

Solution Manual for Environmental and Natural Resource Economics 10th Edition by Tietenberg Lewis ISBN 0133479692 9780133479690

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Chapter 2 The Economic Approach: Property Rights, Externalities, and Environmental Problems

Chapter 2 reviews many of the basic economic concepts that will be used in later chapters. The chapter begins with a discussion of the interactions between the environment and the economy, followed by an explanation of the difference between positive and normative economics. Static efficiency is defined, and consumer surplus and producer surplus are reviewed. The characteristics of an efficient property rights structure are defined and deemed to be necessary for markets to efficiently allocate resources. The remainder of the chapter discusses four cases of market failure: externalities, common property resources, public goods and imperfect market structures. The chapter ends with a discussion of possible remedies to a market failure, including the Coase theorem and private negotiation, legal remedies, and government regulation. This chapter briefly reviews a lot of material that will seem abstract and difficult to the students with a more limited economics background. You can expect to spend some number of days reviewing the material in this chapter, especially if you are teaching non-majors or those with only one semester of college level microeconomics.



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1. Discuss the relationship between the environment and the economic system.
2. Explain the difference between normative and positive economics.
3. Define static efficiency.
4. Review consumer and producer surplus conceptually and graphically.
5. Define an efficient property rights structure, and explain how this property rights structure leads to economic efficiency.
6. Discuss the relationship between profit and producer surplus, and define scarcity rent.
7. Explain the concept of an externality, and show how externalities lead to market failure and an inefficient allocation of resources.

8. Define common property resources, and explain why common property resources tend to be overused.
9. Define public goods, and explain why the private market does not produce the efficient quantity of a public good.
10. Discuss monopoly, asymmetric information, and the government's behavior as sources of market failure.

11. Discuss possible remedies to market failure including private negotiation and the Coase Theorem, legal remedies, and government regulation.



I. The Human–Environment Relationship

A. The Environment as an Asset

1. The environment is an asset that provides the economy with resources and acts as a receptacle for the economy's waste.
2. The environment is a closed system, as defined by the first and second laws of thermodynamics.
3. Privately owned tree lots have both an asset value (while growing) and a use value (when cut). Open access fisheries, however, lose the asset value because there is no way to save fish for the future given you cannot prevent someone else from catching them.

B. The Economic Approach

1. **Positive economics** attempts to describe what is.
2. **Normative economics** deals with what ought to be.
3. Some timely examples of where normative decision-making will be prevalent include dam removal and policies to prevent or mitigate climate change.

II. Environmental Problems and Economic

Efficiency A. Static Efficiency

Resource allocations satisfy the **static efficiency criterion** if economic surplus is maximized. Economic surplus is the sum of consumer surplus and producer surplus.

1. **Consumer surplus** is the difference between total willingness to pay for the good and the actual cost of the good.
2. **Total willingness to pay** is a measure of the total value received from a good.
3. **Producer surplus** is the difference between the price of the good and the marginal cost of producing the good.
4. The supply curve is the marginal cost curve. Make sure students understand this fact.

III. Property Rights

This section focuses on the idea that economic efficiency depends on well-defined property rights.

A. A **property right** is an entitlement held by either an individual or a state.

B. A well-defined or **efficient property right** will be:

1. **Exclusive:** All benefits and costs accrue only to the owner.
2. **Transferable:** Property rights can be exchanged voluntarily.
3. **Enforceable:** Property rights cannot be seized by others.

Owning a resource with these characteristics ensures that the resource will retain both its use value and its asset value. Resources for which the asset value cannot be captured will typically be overexploited (e.g., common pool resources). This concept will be covered later in the chapter, but it might be a good time to remind your students of the concept of opportunity cost and introduce them to the idea of intertemporal opportunity cost.

- C. In a system with well-defined property rights, **static efficiency** is achieved. Self-interested parties make choices that are efficient from society's point of view.

- D. In the short run, producer surplus is equal to profit plus fixed cost. The area under the marginal cost curve is total variable cost. In the long run, producer surplus is equal to profit plus rent. **Rent** is the return to scarce inputs owned by the producer. Under perfect competition, long-run profit equals zero and producer surplus equals rent. [Remind your students that economic profit is not the same as accounting profit.]
- E. **Scarcity rents** are the returns that persist in the long-run competitive equilibrium.

IV. Externalities as a Source of Market Failure

Market failure can be the result of a property right system that fails to achieve exclusivity, transferability, or enforceability. If an agent making a decision does not bear all of the consequences (costs and benefits) of that decision, then the characteristic of exclusivity is violated. This results in what is called an externality.

- A. **Externalities** or third party effects exist whenever one agent's activities affect another agent's welfare.
- B. An **external diseconomy** or **negative externality** imposes costs on a third party. An example of a negative externality is a steel mill upstream from a fish hatchery. If the steel producer does not take into account the costs from waste discharges that might harm the hatchery, these costs are passed on to the fish hatchery and any other "third" or downstream parties. [The textbook example is one of a steel mill upstream from a resort hotel. Both are users of the river.]
- C. **Marginal social costs** (all costs to society) will not be equal to **marginal private costs** (producer's costs). Take some time to discuss the difference between MC_S and MC_P , which can be thought of as **marginal external cost** (MC_E).
- D. The private market equilibrium will be at a point where too much steel is being produced. The price of steel will be too low. Too much pollution is being produced. This is illustrated in text Figure 2.5. It is simplest to assume that marginal private benefits are equal to marginal social benefits, both of which are given by the demand curve. The private market reaches equilibrium, but does not take into account the third party effect (or damages in this case) imposed on the downstream party. At the private market equilibrium, marginal social costs are higher than marginal benefits, resulting in a **deadweight loss**. The market failure results from a negative externality.
- E. Some potential solutions, such as a tax that raises private costs and reduces output could be briefly introduced here and returned to in later chapters.

Many different examples will be useful to help illustrate this concept. Use examples from the text or from the news.

- F. An **external economy** or **positive externality** occurs whenever an activity imposes benefits on a third party. Classic examples of positive externalities include the external benefits from vaccines or education. Individuals who plant flowers in their yards will maximize their own net benefit from the flowers when deciding how much to plant. It is unlikely that the third party benefits that accrue to passersby will be included. Likewise, the decision to get a flu shot is likely driven by the benefits received from not getting the flu—not from the benefits of associated individuals who will also have less chance of getting the flu if you get immunized.

In this case, marginal private benefits will be lower than marginal social benefits. Too little will be produced by the private market and prices will be too high. Again, this case can be illustrated graphically with the simplifying assumption that marginal social costs equal marginal private costs to emphasize the difference in marginal benefits.

A positive externality also provides an argument for government intervention. An example would be a subsidy to the producers, which increases output and lowers price.

- G. **Pecuniary externalities** exist when the external effect comes from altered prices. Market failures are not the result of pecuniary externalities, however, since the price signals sustain efficient allocations.

V. Perverse Incentives Arising From Some Property Rights Structures

There are four general property rights regimes that create different incentives for resource use (or misuse).

- A. Under **private property** regimes, individuals hold entitlements.
- B. Under **state-property** regimes, governments own and control property (e.g., some parks and forests).
- C. **Common-property** regimes are those in which property is jointly owned and managed by a specific group. Common property regimes are quite variable, but many result in overexploitation of the resource. Over-fishing in local fisheries or over-hunting can be good examples. A few successful examples exist such as the system of allocating grazing rights in Switzerland.
- D. Under **res nullis** or **open access** regimes, no one owns or exercises control over the resources. This type of regime leads to the **“tragedy of the commons”** because the resources can be exploited by whoever can get to them first.
- E. **Common pool resources** are characterized by non-exclusivity and divisibility. These characteristics allow the resource to be exploited by anyone. Access cannot be denied, and the amount captured will be eliminated from the original amount available (divisibility). Unrestricted hunting access of the American bison, unregulated groundwater withdrawal, and high seas fisheries are all examples of resources that share the characteristics of common pool resources and the tragedy of the commons. The mentality associated with these open access resources is “get it while the getting is good” and “if I don’t get it, someone else will.” The asset value of the resource is essentially zero since non-exclusivity implies that it cannot be saved for later. [Ask your students what this implies about the effective discount rate.]

VI. Public Goods

- A. **Public goods** are both indivisible and nonexcludable.
- B. **Indivisibility** means that one person’s consumption does not affect another’s.
- C. **Nonexcludability** means that persons cannot be kept from enjoying the benefits of a good even if they do not pay for it.
- D. Clean air, national defense, and biological diversity are all examples of public goods.
- E. **Biological diversity** includes the amount of genetic variation among individuals within in a single species and the number of species in a community. Species have value beyond intrinsic value by providing ecological stability, and potentially providing sources of food, raw materials and medicines. The private market will not produce the efficient amount of biological diversity.
- F. Public goods will be underprovided in a private market because of free-riders. A **free-rider** is someone who derives benefits from a commodity without contributing to its supply. Someone who does not pay taxes, for example, cannot be excluded from the provision of national defense. Likewise, someone who does not contribute to the nature conservancy will not be excluded from the biodiversity benefits from land preservation.
- G. An efficient allocation is determined by the intersection of the demand curve and the marginal cost curve. In the presence of free riders, the private market demand curve will not reflect all of

the benefits of the resource resulting in under-provision of the resource. Additionally, efficient pricing requires that a different price be charged to each consumer. Since the excludability

criterion is violated, consumers may not reveal their true willingness to pay. The market demand curve is derived in text Figure 2.7 from two individual demand curves.

VII. Imperfect Market Structures

- A. Markets that are not competitive will exhibit inefficiencies. **Monopolies** will supply too little of a good at too high a price. A **cartel** is a group of producers who form a collusive agreement to gain monopoly power. OPEC, for example, colludes in order to gain monopoly power. Restricting output raises the price of oil.
- B. At the monopoly output, marginal benefits are greater than marginal costs. Net benefits are not maximized and there is a **deadweight loss**.

VIII. Asymmetric Information

- A. When one party has more information about a given situation than the other party there is asymmetric information. In this case the decision maker with too little information cannot make an efficient decision.
- B. Labeling is one solution to the problem of asymmetric information, as in the case of organic food labeling. Labels provide information to the buyer.

IX. Government Failure

Governments, as well as markets, can also be sources of inefficiency.

- A. **Rent-seeking** behavior may persuade government officials to pursue options that are beneficial to a specific interest group and would not maximize social net benefits. Agricultural producers seeking price supports or consumer groups seeking subsidies are examples of rent seeking.
- B. Incomplete information is other source of inefficient government policies.

X. The Pursuit of Efficiency

Several solutions to the above problems should be covered. It is likely that you will already have covered some of these as the topics arose and students asked what can be done. In fact, an alternative outline format would be to cover the items below in conjunction with the items listed above.

- A. **Private resolution through negotiation** is the simplest means of restoring efficiency. For example, a downstream firm hurt by an upstream polluter could negotiate or bribe the upstream polluter to reduce pollution. "Victim pays" outcomes tend to be unsatisfactory to most students. Other options include consumer boycotts or other means of imposing costs on the polluters.
- B. Property rights that are not well-defined and lead to inefficiencies can be corrected by a court system which imposes either **property rules** or **liability rules**. Examples relevant to the upstream polluter example include discharge permits.
- C. The **Coase Theorem** says that when negotiation costs are negligible and affected parties can freely negotiate, the entitlement can be allocated by the courts to either party and an efficient allocation will result. Only the distribution of costs and benefits among the effective parties is changed. Regardless of which party the property right is assigned to, an efficient level of production will result. Inefficiency causes the pressure for improvement.
- D. The Coase Theorem is not without problems. If the property right is assigned to the polluter, pollution could become a profitable activity. Also, the Coase Theorem relies on some very restrictive assumptions such as the number of polluters being small. If the number of polluters is large, negotiation is difficult and free-riders more prevalent.

- E. The Coase Theorem also relies on **transactions costs** being small. The courts can use liability rules if negotiation is not practical, however transactions costs such as lawyers fees and administrative costs could be large.
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F. **Legislative and executive regulation** are remedies that can take several forms, including taxes and regulatory laws. Gasoline taxes and regulations on unleaded fuels are potential discussion topics as are proposals for carbon taxes. The subject of zoning laws also typically makes for a lively discussion topic.

XI. An Efficient Role for Government

The role of the government in restoring efficiency is considered. If transaction costs are high, corrective action might not be the best response. In other cases it is. Introducing the need to evaluate each decision individually is important here. Most decisions are normative and the need for students to analyze each case will be important in this and later chapters.



Many students will struggle with some of the concepts in this chapter. Students who have taken only one or two economics classes will need to be provided with many concrete examples, and even the serious economics students will need to see a few examples. Some students may be frustrated with the amount of time spent on this chapter and the review of economic models and concepts. Use as many interesting environmental and resource examples as you can to keep them interested. They need to master this material in order to be successful with the later chapters.

Take time to review the basic **supply demand model** and the concept of **static efficiency**. Emphasize that demand is measuring the willingness to pay and supply the willingness to sell. Make sure they understand **consumer and producer surplus**. Discuss the difference between total willingness to pay and marginal willingness to pay and have them identify these concepts graphically. Make sure they understand that the supply curve is the marginal cost curve. Review key cost concepts as necessary, such as total cost, variable cost, fixed cost, and marginal cost. These concepts will be especially useful in the environmental section of the course.

The **externality graph** can be conceptually challenging. Take time to explain the difference between the private marginal cost and the social marginal cost. Use a concrete example and some numbers that can then be plotted on a graph. If your students are up for it, have them identify producer surplus, consumer surplus, and total external cost on the graph to compare the private and social equilibrium. Once they understand the graph and the two equilibrium points, discuss the **Coase theorem**. Have them think about what each party would be willing to pay and willing to accept from the other party. Make sure they understand that it does not matter who owns the resource or the right to pollute. Finally, introduce the concept of a **tax on output** and show how a tax could lead the private market to produce at the socially optimal quantity.

The idea of a **common property resource** is straightforward, but thinking about how one person's actions affect another's can be less clear. Use different examples such as farmers grazing cattle on common land, or fishermen fishing in a common lake to have them think about the difference between average benefit and marginal benefit. Simple numerical examples can be useful. Since common property resources can be overexploited, have them think about how to remedy the situation.

Take time to explain the difference between a private good (an apple, a car, a book, etc.) and a **public good** (flowers or trees planted on campus). Students buy private goods every day. If they decide not to buy a good, they do not get to enjoy its benefits. Public goods on the other hand can be enjoyed even if they are not paid for. Take time to derive the market demand curve for a public good and then show what happens when one or more people decide they will free ride and refuse to pay.



The economy as an asset: students are often pretty enthusiastic about resource and environmental issues. Before delving into the economic models presented in this chapter, have a short discussion based around text Figure 2.1. Have them identify key scarce resources and waste products. Get them to share opinions about how scarce some resources actually are and how polluted the air or water might be. Ask them how they think we should address resource scarcity, or whether they think zero pollution is possible. Get them to think about tradeoffs between economic growth and environmental quality, and opportunity cost.

Static efficiency: use a simple algebraic example to review these concepts. The demand curve for a product is given by $Q_D = 400 - 20P$ and the supply curve for a product is given by $Q_S = 16P - 32$.

- Illustrate the demand curve and the supply curve on the same graph.
- Find the equilibrium price and quantity.
- Find numerical values for the consumer surplus and the producer surplus.
- Identify consumer surplus and producer surplus on your graph.
- Find numerical values for the total willingness to pay for the equilibrium quantity and the total variable cost of supplying the equilibrium quantity. Identify these areas on your graph.

Externalities: use a simple algebraic example to help them understand the difference between a private and social equilibrium.

Demand: $P = 100 - 2Q = MB$

Supply: $P = 10 + 0.5Q = MC_P$

Find the equilibrium price and quantity and illustrate graphically.

Suppose $MC_E = 0.5Q$. What happens to the marginal external cost (the marginal increase in damages from pollution) as more of the good is produced?

Find the marginal social cost $MC_S = MC_P + MC_E$. Illustrate this new cost curve on your graph. Find the socially optimal equilibrium price and quantity.

Which area on the graph represents the net gain from moving to the socially optimal equilibrium point?

Common Property: this example works well if your class is not too large. Buy a few bags of cheap candy. Distribute the candy around the room. Give one person a very short amount of time to gather candy. Record the amount they find. Redistribute the candy around the room. Now repeat the example a few times with more people gathering candy. Record how much each person finds. You should find that the average number of pieces of candy found diminishes with more people hunting for candy. Point out that the typical person will only think about their personal “catch” when hunting for candy and will not think about how their hunting affects the quantity available for others.

Five fishermen live in a village and have no other employment or income earning possibilities besides fishing. They each own a boat that is suitable for fishing, but does not have any resale value. Fish are worth \$5 per pound and the marginal cost of operating the boat is \$500 per month. They all fish in a river next to the village, and they have determined that when there are more of them out there on the river fishing, they each catch less fish per month according to the following schedule:

<u>Boats</u>	<u>Fish Caught per Boat (pounds)</u>
1	200
2	190
3	175
4	155
5	130

If each fisherman acts in his own best interest, will he continue to operate his boat each month?
If so, how much income will he earn per month?

If the fishermen band together and act as a group, how many boats will they choose to operate?
 If income is divided evenly, how much will each fisherman make?

Public Goods: come up with a public good that will be provided on campus such as more trees, more flowers, or more recycle bins. To supply the public good, students must contribute. The more money raised, the greater the amount of the public good supplied. Get students to think about what the good is worth to them. Have them write this number on a piece of paper and turn it in as a secret ballot. Now tell them that student volunteers are going to go around and collect funds in order to supply the public good. Ask them how much they will contribute and have them write this number on a separate piece of paper as a second secret ballot. Open the ballots and see what happens.

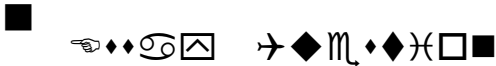
The Coase Theorem: here is a simple bargaining example.

There is a factory that is dumping toxic waste into a river where a resort is located downstream. At the moment the factory is not filtering the water that it dumps into the river. There is a filter it could install that would remove a significant amount of the toxic elements from the water before it is dumped in the river. The factory and the resort have each assessed the situation and come up with the following data:

Gains to:	No Factory	Factory with filter	Factory with no filter
Factory	\$0/day	\$700/day	\$800/day
Resort	\$400/day	\$250/day	\$100/day

If the factory is given ownership of the river, what choice will it make? How much would the resort be willing to pay to get the factory to make another choice? Will the factory accept?

If the resort is given ownership of the river, what choice will it make? How much would the factory be willing to pay to get the resort to make another choice? Will the resort accept?



Monopolies and cartels are usually associated with economic inefficiencies and deadweight losses. With a common-pool resource, however, asset values are non-existent and resources are depleted more quickly than would be optimal. Debate 2.1 examines how OPEC, a cartel, sets prices. Discuss the role of this type pricing with respect to resource conservation.