once the settlers divvied up the land and devised ways to protect their livestock. Today, the ocean are much like an open range. Fishermen catch as much as they can this year, even if they are overfishing. They figure any fish they don't take for themselves will just be taken by someone else.

Source: *The New York Times*, November 4, 2006

35. a. What are the similarities between the problems faced by the earliest settlers in the West and today's fishers?
    b. Can the tragedy of the commons in the oceans be eliminated in the same manner used by the early settlers on the plains?
36. How can ITQs change the short-term outlook of fishers to a long-term outlook?
37. **Commuting More than Pain at Pump**

    Half of the respondents polled in 10 cities said that traffic congestion increased their stress levels and cut their productivity. IBM has been devising ways for cities to cut traffic congestion, such as automated tolling, congestion pricing plans and real-time traffic modeling. Commuters want more options to work from home and improved public transit.

    Source: CNN, May 30, 2008

    a. Explain the problem of congested city streets that results in inefficient usage. Draw a graph to illustrate the inefficient equilibrium.
    b. How could government policies be used to achieve an efficient use of city streets?