Workbook

APEC 257

Natural Resources, the Environment and Economics

By

Molly Espey

Department of Agricultural and Applied Economics
Clemson University
INTRODUCTION

Concepts
Economics
Microeconomics
Macroeconomics
Environmental Economics
Economic Growth and the Environment
Natural Resource Economics
Economic Growth and Resource Use
Opportunity Cost
Positive Economics
Normative Economics
Marginal Analysis

Definitions

Economics: The study of how people make choices to use SCARCE RESOURCES to satisfy UNLIMITED WANTS

The study of the allocation of scarce resources among unlimited wants

Common sense made difficult

Microeconomics: the study of the behavior of individuals or small groups

Macroeconomics: the study of the economic performance of the economy as a whole (total output, employment, inflation)

Environmental Economics: focuses on how and why people make decisions that have environmental consequences and the role of economic institutions (organizations, public or private, laws, etc.) and policies in influencing these decisions

Natural Resource Economics: Study of the use of natural resources (such as energy, minerals, timber, fish, water) as inputs in the production of goods and services

Renewable resources: resources that grow naturally

Nonrenewable resources: resources for which there is no replenishment or rate of growth is so slow as to be imperceptible in the human life span
Opportunity Cost: The cost of choosing to use resources for one purpose as measured by the sacrifice of the next best alternative use of those resources

The value of the next best foregone alternative use of resources

Positive Economics: The study of what is, and how the economy works. Positive analysis in economics is used to forecast the impact of changes in economic policy or economic conditions on such things as production, sales, prices, and income, and to determine who wins and who loses as a result of those changes.

Normative Economics: The study of what the goals of the economy should be. Normative analysis in economics is used to evaluate the desirability of alternative outcomes according to some underlying value judgements or opinions about what is good or bad.

Marginal Analysis: A method economists use to study decision making which involves a systematic comparison of the benefits and costs of actions

Applications and Examples

Opportunity Cost

There is no such thing as a free lunch. Everyone faces opportunity costs for virtually every decision that is made.

(a) Students face an opportunity cost when they choose to go to the movies the night before an exam rather than choosing to study. The opportunity cost of going to the movies is the loss of study time and likely a poorer performance on the exam.

(b) Consumers face an opportunity cost when they choose to spend their money on one product rather than another. The opportunity cost is measured in terms of the next best thing the consumer could have bought instead. For example, the opportunity cost of buying a new pair of shoes might be the foregone opportunity to buy a new jacket.

(c) Producers face an opportunity cost when they choose to produce one product rather than another. A farmer who plants his field in wheat, for example, is foregoing the opportunity to plant any other crop in that field at that time. The opportunity cost is measured as the value of the foregone crop.
Governments face an opportunity cost when they choose how to allocate government funds. If more money is desired for one program, education for example, money must be taken from some other program or more money must be obtained from citizens through higher taxes. The opportunity cost of spending more money for education is the reduction in spending on other government programs or the reduction in household disposable income.

The opportunity cost of any decision is what is given up or foregone. The benefit of the decision is what is gained. For the examples above, the benefits are (a) viewing a movie, (b) a new pair of shoes, (c) revenue from planting wheat, (d) more spending on education.

**Practice Problems**

1. Determine which of the following entail positive economics and which entail normative economics.

   a. A study of the impact of the minimum wage on unemployment among young unskilled workers.

   b. A study of whether or not the government should implement a worker retraining program.

   c. A study of whether or not more money ought to be spent on pollution control programs.

   d. A study of how much a new pollution control program would cost impacted businesses.

   e. A study of the impact on farm incomes of the elimination of agricultural subsidies.

   f. A study of whether or not more water should be diverted from agriculture to the Stillwater National Wildlife Refuge.

2. When the government speed limit was 55 miles per hour, did everyone stay within the 55-mile limit? What are the costs to the driver of going faster? What are some of the costs of going faster that do not fall on the speeding motorist? Do these latter costs affect motorists's decisions?
3. Would the number of people trying to sign up for military service rise or decline during a recession? Explain in terms of opportunity costs.

4. Suppose 70 year-old Pat Long lives alone in a large four bedroom house she bought 20 years ago for $22,000. Today that house is worth $220,000. What is Pat's opportunity cost of continuing to live in the house?

5. a. Suppose you it would take you six hours to complete your tax forms on your own, and the opportunity cost of your time is $6 per hour. Suppose you could hire an accountant to do your taxes, and that the accountant earns $50 per hour and would take two hours to complete your taxes. Should you hire the accountant or do the job yourself? Explain or show your work.

   b. Suppose it only would take you three hours to do your own taxes, but the opportunity cost of your time is $80 per hour. Should you hire the accountant or do the job yourself? Explain or show your work.

6. Mary shops at Store X, where food costs 10 percent more than at Store Y, but the checkout lines are much shorter. Is it irrational for Mary to pay more for her food than she would if she shopped at Store Y? Explain.
Graphing Review

Terms
- Positive relationship
- Negative relationship
- Slope of linear curves
- Slope of nonlinear curves

Definitions

Positive relationship: If y increases as x increases and y decreases as x decreases, all else constant, the relationship between x and y is said to be a "positive relationship". Graphically, a positive relationship is represented as a line that slopes upward from left to right.

Negative relationship: If y decreases as x increases and y increases as x decreases, all else constant, the relationship between x and y is said to be a "negative relationship". Graphically, a negative relationship is represented as a line that slopes downward from left to right.

Slope: Rise over run.
Change in the value on vertical axis divided by change in value on the horizontal axis
The slope of a line is the same at all points on the line.
The slope of a curve changes along the curve.

Practice Problems

1. What type of relationship (positive, negative, or none) exists between each of the following pairs?

   a. The price of hotdogs and the quantity of hot dog buns sold
   b. The amount of rainfall and the quantity of umbrellas sold
   c. Sales of toothbrushes and the price of cat food
   d. The temperature in Reno and sales of ice cream cones in Reno
   e. The price of winter coats and total sales of winter coats
2. Which line depicts a positive relationship?

3. What is the slope of each of the lines below?
4. What happens to the slope of the curve below as x increases? Calculate the value of the slope between points A and B and between points C and D.
MARKET DEMAND AND SUPPLY

Concepts
Markets
Quantity demanded
Demand
Law of Demand
Factors of production
Payments to factors of production
Quantity supplied
Supply
Law of Supply
Market equilibrium
Excess supply
Surplus
Excess demand
Shortage
Normal good
Inferior good
Complements
Nonscarce good
Scarce good
Price floor
Price ceiling

Definitions

Markets: A market is any arrangement through which buyers and sellers meet or communicate to trade goods or services

Quantity demanded: the amount of a good or service buyers are willing and able to purchase over a given time period at a certain price

Demand: a relationship between the price of a good or service and the quantity demanded

Law of Demand: Ceteris paribus (all else held constant), the lower the price of a good or service, the greater the quantity buyers are willing and able to purchase over a given time period, and the higher the price, the less they are willing and able to purchase.
Production: the process of making goods and services (outputs)

Factors of production: basic economic resources that are used to produce outputs
a. natural resources (land, minerals, petroleum, timber, water)
b. labor (both physical and mental)
c. capital (machinery and equipment)
d. entrepreneurship (the talent to develop products and to organize production; innovative ability and the willingness to take risks)

Payments to factors:
a. natural resources earn rent
b. labor earns wages
c. capital earns interest
d. entrepreneurs earn profit

Quantity supplied: the amount of a product or service which a producer is willing and able to produce and make available for sale in the market at a given price for some given time period

Supply: a relationship between the price of a good or service and the quantity supplied

Law of Supply: Ceteris paribus (all else held constant), the higher the price of a good, the greater the quantity supplied, and the lower the price, the lower the quantity supplied

Market equilibrium: occurs at the price at which the quantity demanded of a good or service is equal to quantity supplied

Excess supply: occurs when quantity supplied exceeds quantity demanded. Equivalent to a surplus

Surplus: occurs when quantity supplied exceeds quantity demanded. Equivalent to excess supply

Excess demand: occurs when quantity demanded exceeds quantity supplied. Equivalent to a shortage

Shortage: occurs when quantity demanded exceeds quantity supplied. Equivalent to excess demand.

Normal good: A good for which the demand increases as income increases and demand decreases as income decreases.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inferior good</td>
<td>A good for which the demand decreases as income rises and demand falls as income increases</td>
</tr>
<tr>
<td>Complements</td>
<td>Goods that are used together</td>
</tr>
<tr>
<td>Nonscarce good</td>
<td>A good for which quantity supplied exceeds quantity demanded even at a price of zero</td>
</tr>
<tr>
<td>Scarce good</td>
<td>A good for which quantity demanded exceeds quantity supplied</td>
</tr>
<tr>
<td>Price floor</td>
<td>A minimum price legally established</td>
</tr>
<tr>
<td>Price ceiling</td>
<td>A maximum price that can legally be charged</td>
</tr>
</tbody>
</table>
Applications and Examples

Graphical representation of a surplus:

Graphical representation of a shortage:
Changes in market equilibrium

Market equilibrium price and quantity will change if either demand or supply shift.

Demand curve shifts can be caused by changes in:

a. income
b. tastes and preferences
c. prices of related goods in consumption (either substitutes or complements)
d. expectations
e. wealth (accumulated value of savings)
f. population size

An increase in demand is represented as a shift to the right of the demand curve. A decrease in demand is represented as a shift to the left of the demand curve.

A movement along a given demand curve is called a change in quantity demanded (not a change in demand) and is caused by a change in the price of the good when all of the other factors listed above (a-f) are constant.

Supply curve shifts can be caused by changes in:

a. input prices (input costs)
b. technology
c. prices of related goods in production
d. expectations
e. taxes, subsidies, or other government regulations
f. number of sellers

An increase in supply is represented as a shift to the right of the supply curve. A decrease in supply is represented as a shift to the left of the supply curve.

A movement along a given supply curve is called a change in quantity supplied (not a change in supply) and is caused by a change in the price of the good when all of the other factors listed above (a-f) are constant.
The process of adjustment to a new equilibrium given a change in demand or supply:

Remember: prices and quantity do not adjust instantly.

An increase in demand will result in a shortage at the original market price leading to upward pressure on price. As price rises, quantity supplied will increase (a movement along the supply curve caused by the increase in demand) until quantity demanded and quantity supplied are again equal. Graphically:

\[ \uparrow D \Rightarrow \uparrow P \text{ and } \uparrow Q \]

A decrease in demand will result in a surplus at the original market price leading to downward pressure on price. As price falls, quantity supplied will decrease (a movement along the supply curve caused by the decrease in demand) until quantity demanded and quantity supplied are again equal. Graphically:

\[ \downarrow D \Rightarrow \downarrow P \text{ and } \downarrow Q \]
An increase in supply will result in a surplus at the original market price leading to downward pressure on price. As price falls, quantity demanded will increase (a movement along the demand curve caused by the increase in supply) until quantity demanded and quantity supplied are again equal. Graphically:

\[ \uparrow S \Rightarrow \downarrow P \text{ and } \uparrow Q \]

![Graph showing increase in supply](image1)

A decrease in supply will result in a shortage at the original market price leading to upward pressure on price. As price rises, quantity demanded will decrease (a movement along the demand curve caused by the decrease in supply) until quantity demanded and quantity supplied are again equal. Graphically:

\[ \downarrow S \Rightarrow \uparrow P \text{ and } \downarrow Q \]

![Graph showing decrease in supply](image2)
If demand and supply both increase, both will act to increase quantity exchanged in the market, but the increase in demand will put upward pressure on price, while the increase in supply will put downward pressure on price. The net impact on market price will depend on the relative changes in supply and demand: if the increase in demand is greater than the increase in supply, price will rise, but if the increase in supply is greater than the increase in demand, price will fall. Graphically:

Price could rise,

price could fall,
or price could remain unchanged.

The change in price depends on the relative sizes of the change in demand and the change in supply.

\[ \Delta P \text{ and } \uparrow Q \]

\[ \uparrow D \implies \uparrow P \text{ and } \uparrow Q \]

\[ \uparrow S \implies \downarrow P \text{ and } \uparrow Q \]

Note: Just the opposite reasoning applies if demand and supply both decrease: quantity will decline, but the change in price will depend on the relative sizes of the increase in demand and supply.
If demand increases while supply decreases, both changes will act to increase market equilibrium price, but the increase in demand will put upward pressure on quantity exchanged, while the decrease in supply will put downward pressure on quantity exchanged. The net impact on market equilibrium quantity exchanged will depend on the relative changes in supply and demand: if the increase in demand is greater than the decrease in supply, quantity will rise, but if the decrease in supply is greater than the increase in demand, quantity will fall.

**Graphically:**
Quantity could rise,

```
   P
   |   S`   S
   |       |
   |   P2   |
   |       |
   |   P1   |
   |       |
   |   Q1   |
   |       |
   |   Q2   |
   Q
```

quantity could fall,
or quantity could remain unchanged.

The change in quantity depends on the relative sizes of the change in demand and the change in supply.

\[ \uparrow D \Rightarrow \uparrow P \text{ and } \uparrow Q \]
\[ \downarrow S \Rightarrow \uparrow P \text{ and } \downarrow Q \]
\[ \uparrow P \text{ and } \Delta Q \]

Note: Just the opposite reasoning applies if demand decreases and supply increases: price will decline, but the change in quantity will depend on the relative sizes of the decrease in demand and the increase in supply.

**Price Floor**

If price floor is set for a good or service is above the market clearing price, quantity supplied will increase and quantity demanded will decrease resulting in excess supply or a surplus.

**Price Ceiling**

If a price ceiling is set for a good or service below the market clearing price, quantity supplied will decrease and quantity demanded will increase, resulting in excess demand or a shortage.
Practice Problems

1. Do the following statements use the word "demand" correctly or should the term "quantity demanded" be substituted?
   
a. A reduction in the supply has nearly doubled the price of coffee resulting in a reduction in the demand for coffee.

b. Rising demand for automobiles has led to an increase in the price of automobiles.

c. The rising popularity of skiing and snow boarding over the last decade has led to an increase in the demand for lift tickets.

d. Falling computer prices have resulted in an increase in the demand for computers.
2. Refer to the following graph to answer the questions below.

![Graph showing supply (S) and demand (D) curves for barrels of oil per year and price per barrel.]

a. What is the equilibrium price?

b. What is the equilibrium quantity?

c. If the price is set at $20 by the government, would it result in a surplus or a shortage of oil?

d. How large would the surplus or shortage be?

e. Suppose that the winter is very cold and there is an increase in the demand for oil for heating homes. Show this change on the graph.

f. What happens to the equilibrium quantity sold after this change in demand?

g. What happens to the equilibrium price after this change in demand?
3. a. Suppose that the price of a gallon of gasoline increases to $2.50. What will happen to the demand for automobiles with low fuel efficiency?

b. What will be the effect of this change on market equilibrium price and quantity for these automobiles?

c. What type of economic relationship is there between gasoline and automobiles in general?

d. What would happen to the demand for fuel efficient automobiles if the price of gasoline increased to $2.50 per gallon?

e. What will be the effect of this change on the market equilibrium price and quantity for fuel efficient automobiles?

f. In general, are automobiles normal or inferior goods? Explain.

g. Suppose there are technological advances in the production of fuel efficient automobiles. What will happen to the supply of fuel efficient autos?

h. What will be the effect of this change on the market equilibrium price and quantity for fuel efficient autos?

i. Will this result in a change in demand or a change in quantity demanded?
4. a. Suppose the demand for mercury recycling has increased due to new regulations requiring fluorescent lamps to be recycled. What is the effect of this change in the demand for mercury recycling on the equilibrium quantity of mercury recycled?

b. What impact will this change in demand have on the equilibrium price people will pay to have mercury recycled?

c. Over time, technological advances are likely to reduce the cost of recycling mercury. What impact will lower operating costs have on the supply of mercury recycling facilities?

d. What impact would such a change in supply have on the market equilibrium quantity of mercury recycled?

e. What impact would such a change in supply have on the market equilibrium price paid to have mercury recycled?

f. What would be the net affect of both the change in demand and the change in supply on the market equilibrium price and quantity of mercury recycled?
CONSUMER DEMAND THEORY

Concepts
Total Utility
Marginal Utility
Law of Diminishing Marginal Utility
Total Benefit
Marginal Benefit
Law of Diminishing Marginal Benefit
Net Benefit
Consumer Surplus
Price Elasticity of Demand
Elastic Demand
Inelastic Demand
Perfectly Elastic Demand
Perfectly Inelastic Demand

Definitions
Total Utility: the total satisfaction enjoyed from consuming a given quantity of a good or service
Marginal Utility: the extra satisfaction received from consuming an additional unit of a good in a given period of time
Law of Diminishing Marginal Utility: The marginal utility of any item tends to decrease as more of the item is consumed over a given time period
Total Benefit: the maximum sum of money a consumer would give up to obtain a certain quantity of a good
Marginal Benefit: the dollar value placed on the satisfaction obtained from consuming an additional unit of a good
Law of Diminishing Marginal Benefit: Given a budget constraint, people will give up fewer and fewer dollars for additional units of a good in a given time period
Net Benefit: the difference between total benefit and total expenditure
**Consumer Surplus:** the difference between total benefit and total expenditure

**Price Elasticity of Demand:** Price elasticity of demand is the percentage change in quantity demanded resulting from a one percentage change in price.

**Elastic Demand:** price elasticity of demand is greater than one, ignoring the minus sign

**Inelastic Demand:** price elasticity of demand is greater than or equal to zero but less than 1, ignoring the minus sign

**Perfectly Elastic Demand:** price elasticity of demand is 4 (a horizontal demand curve)

**Perfectly Inelastic Demand:** price elasticity of demand is zero (a vertical demand curve)

**Applications and Examples**

**Utility Theory**

Decision making: Buy the good that has the greatest marginal utility per dollar cost.

Equilibrium: Equate marginal utility per dollar spent across all goods:

\[ \frac{\text{MU}_a}{P_a} = \frac{\text{MU}_b}{P_b} = \frac{\text{MU}_c}{P_c} = ... \]

If the marginal utility per dollar cost is not the same across all goods, you can be better off by increasing consumption of those goods with higher \( \text{MU}/P \) and decreasing consumption of those goods with lower \( \text{MU}/P \).

Basic idea is to spend your money on what makes you the happiest (or is most useful to you - for example, you may not be so happy about buying text books, but they can be useful).

Utility is an individual measure based on tastes and preferences.

**Benefit Theory**

Benefit is simply a dollar value measure of utility. Benefit depends on both tastes and preferences AND income (ability to pay).

Decision making: Buy a good as long the marginal benefit exceeds the price of the good
Consumer's objective: Maximize utility subject to a limited income. This can also be expressed as maximizing net benefit (total benefit minus total expenditure)

Equilibrium: Net benefit is maximized when marginal benefit is just equal to price. As long as MB>P, the consumer's net benefit increases by buying more of this good or service. If MB<P, the consumer would make himself worse off (decrease net benefit) by increasing consumption. Hence, net benefit is maximized when MB=P.

Recognize that marginal benefit is equivalent to demand. Just as demand increases as income increases for normal goods, so does marginal benefit. Just as demand decreases as income increases for inferior goods, so does marginal benefit.

Nonprice costs: Keep in mind that other costs can also influence consumer behavior. For example, travel time can influence your choice of ski resort, congestion can influence your choice of fishing site, waiting time in line can influence your choice of grocery store or restaurant, air pollution or crime rates can influence your demand for housing.

**Consumer Surplus**

Consumer surplus is the same thing as net benefit. Keep in mind it is a net measure - marginal benefit or demand tells you the positive side, cost or price tells you the negative side.

Uses of the concept of consumer surplus:

- determining the net value (value less cost) of a new park or a new lake
- determining the net value of pollution control regulations
- determining the net value of saving an endangered species
- determining the net value of a reduction in soil erosion resulting from no till
- determining the net value of opening a new silver mine

Note: All of the above have benefits and all have costs. The economic question is whether the total benefits outweigh the total costs, that is, whether or not the consumer surplus is positive, or even more important, whether or not it is being maximized.
Elasticity

Mathematically, $\gamma_D = \frac{\%\Delta Q_d}{\%\Delta P}$

Price elasticity of demand is essentially measuring movements along the demand curve. It is a measure of the sensitivity of consumers to changes in prices, how responsive consumers are to price changes in terms of how much they buy.

Since there is a negative relationship between price and quantity demanded, the price elasticity of demand will always be a negative number.

Market studies can be used to determine the value of the price elasticity of demand. This knowledge then can be used to determine:

- how much the quantity demanded will change if the price is changed  (For example, if the federal government raises the entrance fee to national parks, how much will that affect the number of visitors.)

- how much of a price change would be required to generate a particular change in quantity  (For example, if there is a very poor crop of corn in the summer, how much will that affect the market price of corn.)

Keep the cause and effect straight! Along a demand curve, it is changes in price that cause changes in quantity, not the other way around.

The primary determinants of demand elasticity are:
- Availability of substitutes
- Time
- Percentage of income spent on the good

Elasticity and Total Revenue and Total Expenditures

In the absence of taxes, producers' total revenue (TR) is equal to consumers' total expenditures (TE) on any given good or service.

$\%\Delta TR = \%\Delta P + \%\Delta Q_D$

Elastic demand: consumers are very responsive to small price changes so there is a large change in quantity demanded relative to the change in price (*$\%\Delta Q_D* > *$\%\Delta P*$). So for an increase in price, quantity falls a lot and the percentage decrease in quantity outweighs the increase in price and total revenue would fall. For a decrease in price, quantity rises a lot and the percentage increase in quantity outweighs the decrease in price and total revenue would rise.
Inelastic demand: consumers are NOT very responsive to price changes, so there is a small change in quantity demanded relative to the change in price (\(\%\Delta Q_D < \%\Delta P\)). So for an increase in price, quantity falls very little and the percentage increase in price outweighs the decrease in quantity and total revenue would rise. For a decrease in price, quantity rises very little and the percentage decrease in price outweighs the increase in quantity and total revenue would fall.
Practice Problems

1. Suppose you've been to three movies this month and your total utility is 95 and if you go to one more movie this month, your total utility will be 105.
   a. What is the marginal utility to you of the fourth movie this month?
   b. If you went to a fifth movie this month, would you expect the marginal utility to greater than, less than, or equal to the marginal utility of the fourth movie?

2. Suppose you eat hamburgers and pizzas and both cost $1. If you currently get a marginal utility of 10 from hamburgers and a marginal utility of 20 from pizza, are you in equilibrium? If not, what do you need to do to move closer to equilibrium?

3. Suppose the marginal utility your brother gets from consuming steak is 14 and the marginal utility he gets from consuming chicken is 6.
   a. If the price of steak is $7 per pound and the price of chicken is $2 per pound, what will your brother buy next?
   b. If the price of chicken was $3 per pound, what would your brother buy?
4. Explain why people often buy products for which they have a lower marginal benefit rather than another product with a higher marginal benefit. Explain why an increase in income could change the consumer's choice between two goods.

5. Refer to the following table to answer the questions below.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Total Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
</tr>
</tbody>
</table>

a. If the price of this product is $2, how many units will this consumer buy? How much will the consumer's net benefit be?

b. If the price of this product is $1, how many units will this consumer buy? How much will the consumer's net benefit be?
6. Refer to the graph below to answer the following questions.

![Graph of Total Benefit vs. Quantity](image)

a. What is the marginal benefit of the second unit?

b. What is the marginal benefit of the third unit?

c. If the price of this good is $11, how many units will this consumer purchase? How much will the consumer surplus be?

d. Graph the marginal benefit curve.

e. If the price of this good is $8, how many units will this consumer purchase? How much will the consumer surplus be?
7. Refer to the chart below to answer the following questions.

![Chart](chart.png)

a. If the price per cup of coffee is $0.65, how many cups of coffee will this consumer purchase?
   What is the total benefit when the price is $0.65 per cup?
   What is the consumer surplus when the price is $0.65 per cup?

b. If the price per cup of coffee is $0.70, how many cups of coffee will this consumer purchase?
   What is the consumer surplus when the price is $0.70 per cup?
8. Refer to the table below to answer the following questions.

<table>
<thead>
<tr>
<th>Camping trips per year</th>
<th>Total Benefit</th>
<th>Marginal Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>49</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

a. Complete the table.

b. Graph the total benefit and marginal benefit curves.

c. If the price per camping trip, measured in terms of gasoline to get to the camp site and camping permit fees, is $20, how many camping trips will this person take per year? What will the consumer surplus be?

d. If the cost per camping trip was only $6, how many camping trips would this person take per year? What would the consumer surplus be?

e. If the cost per camping trip was $30, how many camping trips would this person take per year? What would the consumer surplus be?
9. a. Suppose the elasticity of the demand for gasoline is -0.20. If the price of gasoline rose by 10%, how much would gasoline consumption fall?

b. If the initial price for gas was $1.20 per gallon, what would the price be after the increase indicated above?

c. What would happen to total expenditures by consumers on gasoline if the price rose by 10%? Explain.

10. a. Suppose the city wants to reduce household waste disposal by 20% by volume. If the charge for waste disposal is by volume, and the elasticity of the demand for waste disposal services is -0.60, how much should disposal fees be raised to achieve a 20% reduction in volume?

b. If current disposal fees are $15 per month per can, what would the new rate be after the price increase indicated in (a)?

c. What would be the impact of this increase in fees on the city's revenues from waste disposal? Explain.
11. Suppose you run a retail dress shop and you want to increase your sales by 6%.

   a. If the price elasticity of demand for your dresses is -1.2, what change in price would be necessary to generate a 6% increase in sales?

   b. If the average price of dresses is currently $60, what would your new price be?

   c. Would your total revenues increase or decrease after this price change?

   d. Is this an elastic demand or an inelastic demand?
PRODUCTION THEORY

Concepts
Economic Profit
Economic Cost
Economic Loss
Normal Profit
Production Function
Short run in production
Long run in production
Law of Diminishing Marginal Returns
Point of Diminishing Marginal Returns
Total Product
Marginal Product
Average Product
Fixed Costs
Variable Costs
Total Costs
Average Total Cost
Average Variable Cost
Marginal Cost
Efficiency in Production

Definitions

**Economic Profit:** Total revenue minus all opportunity costs

**Economic Cost:** All opportunity costs, both explicit and implicit:
- explicit costs - opportunity cost for purchased inputs = market price
- implicit costs - opportunity cost for nonpurchased inputs
  (value of next best foregone alternative use of those resources)

**Economic Loss:** Negative economic profit - not covering all opportunity costs

**Normal Profit:** A return that just covers all opportunity costs (zero economic profit)

**Production Function:** The relationship between inputs and outputs

**Short-run in production:** period of production during which at least one input is fixed in quantity. These inputs are called fixed inputs. Those that can be changed are called variable inputs.

**Long-run in production:** period of production long enough that producers have adequate time to vary all inputs
Law of diminishing marginal returns: the extra production obtained from increases in a variable input (marginal return) will eventually decline as more of the variable input is used together with fixed inputs - too many cooks spoil the broth

Point of diminishing marginal returns: level of usage of the variable input at which MP begins to decline

Total product curve: shows how output varies as more of one variable input is used together with fixed amounts of other inputs and fixed technology.

Marginal Product: the change in total output resulting from use of one more unit of a variable input with other inputs fixed. This is the slope of the total product curve.

Average Product: Average output per unit input
TP / Input level

Fixed Costs: Costs that do not change as the level of output changes

Variable Costs: Costs that change as the level of output changes

Total Costs: Fixed costs plus variable costs

Average Costs: Cost per unit of output
Average variable cost is total variable cost divided by total output (TVC/q)
Average fixed cost is total fixed cost divided by total output  (TFC/q)
Average total cost is total cost divided by total output  (TC/q)

Marginal Cost: the change in total cost as output changes  (ΔTC / Δq)
also equal to the change in total variable cost as output changes

Efficient Production: producing output using the combination of variable inputs which is least costly. Efficiency depends on both the marginal productivity of inputs and input prices
Applications and Examples

Profit

Economists think of profits differently than accountants. A firm may be making an accounting profit, but still may not be doing the best they could given their resources. An economist would say they were making an economic loss because they are not covering all opportunity costs, that is, they could be doing even better using their resources in their next best alternative use. If a firm is making zero economic profits, that's okay! That means they are doing as well using their resources in that business as they could by using them in the next best alternative use. An economic profit is when a firm is doing better than they could with any alternative use of their resources.

Production functions

The production function is the first step to understanding supply. It is the input-output relationship, how much output can be made from various amounts of input usage.

The distinction between the short run and the long run in production is very important. In the short run, there is at least one input fixed in quantity. That restricts how much can be produced. At some point, hiring more workers to run a grape crusher, for example, will not help a winery producer more wine if there is only one vat to hold the juice. After some point, adding more cooks in the kitchen does not make it possible to cook more food if there is only one oven. This means that adding additional variable inputs adds less and less to total output, the law of diminishing marginal returns.

In the long run, businesses can be more responsive to changes in the market place because they are able to change all of their inputs. For example, a fishing company can buy more boats in addition to hiring more fishermen, a timber company can buy more harvesting equipment in addition to hiring more loggers. Biology or ecology students might recognize the input that is fixed in the short run limits production in much the same way that ecological limiting factors limit a species population growth.

Because there is a limiting factor (fixed input) in the short run, short run marginal product tends to decline as more and more of a given variable input is used. For example, as more and more loggers cut trees in a given forest, they must travel further and cut smaller trees and more and more trees are cut. As more and more fishing boats catch fish in a given bay, it becomes more and more difficult to find fish, and each boat has to travel further away and longer to find the same amount of fish as when there were fewer boats fishing. As a mining company mines beyond the initial lode, they must get their minerals deeper and from lower concentrations, increasing the effort needed to get the same amount as they could get from a higher concentration deposit. As a student studies longer and longer in a given night, the amount that is learned each extra hour tends to be smaller and smaller as the student gets more tired. Diminishing marginal returns!
Production Costs

Production cost curves are the second step in understanding supply. Cost curves show a dollar cost to output relationship, how much it costs to produce different amounts of output.

Decision making: Produce as long as the marginal benefit of production (output price) exceeds the marginal cost of production

Producer's objective: Maximize profits

Equilibrium: Profits are maximized when marginal cost is just equal to market price of the output. As long as MC<P, profits will increase when output is increased. If MC>P, profits would decline if output were increased. Hence profits are maximized when MC=P.

The law of diminishing marginal return says that it takes more and more of an input to produce one more unit as input usage rises. That means that it becomes more and more expensive to produce a given another unit of output as output rises, which implies an increasing marginal cost. Look back at the example on the previous page. If you have to travel further to cut trees and you have to cut smaller trees, it becomes more expensive per board foot of lumber. If you have to travel further and stay out longer to catch more fish, it becomes more expensive per fish caught. If you have to mine from deposits with a lower mineral concentration, it will take more mining effort to get a pound of minerals, so it will be more expensive per pound mined. This is one thing that keeps fishermen from catching all the fish in the ocean and keeps mining companies from mining all the minerals in the earth.
Practice Problems

1. Refer to the graph below to answer the following questions.

![Graph showing Marginal Product vs. Number of workers]

a. What is the marginal product of the second worker?

b. How many workers should be hired to maximize monthly production?

c. When does the law of diminishing marginal returns set in?

d. Graph the total product curve.

e. If two workers are hired, what is the total production per month?

f. What is average product when two workers are hired?

g. If five workers are hired, what is the average product?
2. Refer to the table below to answer the following questions.

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Total Product of Labor</th>
<th>Marginal Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>--</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>--</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>--</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>--</td>
</tr>
<tr>
<td>5</td>
<td>29</td>
<td>--</td>
</tr>
</tbody>
</table>

a. What is the marginal product of the second worker?

b. What is the average product if three workers are hired?

c. When does diminishing marginal returns set in?

3. Refer to the graph on the next page to answer the following questions.

a. What is the total product when three workers have been hired?

b. What is marginal product of the third worker?

c. Graph the marginal product.

d. Diminishing marginal returns sets in when which worker is hired?

e. How many workers should be hired if the objective is to maximize total product?

f. What is the average product when two workers have been hired?

g. What is the average product when five workers have been hired?
4. Use the information in the table below to answer the following questions.

<table>
<thead>
<tr>
<th>Number of workers</th>
<th>Marginal Product</th>
<th>Total Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>30</td>
<td>53</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

a. What is the marginal product of the third worker?

b. What is the total product when three workers have been hired?

c. What is the average product when three workers have been hired?
5. Suppose the marginal cost of output for a particular company is $15 and the market price of its product is $16.

   a. Should this company increase output? What would the company gain by increasing output by one more unit?

   b. Suppose the average cost of production is $13, output price is $16, and this company sells 40 units per day. What is the firm's daily profit?

6. Suppose output of a mining operation is 50 tons per month, total monthly cost of production is $18,000, and total fixed costs are $3,000 per month.

   a. What is the total variable cost of production per month?

   b. What is the average variable cost per ton processed?

   c. What is the average fixed cost per ton processed? What would happen to the average fixed cost per ton if output decreased?

   d. What is the average total cost per ton processed?

   e. If the marginal cost of the next ton of output is $350, would the average variable cost increase or decrease if output rose to 51 tons per month?

   f. If the marginal cost is rising, what must be true about marginal product? (Is it increasing or decreasing?)
PERFECT COMPETITION

Concepts

Competitive firm
Short run competitive equilibrium
Short run supply
Shutdown point
Economies of scale
Diseconomies of scale
Constant returns to scale
Long run competitive equilibrium
Price elasticity of supply
Elastic supply
Inelastic supply
Perfectly elastic supply
Perfectly inelastic supply
Consumptive efficiency
Productive efficiency
Allocative efficiency

Definitions

Competitive firm: A firm that sells its product in a competitive market in which it is a price taker

Short run competitive equilibrium: Occurs when market price equals marginal cost

Short run supply: For an individual firm, short run supply is the firm's marginal cost curve above minimum average variable cost. For the market, short run supply is the horizontal summation of each firm's short run supply curve.

Shutdown point: Point a firm reaches when price has fallen below the level that just allows the firm to cover its minimum possible average variable cost

Economies of scale: reductions in average costs of operation resulting from increased size of operations. Also call increasing returns to scale.

Diseconomies of scale: increases in average costs of operation resulting from increased size of operations (usually due to problems in managing large-scale operations). Also called decreasing returns to scale.

Constant returns to scale: prevail when average costs of operation do not change as the size of the operation changes.
Long run competitive equilibrium: occurs when there is no tendency for firms to enter or exit the industry or to expand or contract the size of operation.

Price elasticity of supply: measure the responsiveness of producers to changes in the price of the product they produce. Measured as the percentage change in quantity supplied for a one percentage change in price.

Elastic supply: a supply with an elasticity greater than one

Inelastic supply: a supply with an elasticity less than one but greater than or equal to zero

Perfectly elastic supply: a supply with an elasticity equal to 1. A horizontal supply curve.

Perfectly inelastic supply: a supply with an elasticity equal to zero. A vertical supply curve.

Consumptive efficiency: occurs when the marginal benefit of consumption equals market price (consumers are maximizing net benefit)

Productive efficiency: occurs when the marginal cost of production equals market price (producers are maximizing profit)

Allocative efficiency: occurs when there is no way to make one person better off without making someone else worse off (society's net benefits are maximized - the sum of producers' and consumers' net benefits are maximized)
Applications and Examples

Competitive Firms

Each producer in a perfectly competitive market is a small part of the total supply. Firms in perfectly competitive markets are not concerned with market share as each is such a small part of the total market. This is a more important consideration in industries with fewer firms competing.

No one producer would want to increase the price it charges when none of its competitors are raising their price because the producer would lose most of its customers and lose profits. No one producer would want to decrease the price it charges because it is able to sell all it wants at the going market price. Hence, firms in perfectly competitive markets are called "price takers", as they take the market price as given. Perfectly competitive firms

Decision making: Produce as long as the marginal cost of production is less than the market price of the output produced.

Producer's objective: Maximize profits

Equilibrium: Profits are maximized when marginal cost is just equal to output price. As long as MC<P, the producer's profits will increase when output increases. If MC>P, the producer's profits would decline if output rose. Hence, profits are maximized when MC=P.

Profit

Profit = total revenue minus total cost of production

Remember that total cost equals all economic costs, implicit and explicit.

In the graphical analysis of profits, it is easier to evaluate profits as (P-AC)q*.

This is derived as follows: \( \pi = TR - TC \)
\( = P(q^*) - AC(q^*) \) since \( AC = \frac{TC}{q^*} \) where \( q^* \) is the profit maximizing level of output
\( = (P-AC) q^* \) factoring out \( q^* \)

If P>AC at \( q^* \), economic profits will be positive
If P=AC at \( q^* \), economic profits will be zero
If P<AC at \( q^* \), economic profits will be negative (there will an economic loss)
Graphically:

$$\pi > 0$$
\( \pi = 0 \)

\[ \Pi = 0 \]

\( \pi < 0 \)

\( \Pi < 0 \) (loss)

loss
Shutdown

If a business is making an economic loss, they have a decision to make. The long run decision is whether or not to remain in business. If the decision is to not operate any longer, we refer to that as "closing". This is in contrast to the short run decision to cease operations, but retain ownership of the business and equipment in order to be capable of operating again in the future. We refer to this decision as the "shutdown decision". When a business "shuts down", they still have to pay their fixed costs (mortgage, payments on purchased equipment, etc.), but they produce nothing.

The lesser of two evils: If the firm shuts down, it has to pay fixed costs but receives no revenue.

If the firm stays open, it has to pay fixed costs AND variable costs of operation. It also earns some revenue from production.

The balancing act: The firm will stay open or shutdown, depending on which costs less. If the revenue it can earn in operation is greater than its variable costs of operating, the firm makes enough in operation to cover operating costs plus some of its fixed costs. If the revenue it can earn in operation is less than its variable costs of operating, the firm would add to its losses by staying in operation. The way to compare its revenue in operation to its variable costs of operating is to compare the output price against the average variable cost.

If $P>AVC$, the firm should not shutdown in the short run- its losses in operation are less than its fixed costs (which also represent its losses if it shuts down).

If $P<AVC$, the firm should shutdown - its losses in operation are greater than its fixed costs.
Shutdown point:
If P=AVC, the firm would be just as well of shutting down as it would by staying open and producing. This is called the shutdown point. More technically, P=minimum AVC is the shutdown point.

**Equilibrium**

Short run equilibrium: P=MC
Economic profits could be positive, negative, or zero.

Entry/exit: If firms in a competitive industry are making economic profits, more firms will enter. Entry leads to an increase in supply and increased supply results in lower prices. Entry will continue and prices will continue to decline until there is no more incentive to enter - that is, until economic profits are zero.

If firms in a competitive industry are making an economic loss, some firms will exit from that industry. Exit leads to a reduction in supply and higher prices. Exit will continue and prices will continue to rise until there is no more incentive to exit - that is, until economic profits are again zero. Economic profits being zero implies that price equals average total cost.
Long run equilibrium:  
\[ P = MC \]  
\[ P = ATC \]  
\[ \pi = 0 \]
**Price elasticity of supply**

Mathematically, \( \varepsilon_S = \frac{\%\Delta Q_s}{\%\Delta P} \)

Price elasticity of supply measures movements along the supply curve. It is a measure of the sensitivity of producers to changes in price, how responsive producers are to price changes (caused by demand changes) in terms of how much they produce.

Since there is a positive relationship between price and quantity supplied, the price elasticity of supply will always be a positive number.

Knowledge of the price elasticity of supply can be used to determine:

a. how much the quantity supplied will change if demand changes (which changes the price of the good). For example, if the demand for beef declines, that will reduce the market price of beef and decrease quantity supplied - supply elasticity can be used to figure out how much the quantity of beef will decline. Or, if the demand for methanol fueled vehicles rises, price elasticity of supply can be used to figure out how much quantity supplied will rise.

b. how much of a price change would be necessary to generate a given change in quantity supplied.

One important factor affecting increases in quantity supplied is the producers' capability to increase production. Another important factor is time - the longer the time frame, the more capable producers will be of responding to changes in demand.
Practice Problems

1. a. Assume that egg production is a perfectly competitive industry. Draw a supply and demand diagram of the egg market. Show the equilibrium price and quantity. Next to this diagram, draw a second graph showing the individual egg producer's marginal and average cost curves and marginal revenue (demand) curve.

b. In the graphs you just drew, illustrate the short run effect of an increase in consumers' concern about the health effects of cholesterol for both the industry and the individual firm. State what happens to market equilibrium price and quantity, and what happens to profits of the individual egg producer.

c. What will likely happen in the long run to the number of egg producers in the industry if such a change in consumer demand is permanent? What will this do to the supply and to price in the long run?
2. a. Assume that aluminum production is a perfectly competitive industry. Draw a supply and demand diagram of the aluminum market. Show the equilibrium price and quantity. Next to this diagram, draw a second graph showing an individual aluminum producer's marginal and average cost curves and marginal revenue (demand) curve.

b. In 1992, the former Soviet Union increased aluminum production dramatically, pumping about one million metric tons of aluminum onto world markets (The Wall Street Journal, 1/21/92). Show the impact of such an increase in the world supply of aluminum in both of the diagrams you drew above, assuming the individual firm diagram represents a producer in the United States. Indicate the change in market equilibrium price and quantity, and the impact on the U.S. firm's profits and output level.

3. Suppose grazing fees, on both public and private lands, double.

a. What will happen to the marginal cost of production? If this is to be illustrated graphically, which way would the marginal cost curve shift?

b. What is the impact on the level of output by each individual producer?

c. What would happen to profits of cattle ranchers?

d. What would happen to the market supply of beef?

e. What would happen to market equilibrium price and quantity for beef?
4. Suppose the demand for soybeans rises.
   a. What will happen to market equilibrium price of soybeans?
   b. What will happen to the level of output by each individual producer?
   c. What would happen to soybean producers' profits?
   d. What would happen to the supply of soybeans in the long run?
   e. What would happen to market equilibrium price of soybeans in the long run?

5. Suppose you observe a 20% increase in quantity supplied when price rises by 10%. What is the value of the price elasticity of supply for this product?

6. If quantity supplied declines by 4% when price falls by 8%, what is the value of the price elasticity of supply? Is this an elastic supply or an inelastic supply?

7. If the price elasticity of supply for lumber is 0.8 and rising demand boosts prices by 15%, how much will quantity supplied increase?
8. If the price elasticity of supply for yo-yos is 1.5 and declining demand reduces prices by 20%, how much will quantity supplied decline?

9. Which would you expect to be more elastic, the supply of kiwi fruit in Montana or the supply of corn in Iowa?

10. Is the supply of medical emergency services elastic or inelastic?
NATURAL RESOURCES

Concepts

Nonrenewable resources
Renewable resources

Definitions

*Nonrenewable resources*: Resources for which the natural rate of replenishment is negligible in terms of augmenting the stock of the resource.

*Renewable resources*: Resources that have a natural rate of replenishment sufficient to augment the stock. Resources that naturally regenerate over time.

Applications and Examples

*Nonrenewable resources*

Examples: oil, gas, coal, uranium, aluminum

Three stages of nonrenewable resource use to consider in economics:
1. exploration
2. development
3. extraction

Remember, nonrenewable resource markets are markets just like other markets we've studied and will respond to economic changes (e.g., changes in input costs, output prices, technology) in the same general way. The main difference is that the impact of today's use of the resource on tomorrow's availability must be considered.

*Interest rates* - interest rates are a measure of the opportunity cost of not extracting now since money earned from extraction could be invested in the financial market instead of in the natural resource. Higher interest rates, for example, mean a higher opportunity cost of holding on to resources, hence a decrease in the amount of resources held (or an increase in extraction). If the increase in interest rates also raises extraction costs (if extraction efforts are financed by borrowing money), then this impact will be offset to some extent.

Exploration, development, or extraction decision:

MB vs. MC
Renewable resources

The amount used today can affect the growth rate of these resources, hence affect the amount available for tomorrow.

Examples: Fish, trees, wildlife, grazing lands

Just like nonrenewable resources, renewable resource markets are markets just like other markets we've studied and will respond to economic changes in the same general way. The main difference is that the impact of today's use of the resource on tomorrow's availability must be considered.

For privately owned renewable resources, the economic analysis of supply is basically the same as for other markets. Renewable resource owner, however, has to consider the impact of his extraction on the rate of replenishment. If too much is harvested, the rate of replenishment may not be sufficient to leave enough of the resource for future years. If too little is harvested, opportunities for gain are lost.

Harvest Decision:

\[ MB_{\text{harvest}} \text{ vs. } MC_{\text{harvest}} \]

Nondepletable resources

Nondepletable resources are resources that can not be diminished in quantity. Some examples would be solar and wind power.
Practice Problems

1. Consider the market for oil. Suppose the cost of extracting oil from the ground fell.
   a. What would happen to the extraction rate of oil?
   b. What would happen to oil companies' profits?
   c. What would happen to the market price of oil?

2. Suppose the demand for oil rose.
   a. What would happen to the market equilibrium price of oil?
   b. What would happen to the extraction rate of oil?
   c. What would happen to the profitability of oil producers?

3. a. Suppose the demand for housing fell, decreasing the market price of lumber. How would this change the timber harvest rate?
   b. Suppose the cost of harvesting timber rose. How would this affect the timber harvest rate?
   c. Explain why increasing residential land values in forested areas can represent an increase in the opportunity cost of maintaining forest land as a forest.
4. Suppose there is an increase in the demand for camping at organized campgrounds. What impact would this have on the supply of campgrounds in the long run?

5. Suppose stricter government requirements for reclamation increase the cost of gold mining in the United States.
   a. How would that affect gold mining profits in the United States?
   b. How would that affect gold mine development in the United States?
   c. How would that affect development of gold mines by U.S. firms overseas?

6. Suppose a new study is released that shows that eating salmon once a week significantly reduces one's risk of heart attack. How will this affect:
   a. salmon fishermen's profits in the short run?
   b. salmon fishermen's fishing effort?
   c. wild salmon populations over time?
   d. What will the average salmon fisherman's economic profits be in the long run?
MARKET FAILURE

Concepts

Allocative efficiency
Market inefficiency
Deadweight loss
Pure monopoly
Public goods
Negative externality
Positive externality
Open access resources
Coasian bargaining
Corrective taxes
Corrective subsidies

Definitions

Allocative efficiency: Resources are allocated in a way that allows the maximum possible net benefit from their uses. Allocative efficiency is achieved when MB=MC.

Market inefficiency: Markets are said to be inefficient when net benefits are not maximized (MB≤MC).

Deadweight loss: Loss of net benefits to society. Deadweight loss is a measure of inefficiency.

Pure monopoly: Single seller of a product with no close substitutes

Public goods: Goods that can be consumed by everyone, whether they pay or not. Hard to exclude nonpayers (nonexcludable) and use by one person does not diminish the amount available for others (nonrival in consumption).

Free rider problem: People can enjoy the benefits of a public good without contributing to its costs

Negative externality: Costs of a market transaction that is not reflected in the price buyers and sellers use to make their purchase or sales decision.

Positive externality: Benefits of a market transaction that is not reflected in the price buyers and sellers use to make their purchase or sales decisions.

Open access resources: Resources for which no property rights are established so use of the resource is not priced.
**Coasian bargaining:** Bargaining between individuals in a situation where some externality exists. If property rights are well defined and transaction costs are low, bargaining may result in the socially efficient level of output.

**Corrective taxes:** A tax levied on polluters to simulate a charge equal to the marginal external cost of their actions.

**Corrective subsidies:** An amount paid to consumers or producers of a good equal to the marginal external benefit of consumption or production of the good.

**Applications and Examples**

**Causes of Market inefficiency**

a. Lack of competition due to monopoly or thin markets (few buyers and sellers)
b. Public goods
c. Externalities (including open access resource problem)
d. Uncertainty
e. Poorly defined or defended property rights, or non-transferability of property rights
f. High transaction costs (negotiation, monitoring, enforcement)
Net benefits may be lower than the maximum because of over production or under production.

Over production implies $Q > Q^*$. Net benefits are lower for each $Q > Q^*$ since $MC > MB$:

\[
\begin{array}{c|c|c|c|c|}
 & & & & \\
$ & MC & & MB & \\
& & Q^* & Q' & \\
\end{array}
\]

Under production implies $Q < Q^*$ and the maximum net benefits are not yet realized since $MB > MC$ for each $Q$ up to $Q^*$:

\[
\begin{array}{c|c|c|c|c|c|}
 & & & & & \\
$ & MC & & MB & \\
& & Q & Q^* & \\
\end{array}
\]
Note: The efficiency criterion is not concerned with EQUITY or the distribution of the benefits and costs across members of society.

Monopoly

A monopolist is only able to exercise "monopoly power" (the ability to influence the market price of its product by making more or less of it available to buyers) if there are barriers to entry into the market. Recall that in perfect competition, freedom of entry led to zero economic profits and lower prices in the long run. With monopoly, barriers from entry prevent this from happening.

Market impact: Because there are barriers to entry, quantity tends to be lower and price higher than in competitive industries. This produces a loss of consumer surplus and a lost opportunity for other producers - deadweight loss or loss of net benefits to society.

Public Goods

Public goods are:

a. Nonrival in consumption (a given amount can be enjoyed by additional people without reducing the amount enjoyed by other consumers)
b. Difficult to exclude nonpayers

This is in contrast to private goods which are rival in consumption and exclusion of those who refuse to pay is relatively easy.

This lead to market failure because there is little incentive for private firms to provide public goods as it is difficult to exclude nonpayers (free riders). So despite there being benefits from the provision of public goods, they tend to be undersupplied in private markets.

Examples: National defense, pollution control, fireworks shows, lighthouse light

Keep in mind that publicly owned goods are not necessarily public goods. For example, Amtrak or the Postal Service are publicly owned but both excludable and rival in consumption. Also, public goods are not necessarily publicly owned. In fact, they may not be "owned" at all, for example, biodiversity or clean air resulting from pollution control.
Negative Externalities

Examples - air pollution, water pollution, noise

In a competitive, unregulated market, producers will produce until the price they receive for their output is equal to the marginal cost of production and consumers will buy until the market price is equal to their marginal benefit of consumption. If some costs do not accrue to the producer and are therefore not reflected in the market price (negative externality), then output will be higher than the level that would maximize net benefits:

\[
\text{SMC} \quad \text{PMC} \\
\text{PMB} = \text{SMB}
\]

Private cost - cost falling directly on the producer
External cost - cost falling others that is not reflected in price
Social cost - private cost plus external cost
Competitive equilibrium: \( \text{PMB} = \text{PMC} \)
Socially efficiency: \( \text{SMB} = \text{SMC} \)

Note that if consumers have to pay higher prices, this is not an external cost - only costs not reflected in price are external costs!
Positive Externalities

Examples: flowers in the front yard that are enjoyed by neighbors, a shade tree or fruit tree that gives a benefit to a neighbor (shade or fruit), education, vaccinations

In a competitive, unregulated market, producers will produce until the price they receive for their output is equal to the marginal cost of production and consumers will buy until the market price is equal to their marginal benefit of consumption. If some benefits do not accrue to the producer or consumer, and are therefore not reflected in the market price (negative externality), then output will be lower than the level that would maximize net benefits:

$\text{PM} = \text{SM}$

Private benefits - benefit accruing directly to the consumer
External benefit - benefit accruing to others who did not pay for the good
Social benefit - private benefit plus external benefit

Competitive equilibrium: $\text{PMB} = \text{PMC}$
Social efficiency: $\text{SMB} = \text{SMC}$
Open access resources

Resources for which no property rights are established so use of the resource is not priced.

Examples: Fish in the ocean, open grazing land, birds in the air

The full cost of the use of the resource is not accounted for by the individual user since one person's use also impacts the availability of the resource to others. Since the full cost of use of the resource does not fall on the individual private user, there tends to be overuse of the resource.

The Role of Property Rights

In order for markets to operate efficiently, property rights must be:

a. well defined  
b. transferable  
c. defendable or enforceable

Markets cannot be established for goods for which property rights cannot be guaranteed and easily exchanged. This is the problem with public goods, externalities, and open access resources. For example, hamburgers or jeans can be bought and sold, but how do you sell an acre of the ocean or some volume of air?

Without well defined property rights, there is no clear ownership, no clear responsibility.

If a good cannot be traded, potential gains from trade cannot be realized and net benefits may not be maximized.

If property rights are not enforceable or defendable, someone could take property away and reduce net benefits. For example, how can your right to quiet be defended against noise? How can your groundwater ownership rights be defended against leaching of pollutants from a neighboring property?
The Role of Transaction costs

If it is difficult to charge for the use of a resource, or to prevent use, no market will develop. If it is easy to charge for use and easy to prevent use by nonpayers, markets will develop.

If property rights are costly to define, clear property rights may not be established. Examples: - range land in the old west (before barbed wire) - cattle in the old west (before branding)

If property rights are difficult (costly) to defend or enforce, rights may not be established. Examples: - parking on the street (before parking meters) - open access resources

Transaction costs are also important to consider in efficient regulation of markets. The more costly it is to regulate markets, the less efficient regulation of the markets is likely to be.

Some Solutions for Correcting for Market Inefficiency

1. Property Rights: Establishing well defined, transferable, enforceable property rights can lead to efficient markets.

2. Coasian Bargaining: If property rights are well defined and negotiation costs are low, bargaining between (or among) individuals can lead to efficiency.

3. Corrective Taxes: If a tax is set equal to the marginal external cost, an efficient outcome may be produced in the case of negative externalities.

4. Corrective Subsidies: If a subsidy is provided equal to the marginal external benefit, an efficient outcome may result in the case of positive externalities.

5. Direct Regulation: Production or consumption decisions could be regulated directly in order to decrease negative externalities or increase positive externalities.
Practice Problems

1. Suppose the DeBeers Company is a monopoly supplier of diamonds on the world market. The graph below shows the demand for diamonds and the marginal cost of supplying diamonds. (Remember that the marginal cost curve is equivalent to the market supply.) $Q_{PC}$ represents the quantity that would be produced if the market were perfectly competitive.

![Graph of demand and marginal cost](image)

a. If DeBeers limits the supply of diamonds to the world market at $Q_M$, what would the price of diamonds be? Label it $P_M$ in the graph.

b. Shade in the area that represents the deadweight loss caused by DeBeers limiting the supply to $Q_M$.

c. Explain what is meant by a "deadweight loss".
2. Suppose the government is interested in buying some water rights from farmers in Fallon to allow more water to flow into Pyramid Lake to help the endangered cui-ui fish. Suppose these farmers value these water rights at $400,000.

   a. If the government offered the farmers $350,000, would the farmers sell? Explain why or why not.

   b. If the government offered the farmers $550,000, would the farmers sell? Explain why or why not.

   c. Suppose saving the cui-ui fish has been determined to be worth $600,000. If the government buys water rights from the Fallon farmers at $550,000, what will be the change in net benefits for each of the following (in dollar terms):

      Fallon farmers

      Those who the government represents in this example (taxpayers and environmentalists and the Indians at Pyramid Lake who value saving the cui-ui)

      Society (farmers plus taxpayers, environmentalists, and Indians)

      Will this exchange increase economic efficiency (increase net benefits)?
d. Suppose instead that the government required the farmers to sell their water rights at a price of $350,000. What would be the change in net benefits (in dollars) for:

Fallon farmers

Those who the government represents in this example (taxpayers and environmentalists and the Indians at Pyramid Lake who value saving the cui-ui)

Society (farmers plus taxpayers, environmentalists, and Indians)

Will this exchange increase economic efficiency (increase net benefits)?

3. Vaccinations for diseases reduce the risk of disease for those who get vaccinated, but also reduce the risk for those who have not been vaccinated as there are fewer potential carriers of the disease and hence a lower chance of contagion.

a. Vaccinations are an example of a ___________________ externality.

b. What is done to increase the number of people who get vaccinated for diseases?

4. a. What are some of the private benefits of clearing land in the rainforest for agriculture?

b. What are some of the private costs of clearing land in the rainforest for agriculture?
c. What are some of the external costs of clearing land in the rainforest for agriculture?

d. In the graph below, find the privately optimal level of agricultural production in the rainforest (the level that would result in the absence of any regulations on forest clearing). Label it \( Q_p \).

e. In the graph below, find the socially optimal level of agricultural production in the rainforest. Label it \( Q^* \).

f. Explain why the net benefits to society would decrease if the level of agricultural production is greater than \( Q^* \).
g. In the graph on the previous page, $Q^*$ is the level of agricultural production that maximizes net social benefits. This means that any level of agricultural production less than $Q^*$ would result in lower net social benefits. In the graph, show the deadweight loss that would result if no agricultural production were allowed in the rainforest. Who would be hurt by a ban on agricultural production in this area? Who would benefit from such a ban?

5. Suppose there are a number of businesses emitting pollutants into the Truckee River. If the local government decides to charge the firms a tax per unit of emissions, what would happen to:
   a. the market price of the output of the firm?
   b. the market equilibrium quantity of output?
   c. the amount of pollution emitted by these firms?

6. In what ways can pollution control regulation be considered a public good? (Hint: Think about the characteristics of a public good.)

7. Explain why open access resources tend to be overused.
8. a. For the pollution abatement graph below, explain why an abatement level at A' would not be efficient (why net social benefits would decline relative to A*).

b. In the graph, shade in the area that represents this decrease in net benefits (the deadweight loss) if abatement is at A'.

c. Suppose technology improves, decreasing the cost of abatement. Show the impact of this on the marginal cost curve in the graph.

d. What happens to the efficient level of abatement after technology improves?