Engineering Economics

Dr. Pradyot Ranjan Jena

School of Management

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Course Outline

Course Title	Engineering Economics
Semester	V Semester B.Tech
Course Code	HU 300
Instructor	Dr. Pradyot Ranjan Jena

COURSE DESCRIPTION

The purpose of this course is to help students gain an understanding of the economic factors inherent in engineering design and decision-making. Any engineering project must be not only physically realizable but also economically feasible. The principal aim of this subject is to provide students with some basic techniques of economic analysis to understand the economic process.

Meeting Time

- You can email me at jpradyot@gmail.com

- If you have any queries and any doubts meet me in my office at School of Management.

Course Objectives

- Become acquainted with basic economic concepts such as demand and supply, price, competition, interest rate, profit, inflation, GDP, GNP etc.
- Develop a significant understanding of the **time value of money**.
- Develop the ability to apply various methods for economic analysis of **alternatives**.
- Increase student's knowledge of the impact that interest rate, taxes, inflation have on economic and engineering decisions.
- Develop the ability to estimate project **cash flows** for design alternatives including tax implications.
- Understand the fundamentals of profit and loss analysis and **benefit –cost** analysis.
- Develop the ability to make **replacement** decisions.
- Basic understanding of **depreciation** methods.

Course Content

Basic economic concepts and problems

- Introduction to Engineering Economics- Physical and economic efficiency

- Micro Economic Concepts:

  Demand and Supply, Elasticity and applications,

  Value and Utility, Law of Diminishing Marginal Utility, Indifference Curves, Cost Concepts, Market Equilibrium, Demand forecasting

- Macro Economic Concepts:

  Macroeconomic Aggregates, Growth and Development , Environment and Development, Human Development Index, Growth and Science &Technology,

Course Content

Methods of economic analysis in Engineering

- Time value of money, Interest rate calculations.

- Present worth, Annual equivalent, Future worth, Internal rate of return, Capitalized equivalent, Capital recovery with return. Selection among alternatives, Break-even analysis.

Course Content

Evaluating replacement alternatives

- Replacement analysis, the economic life of an asset, Retirement or abandonment decisions.
- Evaluating public activities: The nature of public activities, Benefit-cost analysis, Cost-effectiveness analysis

Depreciation accounting

- Basic depreciation methods. Basic terminology for Income taxes, Depreciation and Income taxes.

Estimating economic elements

- Cost Estimation, Location Decisions

Texts / References:

- Leland Blank P.E. and Anthony Tarquin P.E., “Engineering Economy”, 7th ed., McGraw Hill, 2012.
- Sullivan W.G., Bontadelli J.A. and Wicks E.M., “Engineering Economy “, 14th ed., Pearson Education Asia, New Delhi,
- Thuesen G.J. and Fabrycky W.J., “Engineering Economy “, 9th ed., Prentice Hall of India, New Delhi, 2002.
- Newnan Donald G., Eschenbach Ted G., Lavelle Jerome P., “Engineering Economic Analysis”, Oxford University Press, 2004.
- N.Gregory Mankiw, “Principles of Economics”, Thomson, 2002.
- Karl E Case, Ray C Fair, and Sharon E Oster, “Principles of Micro Economics”, 11th Edition, Pearson Education, 2014.
- Research articles and case studies.

Weightage for Assessments

• Mid – Semester exams of 1 hour 30 minutes (50 Marks)	25%
• Continuous Assessment	25%
• End-Semester exams of 3 hours (100 Marks) (Full syllabus)	50%
	100%

Pedagogy

The instructional tools consists of lectures, reading concurrent articles, case studies, problem solving and group discussions.

Assessment

Surprise tests, quizzes, assignments, class participation and group interaction will be considered for continuous assessment.

Attendance

As per regulations in Under Graduate Programme Curriculum 2012.

Engineering and Engineering Economy

Introduction

- Engineering activities are not an end in themselves. They are a means for satisfying human wants.
- Engineers have two concerns: 1) Materials and Forces of Nature, and 2) Needs of People
- Resource constraints is responsible for closely associating Engineering with Economics.
- Engineering projects need to be not just physically feasible but economically also.

Engineering and Science

- Engineering is not a science but an application of science. It is an art of adopting skill and knowledge of science.
- Accreditation Board for Engineering and Technology defines Engineering as, “Engineering is a profession in which knowledge of the mathematical and natural sciences are gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind”.

Contd..

- Role of a scientist is to add to humankind’s accumulated body of knowledge and discover universal laws of behavior.
- Role of engineer is to apply this to particular situations to produce products and services.
- Engineering activities rarely are carried out for the satisfaction that may be derived from them directly. Instead, their use is confined to satisfying human wants

Contd..

- Modern civilization depends to a large degree on engineering. For e.g. transportation, communication, national defense and other goods and services used to facilitate work.
- Science is the foundation upon which engineer builds.
- Engineering activity is responsible for improvement in general standard of living.

Bi-Environmental Nature of Engineering

- Engineers are confronted with two environments:
- 1) Physical Environment.
- 2) Economic Environment.
- The success of engineering is to create products and services with the knowledge of physical laws. However, the worth these products and services lies in their utility measured in economic terms.

Contd..

- Physical environment is governed by physical laws which are more exact and much is known with certainty.
- Economic environment is governed by economic laws which are influenced by human behavior. These laws are less exact compared to physical laws.
- Quantification is possible to a large extent in economic environment due to similar reaction of human beings over space and across time to similar events.

- Engineers may have a tendency to disregard economic environment. But role of an engineer goes much beyond physical environment to economic and managerial as well.
- There is also an argument that engineers must confine to physical factors and economic and humanistic factors should be handled by others.

- Engineers can readily extend their inherent ability of analysis to become proficient in the analysis of the economic aspects of engineering application.
- Engineers who will be eventually engaged in managerial activities will find such proficiency is necessary.
- It is the objective of engineering economy to prepare engineers to cope with bi- environmental nature of engineering.

Physical and Economic Efficiency

- There is limited resources and as a result it is necessary to produce greatest output with limited input.
- Opportunity cost:
- Engineering is concerned with physical efficiency: i.e. **output/input**.
- Physical efficiency is always less than 100%

Contd..

- At second level there is economic efficiency i.e. **worth/cost**.
- Economic efficiency must be over 100% to consider a project.
- In final evaluation of ventures, even though engineering plays a major role, economic efficiency must take precedence over physical efficiency.
- Economic efficiency concept brings to the fore all complexities of economic environment.

Engineering for Economic Competitiveness

- Producers strive for sustainable competitive advantage in the market place. (Bajaj Chetak)
- Through the life cycle approach to engineering, economic competitiveness can be enhanced.
- Identification of need, conceptual/preliminary design, detailed design and development, production/construction, utilization and finally phase out and disposal.

- Generally, engineers have focused mainly on the acquisition phase i.e. up to production/construction.
- However, recent experience shows that product competitiveness cannot be achieved through efforts applied largely after product comes in to market place.
- As a result, it is essential that engineers need to be sensitive in the early stages of life cycle.

Engineering Economics

Dr. Pradyot Ranjan Jena

School of Management

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

Course Content

Basic economic concepts and problems

- Introduction to Engineering Economics- Physical and economic efficiency

- Micro Economic Concepts:

  Demand and Supply, Elasticity and applications,

  Value and Utility, Law of Diminishing Marginal Utility, Indifference Curves, Cost Concepts, Market Equilibrium, Demand forecasting

- Macro Economic Concepts:

  Macroeconomic Aggregates, Growth and Development , Environment and Development, Human Development Index, Growth and Science &Technology,

Course Content

Methods of economic analysis in Engineering

- Time value of money, Interest rate calculations.

- Present worth, Annual equivalent, Future worth, Internal rate of return, Capitalized equivalent, Capital recovery with return. Selection among alternatives, Break-even analysis.

Course Content

Evaluating replacement alternatives

- Replacement analysis, the economic life of an asset, Retirement or abandonment decisions.
- Evaluating public activities: The nature of public activities, Benefit-cost analysis, Cost-effectiveness analysis

Depreciation accounting

- Basic depreciation methods. Basic terminology for Income taxes, Depreciation and Income taxes.

Estimating economic elements

- Cost Estimation, Location Decisions

Engineering and Engineering Economy

Introduction

- Engineering activities are not an end in themselves. They are a means for satisfying human wants.
- Engineers have two concerns: 1) Materials and Forces of Nature, and 2) Needs of People
- Resource constraints is responsible for closely associating Engineering with Economics.
- Engineering projects need to be not just physically feasible but economically also.

Engineering and Science

- Engineering is not a science but an application of science. It is an art of adopting skill and knowledge of science.
- Accreditation Board for Engineering and Technology defines Engineering as, “Engineering is a profession in which knowledge of the mathematical and natural sciences are gained by study, experience, and practice is applied with judgment to develop ways to utilize economically the materials and forces of nature for the benefit of mankind”.

Contd..

- Role of a scientist is to add to humankind’s accumulated body of knowledge and discover universal laws of behavior.
- Role of engineer is to apply this to particular situations to produce products and services.
- Engineering activities rarely are carried out for the satisfaction that may be derived from them directly. Instead, their use is confined to satisfying human wants

Contd..

- Modern civilization depends to a large degree on engineering. For e.g. transportation, communication, national defense and other goods and services used to facilitate work.
- Science is the foundation upon which engineer builds.
- Engineering activity is responsible for improvement in general standard of living.

Bi-Environmental Nature of Engineering

- Engineers are confronted with two environments:
- 1) Physical Environment.
- 2) Economic Environment.
- The success of engineering is to create products and services with the knowledge of physical laws. However, the worth these products and services lies in their utility measured in economic terms.

Contd..

- Physical environment is governed by physical laws which are more exact and much is known with certainty.
- Economic environment is governed by economic laws which are influenced by human behavior. These laws are less exact compared to physical laws.
- Quantification is possible to a large extent in economic environment due to similar reaction of human beings over space and across time to similar events.

- Engineers may have a tendency to disregard economic environment. But role of an engineer goes much beyond physical environment to economic and managerial as well.
- There is also an argument that engineers must confine to physical factors and economic and humanistic factors should be handled by others.

- Engineers can readily extend their inherent ability of analysis to become proficient in the analysis of the economic aspects of engineering application.
- Engineers who will be eventually engaged in managerial activities will find such proficiency is necessary.
- It is the objective of engineering economy to prepare engineers to cope with bi- environmental nature of engineering.

Physical and Economic Efficiency

- There is limited resources and as a result it is necessary to produce greatest output with limited input.
- Opportunity cost:
- Engineering is concerned with physical efficiency: i.e. **output/input**.
- Physical efficiency is always less than 100%

Contd..

- At second level there is economic efficiency i.e. **worth/cost**.
- Economic efficiency must be over 100% to consider a project.
- In final evaluation of ventures, even though engineering plays a major role, economic efficiency must take precedence over physical efficiency.
- Economic efficiency concept brings to the fore all complexities of economic environment.

Engineering for Economic Competitiveness

- Producers strive for sustainable competitive advantage in the market place. (Bajaj Chetak)
- Through the life cycle approach to engineering, economic competitiveness can be enhanced.
- Identification of need, conceptual/preliminary design, detailed design and development, production/construction, utilization and finally phase out and disposal.

- Generally, engineers have focused mainly on the acquisition phase i.e. up to production/construction.
- However, recent experience shows that product competitiveness cannot be achieved through efforts applied largely after product comes in to market place.
- As a result, it is essential that engineers need to be sensitive in the early stages of life cycle.

Demand, Supply, and Market Equilibrium

Firms and Households: The Basic Decision-Making Units

firm An organization that transforms resources (inputs) into products (outputs). Firms are the primary producing units in a market economy.

entrepreneur A person who organizes, manages, and assumes the risks of a firm, taking a new idea or a new product and turning it into a successful business.

households The consuming units in an economy.

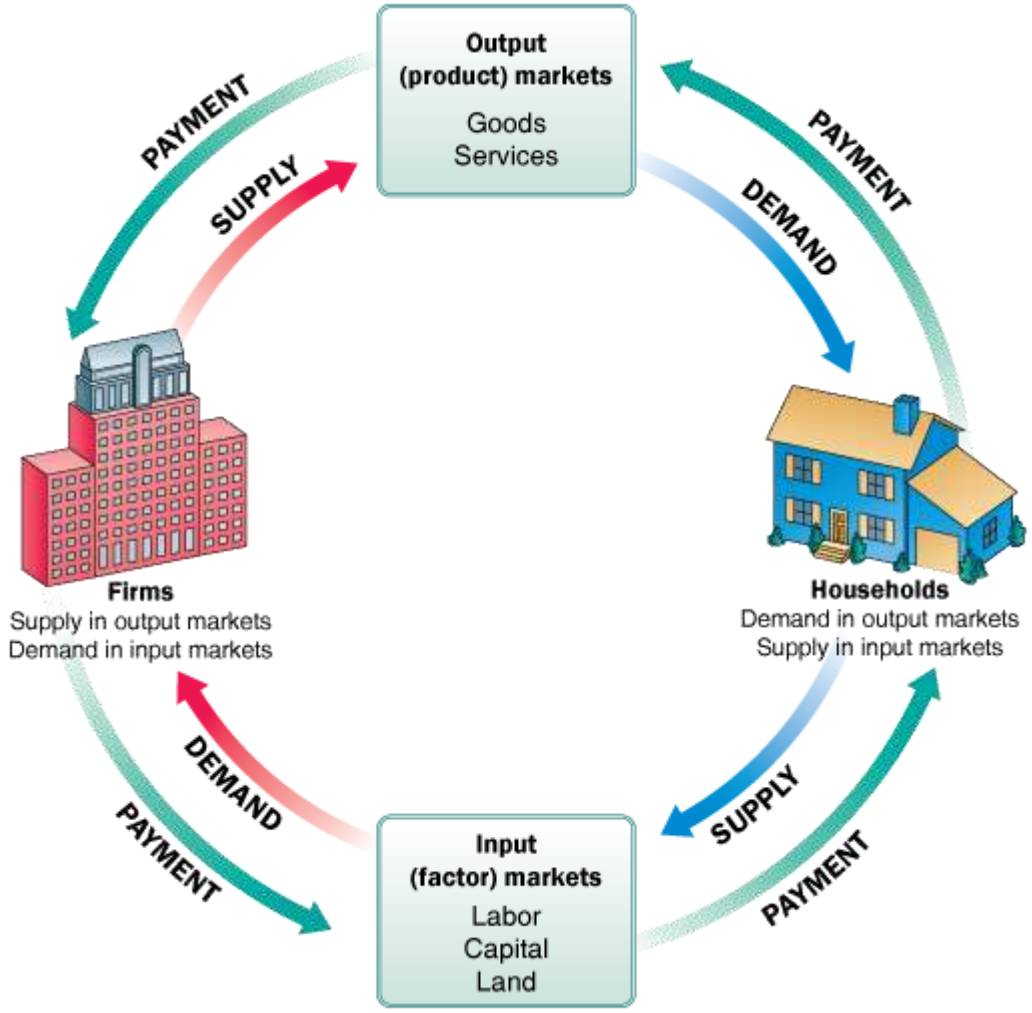
Input Markets and Output Markets: The Circular Flow

product *or* output markets The markets in which goods and services are exchanged.

input *or* factor markets The markets in which the resources used to produce goods and services are exchanged.

FIGURE 1 The Circular Flow of Economic Activity

Here goods and services flow clockwise: Labor services supplied by households flow to firms, and goods and services produced by firms flow to households. Payment (usually money) flows in the opposite (counterclockwise) direction: Payment for goods and services flows from households to firms, and payment for labor services flows from firms to households.



labor market The input/factor market in which households supply work for wages to firms that demand labor.

capital market The input/factor market in which households supply their savings, for interest or for claims to future profits, to firms that demand funds to buy capital goods.

land market The input/factor market in which households supply land or other real property in exchange for rent.

factors of production The inputs into the production process. Land, labor, and capital are the three key factors of production.

Input and output markets are connected through the behavior of both firms and households. Firms determine the quantities and character of outputs produced and the types and quantities of inputs demanded. Households determine the types and quantities of products demanded and the quantities and types of inputs supplied.

Demand in Product/Output Markets

A household's decision about what quantity of a particular output, or product, to demand depends on a number of factors, including:

- The *price of the product* in question.
- The *income available* to the household.
- The household's *amount of accumulated wealth*.
- The *prices of other products* available to the household.
- The household's *tastes and preferences*.
- The household's *expectations* about future income, wealth, and prices.

quantity demanded The amount (number of units) of a product that a household would buy in a given period if it could buy all it wanted at the current market price.

Changes in Quantity Demanded versus Changes in Demand

The most important relationship in individual markets is that between market price and quantity demanded.

Changes in the price of a product affect the *quantity demanded* per period. Changes in any other factor, such as income or preferences, affect *demand*. Thus, we say that an increase in the price of Coca-Cola is likely to cause a decrease in the *quantity of Coca-Cola demanded*. However, we say that an increase in income is likely to cause an increase in the *demand* for most goods.

Price and Quantity Demanded: The Law of Demand

demand schedule Shows how much of a given product a household would be willing to buy at different prices for a given time period.

demand curve A graph illustrating how much of a given product a household would be willing to buy at different prices.

TABLE 3.1 Alex's Demand Schedule for Gasoline

Price (per Gallon)	Quantity Demanded (Gallons per Week)
$ 8.00	0
7.00	2
6.00	3
5.00	5
4.00	7
3.00	10
2.00	14
1.00	20
0.00	26

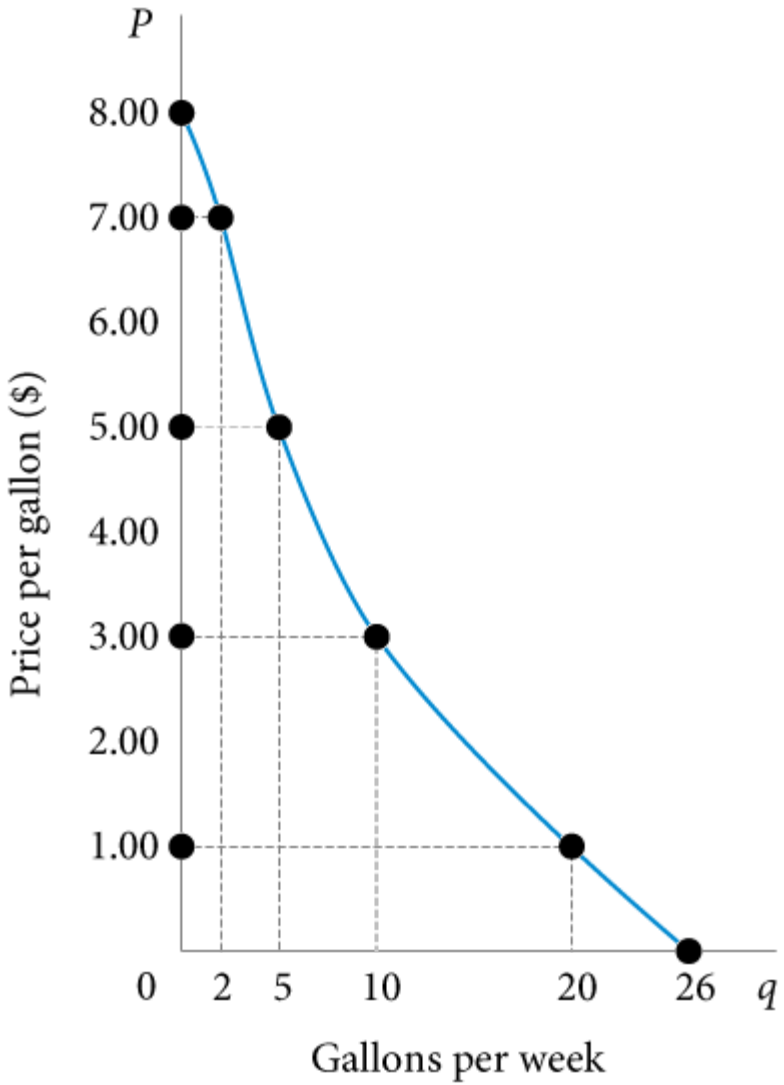


FIGURE 3.2 Alex's Demand Curve

The relationship between price (*P*) and quantity demanded (*q*) presented graphically is called a demand curve.

Demand curves have a negative slope, indicating that lower prices cause quantity demanded to increase.

Note that Alex's demand curve is blue; demand in product markets is determined by household choice.

Demand Curves Slope Downward

law of demand The negative relationship between price and quantity demanded: As price rises, quantity demanded decreases; as price falls, quantity demanded increases.

It is reasonable to expect quantity demanded to fall when price rises, *ceteris paribus*, and to expect quantity demanded to rise when price falls, *ceteris paribus*. Demand curves have a negative slope.

Other Properties of Demand Curves

1. They have a negative slope.

2. They intersect the quantity (*X*) axis a result of time limitations and diminishing marginal utility.

3. They intersect the price (*Y*) axis, a result of limited income and wealth.

The actual shape of an individual household demand curve—whether it is steep or flat, whether it is bowed in or bowed out—depends on the unique tastes and preferences of the household and other factors.

Other Determinants of Household Demand

Income and Wealth

income The sum of all a household's wages, salaries, profits, interest payments, rents, and other forms of earnings in a given period of time. It is a flow measure.

wealth *or* net worth The total value of what a household owns minus what it owes. It is a stock measure.

normal goods Goods for which demand goes up when income is higher and for which demand goes down when income is lower.

inferior goods Goods for which demand tends to fall when income rises.

Prices of Other Goods and Services

substitutes Goods that can serve as replacements for one another; when the price of one increases, demand for the other increases.

complements, complementary goods Goods that "go together"; a decrease in the price of one results in an increase in demand for the other and vice versa.

Tastes and Preferences

Income, wealth, and prices of goods available are the three factors that determine the combinations of goods and services that a household is *able* to buy.

Changes in preferences can and do manifest themselves in market behavior.

Within the constraints of prices and incomes, preference shapes the demand curve, but it is difficult to generalize about tastes and preferences. First, they are volatile. Second, tastes are idiosyncratic.

Expectations

What you decide to buy today certainly depends on today's prices and your current income and wealth.

There are many examples of the ways expectations affect demand.

Increasingly, economic theory has come to recognize the importance of expectations.

It is important to understand that demand depends on more than just *current* incomes, prices, and tastes.

Shift of Demand versus Movement Along a Demand Curve

TABLE 3.2 Shift of Alex's Demand Schedule Due to Increase in Income

	Schedule D_0	Schedule D_1
Price (per Gallon)	Quantity Demanded (Gallons per Week at an Income of $500 per Week)	Quantity Demanded (Gallons per Week at an Income of $700 per Week)
$ 8.00	0	3
7.00	2	5
6.00	3	7
5.00	5	10
4.00	7	12
3.00	10	15
2.00	14	19
1.00	20	24
0.00	26	30

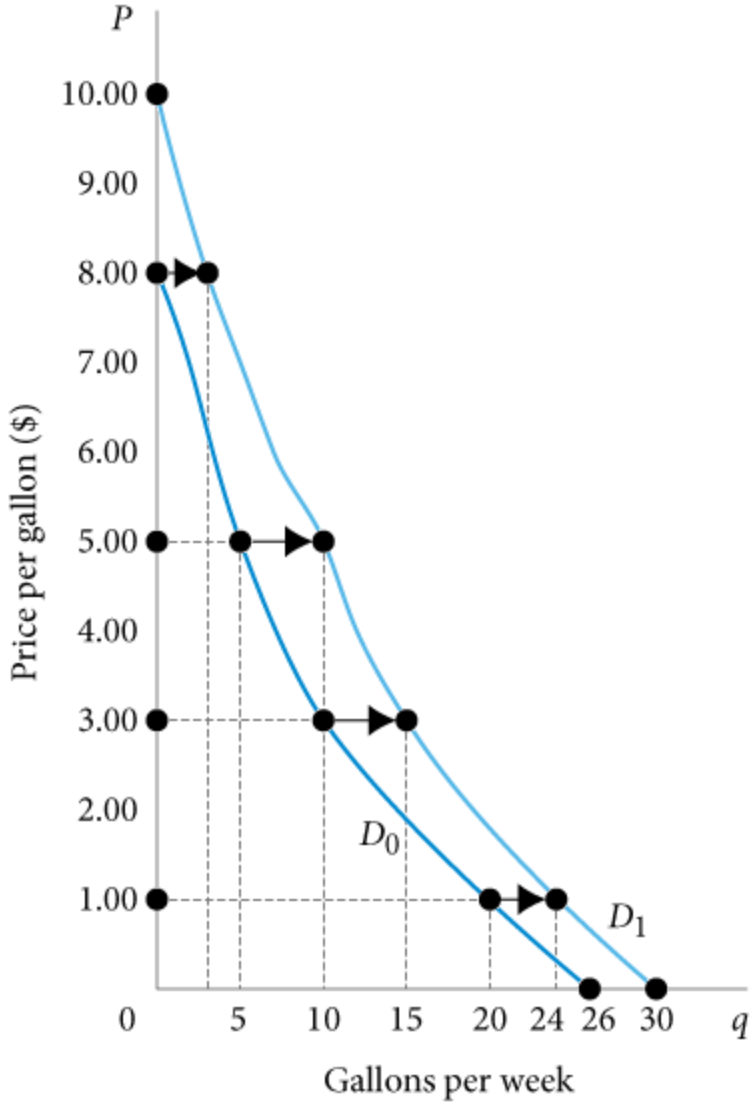


FIGURE 3.3 Shift of a Demand Curve following a Rise in Income

When the price of a good changes, we move *along* the demand curve for that good.

When any other factor that influences demand changes (income, tastes, and so on), the relationship between price and quantity is different; there is a *shift* of the demand curve, in this case from D_0 to D_1.

Gasoline is a normal good.

shift of a demand curve The change that takes place in a demand curve corresponding to a new relationship between quantity demanded of a good and price of that good. The shift is brought about by a change in the original conditions.

movement along a demand curve The change in quantity demanded brought about by a change in price.

Change in price of a good or service leads to

→ Change in *quantity demanded* (movement along a demand curve).

→ Change in income, preferences, or prices of other goods or services leads to Change in *demand* (shift of a demand curve).

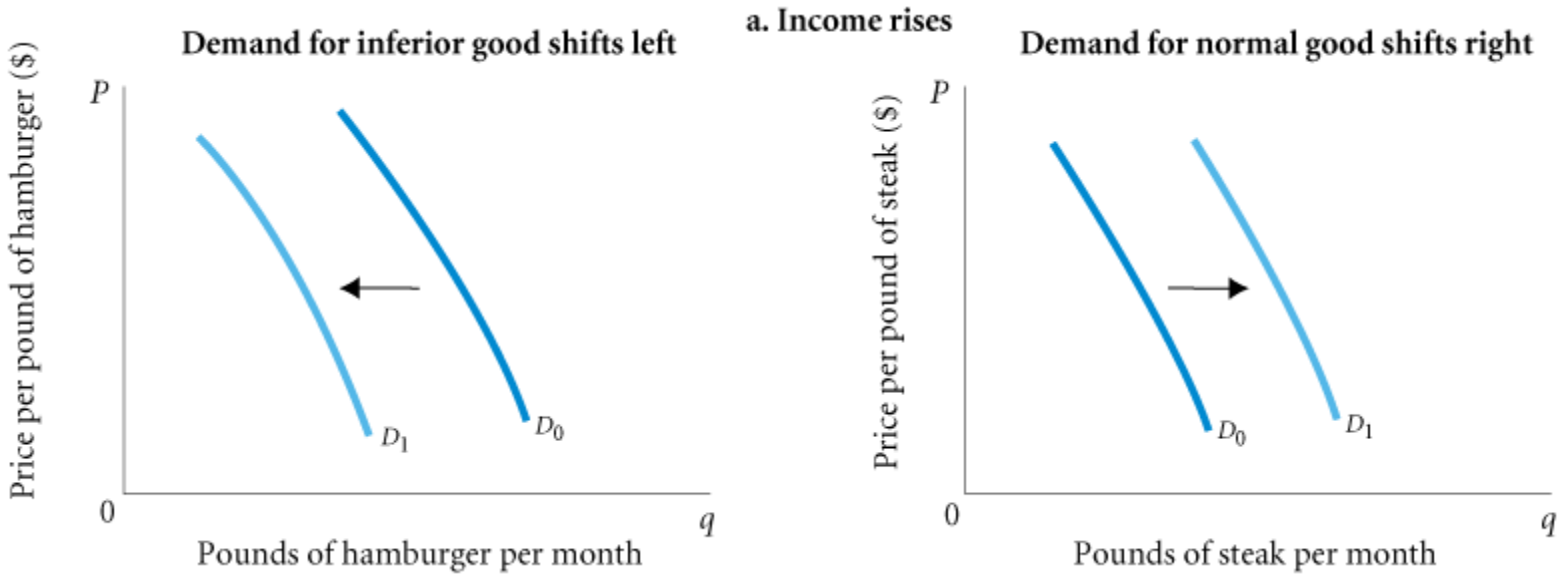
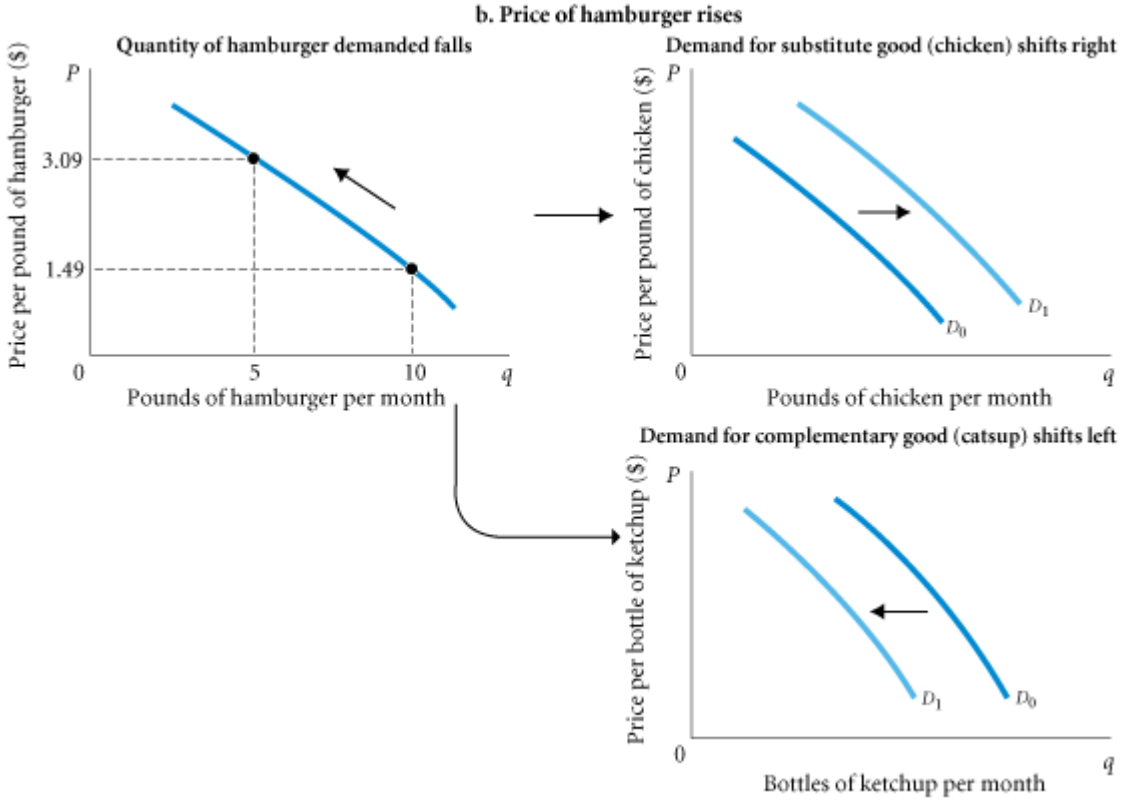


FIGURE 3.4 Shifts versus Movement Along a Demand Curve

a. When income increases, the demand for inferior goods *shifts to the left*
and the demand for normal goods *shifts to the right*.



b. If the price of hamburger rises, the quantity of hamburger demanded declines— this is a movement along the demand curve.
The same price rise for hamburger would shift the demand for chicken (a substitute for hamburger) to the right and the demand for ketchup (a complement to hamburger) to the left.

Supply in Product/Output Markets

Firms build factories, hire workers, and buy raw materials because they believe they can sell the products they make for more than it costs to produce them.

profit The difference between revenues and costs.

law of supply The positive relationship between price and quantity of a good supplied: An increase in market price will lead to an increase in quantity supplied, and a decrease in market price will lead to a decrease in quantity supplied.

supply curve A graph illustrating how much of a product a firm will sell at different prices.

TABLE 3.3 Clarence Brown's Supply Schedule for Soybeans

Price (per Bushel)	Quantity Supplied (Bushels per Year)
$1.50	0
1.75	10,000
2.25	20,000
3.00	30,000
4.00	45,000
5.00	45,000

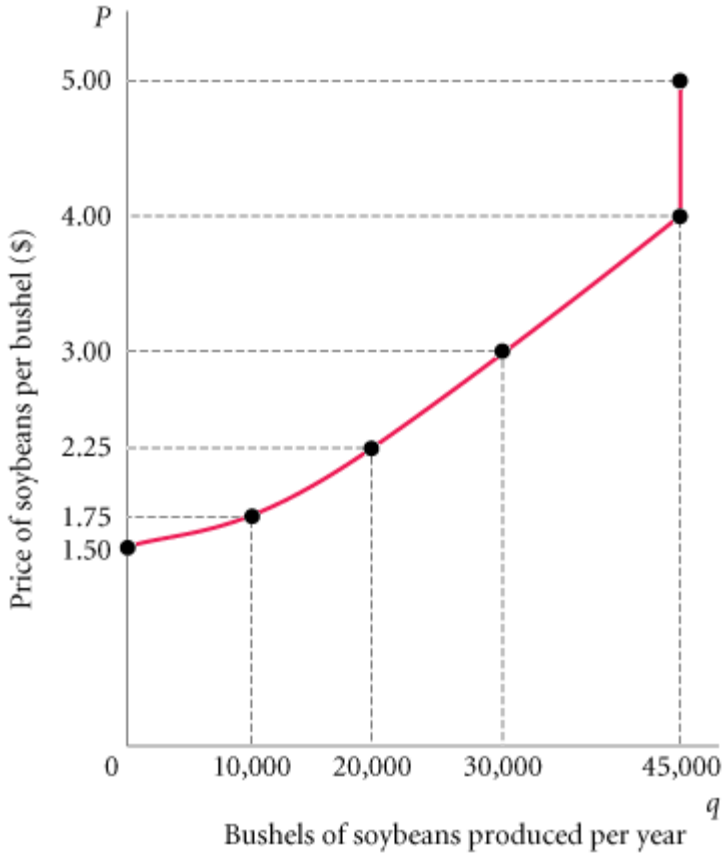


FIGURE 3.6 Clarence Brown's Individual Supply Curve

A producer will supply more when the price of output is higher. The slope of a supply curve is positive.

Other Determinants of Supply

The Cost of Production

For a firm to make a profit, its revenue must exceed its costs.

Cost of production depends on a number of factors, including the available technologies and the prices and quantities of the inputs needed by the firm (labor, land, capital, energy, and so on).

The Prices of Related Products

Assuming that its objective is to maximize profits, a firm's decision about what quantity of output, or product, to supply depends on:

1. The price of the good or service.

2. The cost of producing the product, which in turn depends on:
   - The price of required inputs (labor, capital, and land).
   - The technologies that can be used to produce the product.

3. The prices of related products.

As with demand, it is very important to distinguish between *movements along* supply curves (changes in quantity supplied) and *shifts in* supply curves (changes in supply):

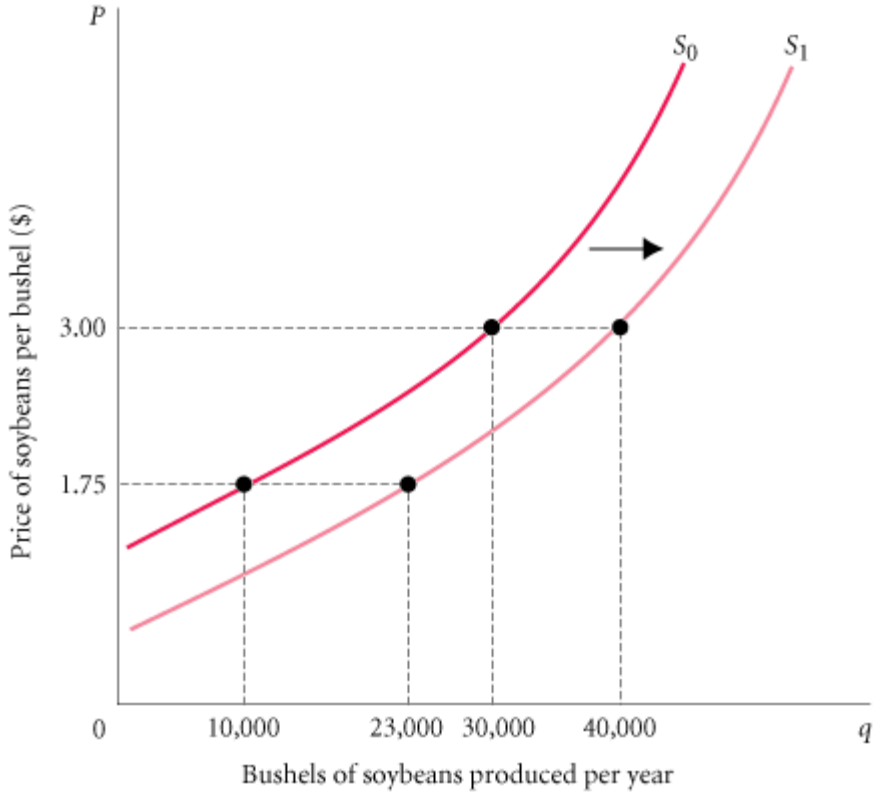
Change in price of a good or service leads to
↳ Change in *quantity supplied* (movement along a supply curve).

Change in costs, input prices, technology, or prices of related goods and services leads to
↳ Change in *supply* (**shift of a supply curve**).

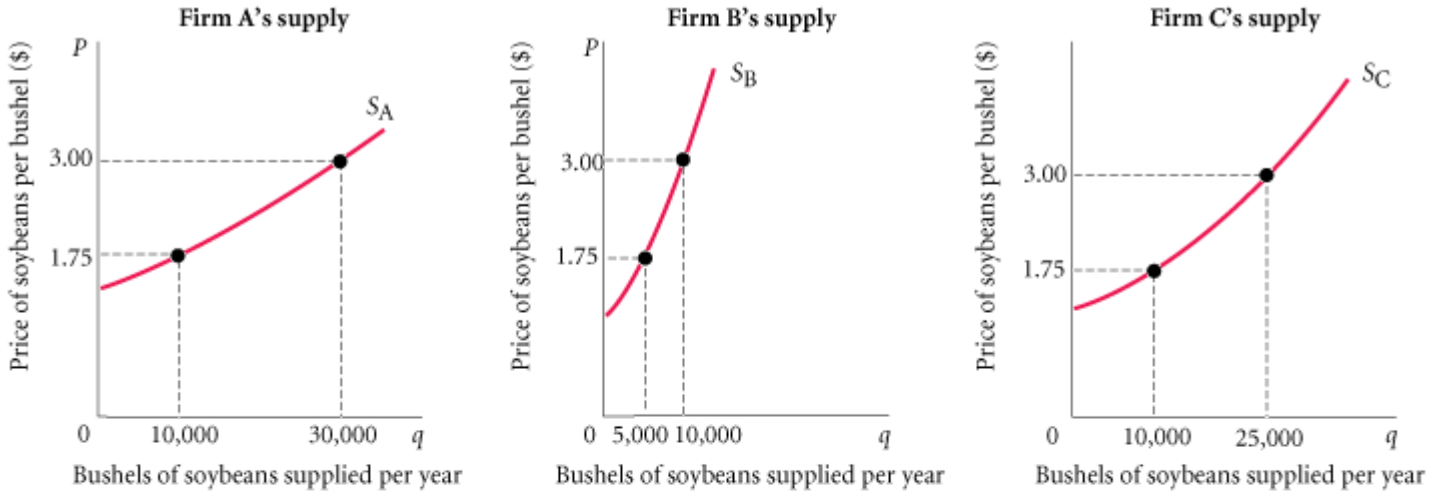
TABLE 3.4 Shift of Supply Schedule for Soybeans following Development of a New Disease-Resistant Seed Strain

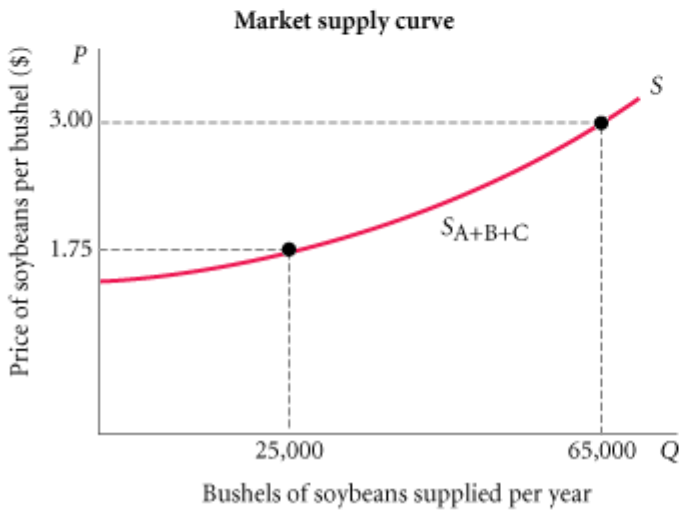
	Schedule S_0	Schedule S_1
Price (per Bushel)	Quantity Supplied (Bushels per Year Using Old Seed)	Quantity Supplied (Bushels per Year Using New Seed)
$1.50	0	5,000
1.75	10,000	23,000
2.25	20,000	33,000
3.00	30,000	40,000
4.00	45,000	54,000
5.00	45,000	54,000

FIGURE 3.7 Shift of the Supply Curve for Soybeans following Development of a New Seed Strain



When the price of a product changes, we move *along* the supply curve for that product; the quantity supplied rises or falls. When any other factor affecting supply changes, the supply curve *shifts*.





Price	Quantity (q) supplied by A	B	C	Total quantity supplied in the market (Q)
$3.00	30,000 +	10,000 +	25,000	= 65,000
1.75	10,000 +	5,000 +	10,000	= 25,000

FIGURE 3.8 Deriving Market Supply from Individual Firm Supply Curves

Total supply in the marketplace is the sum of all the amounts supplied by all the firms selling in the market. It is the sum of all the individual quantities supplied at each price.

Market Equilibrium

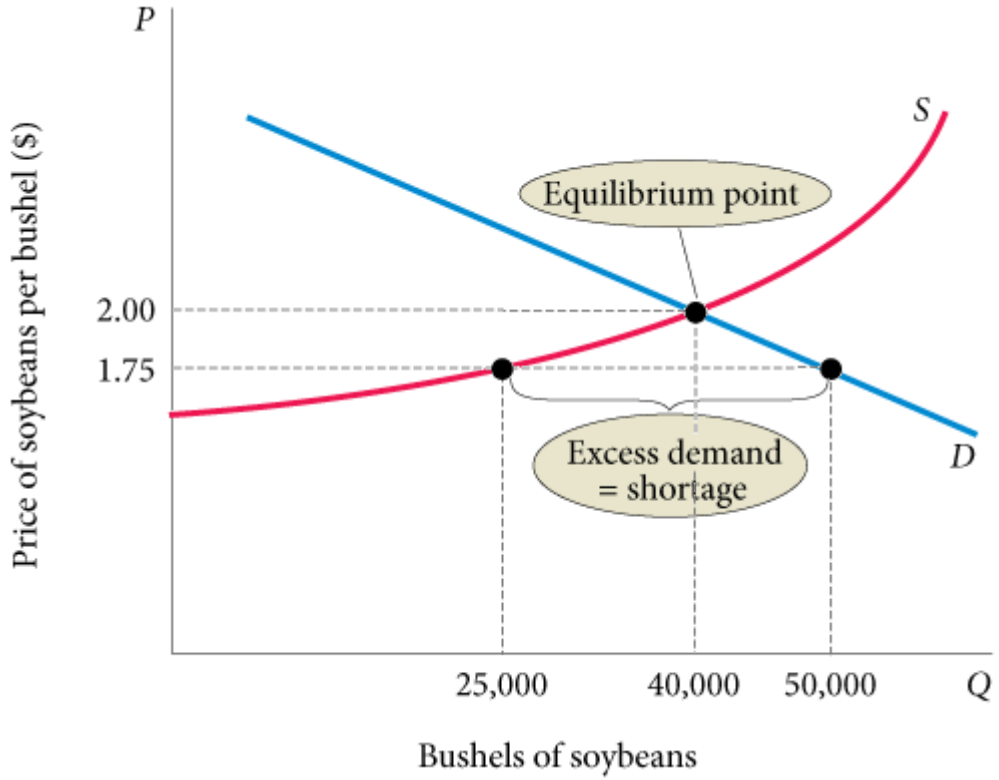
equilibrium The condition that exists when quantity supplied and quantity demanded are equal. At equilibrium, there is no tendency for price to change.

Excess Demand

excess demand *or* shortage The condition that exists when quantity demanded exceeds quantity supplied at the current price.

FIGURE 3.9 Excess Demand, or Shortage

At a price of $1.75 per bushel, quantity demanded exceeds quantity supplied.
When excess *demand* exists, there is a tendency for price to rise.
When quantity demanded equals quantity supplied, excess demand is eliminated and the market is in equilibrium. Here the equilibrium price is $2.00 and the equilibrium quantity is 40,000 bushels.



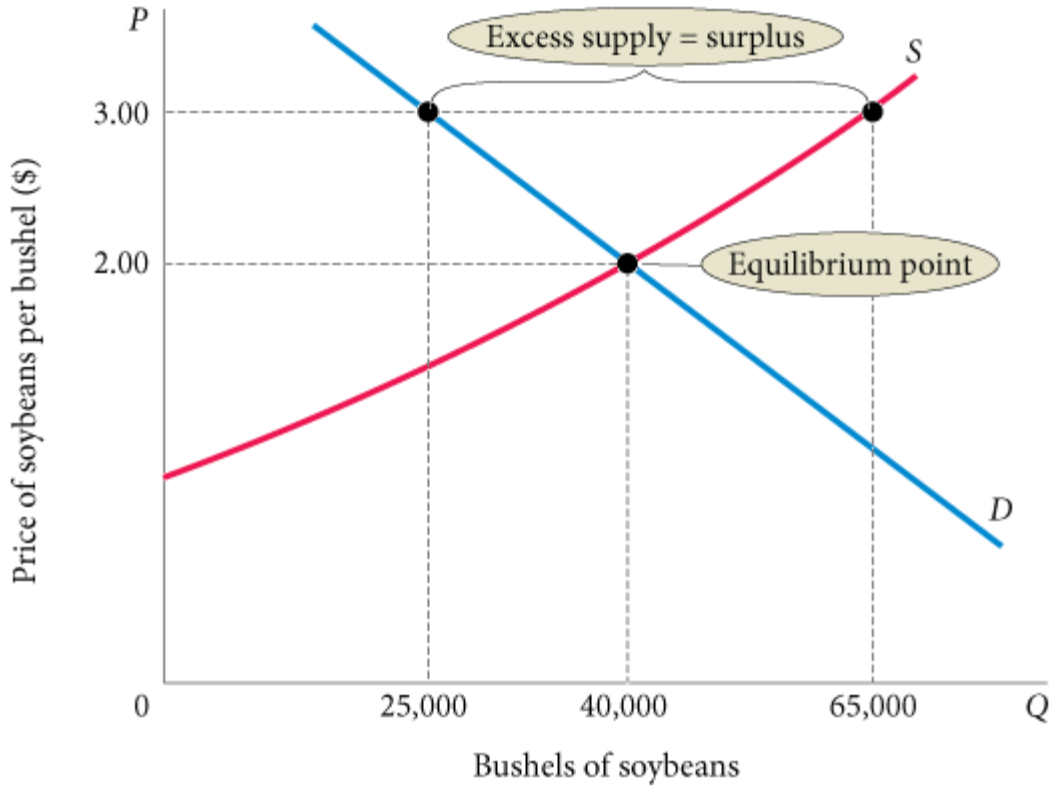
When quantity demanded exceeds quantity supplied, price tends to rise.
When the price in a market rises, quantity demanded falls and quantity supplied rises until an equilibrium is reached at which quantity demanded and quantity supplied are equal.

Excess Supply

excess supply *or* surplus The condition that exists when quantity supplied exceeds quantity demanded at the current price.

FIGURE 3.10 Excess Supply, or Surplus

At a price of $3.00, quantity supplied exceeds quantity demanded by 20,000 bushels. This excess supply will cause the price to fall.



When quantity supplied exceeds quantity demanded at the current price, the price tends to fall. When price falls, quantity supplied is likely to decrease and quantity demanded is likely to increase until an equilibrium price is reached where quantity supplied and quantity demanded are equal.

Changes In Equilibrium

When supply and demand curves shift, the equilibrium price and quantity change.

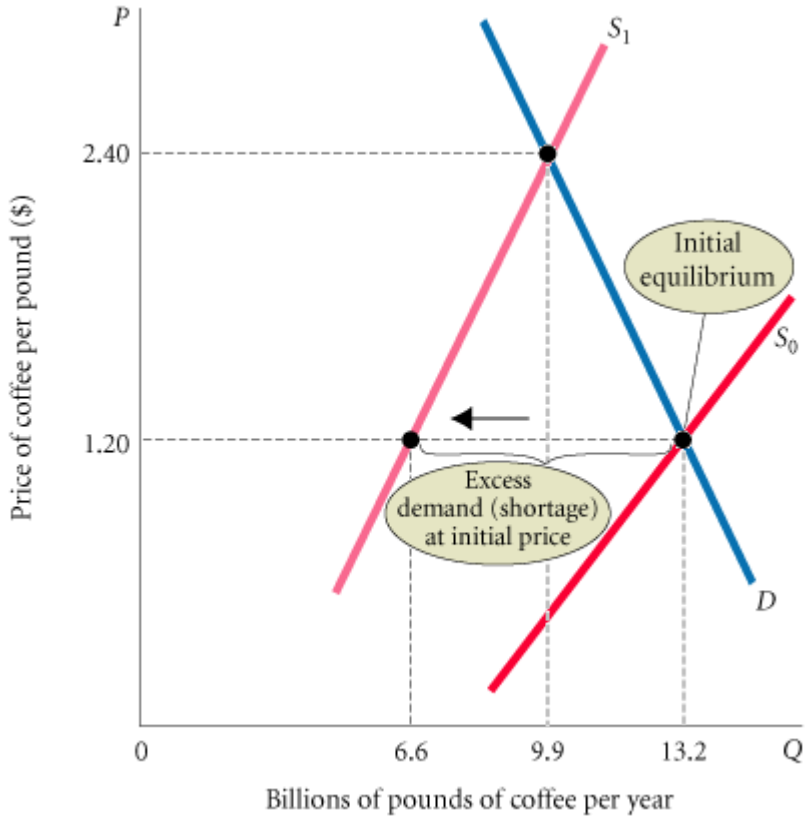


FIGURE 3.11 The Coffee Market: A Shift of Supply and Subsequent Price Adjustment

Before the freeze, the coffee market was in equilibrium at a price of $1.20 per pound.
At that price, quantity demanded equaled quantity supplied.
The freeze shifted the supply curve to the left (from S_0 to S_1), increasing the equilibrium price to $2.40.

ECONOMICS IN PRACTICE

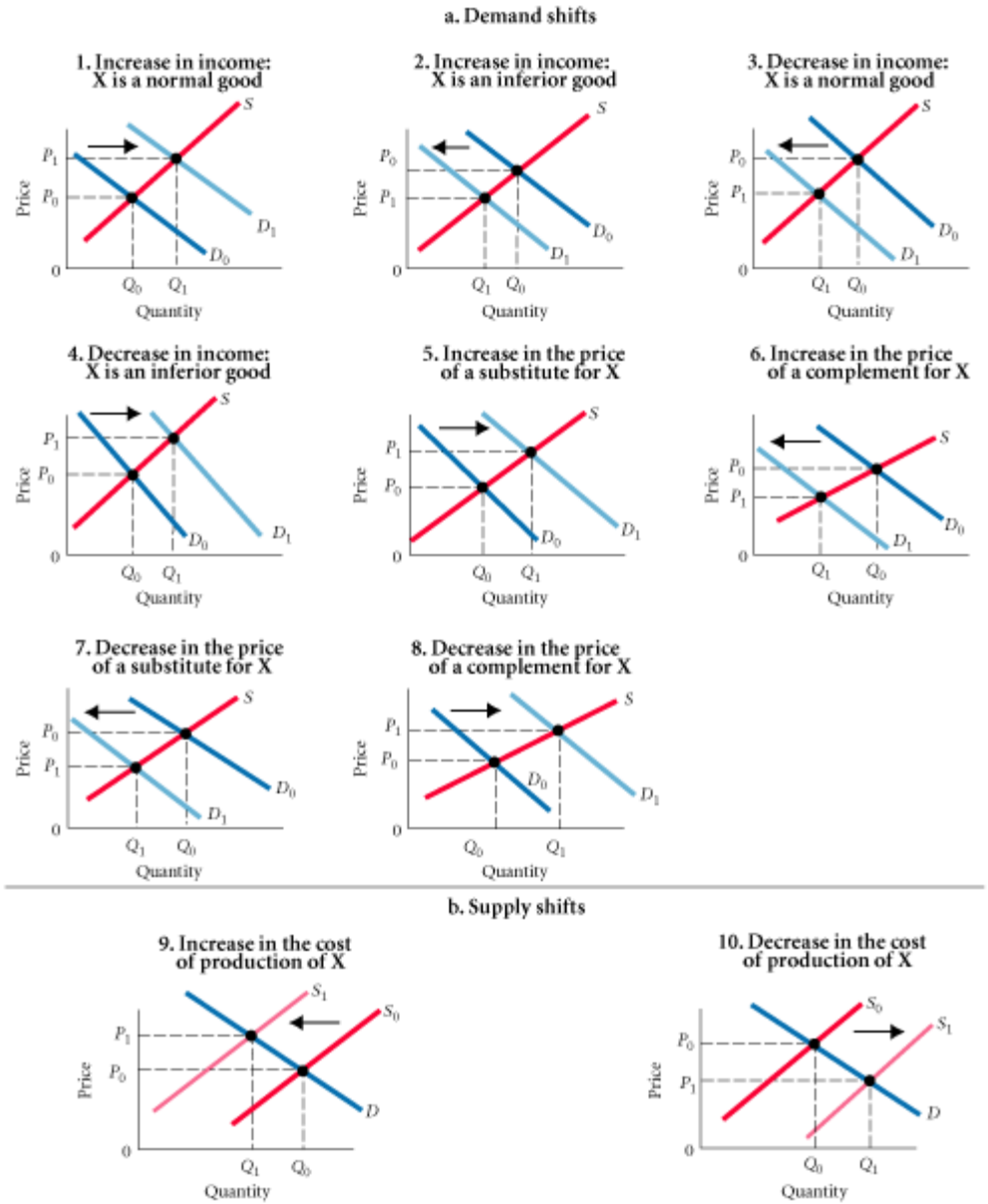
Coffee or Tea?

China is rapidly changing, and tea-drinking habits are no exception. Chinese consumers have discovered coffee!
Some observers suggest that the fast pace of current day China is more compatible with coffee drinking than tea. Perhaps coffee drinking is a complement to economic growth?
With new and large populations now interested in coffee, the world demand for coffee shifts rightward. This is good news for coffee growers. As you already know from this chapter, however, how good that news really is from the point of view of coffee prices depends on the supply side as well!

THINKING PRACTICALLY

1. Show in a graph the effect that the growth in China's interest in coffee will likely have on coffee prices? What features of supply determine how big the price increase will be?

FIGURE 3.12 Examples of Supply and Demand Shifts for Product X



Demand and Supply in Product Markets: A Review

Here are some important points to remember about the mechanics of supply and demand in product markets:

1. A demand curve shows how much of a product a household would buy if it could buy all it wanted at the given price. A supply curve shows how much of a product a firm would supply if it could sell all it wanted at the given price.
2. Quantity demanded and quantity supplied are always per time period—that is, per day, per month, or per year.
3. The demand for a good is determined by price, household income and wealth, prices of other goods and services, tastes and preferences, and expectations.

4. The supply of a good is determined by price, costs of production, and prices of related products. Costs of production are determined by available technologies of production and input prices.

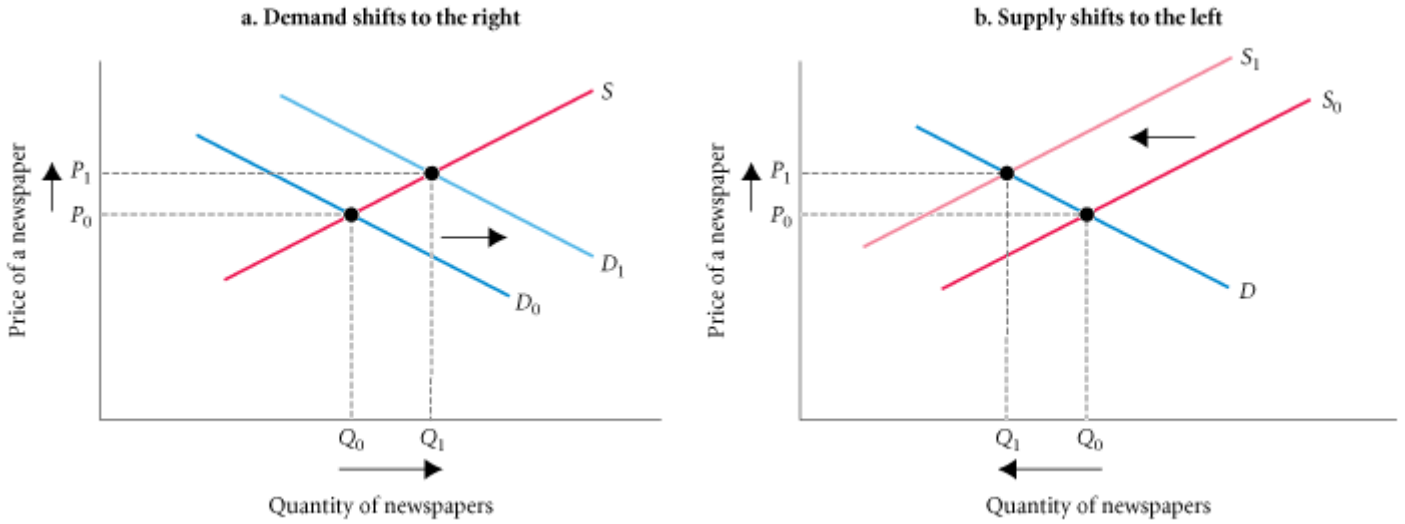
5. Be careful to distinguish between movements along supply and demand curves and shifts of these curves. When the price of a good changes, the quantity of that good demanded or supplied changes—that is, a movement occurs along the curve. When any other factor changes, the curve shifts, or changes position.

6. Market equilibrium exists only when quantity supplied equals quantity demanded at the current price.

ECONOMICS IN PRACTICE

Why Do the Prices of Newspapers Rise?

In 2006, the average price for a daily edition of a Baltimore newspaper was $0.50. In 2007, the average price had risen to $0.75.



Looking Ahead: Markets and the Allocation of Resources

You can already begin to see how markets answer the basic economic questions of what is produced, how it is produced, and who gets what is produced.

- Demand curves reflect what people are willing and able to pay for products; demand curves are influenced by incomes, wealth, preferences, prices of other goods, and expectations.
- Firms in business to make a profit have a good reason to choose the best available technology—lower costs mean higher profits.
- When a good is in short supply, price rises. As it does, those who are willing and able to continue buying do so; others stop buying.

Assignment

Name	**Quantity**	**Maximum price** willing to pay
Mary	1	4
Bob	1	1
Jane	1	5
Ed	1	3
Alice	1	2

Use this data to construct a demand schedule and a demand curve.

Elasticity

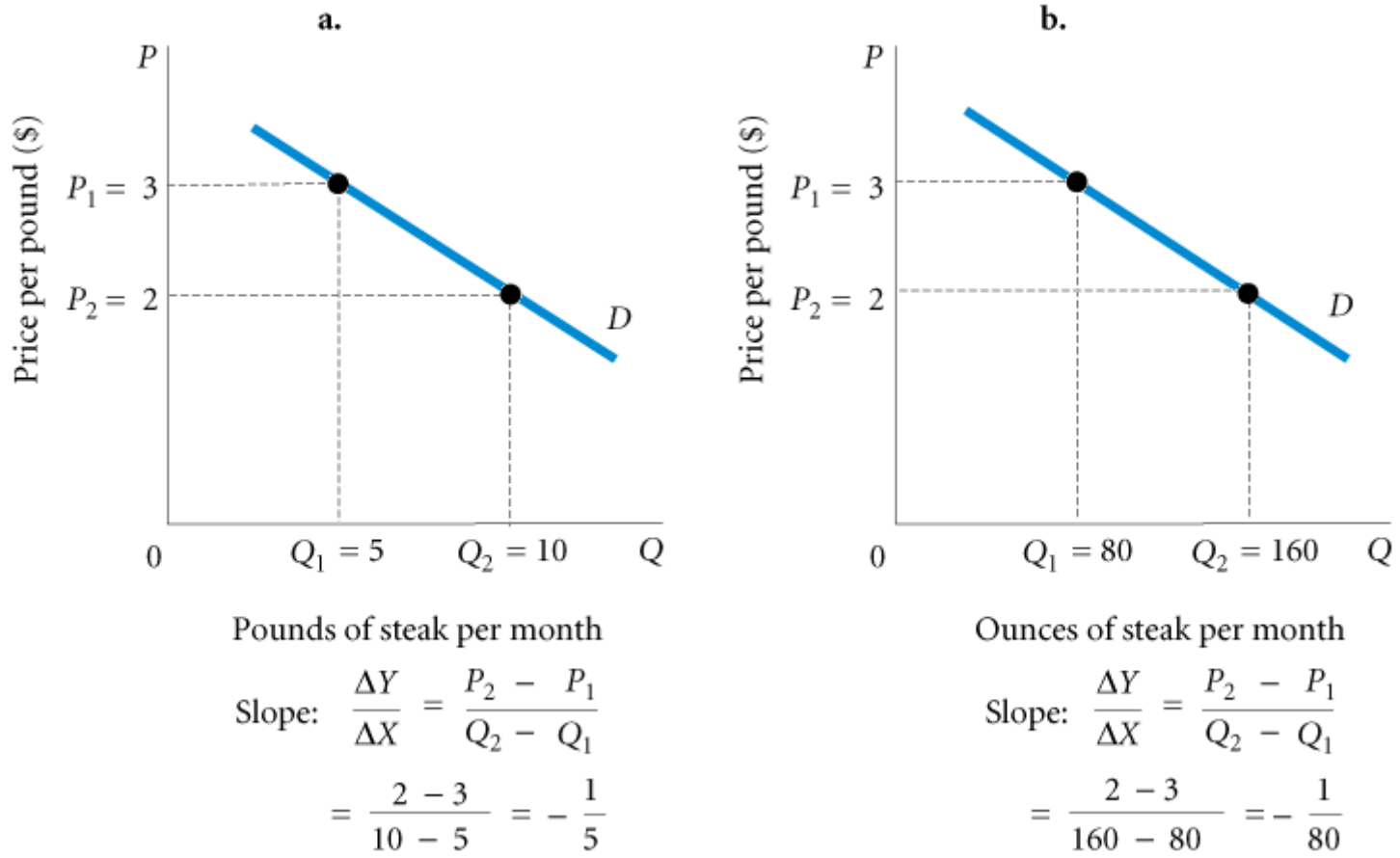
CHAPTER OUTLINE

elasticity A general concept used to quantify the response in one variable when another variable changes.

$$\text{elasticity of } A \text{ with respect to } B = \frac{\%\Delta A}{\%\Delta B}$$

Price Elasticity of Demand

Slope and Elasticity



▲ **FIGURE 5.1 Slope Is Not a Useful Measure of Responsiveness**

Changing the unit of measure from pounds to ounces changes the numerical value of the demand slope dramatically, but the behavior of buyers in the two diagrams is identical.

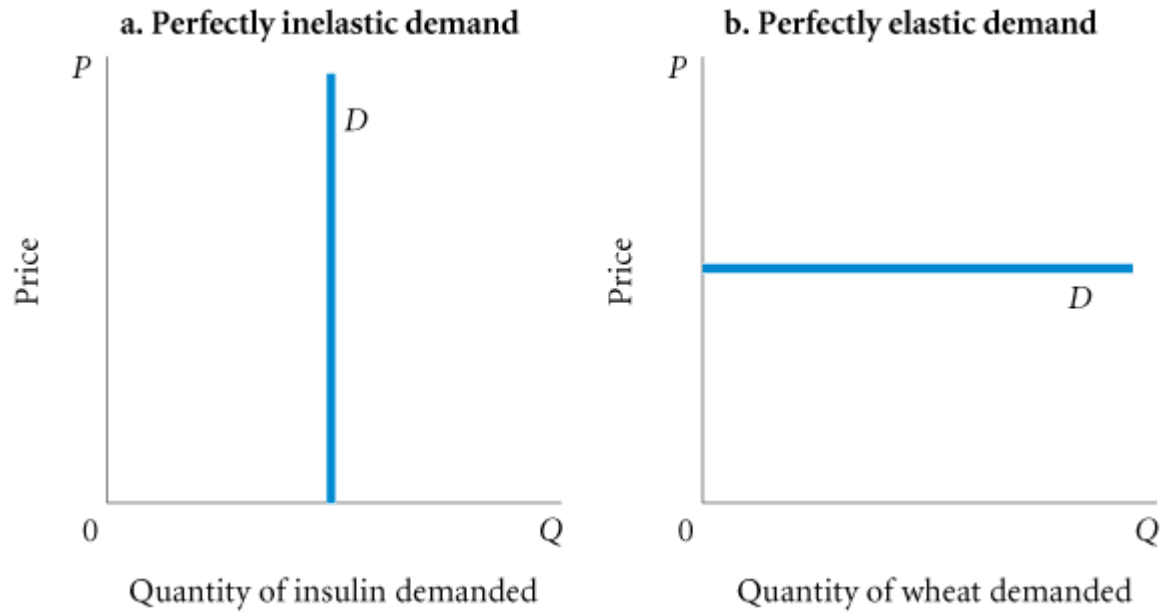
price elasticity of demand The ratio of the percentage of change in quantity demanded to the percentage of change in price; measures the responsiveness of quantity demanded to changes in price.

$$\text{price elasticity of demand} = \frac{\%\ \text{change in quantity demanded}}{\%\ \text{change in price}}$$

Types of Elasticity

perfectly inelastic demand Demand in which quantity demanded does not respond at all to a change in price.

perfectly elastic demand Demand in which quantity drops to zero at the slightest increase in price.



▲ **FIGURE 5.2 Perfectly Inelastic and Perfectly Elastic Demand Curves**

Figure 5.2(a) shows a perfectly inelastic demand curve for insulin.
Price elasticity of demand is zero.
Quantity demanded is fixed; it does not change at all when price changes.
Figure 5.2(b) shows a perfectly elastic demand curve facing a wheat farmer.
A tiny price increase drives the quantity demanded to zero.
In essence, perfectly elastic demand implies that individual producers can sell all they want at the going market price but cannot charge a higher price.

elastic demand A demand relationship in which the percentage change in quantity demanded is larger than the percentage change in price in absolute value (a demand elasticity with an absolute value greater than 1).

inelastic demand Demand that responds somewhat, but not a great deal, to changes in price. Inelastic demand always has a numerical value between zero and 1.

unitary elasticity A demand relationship in which the percentage change in quantity of a product demanded is the same as the percentage change in price in absolute value (a demand elasticity of 1).

A warning:

You must be very careful about signs. Because it is generally understood that demand elasticities are negative (demand curves have a negative slope), they are often reported and discussed without the negative sign.

Calculating Elasticities

Calculating Percentage Changes

To calculate percentage change in quantity demanded using the initial value as the base, the following formula is used:

$$\%\ \text{change in quantity demanded} = \frac{\text{change in quantity demanded}}{Q_1} \times 100\% = \frac{Q_2 - Q_1}{Q_1} \times 100\%$$

We can calculate the percentage change in price in a similar way. Once again, let us use the initial value of P—that is, P_1—as the base for calculating the percentage. By using P_1 as the base, the formula for calculating the percentage of change in P is

$$\begin{aligned}\%\ \text{change in price} &= \frac{\text{change in price}}{P_1} \times 100\% \\ &= \frac{P_2 - P_1}{P_1} \times 100\%\end{aligned}$$

Elasticity Is a Ratio of Percentages

Once the changes in quantity demanded and price have been converted to percentages, calculating elasticity is a matter of simple division. Recall the formal definition of elasticity:

Price Elasticity of demand is always –ve and Qunatity inversely proportional to Price

$$\text{price elasticity of demand} = \frac{\%\ \text{change in quantity demanded}}{\%\ \text{change in price}}$$

The Midpoint Formula

midpoint formula A more precise way of calculating percentages using the value halfway between P_1 and P_2 for the base in calculating the percentage change in price and the value halfway between Q_1 and Q_2 as the base for calculating the percentage change in quantity demanded.

$$\%\ \text{change in quantity demanded} = \frac{\text{change in quantity demanded}}{(Q_1 + Q_2)/2} \times 100\%$$

$$= \frac{Q_2 - Q_1}{(Q_1 + Q_2)/2} \times 100\%$$

Point Elasticity

point elasticity A measure of elasticity that uses the slope measurement.

We have defined elasticity as the percentage change in quantity demanded divided by the percentage change in price. We can write this as

$$\frac{\frac{\Delta Q}{Q_1}}{\frac{\Delta P}{P_1}}$$

Where Δ denotes a small change and Q_1 and P_1 refer to the original price and quantity demanded.
This can be rearranged and written as

$$\frac{\Delta Q}{\Delta P} \cdot \frac{P_1}{Q_1}$$

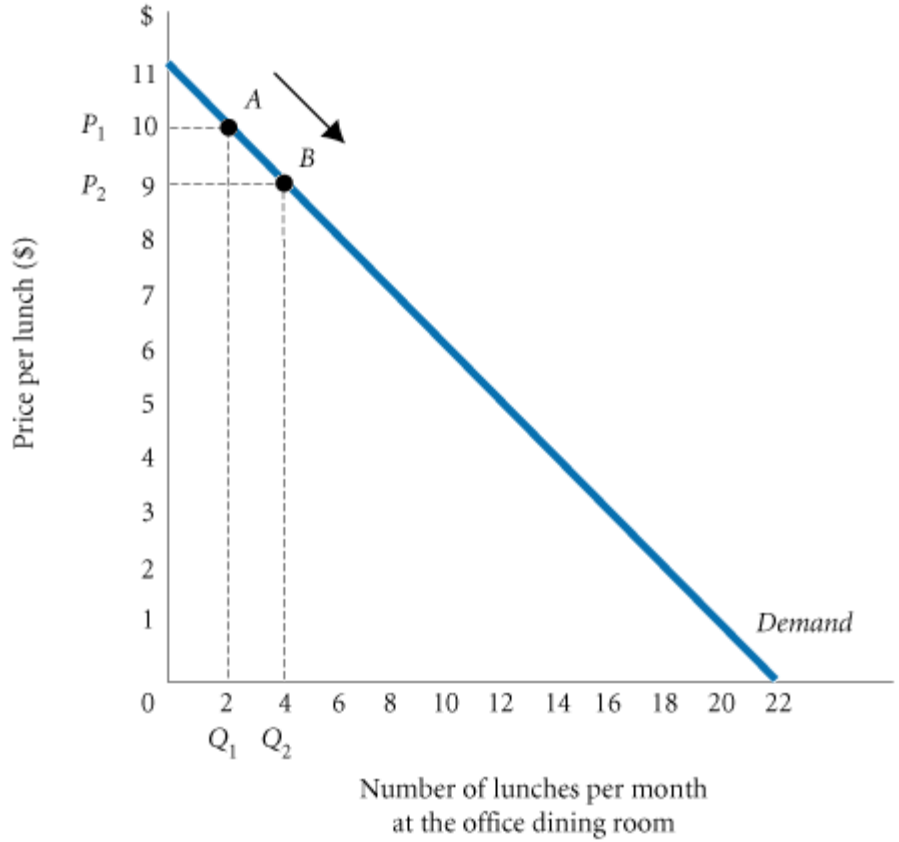
Notice that $\Delta Q/\Delta P$ is the reciprocal of the slope.

Elasticity Changes Along a Straight-Line Demand Curve

TABLE 5.1 Demand Schedule for Office Dining Room Lunches

Price (per Lunch)	Quantity Demanded (Lunches per Month)
$11	0
10	2
9	4
8	6
7	8
6	10
5	12
4	14
3	16
2	18
1	20
0	22

▼ **FIGURE 5.3 Demand Curve for Lunch at the Office Dining Room**



To calculate price elasticity of demand between points *A* and *B* on the demand curve, first calculate the percentage change in quantity demanded:

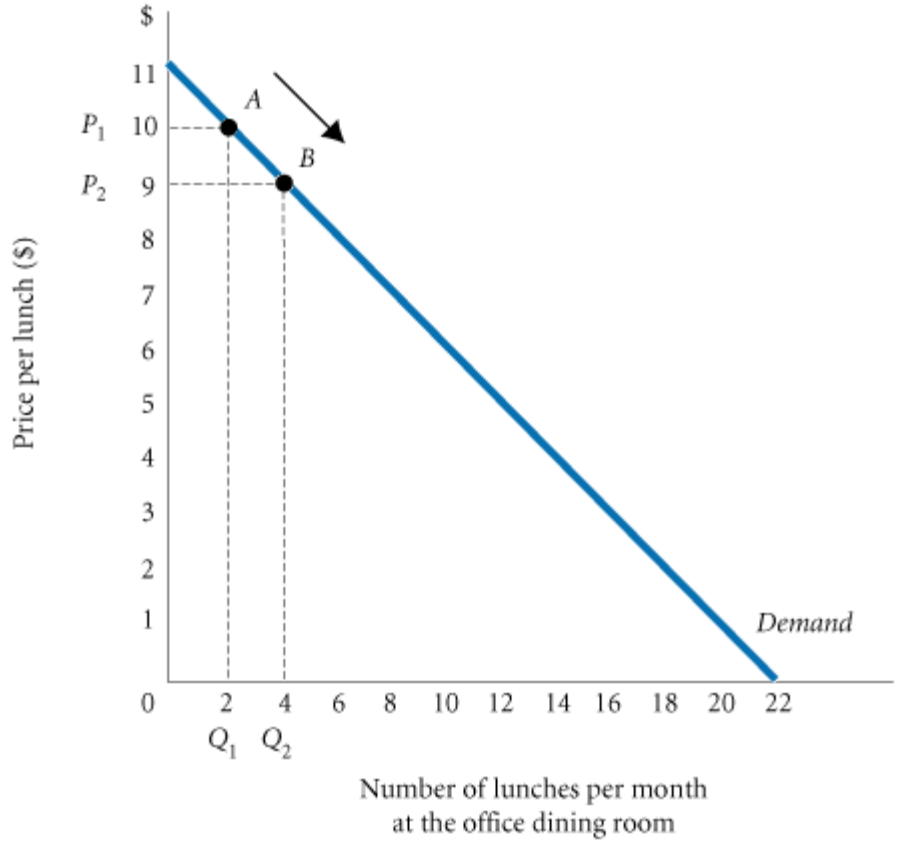
$$\%\ \text{change in quantity demanded} = \frac{4-2}{(2+4)/2} \times 100\% = \frac{2}{3} \times 100\% = 66.7\%$$

Elasticity Changes Along a Straight-Line Demand Curve

TABLE 5.1 Demand Schedule for Office Dining Room Lunches

Price (per Lunch)	Quantity Demanded (Lunches per Month)
$11	0
10	2
9	4
8	6
7	8
6	10
5	12
4	14
3	16
2	18
1	20
0	22

▼ **FIGURE 5.3 Demand Curve for Lunch at the Office Dining Room**



Next, calculate the percentage change in price:

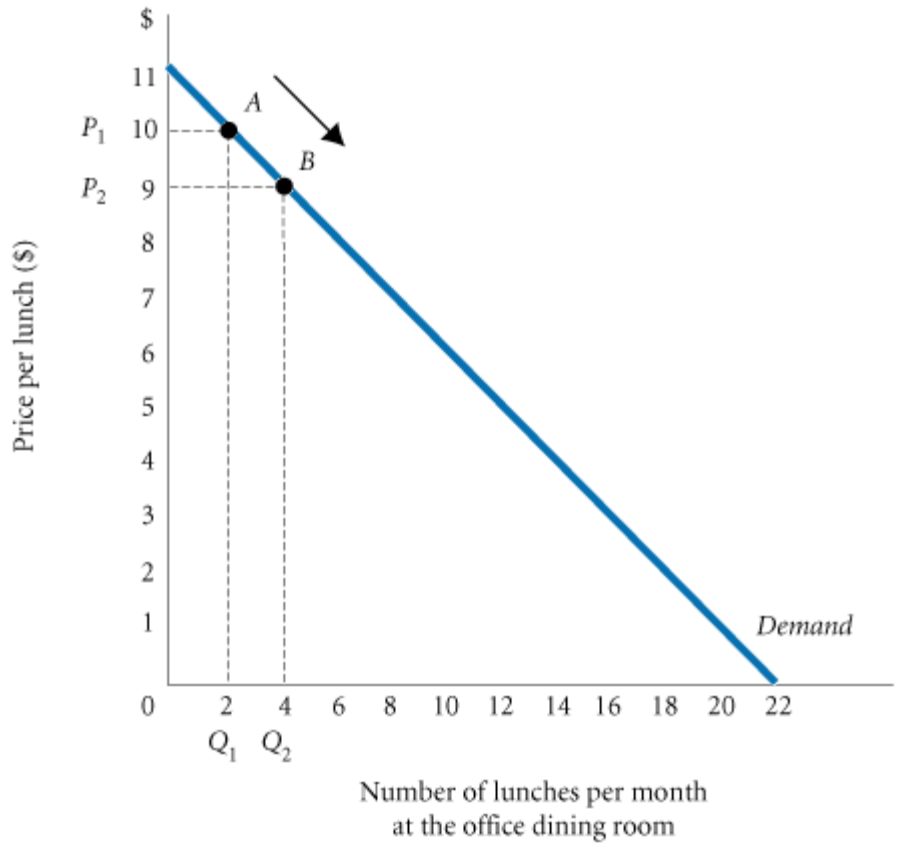
$$\%\ \text{change in price} = \frac{9-10}{(10+9)/2} \times 100\% = \frac{-1}{9.5} \times 100\% = -10.5\%$$

Elasticity Changes Along a Straight-Line Demand Curve

TABLE 5.1 Demand Schedule for Office Dining Room Lunches

Price (per Lunch)	Quantity Demanded (Lunches per Month)
$11	0
10	2
9	4
8	6
7	8
6	10
5	12
4	14
3	16
2	18
1	20
0	22

▼ **FIGURE 5.3 Demand Curve for Lunch at the Office Dining Room**



Elasticity > 1 ➔Elastic
Elasticity <1 ➔Inelastic

Elasticity of a product changes

Ingraph upper edge is elastic(>1)
And below is inelastic(<1)

Finally, calculate elasticity:

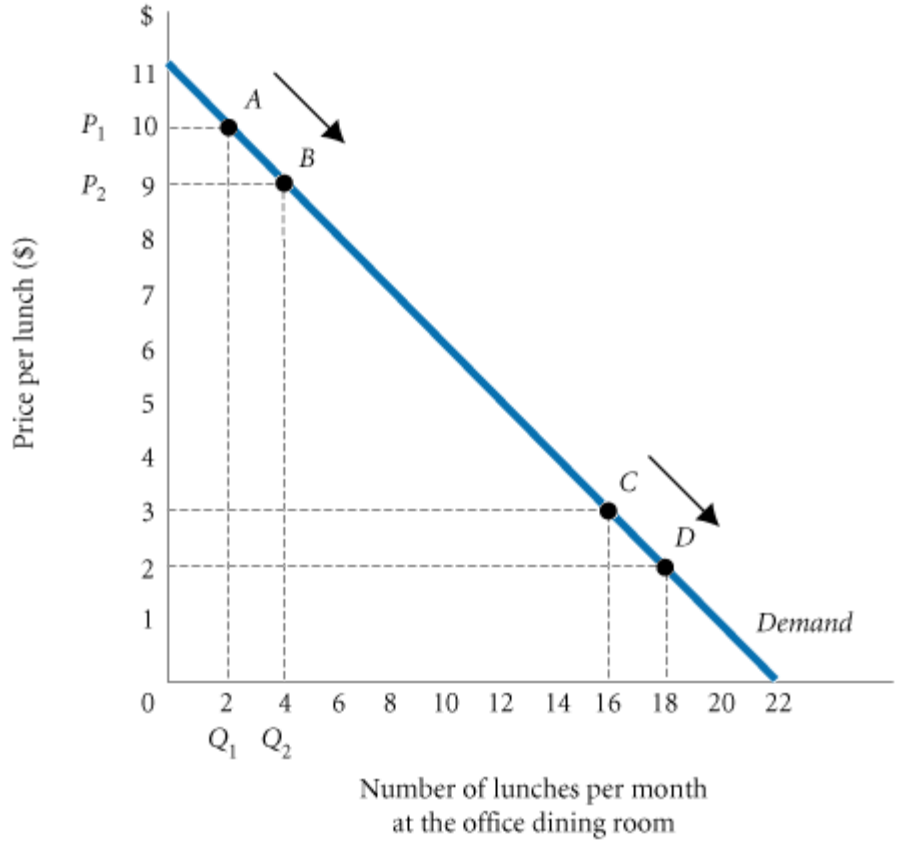
$$\text{elasticity of demand} = \frac{66.7\%}{-10.5\%} = -6.33$$

Elasticity Changes Along a Straight-Line Demand Curve

TABLE 5.1 Demand Schedule for Office Dining Room Lunches

Price (per Lunch)	Quantity Demanded (Lunches per Month)
$11	0
10	2
9	4
8	6
7	8
6	10
5	12
4	14
3	16
2	18
1	20
0	22

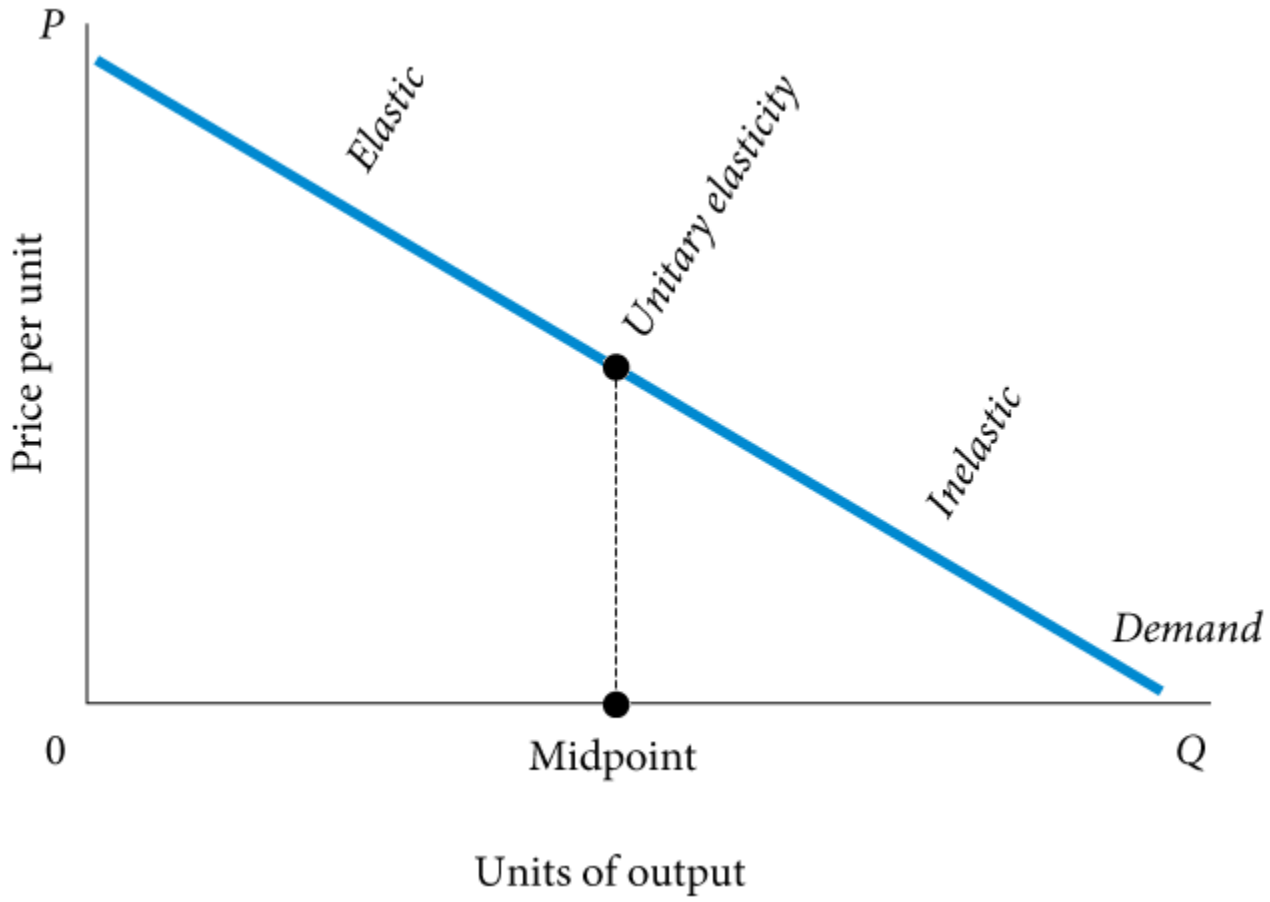
▼ **FIGURE 5.3 Demand Curve for Lunch at the Office Dining Room**



Between points *A* and *B*, demand is quite elastic at −6.33.

Between points *C* and *D*, demand is quite inelastic at −.294. (You can work this number out for yourself using the midpoint formula.)

▼ **FIGURE 5.4** **Point Elasticity Changes Along a Demand Curve**



Elasticity and Total Revenue

In any market, $P \times Q$ is total revenue (TR) received by producers:

$$TR = P \times Q$$
total revenue = price × quantity

When price (P) declines, quantity demanded (Q_D) increases. The two factors, P and Q_D, move in opposite directions:

effects of price changes on quantity demanded:

$$P \uparrow \rightarrow Q_{\mathrm{D}} \downarrow$$
and
$$P \downarrow \rightarrow Q_{\mathrm{D}} \uparrow$$

Because total revenue is the product of *P* and *Q*, whether *TR* rises or falls in response to a price increase depends on which is bigger: the percentage increase in price or the percentage decrease in quantity demanded.

effect of price increase on
a product with inelastic demand:

$$\uparrow P \times Q_{\mathrm{D}} \downarrow = TR \uparrow$$

If the percentage decline in quantity demanded following a price increase is larger than the percentage increase in price, total revenue will fall.

effect of price increase on
a product with elastic demand:

$$\uparrow P \times Q_{\mathrm{D}} \downarrow = TR \downarrow$$

The opposite is true for a price cut. When demand is elastic, a cut in price increases total revenues:

effect of price cut on a product with elastic demand:

$$\downarrow P \times Q_{\mathrm{D}} \uparrow = TR \uparrow$$

When demand is inelastic, a cut in price reduces total revenues:

effect of price cut on a product with inelastic demand:

$$\downarrow P \times Q_{\mathrm{D}} \uparrow = TR \downarrow$$

Other Important Elasticities

Income Elasticity of Demand

income elasticity of demand A measure of the responsiveness of demand to changes in income.

$$\text{income elasticity of demand} = \frac{\%\ \text{change in quantity demanded}}{\%\ \text{change in income}}$$

Income elasticity is +ve more times

While it can be -ve

Cross-Price Elasticity of Demand

cross-price elasticity of demand A measure of the response of the quantity of one good demanded to a change in the price of another good.

$$\text{cross-price elasticity of demand} = \frac{\%\ \text{change in quantity of } Y \text{ demanded}}{\%\ \text{change in price of } X}$$

Elasticity of Supply

elasticity of supply A measure of the response of quantity of a good supplied to a change in price of that good. Likely to be positive in output markets.

$$\text{elasticity of supply} = \frac{\%\ \text{change in quantity supplied}}{\%\ \text{change in price}}$$

elasticity of labor supply A measure of the response of labor supplied to a change in the price of labor.

$$\text{elasticity of labor supply} = \frac{\%\ \text{change in quantity of labor supplied}}{\%\ \text{change in the wage rate}}$$

Elastic supply be always +ve

If 2% in wage Then >2% in labor supply

Utility, Indifference Curve and Budget Constraint

budget constraint The limits imposed on household choices by income, wealth, and product prices.

TABLE 6.1 Possible Budget Choices of a Person Earning $1,000 per Month after Taxes

Option	Monthly Rent	Food	Other Expenses	Total	Available?
A	$ 400	$250	$350	$1,000	Yes
B	600	200	200	1,000	Yes
C	700	150	150	1,000	Yes
D	1,000	100	100	1,200	No

choice set *or* **opportunity set** The set of options that is defined and limited by a budget constraint.

Preferences, Tastes, Trade-Offs, and Opportunity Cost

Within the constraints imposed by limited incomes and fixed prices, households are free to choose what they will and will not buy.

Whenever a household makes a choice, it is weighing the good or service that it chooses against all the other things that the same money could buy.

As long as a household faces a limited budget—and all households ultimately do—the real cost of any good or service is the value of the other goods and services that could have been purchased with the same amount of money.

The Equation of the Budget Constraint

In general, the budget constraint can be written

$$P_X X + P_Y Y = I,$$

where P_X = the price of X, X = the quantity of X consumed, P_Y = the price of Y, Y = the quantity of Y consumed, and I = household income.

The Basis of Choice: Utility

utility The satisfaction a product yields.

Diminishing Marginal Utility

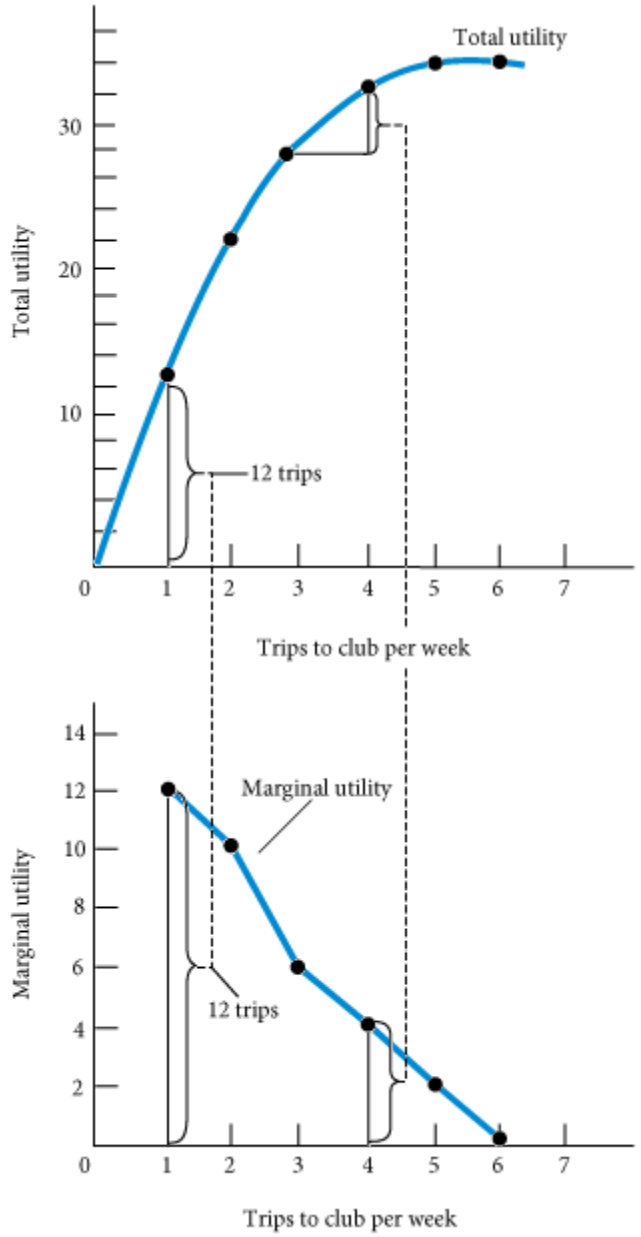
marginal utility (*MU*) The additional satisfaction gained by the consumption or use of *one more* unit of a good or service.

total utility The total amount of satisfaction obtained from consumption of a good or service.

law of diminishing marginal utility The more of any one good consumed in a given period, the less satisfaction (utility) generated by consuming each additional (marginal) unit of the same good.

TABLE 6.2 Total Utility and Marginal Utility of Trips to the Club per Week

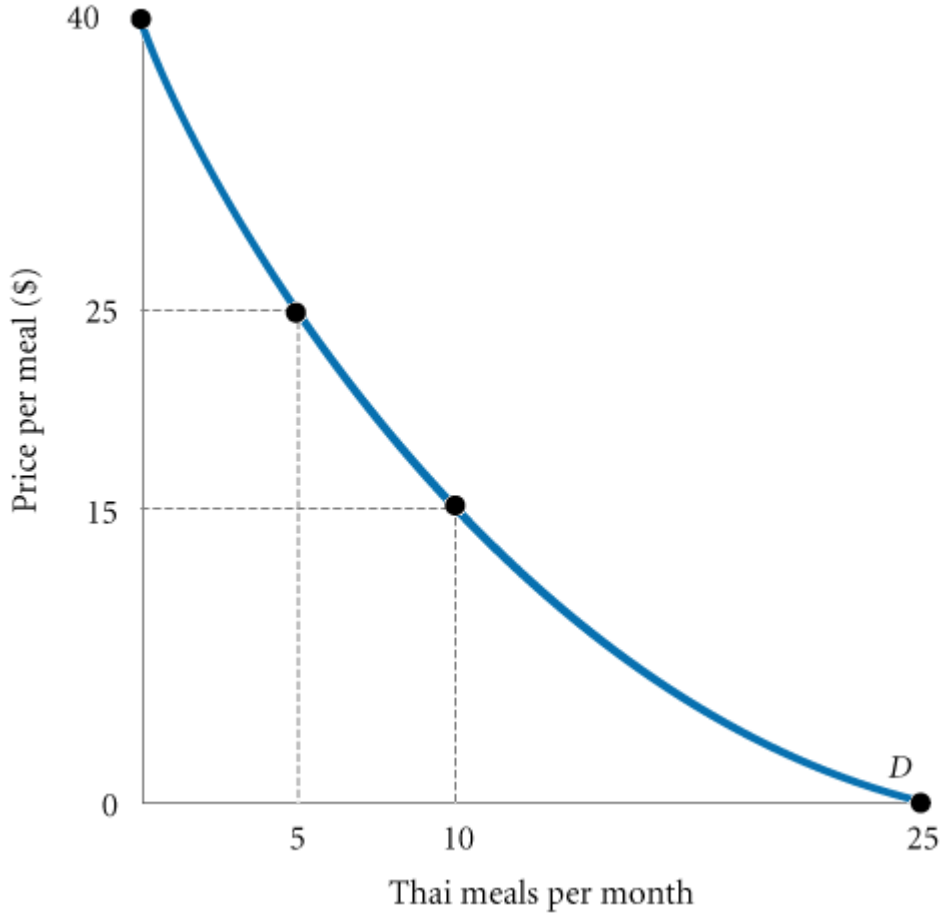
Trips to Club	Total Utility	Marginal Utility
1	12	12
2	22	10
3	28	6
4	32	4
5	34	2
6	34	0



▶ **FIGURE 6.3 Graphs of Frank's Total and Marginal Utility**

Marginal utility is the additional utility gained by consuming one additional unit of a commodity. When marginal utility is zero, total utility stops rising.

Diminishing Marginal Utility and Downward-Sloping Demand



◄ FIGURE 6.4 Diminishing Marginal Utility and Downward-Sloping Demand

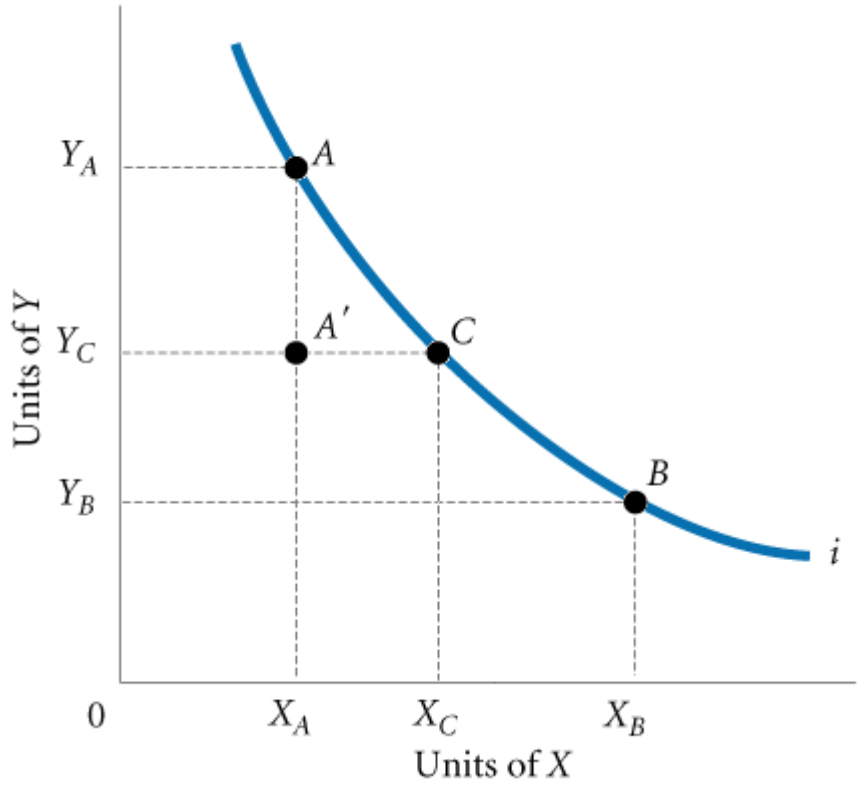
At a price of $40, the utility gained from even the first Thai meal is not worth the price.

However, a lower price of $25 lures Ann and Tom into the Thai restaurant 5 times a month. (The utility from the sixth meal is not worth $25.)

If the price is $15, Ann and Tom will eat Thai meals 10 times a month—until the marginal utility of a Thai meal drops below the utility they could gain from spending $15 on other goods.

At 25 meals a month, they cannot tolerate the thought of another Thai meal even if it is free.

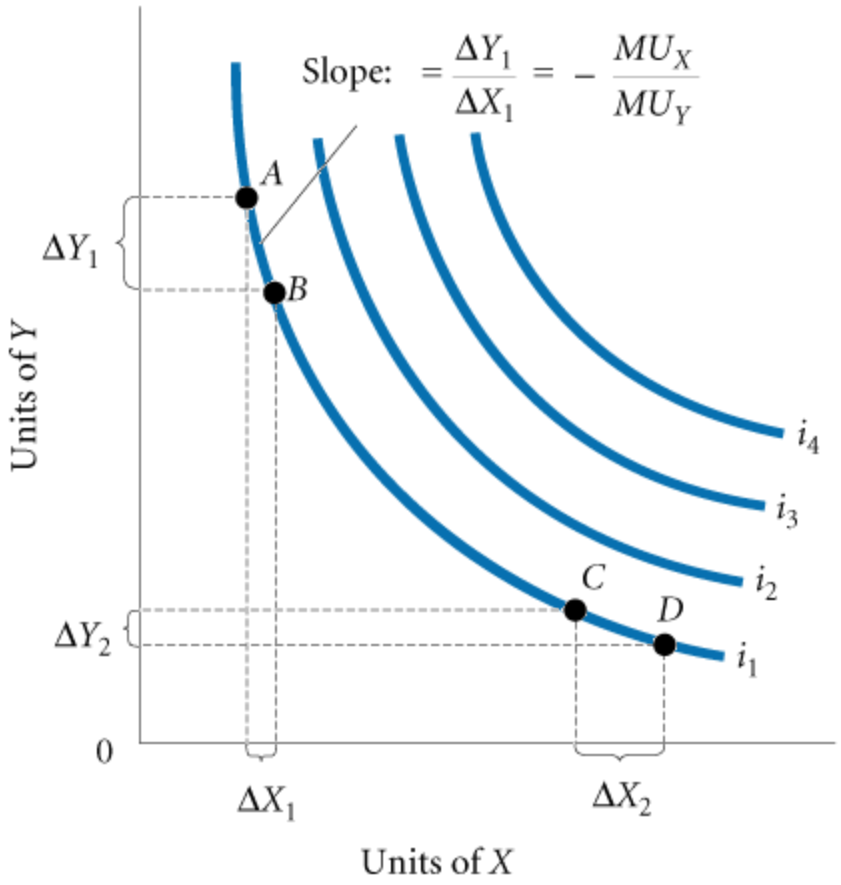
Deriving Indifference Curves



◀ **FIGURE 6A.1 An Indifference Curve**

An indifference curve is a set of points, each representing a combination of some amount of good *X* and some amount of good *Y*, that all yield the same amount of total utility.
The consumer depicted here is indifferent between bundles *A* and *B*, *B* and *C*, and *A* and *C*. Because "more is better," our consumer is unequivocally worse off at *A′* than at *A*.

Properties of Indifference Curves



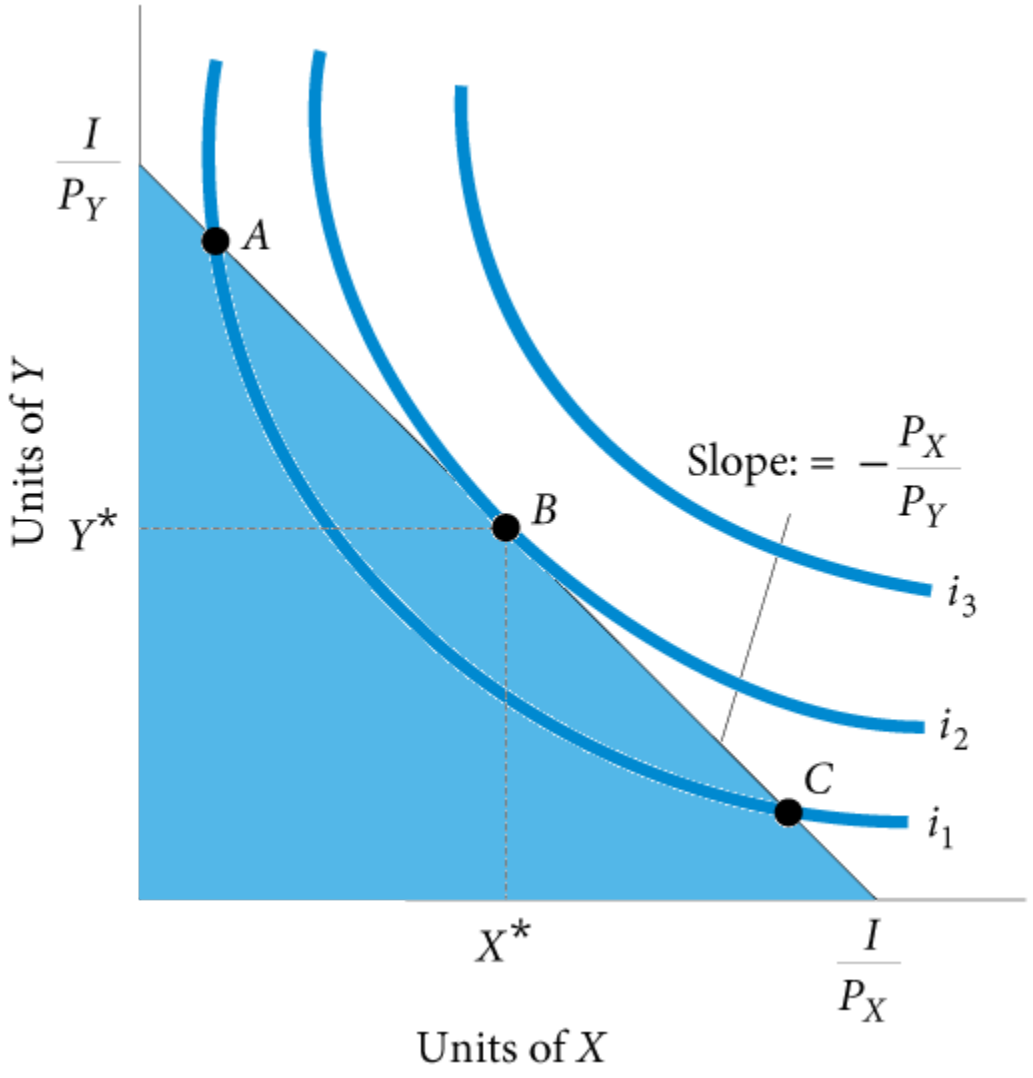
◀ **FIGURE 6A.2 A Preference Map: A Family of Indifference Curves**
Each consumer has a unique family of indifference curves called a preference map. Higher indifference curves represent higher levels of total utility.

$$MU_X \cdot \Delta X = -(MU_Y \cdot \Delta Y)$$

When we divide both sides by MU_Y and by ΔX, we obtain

$$\frac{\Delta Y}{\Delta X} = -\left(\frac{MU_X}{MU_Y}\right)$$

The slope of an indifference curve is the ratio of the marginal utility of *X* to the marginal utility of *Y*, and it is negative.



◀ **FIGURE 6A.3 Consumer Utility-Maximizing Equilibrium**

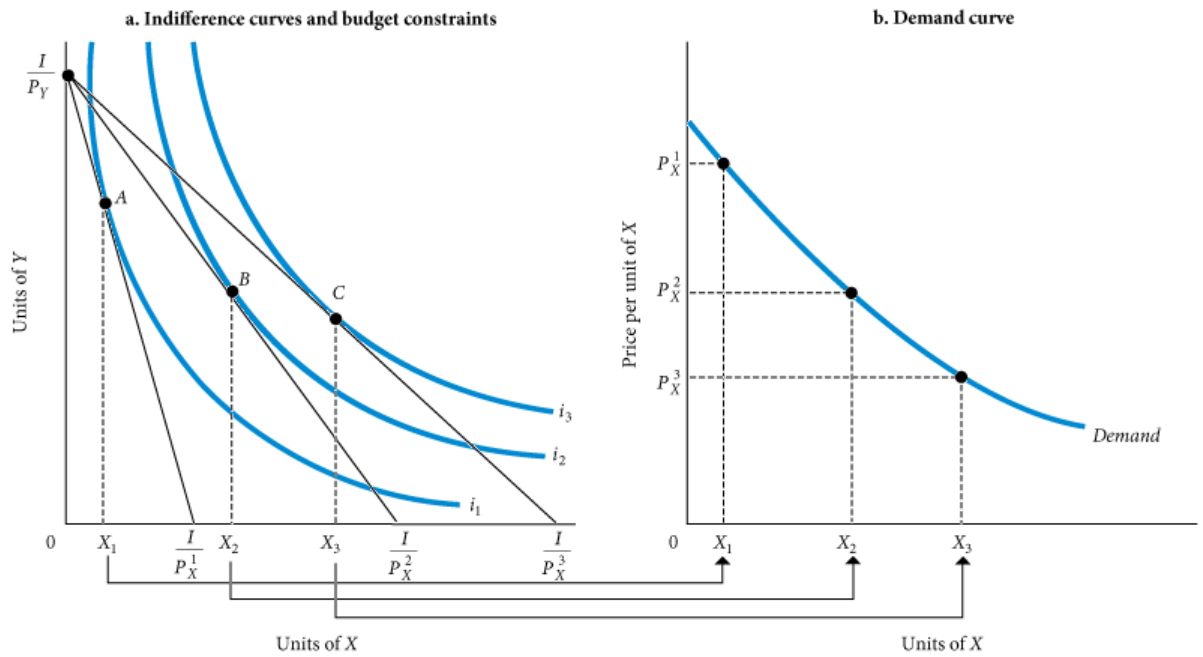
Consumers will choose the combination of *X* and *Y* that maximizes total utility. Graphically, the consumer will move along the budget constraint until the highest possible indifference curve is reached. At that point, the budget constraint and the indifference curve are tangent. This point of tangency occurs at *X** and *Y** (point *B*).

$$-\underbrace{\frac{MU_X}{MU_Y}}_{\text{slope of indifference curve}} = \underbrace{-\frac{P_X}{P_Y}}_{\text{slope of budget constraint}}$$

By multiplying both sides of this equation by MU_Y and dividing both sides by P_X, we can rewrite this utility-maximizing rule as

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

Deriving a Demand Curve from Indifference Curves and Budget Constraints



▲ **FIGURE 6A.4 Deriving a Demand Curve from Indifference Curves and Budget Constraint**

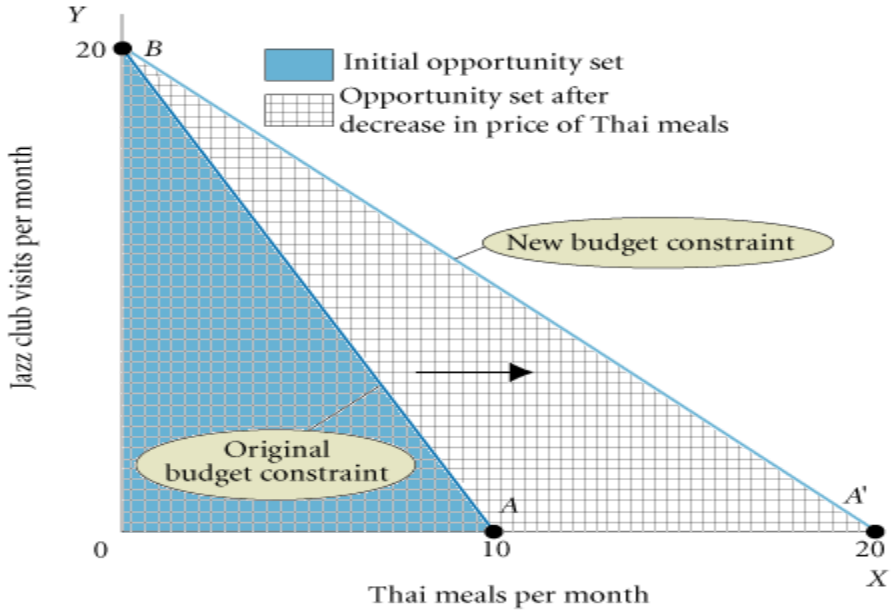
Indifference curves are labeled i_1, i_2, and i_3; budget constraints are shown by the three diagonal lines from I/P_Y to I/P^1_X, I/P^2_X and I/P^3_X. Lowering the price of X from P^1_X to P^2_X and then to P^3_X swivels the budget constraint to the right. At each price, there is a different utility-maximizing combination of X and Y. Utility is maximized at point A on i_1, point B on i_2, and point C on i_3.
Plotting the three prices against the quantities of X chosen results in a standard downward-sloping demand curve.

A Question

- Suppose the price of good X, Px = 50 and price of Y, Py = 150, the total income is 1000 which you have planned to spend on X and Y.
- You have already bought 8 units of X. How many units of Y can you buy?

Budget Constraints Change When Prices Rise or Fall

When the price of a good decreases, the budget constraint swivels to the right, increasing the opportunities available and expanding choice.



The Utility-Maximizing Rule

In general, utility-maximizing consumers spread out their expenditures until the following condition holds:

$$\text{utility - maximizing rule: } \frac{MU_X}{P_X} = \frac{MU_Y}{P_Y} \text{ for all goods,}$$

where MU_X is the marginal utility derived from the last unit of *X* consumed, MU_Y is the marginal utility derived from the last unit of *Y* consumed, P_X is the price per unit of *X*, and P_Y is the price per unit of *Y*.

utility-maximizing rule Equating the ratio of the marginal utility of a good to its price for all goods.

diamond/water paradox A paradox stating that (1) the things with the greatest value in use frequently have little or no value in exchange and (2) the things with the greatest value in exchange frequently have little or no value in use.

Price Change: Income and Substitution Effects

THE IMPACT OF A PRICE CHANGE

- **Economists often separate the impact of a price change into two components:**
  - **the substitution effect; and**
  - **the income effect.**

THE IMPACT OF A PRICE CHANGE

- **The substitution effect involves the substitution of good x_1 for good x_2 or vice-versa due to a change in relative prices of the two goods.**
- **The income effect results from an increase or decrease in the consumer's real income or purchasing power as a result of the price change.**
- **The sum of these two effects is called the price effect.**

THE IMPACT OF A PRICE CHANGE

- **The decomposition of the price effect into the income and substitution effect can be done in several ways**
- **There are two main methods:**

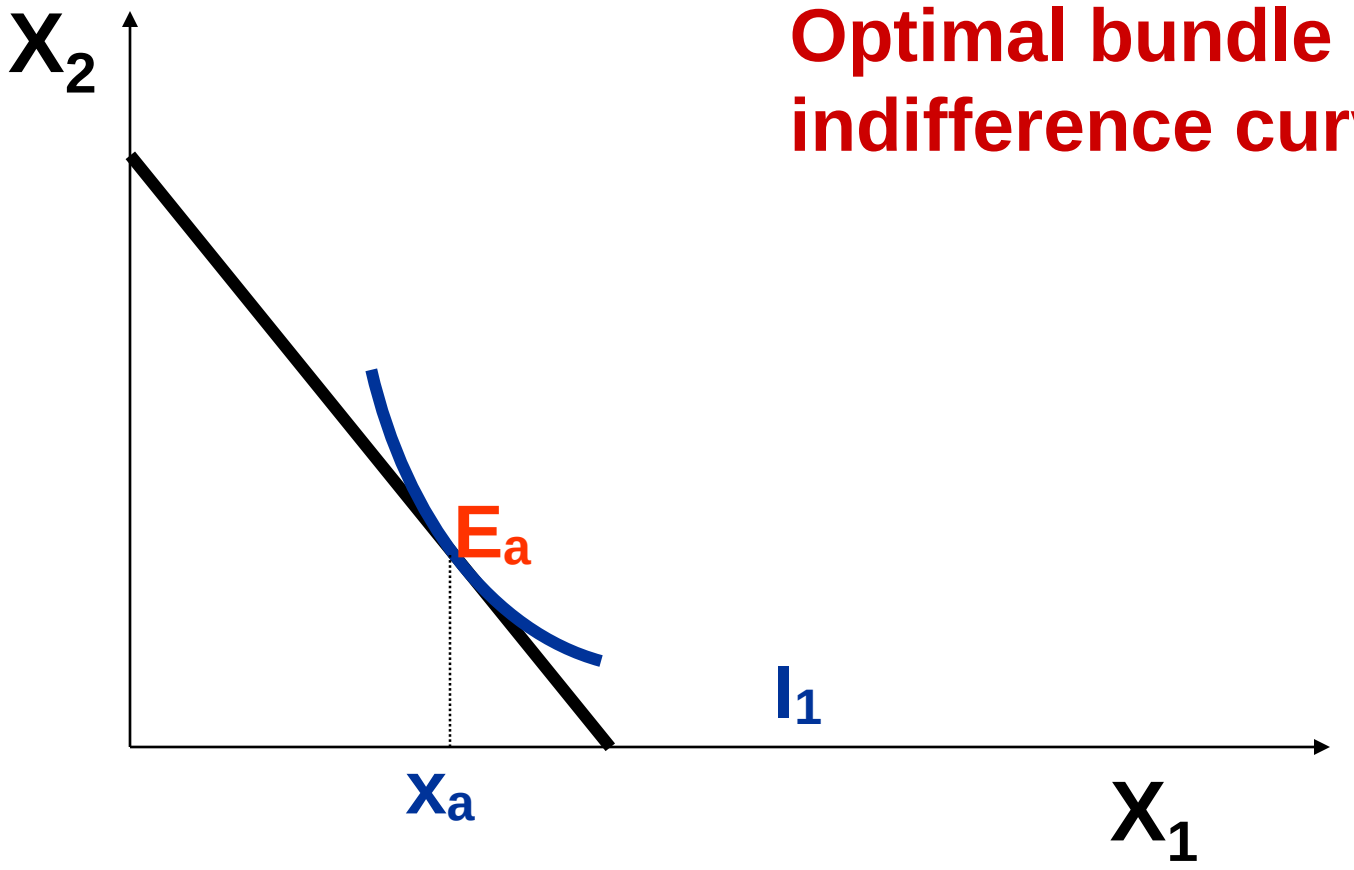
  (i) The Hicksian method; and

  (ii) The Slutsky method

THE HICKSIAN METHOD

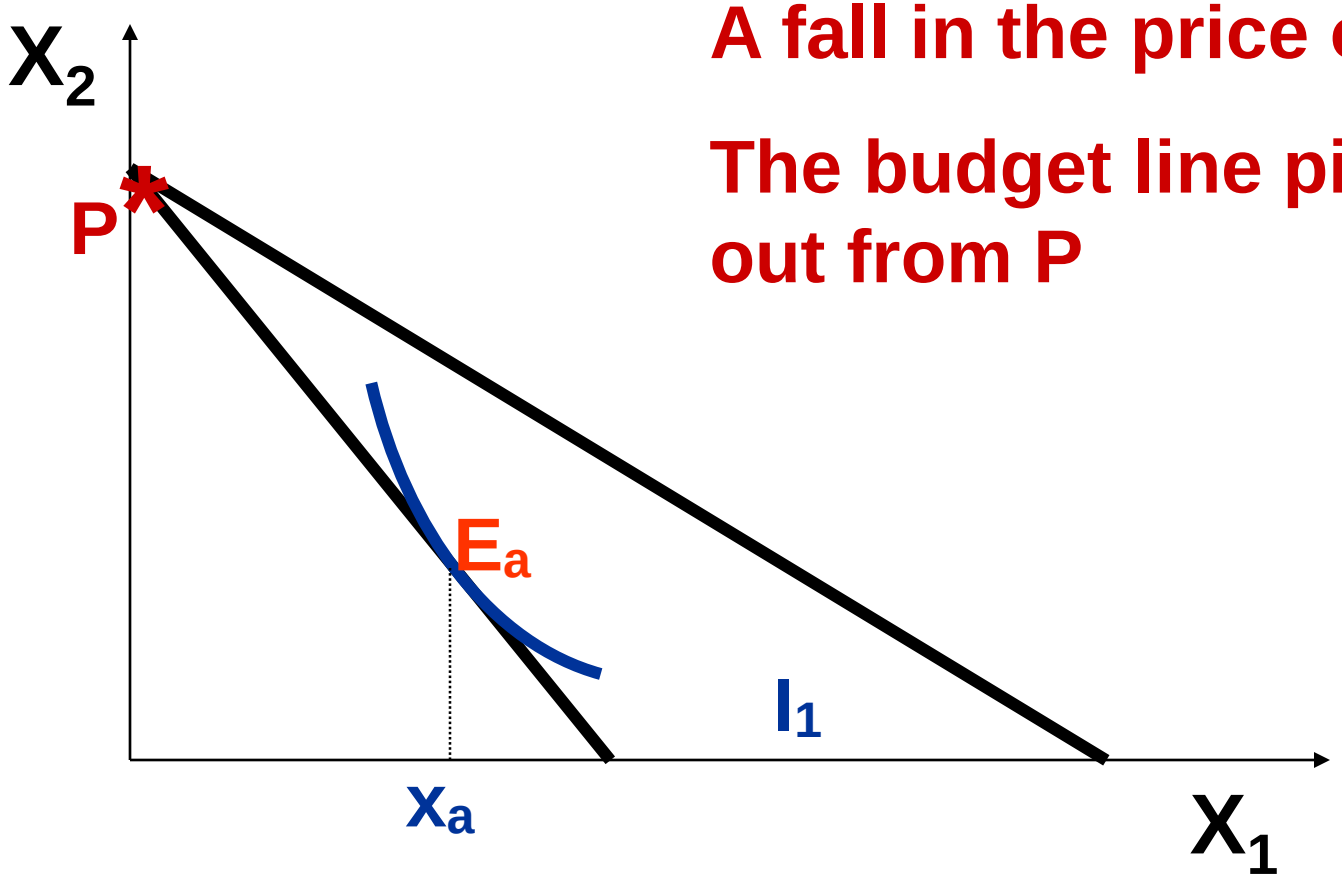
- **Sir John R.Hicks (1904-1989)**
- **Awarded the Nobel Laureate in Economics (with Kenneth J. Arrrow) in 1972 for work on general equilibrium theory and welfare economics.**

THE HICKSIAN METHOD



Optimal bundle is E_a, on indifference curve I_1.

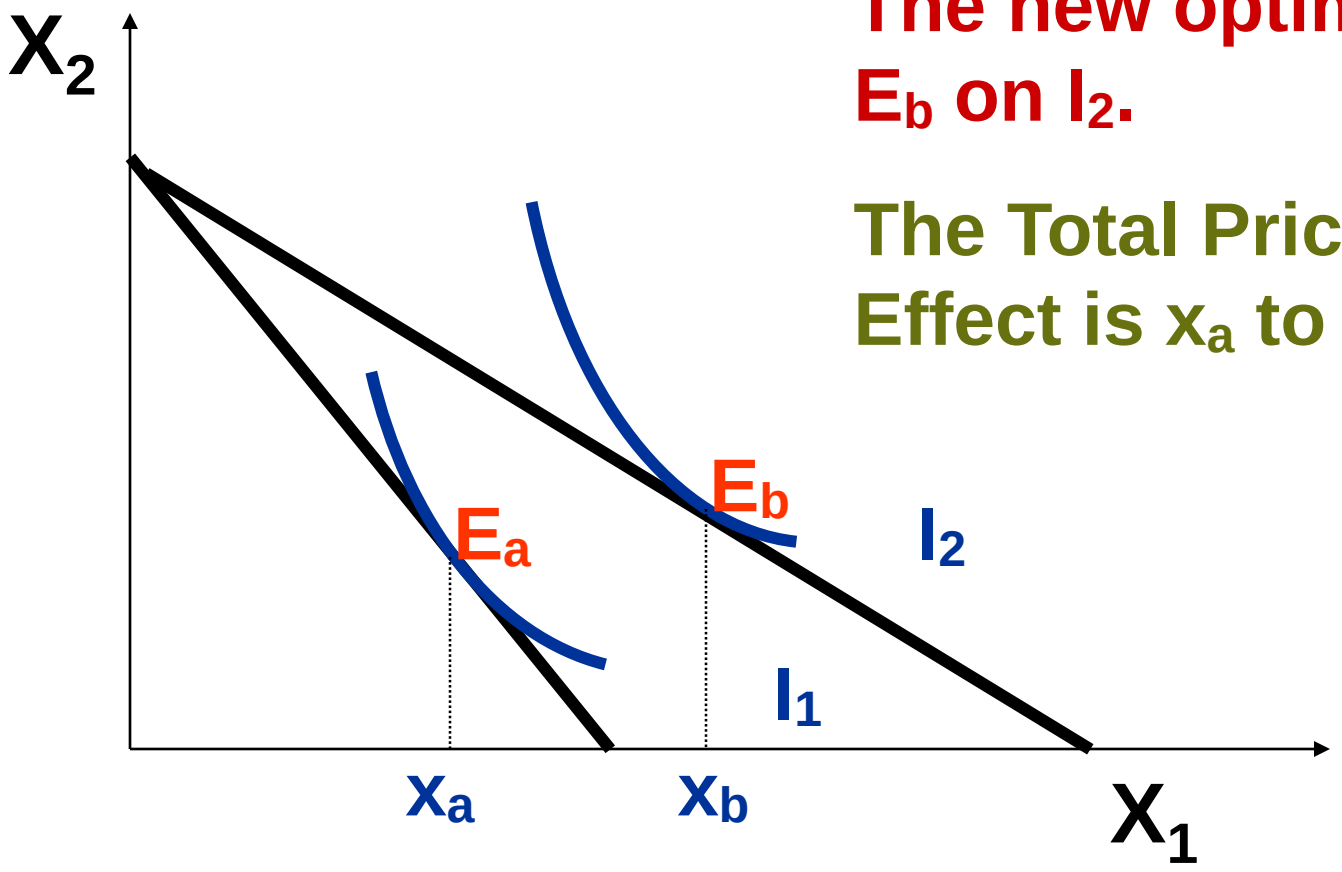
THE HICKSIAN METHOD



A fall in the price of X_1

The budget line pivots out from P

THE HICKSIAN METHOD



The new optimum is E_b on I_2.

The Total Price Effect is x_a to x_b

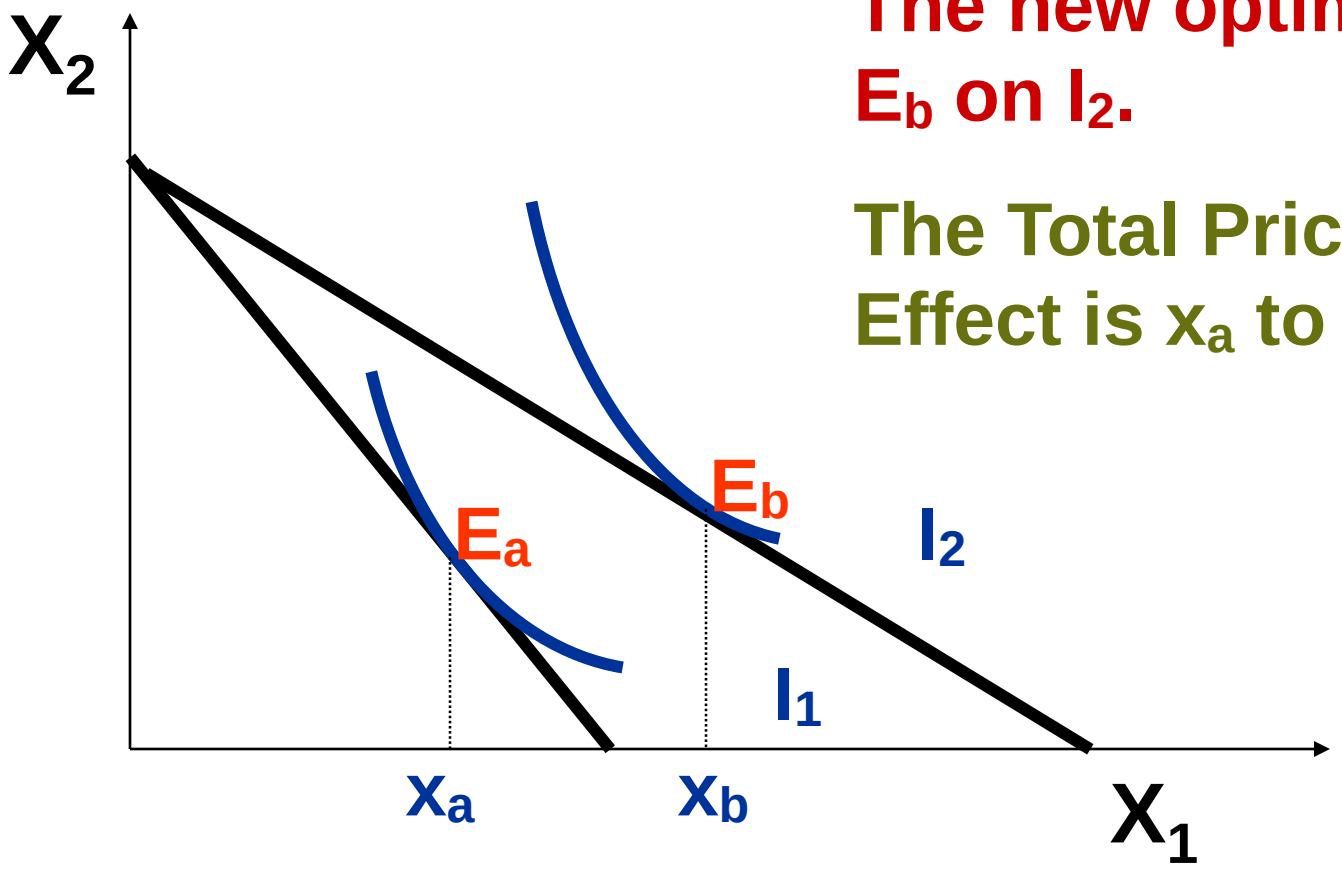
THE HICKSIAN METHOD

- **To isolate the substitution effect we ask….**

  “what would the consumer’s optimal bundle be if s/he faced the new lower price for X_1 but experienced no change in real income?”

- **This amounts to returning the consumer to the original indifference curve (I_1)**

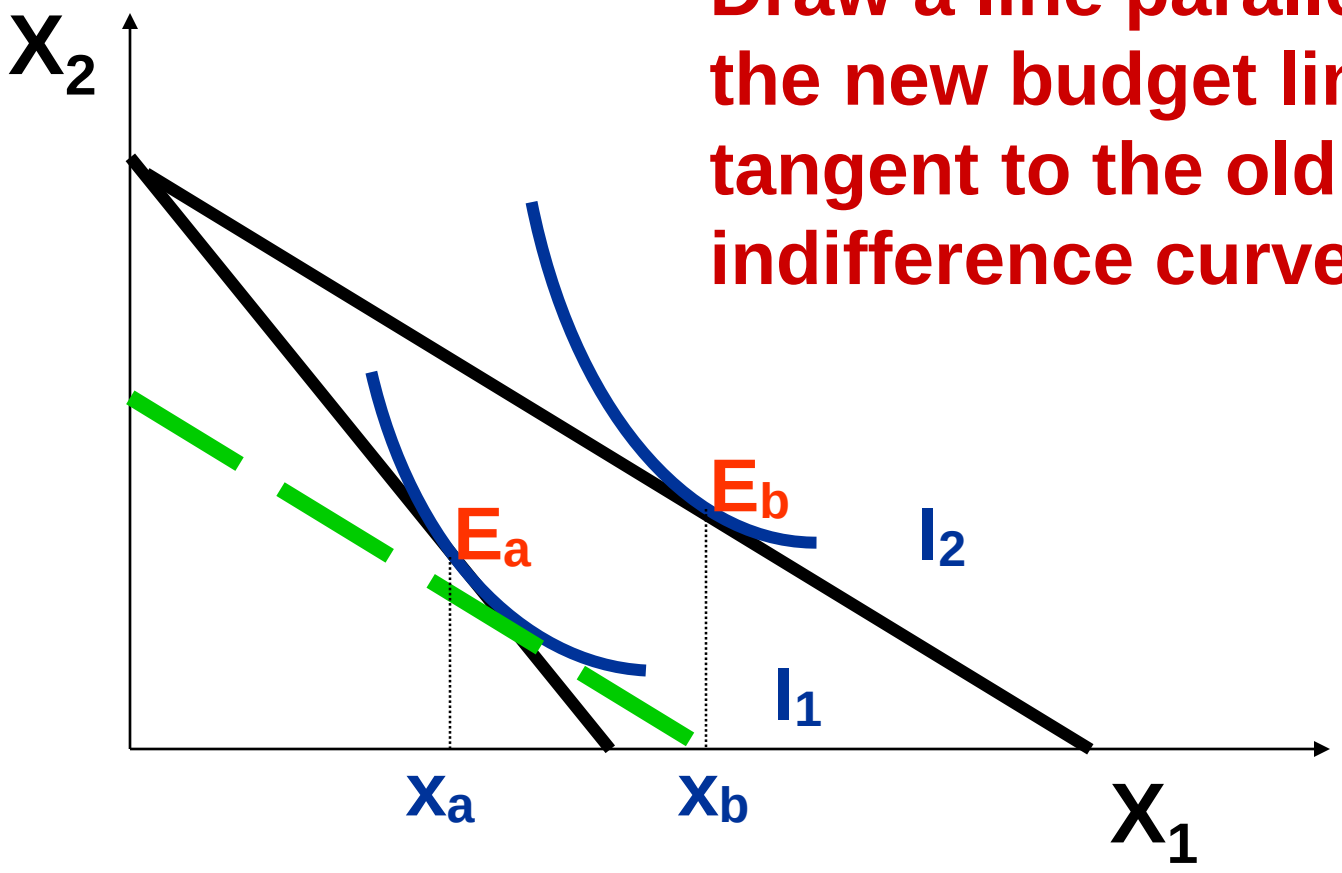
THE HICKSIAN METHOD



The new optimum is E_b on I_2.

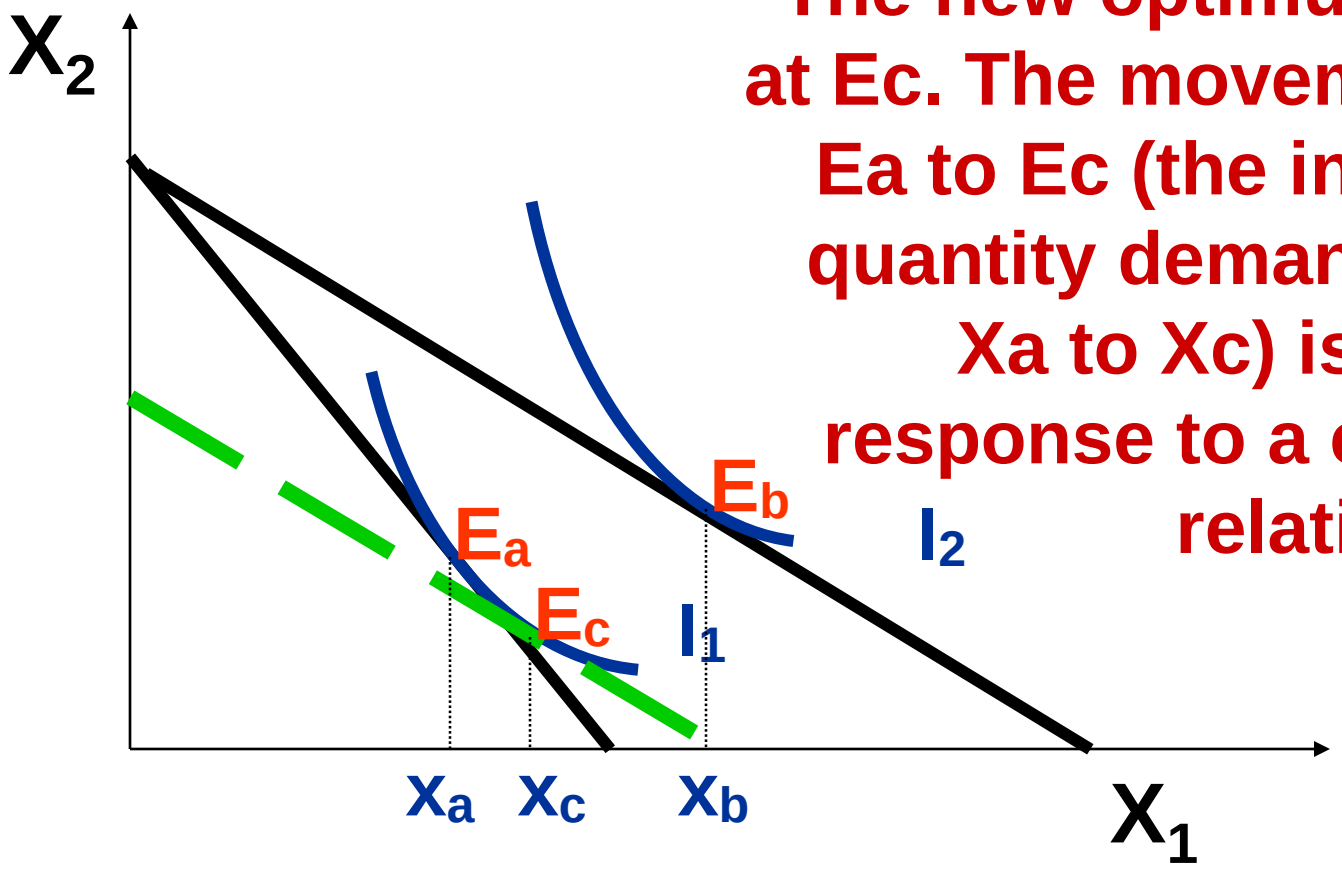
The Total Price Effect is x_a to x_b

THE HICKSIAN METHOD



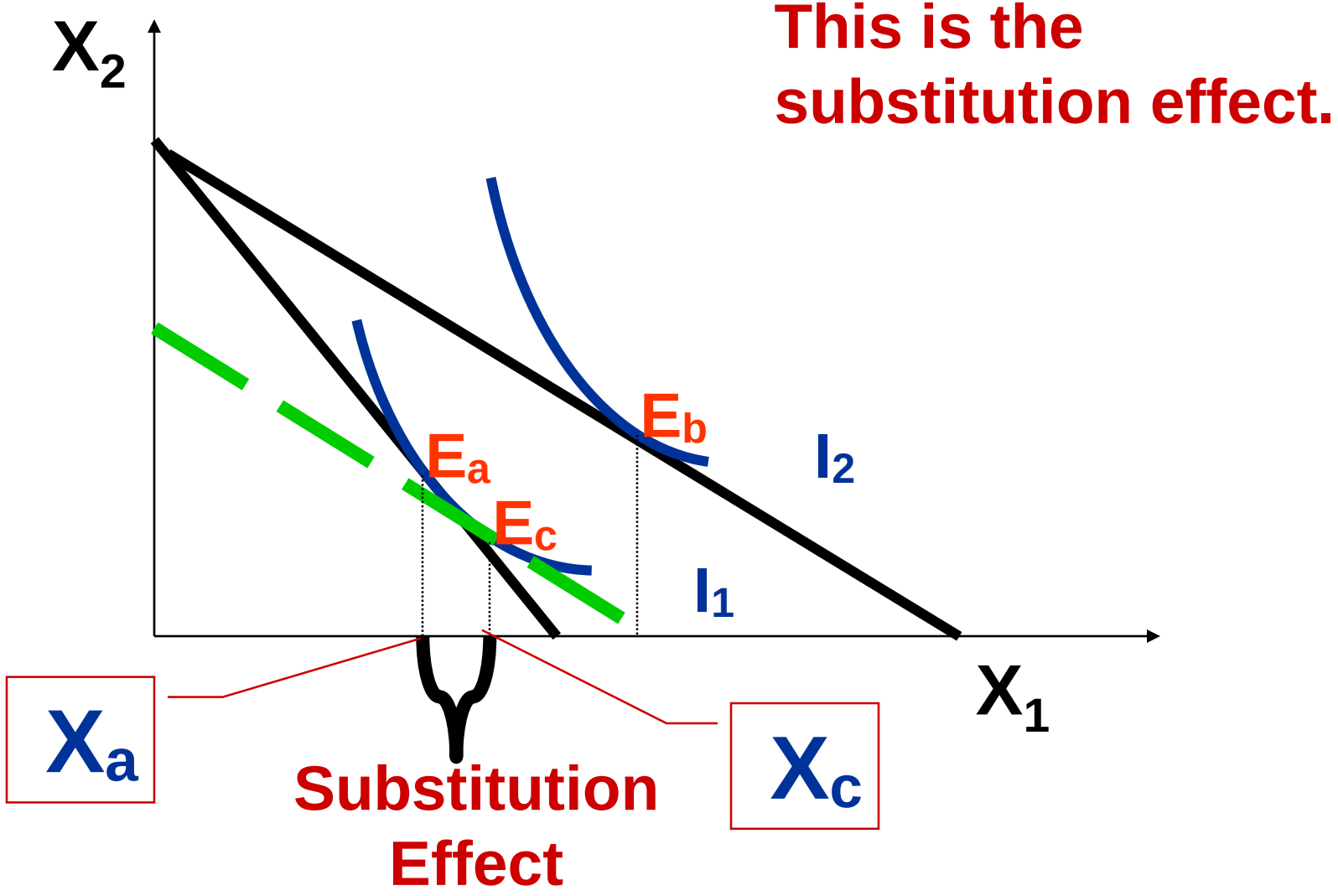
Draw a line parallel to the new budget line and tangent to the old indifference curve

THE HICKSIAN METHOD



The new optimum on I_1 is at Ec. The movement from Ea to Ec (the increase in quantity demanded from Xa to Xc) is solely in response to a change in relative prices

THE HICKSIAN METHOD

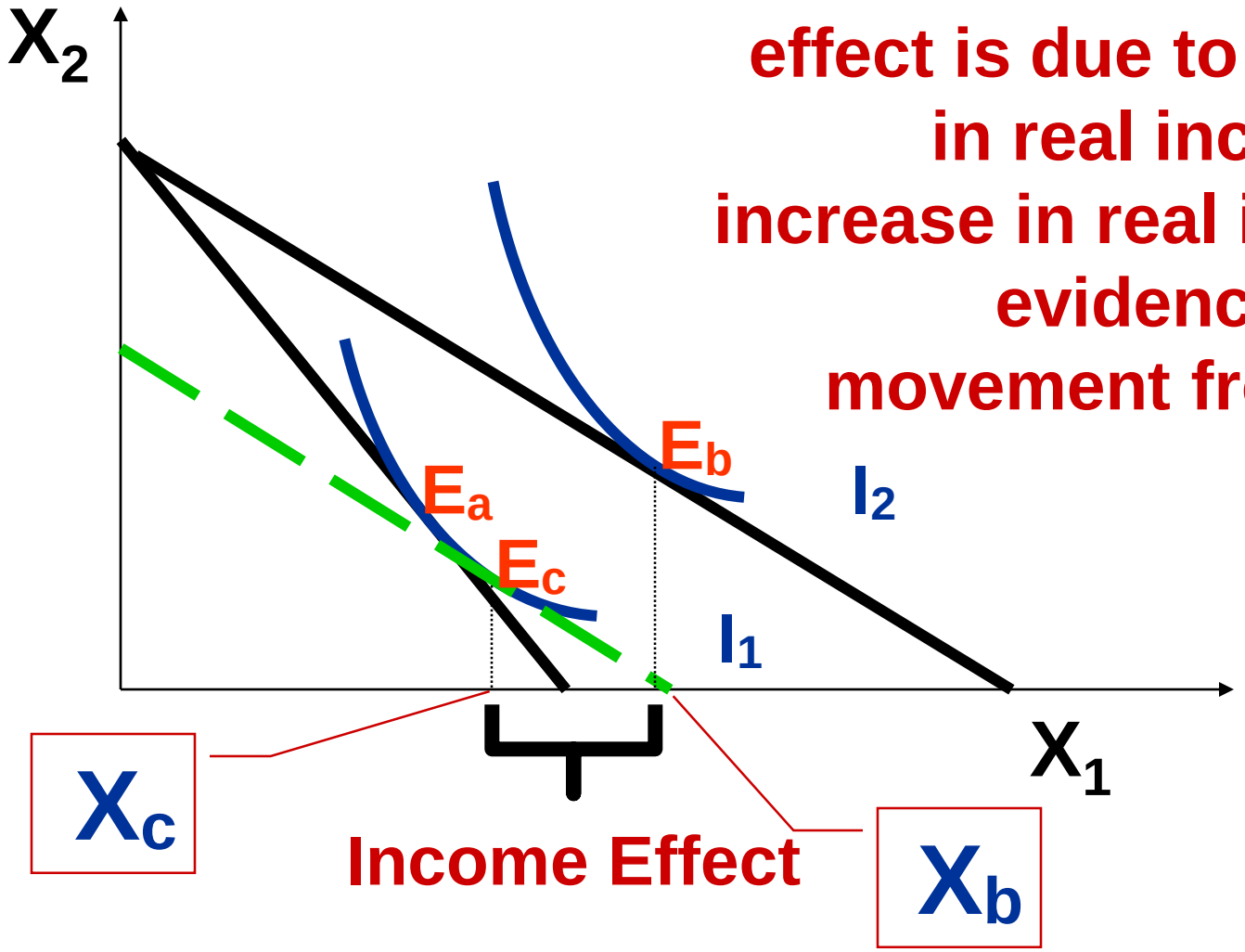


THE HICKSIAN METHOD

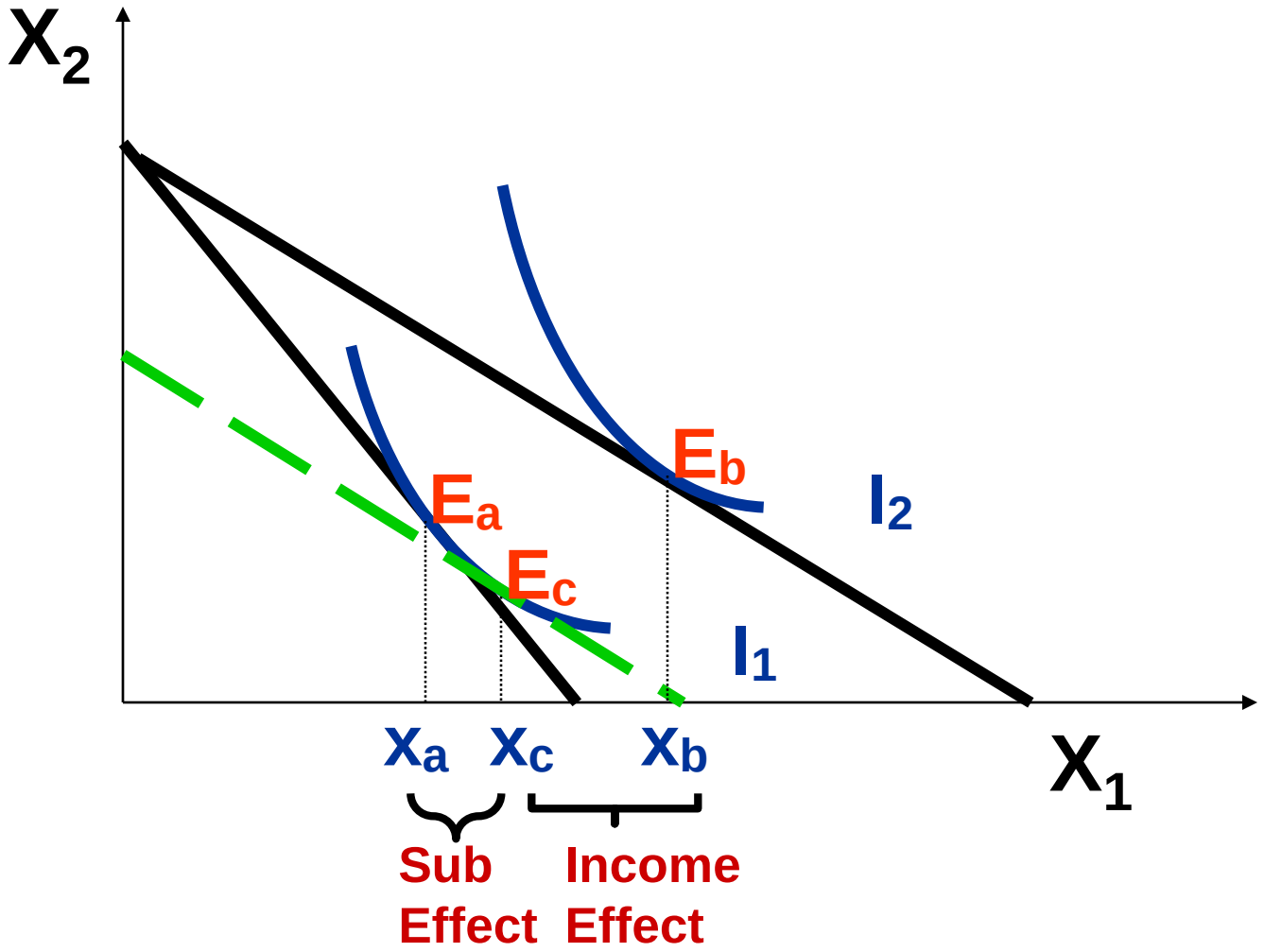
- **To isolate the income effect …**
- **Look at the remainder of the total price effect**
- **This is due to a change in real income.**

THE HICKSIAN METHOD

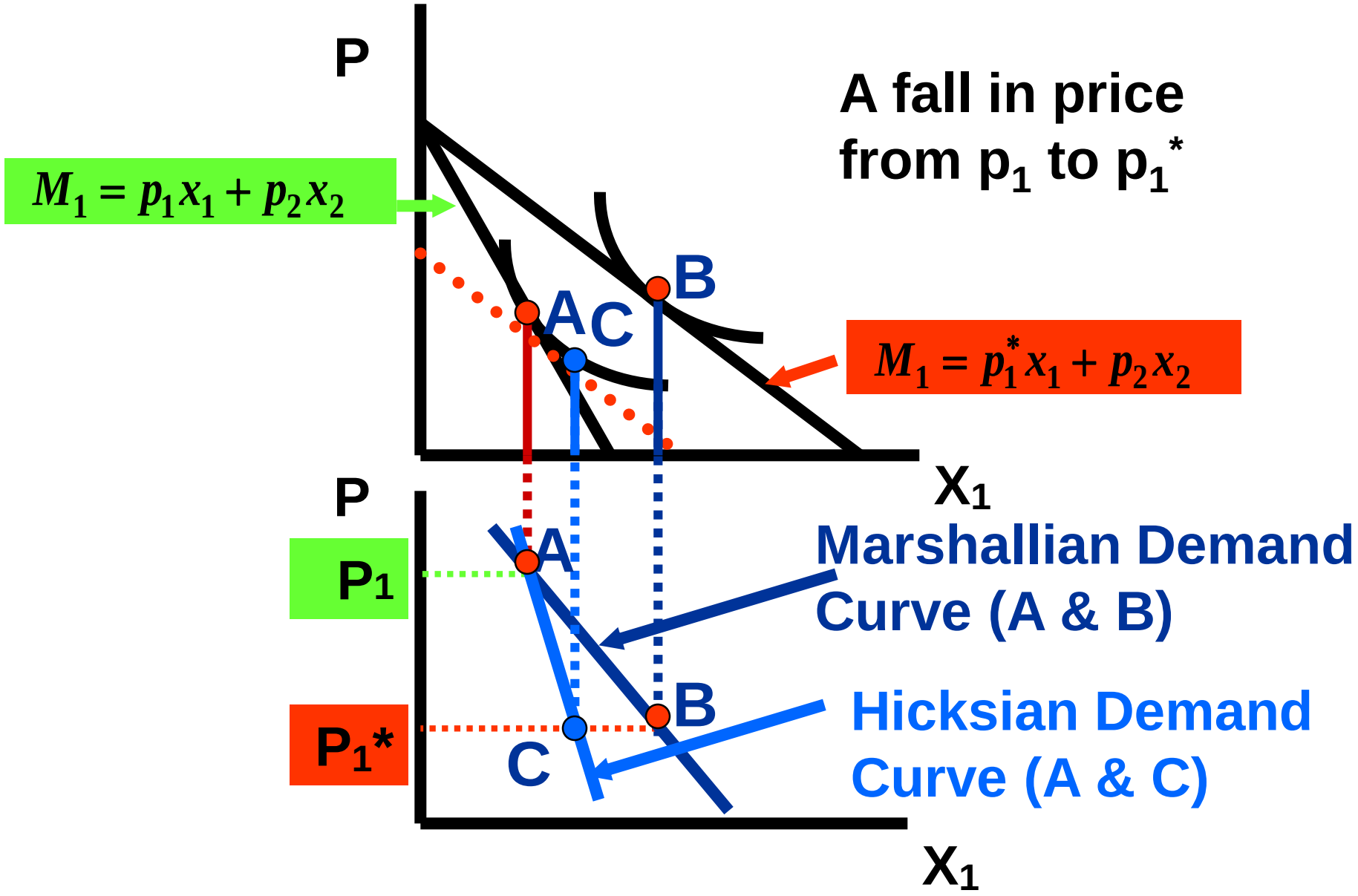
The remainder of the total effect is due to a change in real income. The increase in real income is evidenced by the movement from I_1 to I_2



THE HICKSIAN METHOD



HICKSIAN ANALYSIS and DEMAND CURVES



HICKSIAN ANALYSIS and DEMAND CURVES

Hicksian (compensated) demand curves cannot be upward-sloping (i.e. substitution effect cannot be positive)

NORMAL GOODS

- **Since both the substitution and income effects increase demand when own-price falls, a normal good's ordinary demand curve slopes downwards.**
- **The "Law" of Downward-Sloping Demand therefore always applies to normal goods.**

INFERIOR GOODS

- **Some goods are (sometimes) inferior (i.e. demand is reduced by higher income).**
- **The substitution and income effects "oppose" each other when an inferior good's own price changes.**

Cost Curves

Short-Run versus Long-Run Decisions

short run The period of time for which two conditions hold: The firm is operating under a fixed scale (fixed factor) of production, and firms can neither enter nor exit an industry.

long run That period of time for which there are no fixed factors of production: Firms can increase or decrease the scale of operation, and new firms can enter and existing firms can exit the industry.

Costs in the Short Run

fixed cost Any cost that does not depend on the firms' level of output. These costs are incurred even if the firm is producing nothing. There are no fixed costs in the long run.

variable cost A cost that depends on the level of production chosen.

total cost (*TC*) Total fixed costs plus total variable costs.

$$TC = TFC + TVC$$

Fixed Costs

Total Fixed Cost (*TFC*)

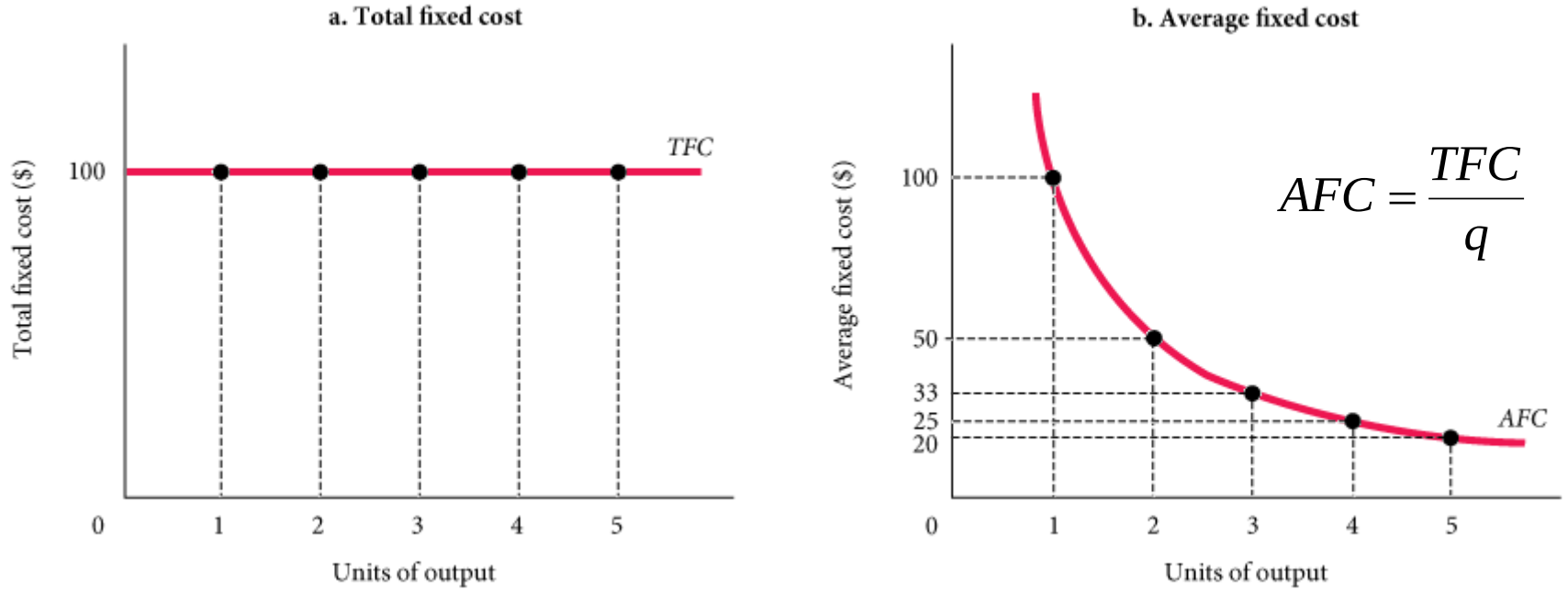
total fixed costs (*TFC*) *or* overhead The total of all costs that do not change with output even if output is zero.

TABLE 8.1 Short-Run Fixed Cost (Total and Average) of a Hypothetical Firm

(1) *q*	(2) *TFC*	(3) *AFC (TFC/q)*
0	$100	$ –
1	100	100
2	100	50
3	100	33
4	100	25
5	100	20

Average Fixed Cost (*AFC*)

average fixed cost (*AFC*) Total fixed cost divided by the number of units of output; a per-unit measure of fixed costs.



▲ **FIGURE 8.2 Short-Run Fixed Cost (Total and Average) of a Hypothetical Firm**

Average fixed cost is simply total fixed cost divided by the quantity of output. As output increases, average fixed cost declines because we are dividing a fixed number ($1,000) by a larger and larger quantity.

spreading overhead The process of dividing total fixed costs by more units of output. Average fixed cost declines as quantity rises.

Variable Costs

Total Variable Cost (*TVC*)

total variable cost (*TVC*) The total of all costs that vary with output in the short run.

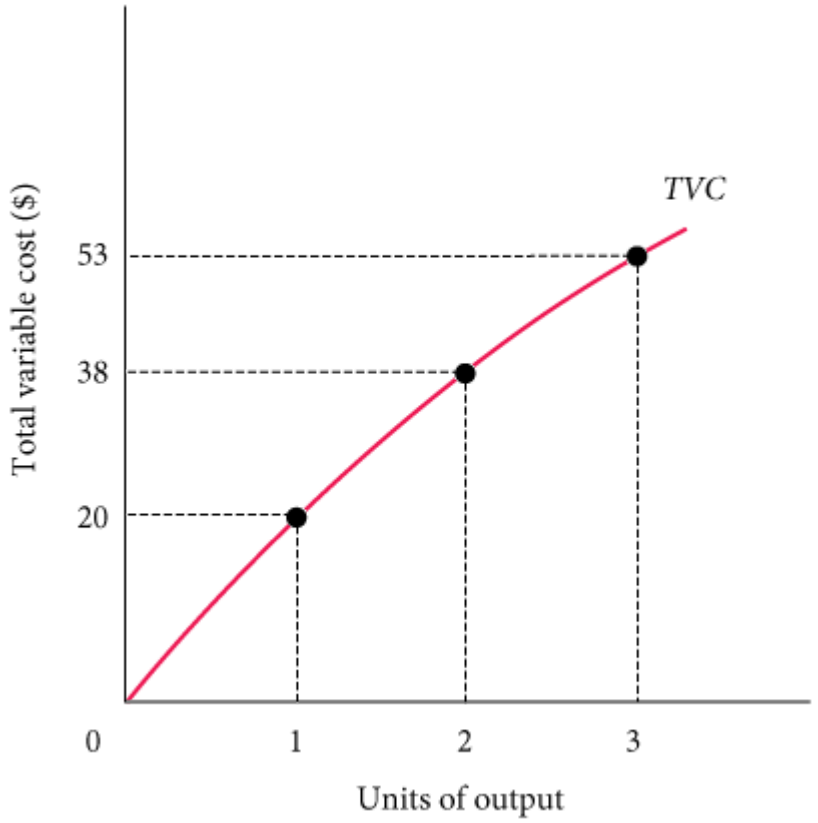
TABLE 8.2 Derivation of Total Variable Cost Schedule from Technology and Factor Prices

Produce	Using Technique	Units of Input Required (Production Function) *K*	*L*	Total Variable Cost Assuming P_K = \$2, P_L = \$1 $TVC = (K \times P_K) + (L \times P_L)$
1 unit of output	*A*	10	7	(10 x \$2) + (7 x \$1) = \$27
	B	6	8	(6 x \$2) + (8 x \$1) = \$20
2 units of output	*A*	16	8	(16 x \$2) + (8 x \$1) = \$40
	B	11	16	(11 x \$2) + (16 x \$1) = \$38
3 units of output	*A*	19	15	(19 x \$2) + (15 x \$1) = \$38
	B	18	22	(18 x \$2) + (22 x \$1) = \$58

total variable cost curve A graph that shows the relationship between total variable cost and the level of a firm's output.

▶ **FIGURE 8.3 Total Variable Cost Curve**

In Table 8.2, total variable cost is derived from production requirements and input prices.
A total variable cost curve expresses the relationship between *TVC* and total output.



Marginal Cost (*MC*)

marginal cost (*MC*) The increase in total cost that results from producing 1 more unit of output. Marginal costs reflect changes in variable costs.

TABLE 8.3 Derivation of Marginal Cost from Total Variable Cost

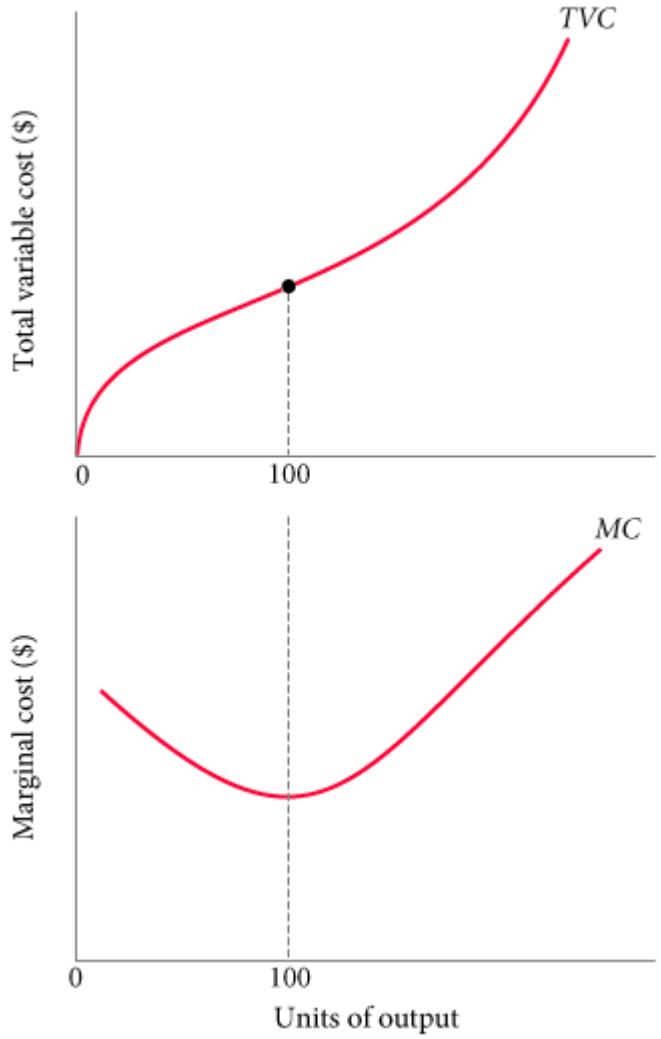
Units of Output	Total Variable Costs ($)	Marginal Costs ($)
0	0	
1	20	20
2	38	18
3	53	15

Graphing Total Variable Costs and Marginal Costs

FIGURE 8.5 Total Variable Cost and Marginal Cost for a Typical Firm

Total variable costs always increase with output.
Marginal cost is the cost of producing each additional unit.
Thus, the marginal cost curve shows how total variable cost changes with single-unit increases in total output.

$$\text{slope of } TVC = \frac{\Delta TVC}{\Delta q} = \frac{\Delta TVC}{1} = \Delta TVC = MC$$



Average Variable Cost (*AVC*)

average variable cost (*AVC*) Total variable cost divided by the number of units of output.

$$AVC = \frac{TVC}{q}$$

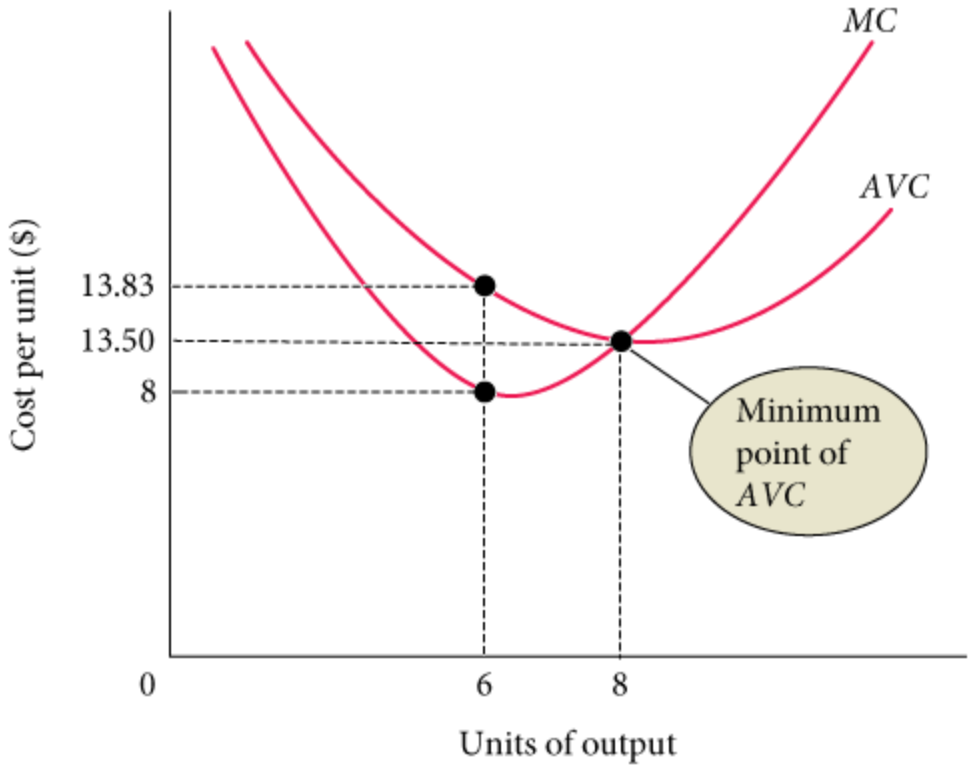
TABLE 8.4 Short-Run Costs of a Hypothetical Firm

(1) *q*	(2) *TVC*	(3) *MC* (Δ *TVC*)	(4) *AVC* (*TVC*/*q*)	(5) *TFC*	(6) *TC* (*TVC* + *TFC*)	(7) *AFC* (*TFC*/*q*)	(8) *ATC* (*TC*/*q* or *AFC* + *AVC*)
0	$ 0.00	$ -	$ -	$ 100.00	$ 100.00	$ -	$ -
1	20.00	20.00	20.00	100.00	120.00	100.00	120.00
2	38.00	18.00	19.00	100.00	138.00	50.00	69.00
3	53.00	15.00	17.66	100.00	153.00	33.33	51.00
4	65.00	12.00	16.25	100.00	165.00	25.00	41.25
5	75.00	10.00	15.00	100.00	175.00	20.00	35.00
6	83.00	8.00	13.83	100.00	183.50	16.67	30.50
7	94.50	11.50	13.50	100.00	194.50	14.28	27.78
8	108.00	13.50	13.50	100.00	208.00	12.50	26.00
9	128.50	20.50	14.28	100.00	228.50	11.11	25.39
10	168.50	40.00	16.85	100.00	268.50	10.00	26.85

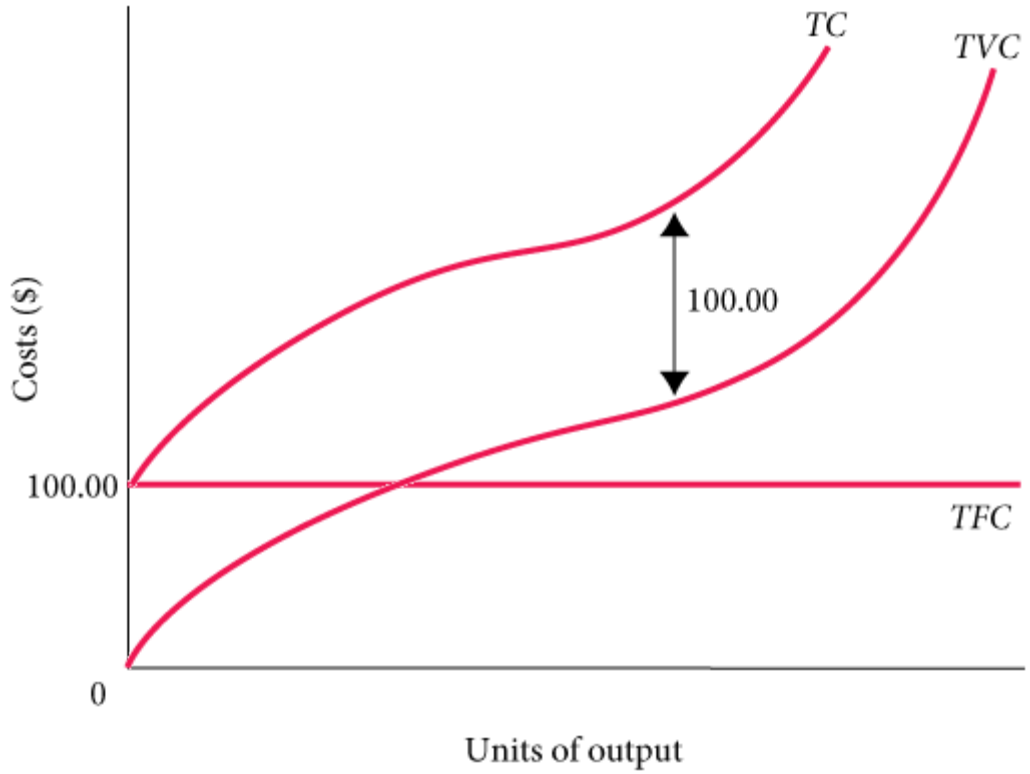
Graphing Average Variable Costs and Marginal Costs

▶ FIGURE 8.6 More Short-Run Costs

When marginal cost is *below* average cost, average cost is declining.
When marginal cost is *above* average cost, average cost is increasing.
Rising marginal cost intersects average variable cost at the minimum point of *AVC*.



Total Costs



▲ **FIGURE 8.7 Total Cost = Total Fixed Cost + Total Variable Cost**

Adding *TFC* to *TVC* means adding the same amount of total fixed cost to every level of total variable cost.

Thus, the total cost curve has the same shape as the total variable cost curve; it is simply higher by an amount equal to *TFC*.

Average Total Cost (*ATC*)

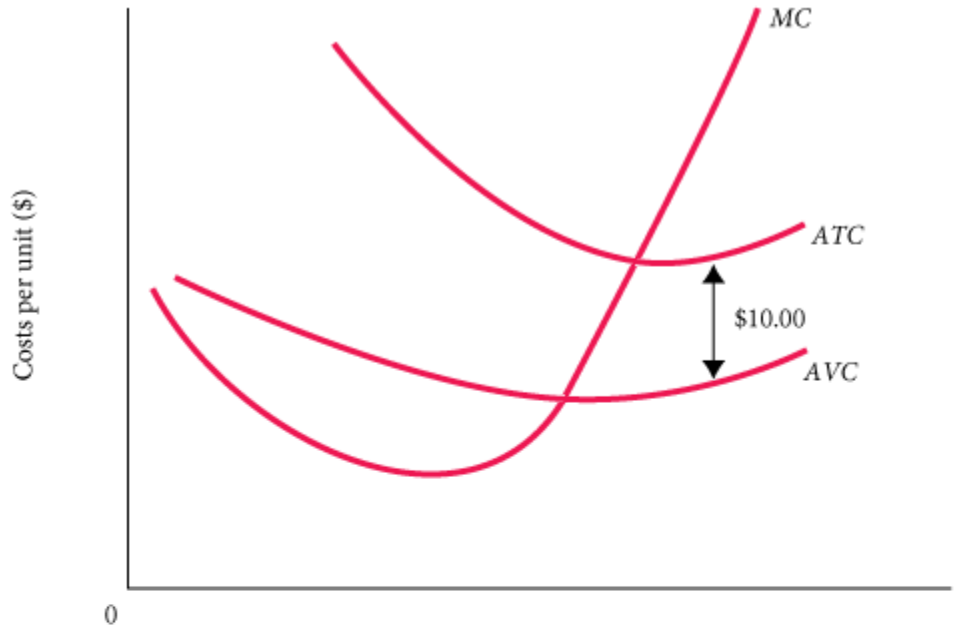
average total cost (*ATC*) Total cost divided by the number of units of output.

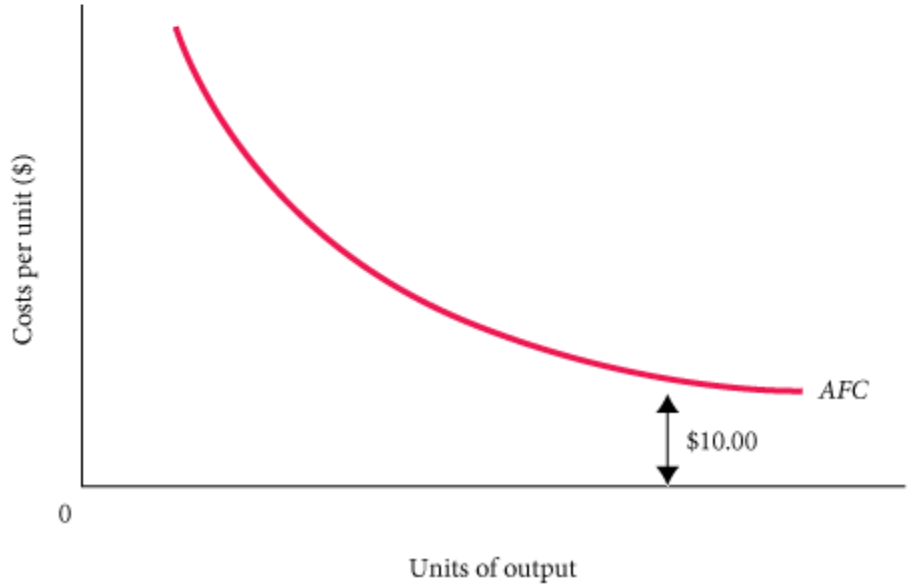
$$ATC = \frac{TC}{q}$$

$$ATC = AFC + AVC$$

Average Total Cost = Average Variable Cost + Average Fixed Cost

To get average total cost, we add average fixed and average variable costs at all levels of output. Because average fixed cost falls with output, an ever-declining amount is added to *AVC*. Thus, *AVC* and *ATC* get closer together as output increases, but the two lines never meet.

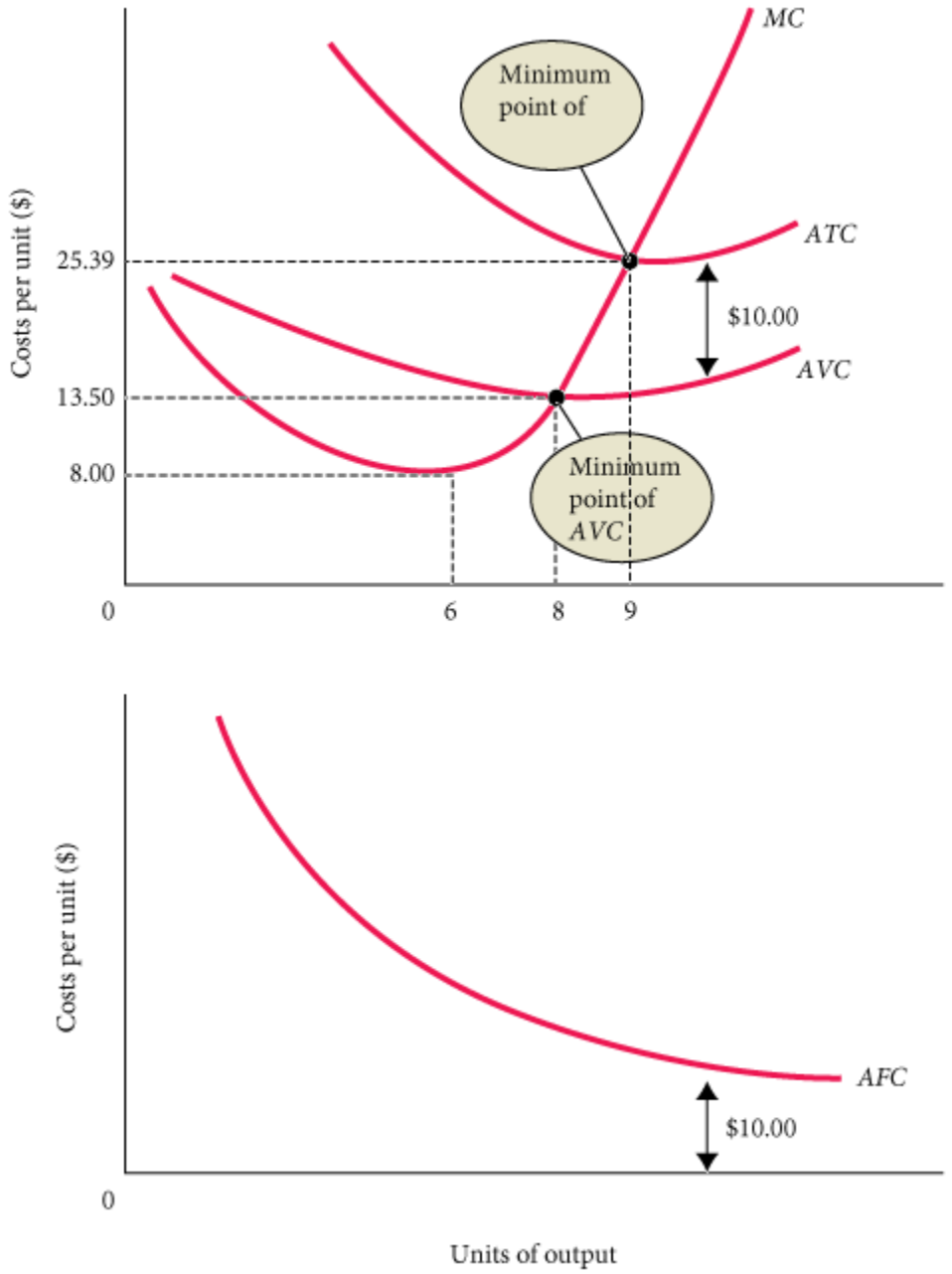




The Relationship Between Average Total Cost and Marginal Cost

The relationship between average *total* cost and marginal cost is exactly the same as the relationship between average *variable* cost and marginal cost.

If marginal cost is *below* average total cost, average total cost will *decline* toward marginal cost. If marginal cost is *above* average total cost, average total cost will *increase*. As a result, marginal cost intersects average *total* cost at *ATC*'s minimum point for the same reason that it intersects the average *variable* cost curve at its minimum point.



Short-Run Costs: A Review

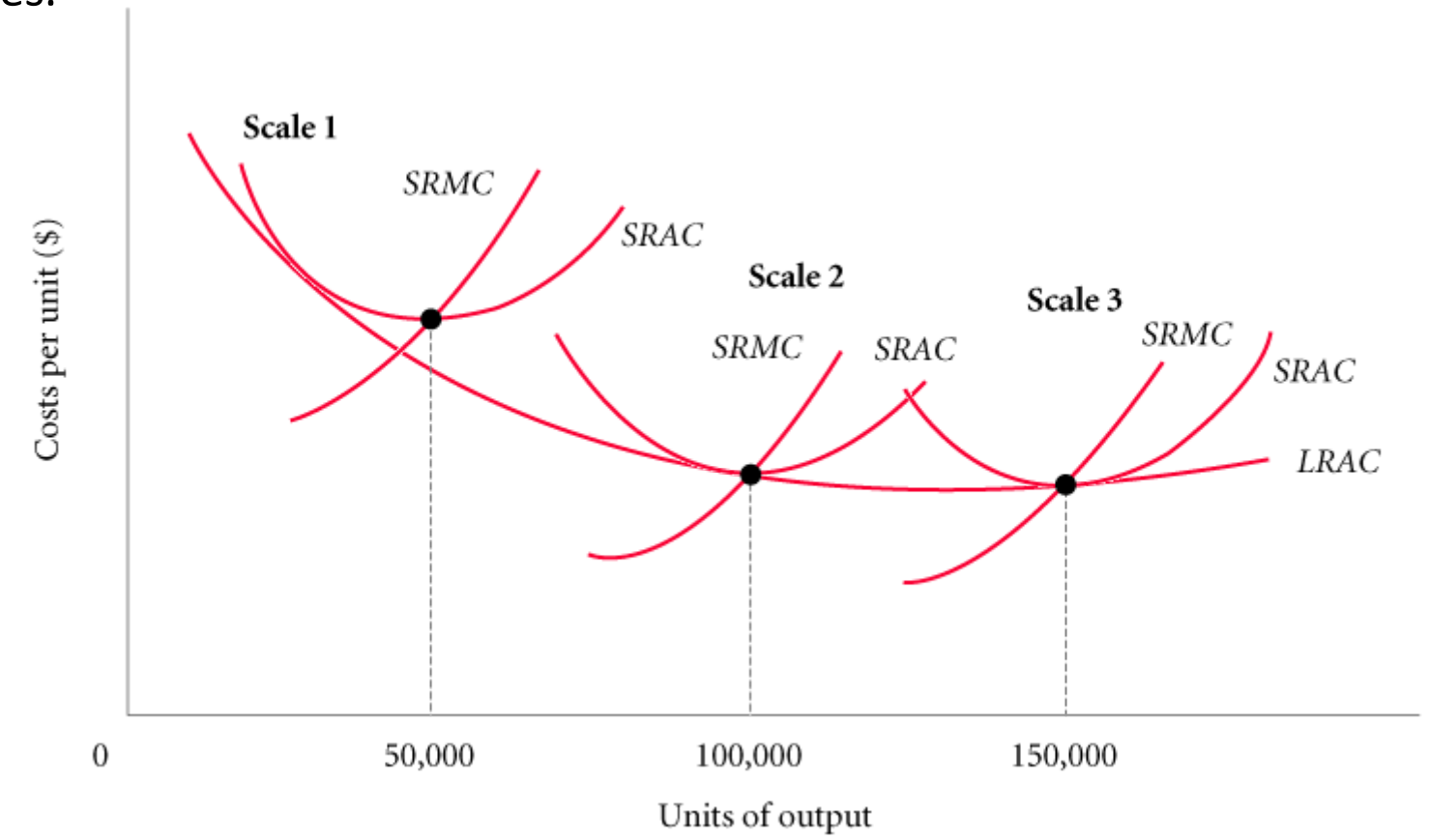
TABLE 8.5 A Summary of Cost Concepts

Term	Definition	Equation
Accounting costs	Out-of-pocket costs or costs as an accountant would define them. Sometimes referred to as *explicit costs*.	–
Economic costs	Costs that include the full opportunity costs of all inputs. These include what are often called *implicit costs*.	–
Total fixed costs (*TFC*)	Costs that do not depend on the quantity of output produced. These must be paid even if output is zero.	–
Total variable costs (*TVC*)	Costs that vary with the level of output.	–
Total cost (*TC*)	The total economic cost of all the inputs used by a firm in production.	$TC = TFC + TVC$
Average fixed costs (*AFC*)	Fixed costs per unit of output.	$AFC = TFC/q$
Average variable costs (*AVC*)	Variable costs per unit of output.	$AVC = TVC/q$
Average total costs (*ATC*)	Total costs per unit of output.	$ATC = TC/q$ $ATC = AFC + AVC$
Marginal costs (*MC*)	The increase in total cost that results from producing 1 additional unit of output.	$MC = \Delta TC/\Delta q$

Why short run average cost curves are U-shaped?

Long-run Average cost curve

long-run average cost curve (*LRAC*) The "envelope" of a series of short-run cost curves.



minimum efficient scale (MES) The smallest size at which the long-run average cost curve is at its minimum.

Profit Maximization in Perfectly Competitive Market

Output Decisions: Revenues, Costs, and Profit Maximization

Perfect Competition

perfect competition An industry structure in which there are many firms, each small relative to the industry, producing identical products and in which no firm is large enough to have any control over prices. In perfectly competitive industries, new competitors can freely enter and exit the market.

homogeneous products Undifferentiated products; products that are identical to, or indistinguishable from, one another.

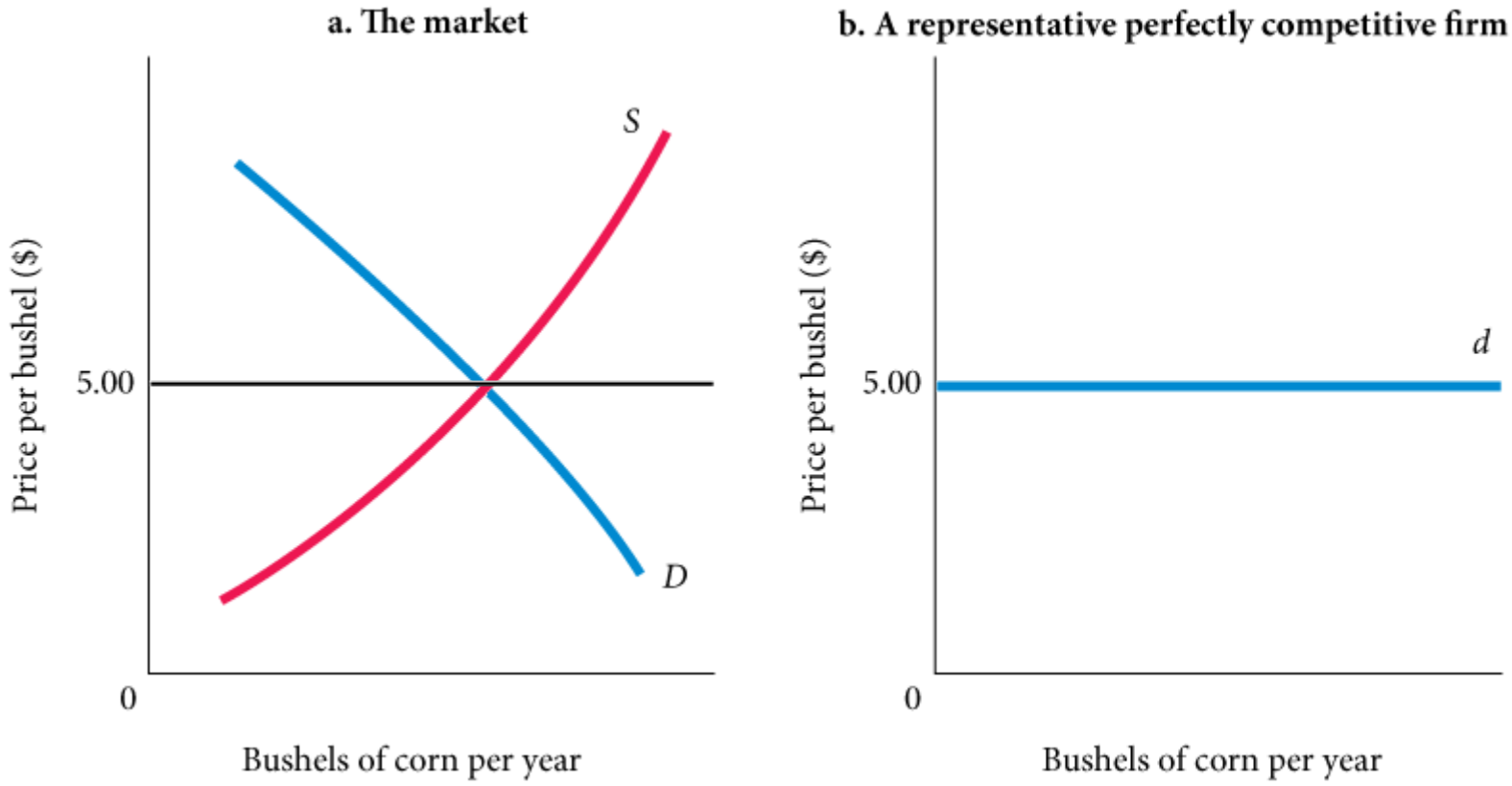


FIGURE 8.9 Demand Facing a Single Firm in a Perfectly Competitive Market

If a representative firm in a perfectly competitive market raises the price of its output above $5.00, the quantity demanded of *that firm's* output will drop to zero.

Each firm faces a perfectly elastic demand curve, *d*.

Total Revenue and Marginal Revenue

total revenue (*TR*) The total amount that a firm takes in from the sale of its product: the price per unit times the quantity of output the firm decides to produce (*P* x *q*).

$$\text{total revenue} = \text{price} \times \text{quantity}$$

$$TR = P \times q$$

marginal revenue (*MR*) The additional revenue that a firm takes in when it increases output by one additional unit. In perfect competition, *P* = *MR*.

The *marginal revenue curve and the demand curve facing a competitive firm are identical*. The horizontal line in Figure 8.9(b) can be thought of as both the demand curve facing the firm and its marginal revenue curve:

$$P^* = d = MR$$

The Profit-Maximizing Level of Output

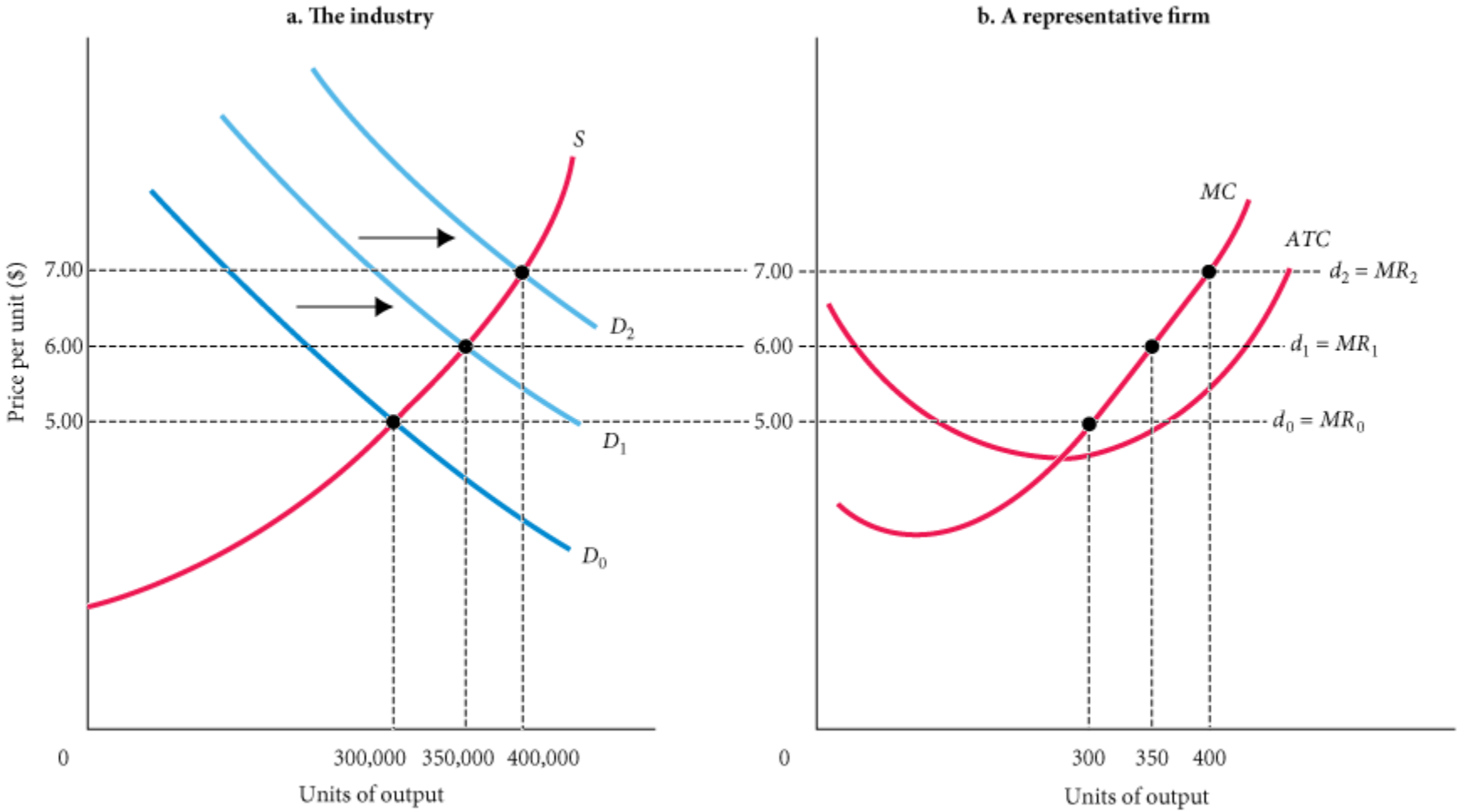
As long as marginal revenue is greater than marginal cost, even though the difference between the two is getting smaller, added output means added profit. Whenever marginal revenue exceeds marginal cost, the revenue gained by increasing output by 1 unit per period exceeds the cost incurred by doing so.

The profit-maximizing perfectly competitive firm will produce up to the point where the price of its output is just equal to short-run marginal cost—the level of output at which $P^* = MC$.

The profit-maximizing output level for *all* firms is the output level where $MR = MC$.
In perfect competition, however, MR = P, as shown earlier. Hence, for perfectly competitive firms, we can rewrite our profit-maximizing condition as $P = MC$.

Important note: The key idea here is that firms will produce as long as marginal revenue exceeds marginal cost.

The Short-Run Supply Curve



At any market price, the marginal cost curve shows the output level that maximizes profit.

Thus, the marginal cost curve of a perfectly competitive profit-maximizing firm is the firm's short-run supply curve.

Minimizing Losses

- If total revenue exceeds total variable cost, the excess revenue can be used to offset fixed costs and reduce losses, and it will pay the firm to keep operating.
- If total revenue is smaller than total variable cost, the firm that operates will suffer losses in excess of fixed costs. In this case, the firm can minimize its losses by shutting down.

Producing at a Loss to Offset Fixed Costs

shutdown point The lowest point on the average variable cost curve. When price falls below the minimum point on *AVC*, total revenue is insufficient to cover variable costs and the firm will shut down and bear losses equal to fixed costs.

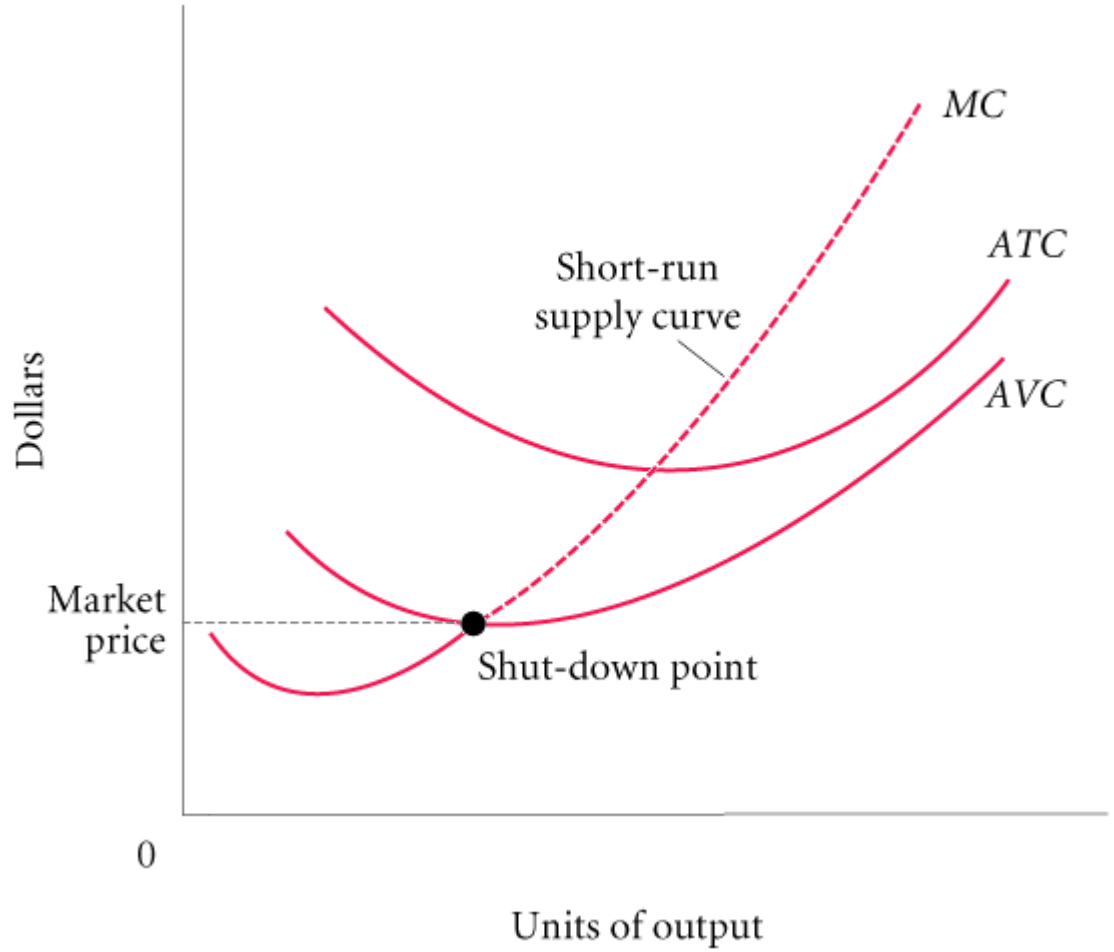


FIGURE 9.2 Short-Run Supply Curve of a Perfectly Competitive Firm

At prices below average variable cost, it pays a firm to shut down rather than continue operating. Thus, the short-run supply curve of a competitive firm is the part of its marginal cost curve that lies *above* its average variable cost curve.

Long-Run Directions: A Review

TABLE 9.2 Profits, Losses, and Perfectly Competitive Firm Decisions in the Long and Short Run

	Short-Run Condition	Short-Run Decision	Long-Run Decision
Profits	$TR > TC$	$P = MC$: operate	Expand: new firms enter
Losses	1. $TR \geq TVC$	$P = MC$: operate (loss < total fixed cost)	Contract: firms exit
	2. $TR < TVC$	Shut down: loss = total fixed cost	Contract: firms exit

U-Shaped Long-Run Average Costs

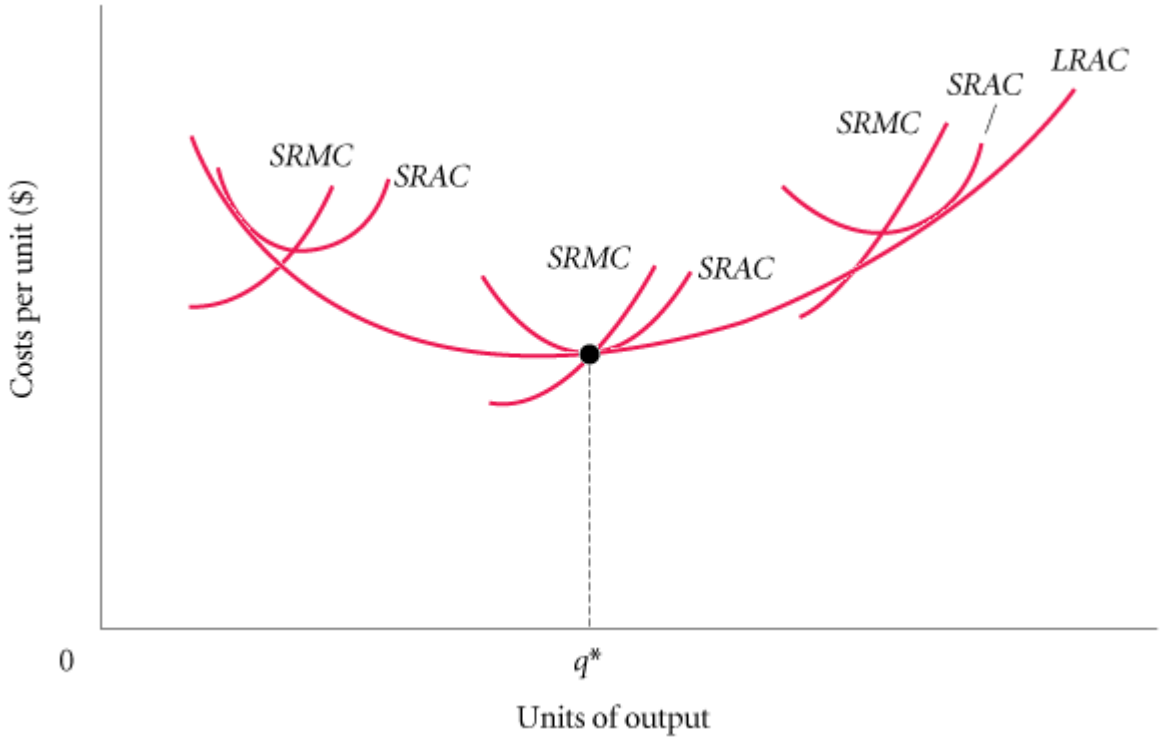


FIGURE 9.5 A Firm Exhibiting Economies and Diseconomies of Scale

Economies of scale push this firm's average costs down to q^*.
Beyond q^*, the firm experiences diseconomies of scale;
q^* is the level of production at lowest average cost, using optimal scale.

optimal scale of plant The scale of plant that minimizes average cost.

Long-Run Adjustments to Short-Run Conditions

Short-Run Profits: Moves In and Out of Equilibrium

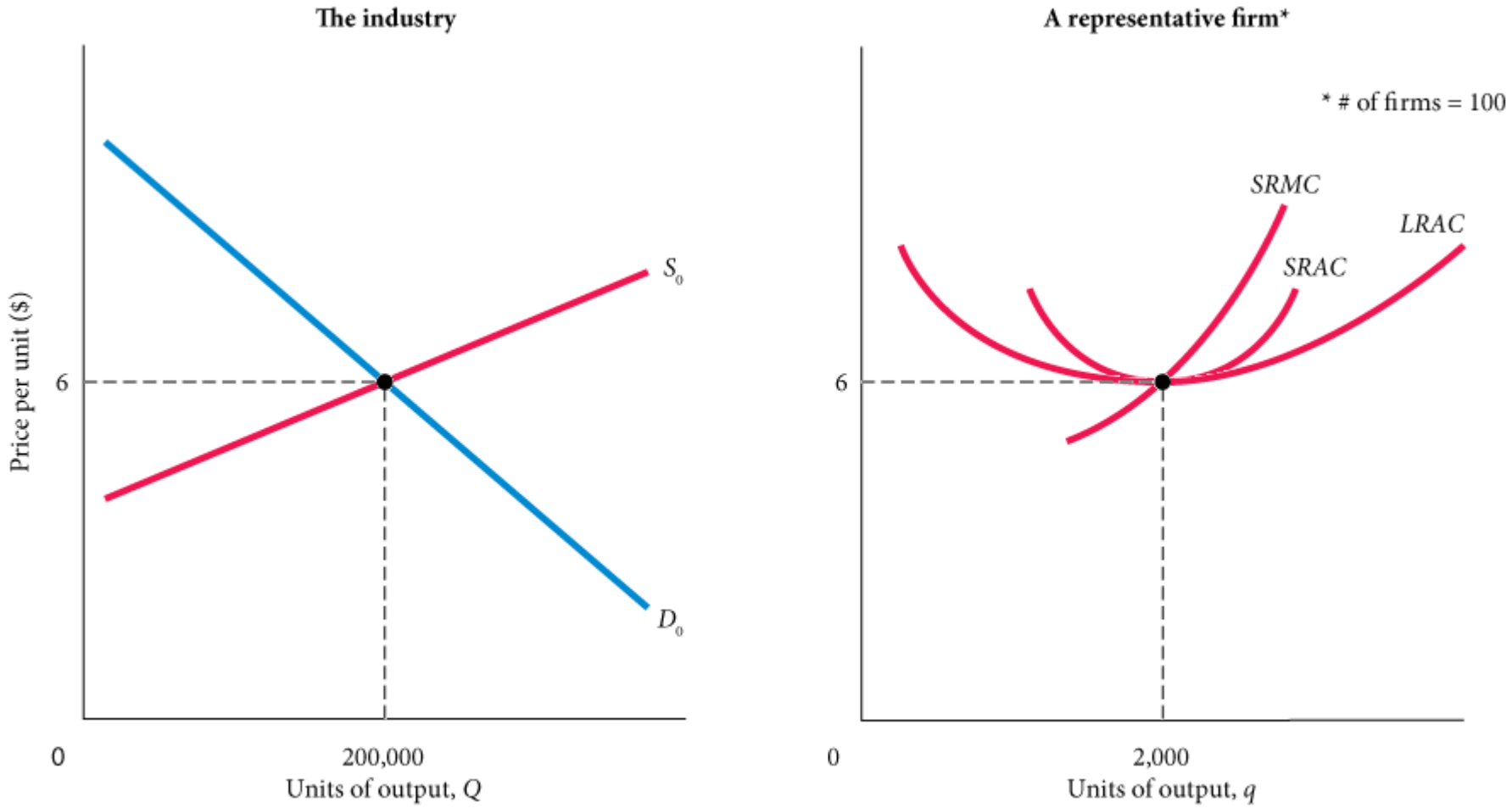


FIGURE 9.6 Equilibrium for an Industry with U-shaped Cost Curves

In equilibrium, each firm has

$$SRMC = SRAC = LRAC$$

Firms make no excess profits so that

$$P = SRMC = SRAC = LRAC$$

and there are enough firms so that supply equals demand.

▼ **FIGURE 15.1 Characteristics of Different Market Organizations**

	Number of firms	Products differentiated or homogeneous	Price a decision variable	Easy entry	Distinguished by	Examples
Perfect competition	Many	Homogeneous	No	Yes	Market sets price	Wheat farmer Textile firm
Monopoly	One	One version or many versions of a product	Yes	No	Still constrained by market demand	Public utility Patented drug
Monopolistic competition	Many	Differentiated	Yes, but limited	Yes	Price and quality competition	Restaurants Hand soap
Oligopoly	Few	Either	Yes	Limited	Strategic behavior	Automobiles Aluminum

Imperfect Competition and Market Power: Core Concepts

imperfectly competitive industry An industry in which individual firms have some control over the price of their output.

market power An imperfectly competitive firm's ability to raise price without losing all of the quantity demanded for its product.

Forms of Imperfect Competition and Market Boundaries

A *monopoly* is an industry with a single firm in which the entry of new firms is blocked.

An *oligopoly* is an industry in which there is a small number of firms, each large enough so that its presence affects prices.

Firms that differentiate their products in industries with many producers and free entry are called *monopolistic competitors*.

pure monopoly An industry with a single firm that produces a product for which there are no close substitutes and in which significant barriers to entry prevent other firms from entering the industry to compete for profits.

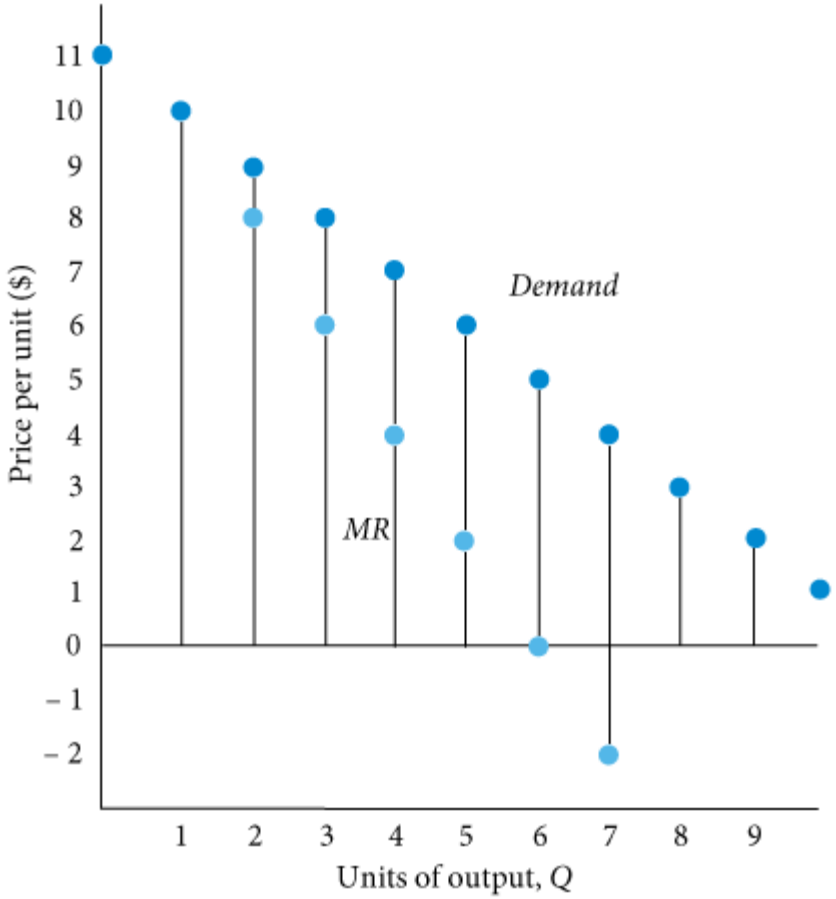
Price and Output Decisions in Pure Monopoly Markets

Demand in Monopoly Markets

Marginal Revenue and Market Demand

TABLE 13.1 Marginal Revenue Facing a Monopolist

(1) Quantity	(2) Price	(3) Total Revenue	(4) Marginal Revenue
0	$11	0	–
1	10	$10	$10
2	9	18	8
3	8	24	6
4	7	28	4
5	6	30	2
6	5	30	0
7	4	28	−2
8	3	24	−4
9	2	18	−6
10	1	10	−8

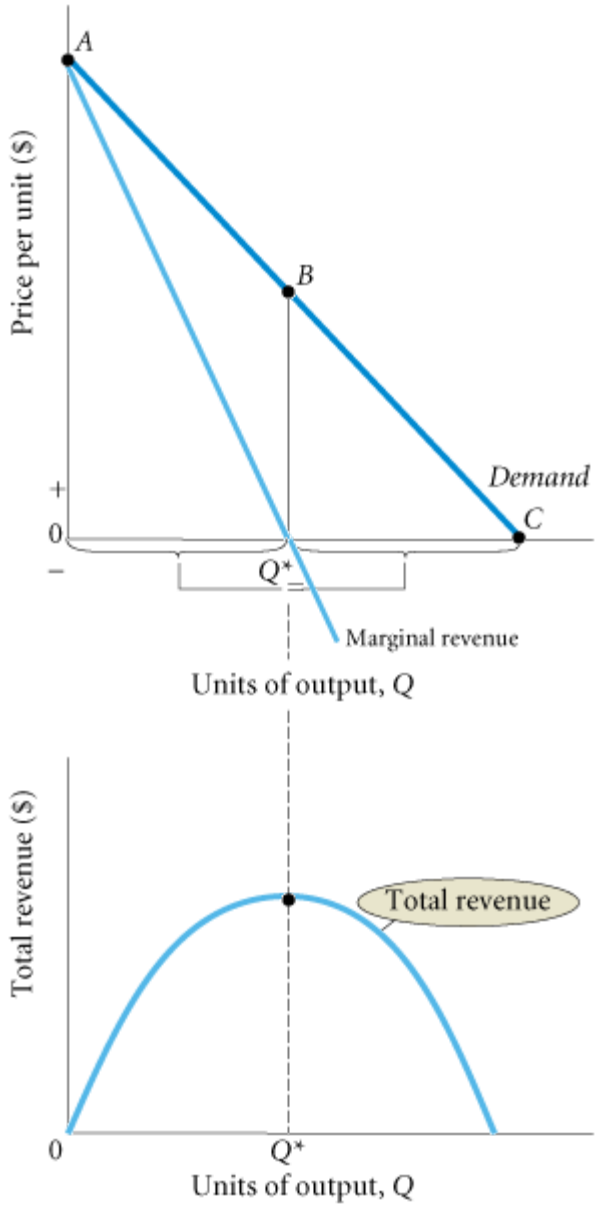


▲ **FIGURE 13.2 Marginal Revenue Curve Facing a Monopolist**

At every level of output except 1 unit, a monopolist's marginal revenue (*MR*) is below price. This is so because (1) we assume that the monopolist must sell all its product at a single price (no price discrimination) and (2) to raise output and sell it, the firm must lower the price it charges. Selling the additional output will raise revenue, but this increase is offset somewhat by the lower price charged for all units sold. Therefore, the increase in revenue from increasing output by 1 (the marginal revenue) is less than the price.

▶ **FIGURE 13.3 Marginal Revenue and Total Revenue**

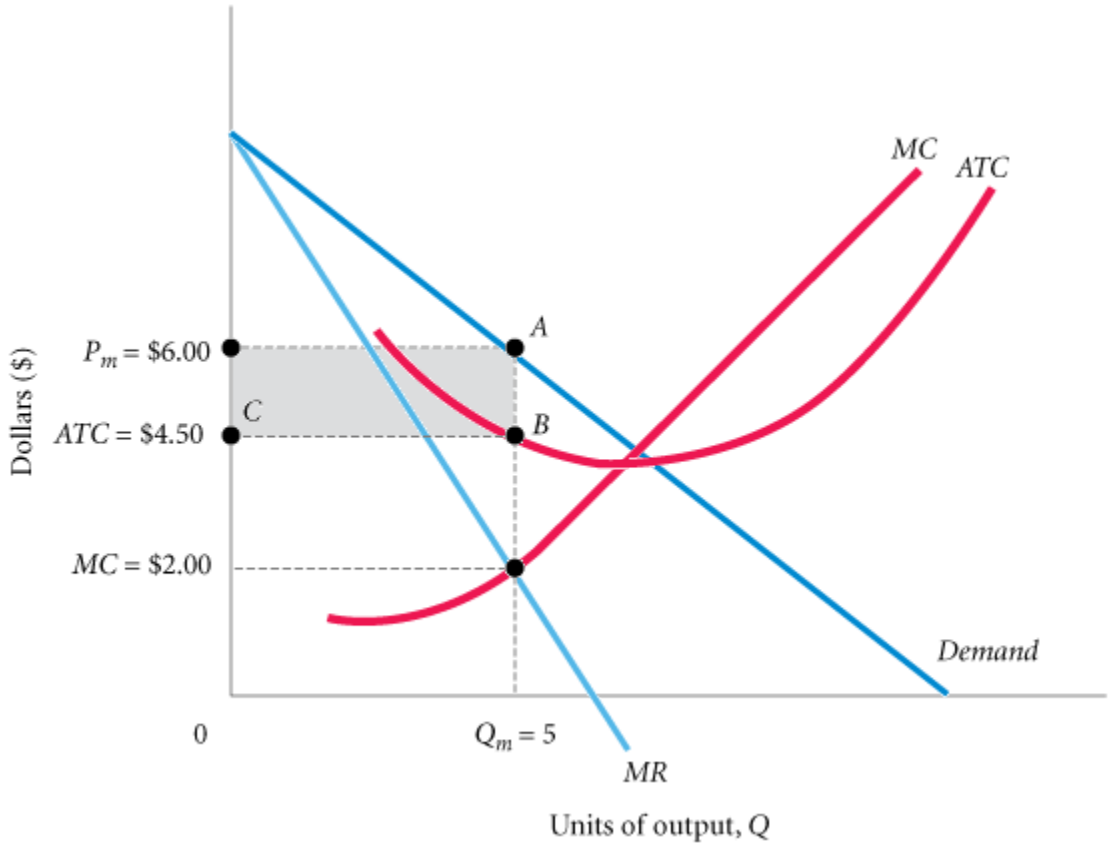
A monopoly's marginal revenue curve bisects the quantity axis between the origin and the point where the demand curve hits the quantity axis.
A monopoly's *MR* curve shows the change in total revenue that results as a firm moves along the segment of the demand curve that lies exactly above it.



The Monopolist's Profit-Maximizing Price and Output

▶ **FIGURE 13.4 Price and Output Choice for a Profit-Maximizing Monopolist**

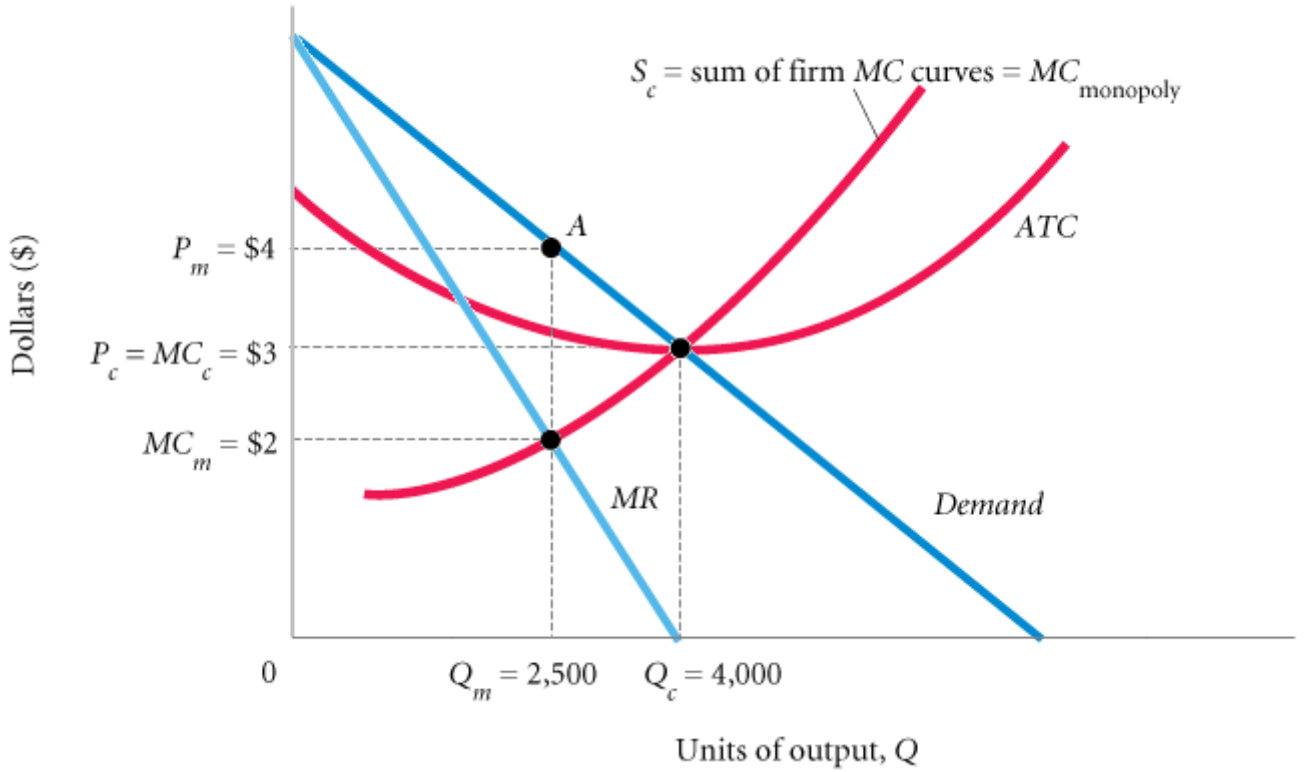
A profit-maximizing monopolist will raise output as long as marginal revenue exceeds marginal cost. Maximum profit is at an output of 5 units per period and a price of $6. Above 5 units of output, marginal cost is greater than marginal revenue; increasing output beyond 5 units would reduce profit. At 5 units, $TR = P_mAQ_m0$, $TC = CBQ_m0$, and profit = P_mABC.



The Absence of a Supply Curve in Monopoly

A monopoly firm has no supply curve that is independent of the demand curve for its product.

A monopolist sets both price and quantity, and the amount of output that it supplies depends on its marginal cost curve and the demand curve that it faces.



▲ **FIGURE 13.6 Comparison of Monopoly and Perfectly Competitive Outcomes for a Firm with Constant Returns to Scale**

In the newly organized monopoly, the marginal cost curve is the same as the supply curve that represented the behavior of all the independent firms when the industry was organized competitively.

Quantity produced by the monopoly will be less than the perfectly competitive level of output, and the monopoly price will be higher than the price under perfect competition.

Under monopoly, $P = P_m$ = \$4 and $Q = Q_m$ = 2,500.

Under perfect competition, $P = P_c$ = \$3 and $Q = Q_c$ = 4,000.

Monopoly in the Long Run: Barriers to Entry

barriers to entry Factors that prevent new firms from entering and competing in imperfectly competitive industries.

Economies of Scale

natural monopoly An industry that realizes such large economies of scale that single-firm production of that good or service is most efficient.

Industry Characteristics

monopolistic competition A common form of industry (market) structure characterized by a large number of firms, no barriers to entry, and product differentiation.

TABLE 15.1 Percentage of Value of Shipments Accounted for by the Largest Firms in Selected Industries, 2002

Industry Designation	Four Largest Firms	Eight Largest Firms	Twenty Largest Firms	Number of Firms
Travel trailers and campers	38	45	58	733
Games, toys	39	48	63	732
Wood office furniture	34	43	56	546
Book printing	33	54	68	560
Curtains and draperies	17	25	38	1,778
Fresh or frozen seafood	14	24	48	529
Women's dresses	18	23	48	528
Miscellaneous plastic products	6	10	18	6,775

Product Differentiation and Advertising

product differentiation A strategy that firms use to achieve market power. Accomplished by producing goods that differ from others in the market.

How Many Varieties?

In well-working markets, the level of product variety reflects the underlying heterogeneity of consumers' tastes in that market, the gains if any from coordination, and cost economies from standardization.

In industries that are monopolistically competitive, differences in consumer tastes, lack of need for coordination, and modest or no scale economies from standardization give rise to a large number of firms, each of which has a different product.

How Do Firms Differentiate Products?

horizontal differentiation Products differ in ways that make them better for some people and worse for others.

vertical differentiation A product difference that, from everyone's perspective, makes a product better than rival products.

behavioral economics A branch of economics that uses the insights of psychology and economics to investigate decision making.

oligopoly A form of industry (market) structure characterized by a few dominant firms. Products may be homogenous or differentiated.

Oligopolists compete with one another not only in price but also in developing new products, marketing and advertising those products, and developing complements to use with the products.

Macro Economic Aggregates

Measuring National Output and National Income

Gross Domestic Product

- Final Goods and Services
- Exclusion of Used Goods and Paper Transactions
- Exclusion of Output Produced Abroad by Domestically Owned Factors of Production

Calculating GDP

- The Expenditure Approach
- The Income Approach

Nominal versus Real GDP

- Calculating Real GDP
- Calculating the GDP Deflator
- The Problems of Fixed Weights

Limitations of the GDP Concept

- GDP and Social Welfare
- The Informal Economy
- Gross National Income per Capita

national income and product accounts Data collected and published by the government describing the various components of national income and output in the economy.

Gross Domestic Product

gross domestic product (GDP) The total market value of all final goods and services produced within a given period by factors of production located within a country.

GDP is the total market value of a country's output. It is the market value of all final goods and services produced within a given period of time by factors of production located within a country.

Final Goods and Services

final goods and services Goods and services produced for final use.

intermediate goods Goods that are produced by one firm for use in further processing by another firm.

value added The difference between the value of goods as they leave a stage of production and the cost of the goods as they entered that stage.

In calculating GDP, we can sum up the value added at each stage of production or we can take the value of final sales. We do not use the value of total sales in an economy to measure how much output has been produced.

Macro Economic Aggregates

Measuring National Output and National Income

Gross Domestic Product

- Final Goods and Services
- Exclusion of Used Goods and Paper Transactions
- Exclusion of Output Produced Abroad by Domestically Owned Factors of Production

Calculating GDP

- The Expenditure Approach
- The Income Approach

Nominal versus Real GDP

- Calculating Real GDP
- Calculating the GDP Deflator
- The Problems of Fixed Weights

Limitations of the GDP Concept

- GDP and Social Welfare
- The Informal Economy
- Gross National Income per Capita

national income and product accounts Data collected and published by the government describing the various components of national income and output in the economy.

Gross Domestic Product

gross domestic product (GDP) The total market value of all final goods and services produced within a given period by factors of production located within a country.

GDP is the total market value of a country's output. It is the market value of all final goods and services produced within a given period of time by factors of production located within a country.

Final Goods and Services

final goods and services Goods and services produced for final use.

intermediate goods Goods that are produced by one firm for use in further processing by another firm.

value added The difference between the value of goods as they leave a stage of production and the cost of the goods as they entered that stage.

In calculating GDP, we can sum up the value added at each stage of production or we can take the value of final sales. We do not use the value of total sales in an economy to measure how much output has been produced.

Exclusion of Used Goods and Paper Transactions

GDP is concerned only with new, or current, production. Old output is not counted in current GDP because it was already counted when it was produced.

GDP does not count transactions in which money or goods changes hands but in which no new goods and services are produced.

Exclusion of Output Produced Abroad by Domestically Owned Factors of Production

GDP is the value of output produced by factors of production *located within a country*.

gross national product (GNP) The total market value of all final goods and services produced within a given period by factors of production owned by a country's citizens, regardless of where the output is produced.

Calculating GDP

expenditure approach A method of computing GDP that measures the total amount spent on all final goods and services during a given period.

income approach A method of computing GDP that measures the income—wages, rents, interest, and profits—received by all factors of production in producing final goods and services.

The Expenditure Approach

There are four main categories of expenditure:

- Personal consumption expenditures (*C*): household spending on consumer goods
- Gross private domestic investment (*I*): spending by firms and households on new capital, that is, plant, equipment, inventory, and new residential structures
- Government consumption and gross investment (*G*)
- Net exports (*EX* − *IM*): net spending by the rest of the world, or exports (*EX*) minus imports (*IM*)

$$\text{GDP} = C + I + G + (EX - IM)$$

TABLE 6.2 Components of GDP: The Expenditure Approach

	Billions of Dollars		Percentage of GDP	
Personal consumption expenditures (C)	11,119.5		70.9	
Durable goods		1,218.8		7.8
Nondurable goods		2,563.0		16.3
Services		7,337.7		46.8
Gross private domestic investment (I)	2,059.5		13.1	
Nonresidential		1,616.6		10.3
Residential		382.4		2.4
Change in business inventories		60.6		0.4
Government consumption and gross investment (G)	3,063.6		19.5	
Federal		1,214.2		7.7
State and local		1,849.4		11.8
Net exports *(EX – IM)*	−566.7		−3.6	
Exports (*EX*)		2,179.7		13.9
Imports (*IM*)		2,746.3		17.5
Gross domestic product	15,676.0		100.0	

Note: Numbers may not add exactly because of rounding.

Personal Consumption Expenditures (*C*)

personal consumption expenditures (*C*) Expenditures by consumers on goods and services.

durable goods Goods that last a relatively long time, such as cars and household appliances.

nondurable goods Goods that are used up fairly quickly, such as food and clothing.

services The things we buy that do not involve the production of physical things, such as legal and medical services and education.

Gross Private Domestic Investment (*I*)

gross private domestic investment (*I*) Total investment in capital—that is, the purchase of new housing, plants, equipment, and inventory by the private (or nongovernment) sector.

nonresidential investment Expenditures by firms for machines, tools, plants, and so on.

residential investment Expenditures by households and firms on new houses and apartment buildings.

change in business inventories The amount by which firms' inventories change during a period. Inventories are the goods that firms produce now but intend to sell later.

Change in Business Inventories

GDP = Final sales + Change in business inventories

Gross Investment versus Net Investment

depreciation The amount by which an asset's value falls in a given period.

gross investment The total value of all newly produced capital goods (plant, equipment, housing, and inventory) produced in a given period.

net investment Gross investment minus depreciation.

$$\text{capital}_{\text{end of period}} = \text{capital}_{\text{beginning of period}} + \text{net investment}$$

Government Consumption and Gross Investment (*G*)

government consumption and gross investment (*G*) Expenditures by federal, state, and local governments for final goods and services.

Net Exports (*EX* − *IM*)

net exports (*EX* − *IM*) The difference between exports (sales to foreigners of U.S.-produced goods and services) and imports (U.S. purchases of goods and services from abroad). The figure can be positive or negative.

net national product (NNP) Gross national product minus depreciation; a nation's total product minus what is required to maintain the value of its capital stock.

TABLE 6.4 GDP, GNP, NNP, and National Income, 2012

	Dollars (Billions)
GDP	15,676.0
Plus: Receipts of factor income from the rest of the world	+774.1
Less: Payments of factor income to the rest of the world	−537.0
Equals: **GNP**	15,913.1
Less: Depreciation	−2,011.4
Equals: **Net national product (NNP)**	13,901.7
Less: Indirect business tax	−68.5
Equals: **National income**	13,833.2

The Income Approach

national income The total income earned by the factors of production owned by a country's citizens.

compensation of employees Includes wages, salaries, and various supplements—employer contributions to social insurance and pension funds, for example—paid to households by firms and by the government.

proprietors' income The income of unincorporated businesses.

rental income The income received by property owners in the form of rent.

corporate profits The income of corporations.

net interest The interest paid by business.

TABLE 6.5 National Income, Personal Income, Disposable Personal Income, and Personal Saving

	Dollars (Billions)
National income	13,833.2
Less: Amount of national income not going to households	−430.8
Equals: **Personal income**	13,402.4
Less: Personal income taxes	−1,471.9
Equals: **Disposable personal income**	11,930.6
Less: Personal consumption expenditures	−11,119.5
Personal interest payments	−172.3
Transfer payments made by households	−168.1
Equals: **Personal saving**	470.8
Personal saving as a percentage of disposable personal income:	3.9%

disposable personal income *or* after-tax income Personal income minus personal income taxes. The amount that households have to spend or save.

personal saving The amount of disposable income that is left after total personal spending in a given period.

personal saving rate The percentage of disposable personal income that is saved. If the personal saving rate is low, households are spending a large amount relative to their incomes; if it is high, households are spending cautiously.

Nominal versus Real GDP

current prices The current prices that we pay for goods and services.

nominal GDP Gross domestic product measured in current prices.

weight The importance attached to an item within a group of items.

Calculating Real GDP

TABLE 6.6 A Three-Good Economy

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					GDP in Year 1 in Year 1 Prices	GDP in Year 2 in Year 1 Prices	GDP in Year 1 in Year 2 Prices	GDP in Year 2 in Year 2 Prices
	Production		Price per Unit					
	Year 1 Q_1	Year 2 Q_2	Year 1 P_1	Year 2 P_2	$P_1 \times Q_1$	$P_1 \times Q_2$	$P_2 \times Q_1$	$P_2 \times Q_2$
Good *A*	6	11	$0.50	$0.40	$3.00	$5.50	$2.40	$4.40
Good *B*	7	4	0.30	1.00	2.10	1.20	7.00	4.00
Good *C*	10	12	0.70	0.90	7.00	8.40	9.00	10.80
Total					$12.10	$15.10	$18.40	$19.20
					Nominal GDP in year 1			Nominal GDP in year 2

base year The year chosen for the weights in a fixed-weight procedure.

fixed-weight procedure A procedure that uses weights from a given base year.

Calculating the GDP Deflator

Policy makers not only need good measures of how real output is changing but also good measures of how the overall price level is changing.

The GDP deflator is one measure of the overall price level.

The Problems of Fixed Weights

The use of fixed-price weights does not account for the responses in the economy to supply shifts.

The fixed-weight procedure ignores the substitution away from goods whose prices are increasing and toward goods whose prices are decreasing or increasing less rapidly.

Limitations of the GDP Concept

GDP and Social Welfare

If crime levels went down, society would be better off, but a decrease in crime is not an increase in output and is not reflected in GDP.

An increase in leisure is also an increase in social welfare, sometimes associated with a *decrease* in GDP.

Most nonmarket and domestic activities, such as housework and child care, are not counted in GDP even though they amount to real production.

GDP also has nothing to say about the distribution of output among individuals in a society.

Green Accounting

Recently many economists and policy makers have become concerned about the exclusion of one particularly large and important nonmarket activity from the national income accounts: the environment.

The market goods that many industries produce go into the national income and product accounts, but the environmental costs of air pollution are not subtracted.

Recent work by Nick Muller, Robert Mendelsohn, and Bill Nordhaus estimates that including properly valued air pollution in the national income and product accounts as an offset to the value of the marketed goods produced by some industries would make their contribution to our nation's GDP negative!

The Informal Economy

informal economy The part of the economy in which transactions take place and in which income is generated that is unreported and therefore not counted in GDP.

Human Development Index (HDI)

Understanding Indexes

- **What is an index?**
- An index is a composite of indicators that produces a single calculation which can then be ranked.

The Human Development Index (HDI)

…is the best known composite index of social and economic well-being…

The Concept of Human Development

"The basic purpose of development is to enlarge people's choices. In principle, these choices can be infinite and can change over time. People often value achievements that do not show up at all, or not immediately, in income or growth figures: greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities. The objective of development is to create an enabling environment for people to enjoy long, healthy and creative lives."

Mahbub ul Haq -- Founder of the Human Development Report

Calculating HDI: New Method

- Indicator that measures the overall development of a nation; Life expectancy at birth, longevity, Education, Income
- It is the statistic used to rank countries by level of standard of living and quality of life.
- It goes from 0 to 1 (1 –most ; 0- worst)

Components of HDI

- **Life expectancy at birth:** Number of years a newborn infant could expect to live if prevailing patterns of age-specific mortality rates at the time of birth stay the same throughout the infant's life.
- **Mean years of schooling**: Average number of years of education received by people aged 25 and older, converted from education attainment levels using official durations of each level.
- **Expected years of schooling**: Number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rates persist throughout the child's life.

Contd..

- **Gross national income (GNI) per capita**: Aggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to international dollars using purchasing power parity (PPP) rates, divided by midyear population.

Contd..

- **Human Development Index (HDI)**: A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge and a decent standard of living.

Calculating Human Development Index

- The Human Development Index (HDI) is a summary measure of human development.
- It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living.
- The HDI is the geometric mean of normalized indices measuring achievements in each dimension.

Steps to estimate the Human Development Index

- **Step 1. Creating the dimension indices**
- Minimum and maximum values (goalposts) are set in order to transform the indicators into indices between 0 and 1.
- These goalposts act as the ‘natural zeroes’ and ‘aspirational goals’, respectively, from which component indicators are standardized

Goal Posts

Dimension	Indicator	Minimum	Maximum
Health	Life expectancy (years)	20	85
Education	Expected years of schooling	0	18
	Mean years of schooling	0	15
Standard of living	Gross national income per capita (PPP 2011 $)	100	75,000

Goal Posts Contd..

- The justification for placing the natural zero for life expectancy at 20 years is based on historical evidence.
- Societies can subsist without formal education, justifying the education minimum of 0 years.
- The maximum for mean years of schooling, 15, is the projected maximum of this indicator for 2025.
- The maximum for expected years of schooling, 18, is equivalent to achieving a master’s degree in most countries.

Goal Posts Contd..

- The low minimum value for gross national income (GNI) per capita, $100, is justified by the considerable amount of unmeasured subsistence and nonmarket production in economies close to the minimum, which is not captured in the official data.
- The maximum is set at $75,000 per capita.
- Kahneman and Deaton (2010) have shown that there is a virtually no gain in human development and well-being from annual income beyond $75,000.

- the sub indices are calculated as follows:

$$\text{Dimension index} = \frac{\text{actual value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}}. \quad (1)$$

How is the HDI calculated?

- LEI = Life Expectancy Index
- EI = Education Index
- II = Income Index

$$\mathrm{HDI} = \sqrt[3]{\mathrm{LEI} \cdot \mathrm{EI} \cdot \mathrm{II}}.$$

Formula for HDI calculation

- Life Expectancy Index (LEI) = $\frac{LE - 20}{85 - 20}$

- Education Index (EI) = (MYSI + EYSI)/2

  MYSI = MYS/15

  EYSI = EYS/18

- Income Index (II) = $\frac{\ln(GNIpc) - \ln(100)}{\ln(75000) - \ln(100)}$

- Finally, the HDI is the geometric mean of the previous three normalized indices:

$$HDI = \sqrt[3]{LEI.EI.II}$$

Methodology used to express income

- The World Bank's 2014 World Development Indicators database contains estimates of GNI per capita in 2011 purchasing power parity (PPP) terms for many countries.
- For countries missing this indicator, the Human Development Report Office calculates it by converting GNI from current to constant terms using two steps.
- First, the value of nominal GNI per capita is converted into PPP terms for the base year (2011).
- Second, a time series of GNI per capita in 2011 PPP terms is constructed by applying the real growth rates to the GNI per capita in PPP terms for the base year.
- The real growth rate is implied by the ratio of the nominal growth of current GNI per capita in local currency terms to the GDP deflator.

Purchasing Power Parity (PPP) $

- Official PPP conversion rates are produced by the International Comparison Program, whose surveys periodically collect thousands of prices of matched goods and services in many countries.
- The last round of this exercise refers to 2011 and covered 180 countries.

Is the HDI Enough to Measure a Country's Level of Development?

- According to the UNDP, the answer is:
- "Not at all."
- "The concept of human development is much broader than what can be captured in the HDI, or any other composite indices…"
- "The HDI and the other composite indices can only offer a broad proxy on some of the key issues of human development…"
- "A fuller picture of a country's level of human development requires analysis of other human development indicators and information."