Microeconomics

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Chapter 1
Preliminaries

Topics to be Discussed

- The Themes of Microeconomics
- What Is a Market?
- Real Versus Nominal Prices
- Why Study Microeconomics?

Preliminaries

- Microeconomics deals with:
  - Behavior of individual units
    - When Consuming
      - How we choose what to buy

Preliminaries

- Microeconomics deals with:
  - Behavior of individual units
    - When Producing
      - How we choose what to produce

Preliminaries

- Microeconomics deals with:
  - Markets: The interaction of consumers and producers

Preliminaries

- Macroeconomics deals with:
  - Analysis of aggregate issues:
    - Economic growth
    - Inflation
    - Unemployment

Preliminaries

- The Linkage Between Micro and Macro-economics
  - Microeconomics is the foundation of macroeconomic analysis

The Themes of Microeconomics

- According to Mick Jagger* & the Rolling Stones
  - "You can't always get what you want"

*Economics degree from London School of Economics

The Themes of Microeconomics

- Why Not?
  - Limited Resources

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The Themes of Microeconomics

- Microeconomics
  - Allocation of Scarce Resources and *Trade-offs*
    - In a planned economy
    - In a market economy

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The Themes of Microeconomics

- Microeconomics and *Optimal Trade-offs*
  1. Consumer Theory
  2. Workers
  3. Theory of the Firm

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The Themes of Microeconomics

- Microeconomics and *Prices*
  - The role of *prices* in a market economy
  - How *prices* are determined

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Theories and Models

- Microeconomic Analysis
  - Theories are used to explain observed phenomena in terms of a set of basic rules and assumptions.
  - For example
    - The Theory of the Firm
    - The Theory of Consumer Behavior

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Theories and Models

- Microeconomic Analysis
  - Models:
    - a mathematical representation of a theory used to make a prediction.

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Theories and Models

- Microeconomic Analysis
  - Validating a Theory
    - The validity of a theory is determined by the quality of its prediction, given the assumptions.

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Theories and Models

- Microeconomic Analysis
  - Evolving the Theory
    - Testing and refining theories is central to the development of the science of economics.

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Positive Versus Normative Analysis

- Positive Analysis
  - Positive analysis is the use of theories and models to predict the impact of a choice.
  - For example:
    - What will be the impact of an import quota on foreign cars?
    - What will be the impact of an increase in the gasoline excise tax?

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Positive versus Normative Analysis

- Normative Analysis
  - Normative analysis addresses issues from the perspective of "What ought to be?"
  - For example:
    - Consider the equity and efficiency trade-off of an increase in the gasoline excise tax versus import restriction on foreign oil.

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What is a Market?

- Markets
  - A geographically defined area where buyers and sellers interact to determine the price of a product or a set of products.

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What is a Market?

- Markets vs. Industries
  - Industries are the supply side of the market.

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What is a Market?

- Defining the Market
  - The market parameters must be set before an analysis of the market can take place.

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What is a Market?

- Arbitrage
  - Buying a product at a low price in one location and selling at a high price in another

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What is a Market?

- Competitive vs. Noncompetitive Markets
  - Competitive Markets
    - Because of the large number of buyers and sellers, no individual buyer or seller can influence the price.
    - Example: Most agricultural markets

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What is a Market?

- Competitive vs. Noncompetitive Markets
  - Noncompetitive Markets
    - Markets where individual producers can influence the price.
    - Example: OPEC

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What is a Market?

- Market Price
  - Competitive markets establish one price.
  - Noncompetitive markets may set many prices for the same product.

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What is a Market?

- Market Definition & The Extent of a Market
  - Market Definition
    - Which buyers and sellers should be included in a given market

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What is a Market?

- Market Definition - The Extent of a Market
  - Market Extent
    - Defines the boundaries of the market
      - Geographic
      - Range of products

What is a Market?

- Examples
  - Geographic boundaries
    - Gasoline: US vs California
    - Housing: Chicago vs a Chicago neighborhood

What is a Market?

- Examples
  - Range of Products
    - Gasoline: regular, super, & diesel
    - Cameras: SLR's, point & shoot, digital

What is a Market?

- Examples
  - Markets for Prescription Drugs
    - Well-defined markets - therapeutic drugs
    - Ambiguous markets - painkillers

Real Versus Nominal Prices

- Nominal price is the absolute or *current dollar price* of a good or service when it is sold.
- Real price is the price relative to an aggregate measure of prices or *constant dollar price*.

Real Versus Nominal Prices

- The Consumer Price Index (CPI) is an aggregate measure.
  - Real prices are emphasized to permit the analysis of relative prices.

Real Versus Nominal Prices

- Calculating Real Prices

$$\underset{\text{(base year = 100)}}{\text{Real Price}} = \frac{\text{CPI}_{\text{base year}}}{\text{CPI}_{\text{current year}}} \times \text{Nominal Price}_{\text{current year}}$$

An Example: Calculating the Real Price of Milk

Year	Nominal Price of Milk	CPI	Real Price of Milk in 1970 dollars
1970	.40	38.8	.40 = 38.8/38.8 x .40
1980	.65	82.4	.31 = 38.8/82.4 x .65
1999	1.05	167.0	.24 = 38.8/167.0 x 1.05

Calculating Real Prices: An Example - Eggs & College

$$\underset{\text{1998 (1970 = 100)}}{\text{Real Price of Eggs}} = \frac{38.8_{\ 1970}}{163} \times 1.04$$

$$\underset{\text{1998 (1970 = 100)}}{\text{Real Price of a College Education}} = \frac{38.8}{163.0} \times \$19{,}213 = \$4{,}573$$

Calculating Real Prices: An Example - Eggs & College

	1970	1975	1980	1985	1990	1998
Consumer Price Index (1983 = 100)	38.8	53.8	82.4	107.6	130.7	163.0
Nominal Prices						
Grade A Large Eggs	$0.61	$0.77	$0.84	$0.80	$0.98	$1.04
College Education	$2,530	$3,403	$4,912	$8,156	$12,800	$19,213
Real Prices ($1970)						
Grade A Large Eggs	$0.61	$0.56	$0.40	$0.29	$0.30	$0.25
College Education	$2,530	$2,454	$2,313	$2,941	$3,800	$4,573

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An Example: The Minimum Wage

- Observations
  1. The minimum wage has been increasing in nominal terms since 1940.
  2. The 1999 real minimum wage was no higher in 1999 than 1950.

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An Example: The Minimum Wage

- What Do You Think?
  - What are the positive and normative issues of raising the minimum wage?

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Why Study Microeconomics?

- Microeconomic concepts are used by everyone to assist them in making choices as consumers and producers.

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Why Study Microeconomics?

- Two Examples
  - Ford and the development of its SUV's
  - Public Policy Design
    - Automobile emission standards for the 21st century

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Why Study Microeconomics?

- Ford and the development of its SUV's
  - Questions
    - Consumer acceptance and demand
    - Production cost
    - Pricing strategy

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Why Study Microeconomics?

- Ford and the development of its SUV's
  - Questions
    - Risk analysis
    - Organizational decisions
    - Government regulation

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Why Study Microeconomics?

- Auto emission standards for the 21st century
  - Questions
    - Impact on consumers
    - Impact on producers
    - How to enforce the standards
    - What are the benefits and costs?

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Summary

- Microeconomics is concerned with the decisions made by small economic units.
- Microeconomics relies heavily on the use of theory and models.

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Summary

- Microeconomics is concerned with positive questions and normative analysis.
- A *market* refers to a collection of buyers and sellers who interact and to the possibility for sales and purchases that results from that interaction.

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Summary

- The market price is established by the interaction of buyers and sellers.
- A market's geographic boundaries and range of products must be defined.
- To eliminate the effects of inflation we measure real prices, rather than nominal prices.

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End of Chapter 1 Preliminaries

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Chapter 2 The Basics of Supply and Demand

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Topics to Be Discussed

- Supply and Demand
- The Market Mechanism
- Changes in Market Equilibrium
- Elasticities of Supply and Demand
- Short-Run Versus Long-Run Elasticities

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Topics to Be Discussed

- Understanding and Predicting the Effects of Changing Market Conditions
- Effects of Government Intervention--Price Controls

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Introduction

- Applications of Supply and Demand Analysis
  - Understanding and predicting how world economic conditions affect market price and production
  - Analyzing the impact of government price controls, minimum wages, price supports, and production incentives

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Introduction

- Applications of Supply and Demand Analysis
  - Analyzing how taxes, subsidies, and import restrictions affect consumers and producers

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Supply and Demand

- The Supply Curve
  - The supply curve shows how much of a good producers are willing to sell at a given price, holding constant other factors that might affect quantity supplied

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Supply and Demand

- The Supply Curve
  - This price-quantity relationship can be shown by the equation:

$$Q_S = Q_S(P)$$

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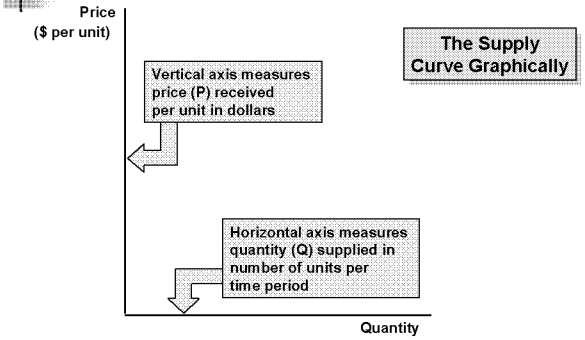
Supply and Demand



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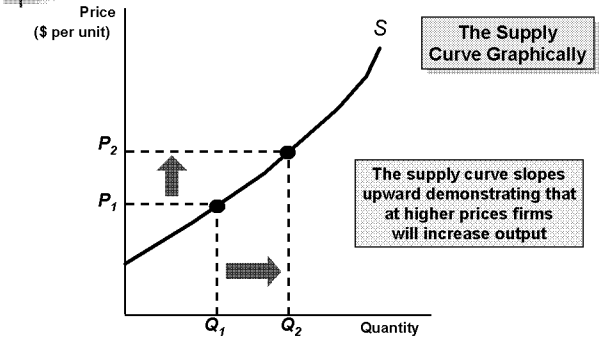
Supply and Demand



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Supply and Demand

- Non-price Determining Variables of Supply
  - Costs of Production
    - Labor
    - Capital
    - Raw Materials

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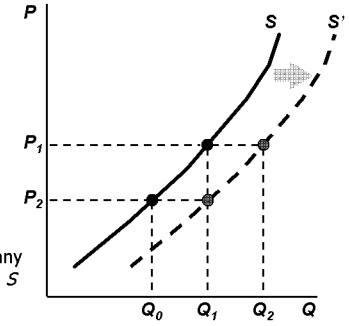
Supply and Demand

Change in Supply

- The cost of raw materials falls
  - At P_1, produce Q_2
  - At P_2, produce Q_1
  - Supply curve shifts right to S'
  - More produced at any price on S' than on S



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Supply and Demand

- Supply - A Review
  - Supply is determined by non-price supply-determining variables as such as the cost of labor, capital, and raw materials.
  - Changes in supply are shown by shifting the entire supply curve.

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Supply and Demand

- Supply - A Review
  - *Changes in quantity supplied* are shown by movements along the supply curve and are caused by a change in the price of the product.

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Supply and Demand

- The Demand Curve
  - The demand curve shows how much of a good consumers are willing to buy as the price per unit changes holding non-price factors constant.
  - This price-quantity relationship can be shown by the equation:

$$Q_D = Q_D(P)$$

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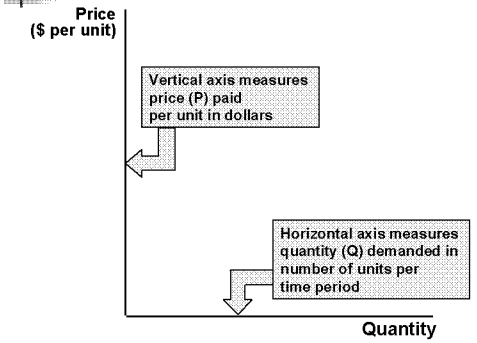
Supply and Demand



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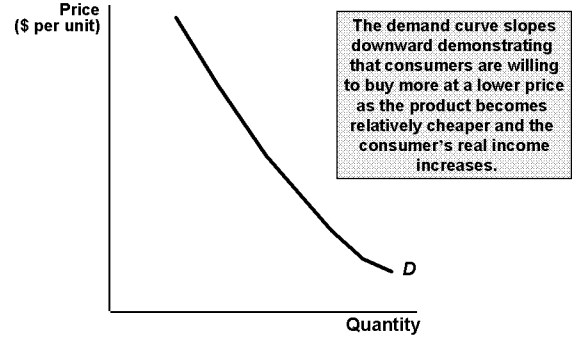
Supply and Demand



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Supply and Demand

- Non-price Determining Variables of Demand
  - Income
  - Consumer Tastes
  - Price of Related Goods
    - Substitutes
    - Complements

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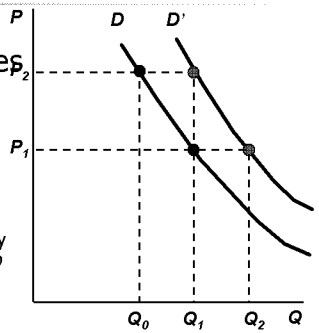
Supply and Demand

Change in Demand

- Income Increases
  - At P_1, produce Q_2
  - At P_2, produce Q_1
  - Demand Curve shifts right
  - More purchased at any price on D' than on D



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Shifts in Supply and Demand

- Demand - A Review
  - Demand is determined by non-price demand-determining variables, such as, income, price of related goods, and tastes.
  - Changes in demand are shown by shifting the entire demand curve.
  - *Changes in quantity demanded* are shown by movements along the demand curve.

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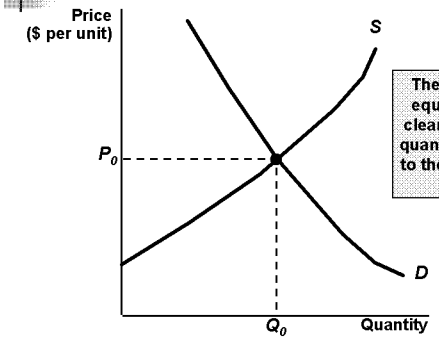
The Market Mechanism



The curves intersect at equilibrium, or market-clearing, price. At P_0 the quantity supplied is equal to the quantity demanded at Q_0.

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The Market Mechanism

- Characteristics of the equilibrium or market clearing price:
  - $Q_D = Q_S$
  - No shortage
  - No excess supply
  - No pressure on the price to change

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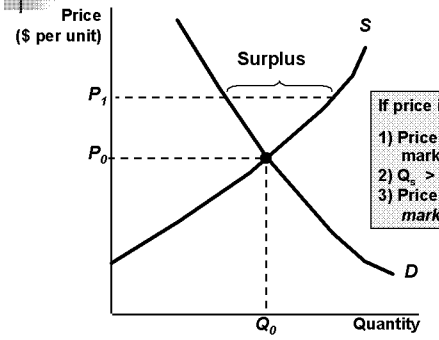
The Market Mechanism



If price is above equilibrium:

1) Price is above the market clearing price
2) $Q_s > Q_d$
3) Price falls to the *market-clearing* price

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The Market Mechanism

A Surplus

- The market price is above equilibrium
  - There is excess supply
  - Producers lower prices
  - Quantity demanded increases and quantity supplied decreases
  - The market continues to adjust until the equilibrium price is reached.

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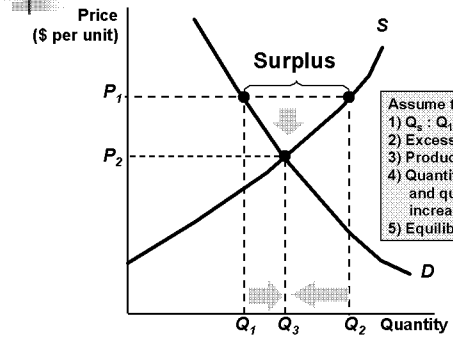
The Market Mechanism



Assume the price is P_1, then:
1) $Q_s : Q_1 > Q_d : Q_2$
2) Excess supply is Q_1:Q_2.
3) Producers lower price.
4) Quantity supplied decreases and quantity demanded increases.
5) Equilibrium at P_2Q_3

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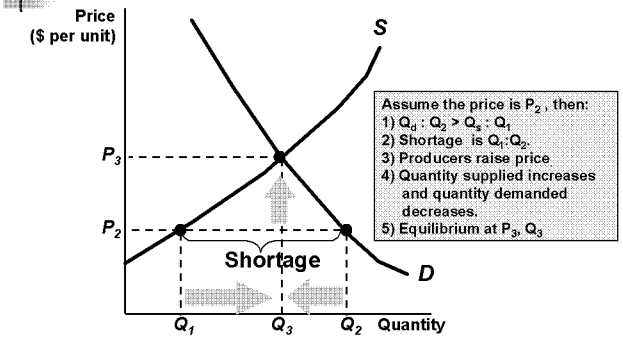
The Market Mechanism

Surplus - Review:

- The market price is above equilibrium:
  - There is excess supply
  - Producers lower prices
  - Quantity demanded increases and quantity supplied decreases
  - The market continues to adjust until the equilibrium price is reached

The Market Mechanism



The Market Mechanism

Shortage

- The market price is below equilibrium:
  - There is a shortage
  - Producers raise prices
  - Quantity demanded decreases and quantity supplied increases
  - The market continues to adjust until the new equilibrium price is reached.

The Market Mechanism

- Market Mechanism Summary

1) Supply and demand interact to determine the market-clearing price.

2) When not in equilibrium, the market will adjust to alleviate a shortage or surplus and return the market to equilibrium.

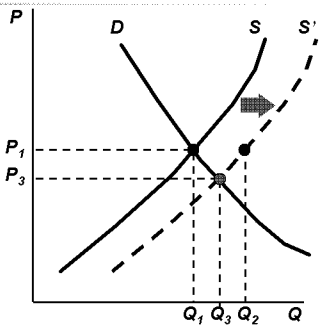
3) Markets must be competitive for the mechanism to be efficient.

Changes In Market Equilibrium

- Equilibrium prices are determined by the relative level of supply and demand.
- Supply and demand are determined by particular values of supply and demand determining variables.
- Changes in any one or combination of these variables can cause a change in the equilibrium price and/or quantity.

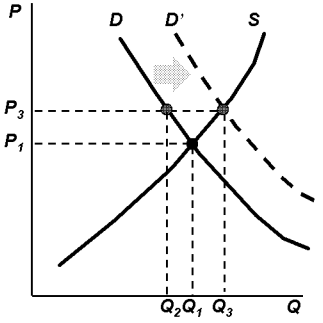
Changes In Market Equilibrium

- Raw material prices fall
  - S shifts to S'
  - Surplus @ P_1 of Q_1, Q_2
  - Equilibrium @ P_3, Q_3



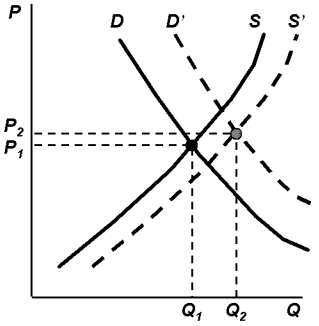
Changes In Market Equilibrium

- Income Increases
  - Demand shifts to D_1
  - Shortage @ P_1 of Q_1, Q_2
  - Equilibrium @ P_3, Q_3



Changes In Market Equilibrium

- Income Increases & raw material prices fall
  - The increase in D is greater than the increase in S
  - Equilibrium price and quantity increase to P_2, Q_2



Shifts in Supply and Demand

- When supply and demand change simultaneously, the impact on the equilibrium price and quantity is determined by:

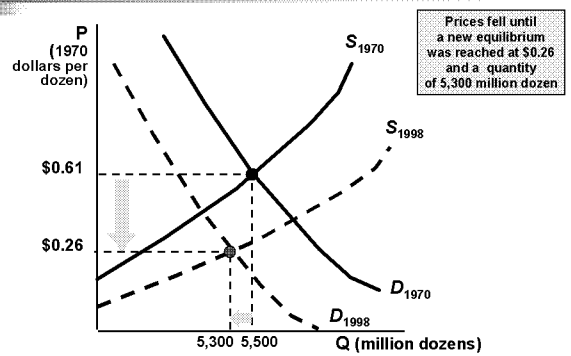
1) The relative size and direction of the change

2) The shape of the supply and demand models

The Price of Eggs and the Price of a College Education Revisited

- The real price of eggs fell 59% from 1970 to 1998.
- Supply increased due to the increased mechanization of poultry farming and the reduced cost of production.
- Demand decreased due to the increasing consumer concern over the health and cholesterol consequences of eating eggs.

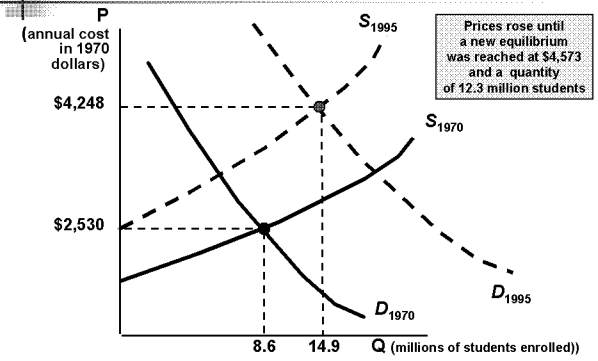
Market for Eggs



The Price of a College Education

- The real price of a college education rose 68 percent from 1970 to 1995.
- Supply decreased due to higher costs of equipping and maintaining modern classrooms, laboratories and libraries, and higher faculty salaries.
- Demand increased due a larger percentage of a larger number of high school graduates attending college.

Market for a College Education



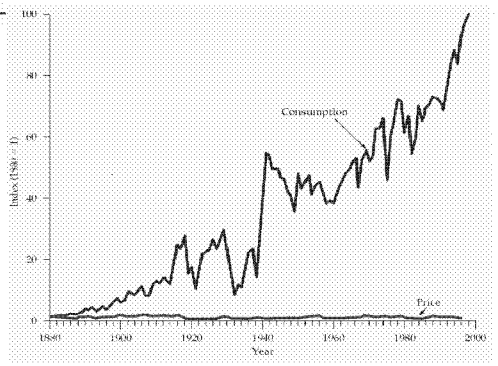
Changes In Market Equilibrium

- Wage Inequality in the United States
  - Real after-tax income from 1977 to 1999:
    - Rose 40+% for the top 20% of the income distribution
    - Fell 10+% for the bottom 20%

Changes In Market Equilibrium

- Question
  - Why did the income distribution become more unequal for 1977 to 1999?

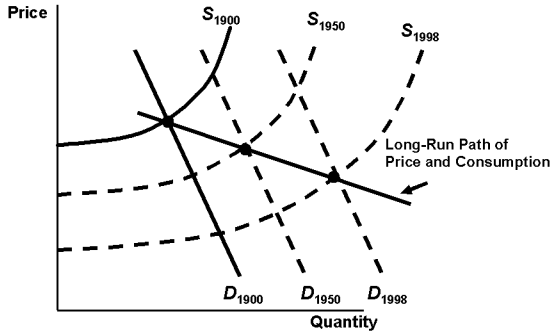
Consumption & Price of Copper 1880-1998



The Long-Run Behavior of Natural Resource Prices

- Observations
  - Consumption of copper has increased about a hundred fold from 1880 through 1998 indicating a large increase in demand.
  - The real price for copper has remained relatively constant.

Changes In Market Equilibrium



Changes In Market Equilibrium

- Conclusion
  - Decreases in the costs of production have increased the supply by more than enough to offset the increase in demand.

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Changes In Market Equilibrium

- Observation
  - To accurately predict the future price of a product or service, it is necessary to consider the potential change in supply and demand.
  - 1970 predictions for oil and other minerals proved incorrect because they only considered the demand side of the market.

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Elasticities of Supply and Demand

- Generally, elasticity is a measure of the sensitivity of one variable to another.
- It tells us the percentage change in one variable in response to a one percent change in another variable.

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Elasticities of Supply and Demand

Price Elasticity of Demand

- Measures the sensitivity of quantity demanded to price changes.
  - It measures the percentage change in the quantity demanded for a good or service that results from a one percent change in the price.

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Elasticities of Supply and Demand

- The price elasticity of demand is:

$$E_P = (\%\Delta Q)/(\%\Delta P)$$

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Elasticities of Supply and Demand

Price Elasticity of Demand

- The percentage change in a variable is the absolute change in the variable divided by the original level of the variable.

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Elasticities of Supply and Demand

Price Elasticity of Demand

- So the price elasticity of demand is also:

$$E_P = \frac{\Delta Q/Q}{\Delta P/P} = \frac{P}{Q}\frac{\Delta Q}{\Delta P}$$

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Elasticities of Supply and Demand

- Interpreting Price Elasticity of Demand Values
  1) Because of the inverse relationship between P and Q; E_P is negative.
  2) If $E_P > 1$, the percent change in quantity is greater than the percent change in price. We say the *demand is price elastic*.

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Elasticities of Supply and Demand

- Interpreting Price Elasticity of Demand Values
  3) If $E_P < 1$, the percent change in quantity is less than the percent change in price. We say the *demand is price inelastic*.

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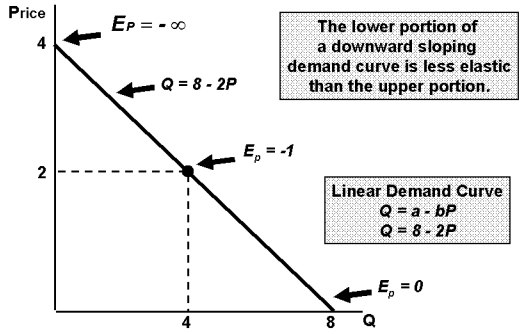
Elasticities of Supply and Demand

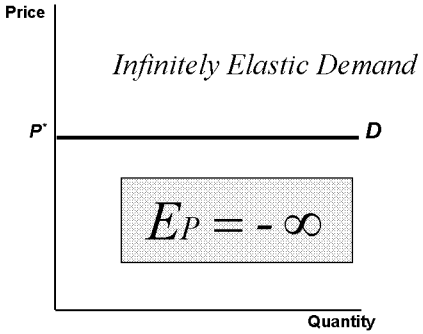
Price Elasticity of Demand

- The primary determinant of price elasticity of demand is the *availability of substitutes.*
  - Many substitutes demand is price elastic
  - Few substitutes demand is price inelastic

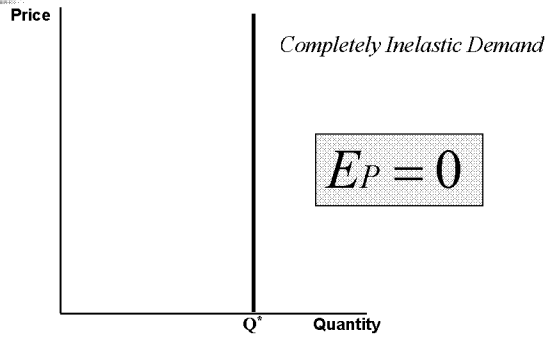
Price Elasticities of Demand



Price Elasticities of Demand



Price Elasticities of Demand



Elasticities of Supply and Demand

Other Demand Elasticities

- Income elasticity of demand measures the percentage change in quantity demanded resulting from a one percent change in income.

Elasticities of Supply and Demand

Other Demand Elasticities

- The income elasticity of demand is:

$$E_I = \frac{\Delta Q/Q}{\Delta I/I} = \frac{I}{Q}\frac{\Delta Q}{\Delta I}$$

Elasticities of Supply and Demand

Other Demand Elasticities

- Cross elasticity of demand measures the percentage change in the quantity demanded of one good that results from a one percent change in the price of another good.
- For example consider the substitute goods, butter and margarine.

Elasticities of Supply and Demand

- The cross elasticity of demand is:

$$E_{Q_b P_m} = \frac{\Delta Q_b/Q_b}{\Delta P_m/P_m} = \frac{P_m}{Q_b}\frac{\Delta Q_b}{\Delta P_m}$$

- The cross elasticity for substitutes is positive, while that for complements is negative.

Elasticities of Supply and Demand

Elasticities of Supply

- Price elasticity of supply measures the percentage change in quantity supplied resulting from a 1 percent change in price.
- The elasticity is usually positive because price and quantity supplied are directly related.

Elasticities of Supply and Demand

Elasticities of Supply

- We can refer to elasticity of supply with respect to interest rates, wage rates, and the cost of raw materials.

Elasticities of Supply and Demand

The Market for Wheat

- 1981 Supply Curve for Wheat
  - $Q_S = 1{,}800 + 240P$
- 1981 Demand Curve for Wheat
  - $Q_D = 3{,}550 - 266P$

Elasticities of Supply and Demand

The Market for Wheat

- Equilibrium: $Q_S = Q$

$$1{,}800 + 240P = 3{,}550 - 266P$$

$$506P = 1{,}750$$

$$P = 3.46/bushel$$

$$Q = 1{,}800 + (240)(3.46) = 2{,}630 \text{ million bushels}$$

Elasticities of Supply and Demand

The Market for Wheat

$$E_P^D = \frac{P}{Q}\frac{\Delta Q_D}{\Delta P} = \frac{3.46}{2{,}630}(-2.66) = -.035 \text{ Inelastic}$$

$$E_P^S = \frac{P}{Q}\frac{\Delta Q_S}{\Delta P} = \frac{3.46}{2{,}630}(2.40) = .032 \text{ Inelastic}$$

Elasticities of Supply and Demand

The Market for Wheat

- Assume the price of wheat is \$4.00/bushel

$$Q_D = 3{,}550 - (266)(4.00) = 2{,}486$$

$$Q_P^D = \frac{4.00}{2{,}486}(-266) = -0.43$$

Changes in the Market: 1981-1998

The Market for Wheat

	Supply (Q_S)	Demand (Q_D)	Equilibrium Price ($Q_S = Q_D$)
1981	$1800 + 240P$	$3550 - 266P$	$1800+240P = 3550-266P$ $506P = 1750$ P_{1981} = \$3.46/bushel
1998	$1{,}944 + 207P$	$3{,}244 - 283P$	$1{,}944+207P = 3{,}244-283P$ P_{1998} = \$2.65/bushel

Short-Run Versus Long-Run Elasticities

Demand

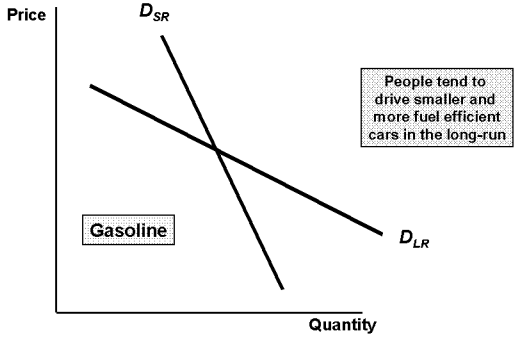
- Price elasticity of demand varies with the amount of time consumers have to respond to a price.

Short-Run Versus Long-Run Elasticities

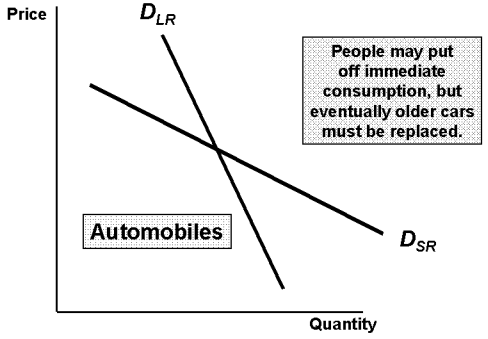
Demand

- Most goods and services:
  - Short-run elasticity is less than long-run elasticity. (e.g. gasoline, Drs.)
- Other Goods (durables):
  - Short-run elasticity is greater than long-run elasticity (e.g. automobiles)

Gasoline: Short-Run and Long-Run Demand Curves



Automobiles: Short-Run and Long-Run Demand Curves



Short-Run Versus Long-Run Elasticities

Income Elasticities

- Income elasticity also varies with the amount of time consumers have to respond to an income change.

Short-Run Versus Long-Run Elasticities

Income Elasticities

- Most goods and services:
  - Income elasticity is greater in the long-run than in the short run.
    - Higher incomes may be converted into bigger cars so the income elasticity of demand for gasoline increases with time.

Short-Run Versus Long-Run Elasticities

Income Elasticities

- Other Goods (durables):
  - Income elasticity is less in the long-run than in the short-run.
    - Originally, consumers will want to hold more cars.
    - Later, purchases will only to be to replace old cars.

Short-Run Versus Long-Run Elasticities

The Demand for Gasoline and Automobiles

- Gasoline and automobiles are complementary goods.

Short-Run Versus Long-Run Elasticities

The Demand for Gasoline and Automobiles

- Gasoline
  - The long-run price and income elasticities are larger than the short-run elasticities.
- Automobiles
  - The long-run price and income elasticities are smaller than the short-run elasticities.

Short-Run Versus Long-Run Elasticities

The Demand for Gasoline

	Years Following Price or Income Change					
Elasticity	**1**	**2**	**3**	**4**	**5**	**6**
Price	**-0.11**	**-0.22**	**-0.32**	**-0.49**	**-0.82**	**-1.17**
Income	**0.07**	**0.13**	**0.20**	**0.32**	**0.54**	**0.78**

Short-Run Versus Long-Run Elasticities

The Demand for Automobiles

	Years Following Price or Income Change					
Elasticity	**1**	**2**	**3**	**4**	**5**	**6**
Price	**-1.20**	**-0.93**	**-0.75**	**-0.55**	**-0.42**	**-0.40**
Income	**3.00**	**2.33**	**1.88**	**1.38**	**1.02**	**1.00**

Short-Run Versus Long-Run Elasticities

The Demand for Gasoline and Automobiles

- Data Explains:

  1) Why the price of oil did not continue to rise above $30/barrel even though it rose very rapidly in the early 1970s.

  2) Why automobile sales are so sensitive to the business cycle.

Short-Run Versus Long-Run Elasticities

Supply

- Most goods and services:
  - Long-run price elasticity of supply is greater than short-run price elasticity of supply.
- Other Goods (durables, recyclables):
  - Long-run price elasticity of supply is less than short-run price elasticity of supply

Short-Run Versus Long-Run Elasticities

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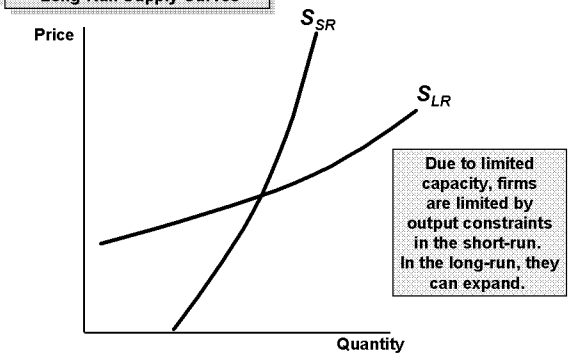
Primary Copper: Short-Run and Long-Run Supply Curves



Due to limited capacity, firms are limited by output constraints in the short-run. In the long-run, they can expand.

Short-Run Versus Long-Run Elasticities

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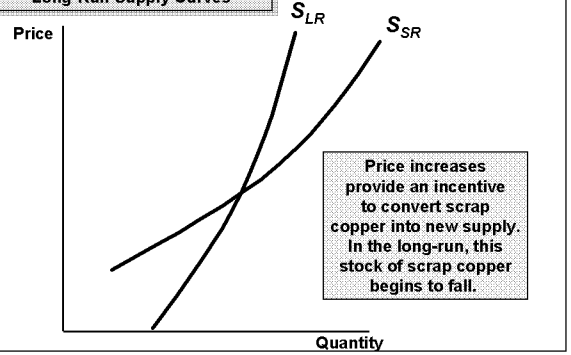
Secondary Copper: Short-Run and Long-Run Supply Curves



Price increases provide an incentive to convert scrap copper into new supply. In the long-run, this stock of scrap copper begins to fall.

Short-Run Versus Long-Run Elasticities

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Supply of Copper

Price Elasticity of:	Short-run	Long-run
Primary supply	**0.20**	**1.60**
Secondary supply	**0.43**	**0.31**
Total supply	**0.25**	**1.50**

Short-Run Versus Long-Run Elasticities

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Weather in Brazil and the price of Coffee in New York

- Elasticity explains why coffee prices are very volatile.
  - Due to the differences in supply elasticity in the long-run and short run.

Price of Brazilian Coffee

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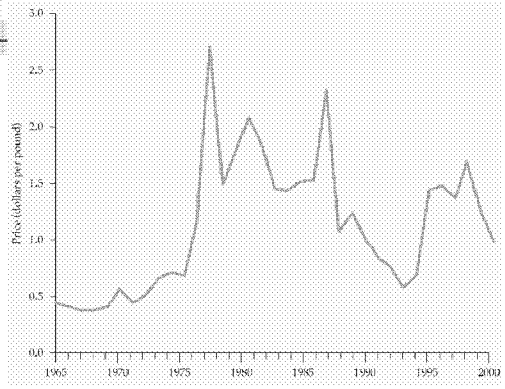

Short-Run Versus Long-Run Elasticities

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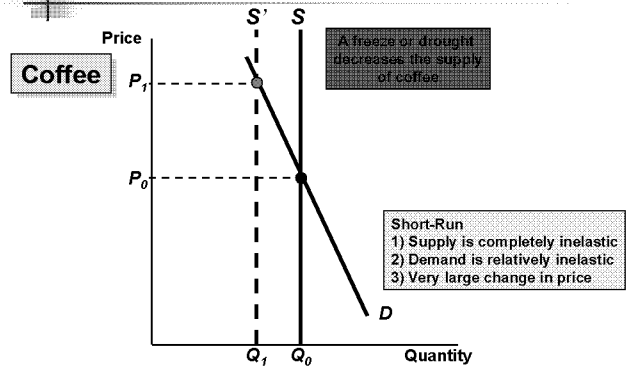

A freeze or drought decreases the supply of coffee

Short-Run
1) Supply is completely inelastic
2) Demand is relatively inelastic
3) Very large change in price

Short-Run Versus Long-Run Elasticities

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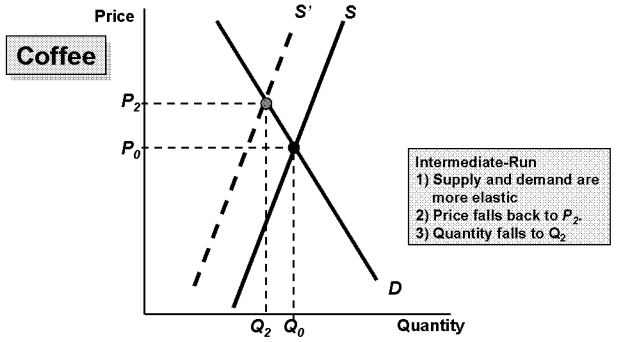

Intermediate-Run
1) Supply and demand are more elastic
2) Price falls back to P_2.
3) Quantity falls to Q_2

Short-Run Versus Long-Run Elasticities

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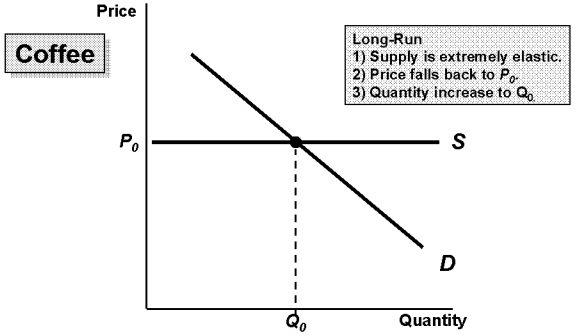

Long-Run
1) Supply is extremely elastic.
2) Price falls back to P_0.
3) Quantity increase to Q_0

Understanding and Predicting the Effects of Changing Market Conditions

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- First, we must learn how to "fit" linear demand and supply curves to market data.
- Then we can determine numerically how a change in a variable will cause supply or demand to shift and thereby affect the market price and quantity.

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Understanding and Predicting the Effects of Changing Market Conditions

- Available Data
  - Equilibrium Price, *P**
  - Equilibrium Quantity, *Q**
  - Price elasticity of supply, E_S, and demand, E_D.

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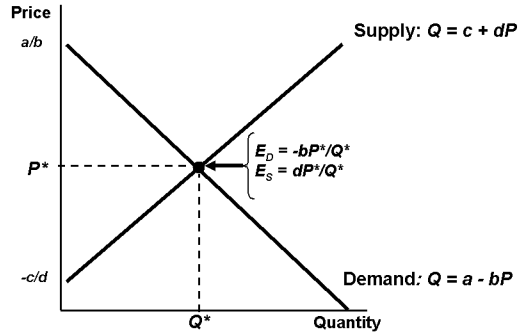
Understanding and Predicting the Effects of Changing Market Conditions



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Understanding and Predicting the Effects of Changing Market Conditions

- Let's begin with the equations for supply and demand:

  Demand: $Q_D = a - bP$

  Supply: $Q_S = c + dP$

- We must choose numbers for *a, b, c,* and *d.*

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Understanding and Predicting the Effects of Changing Market Conditions

- Step 1:

  Recall:

$$E = (P/Q)(\Delta Q/\Delta P)$$

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Understanding and Predicting the Effects of Changing Market Conditions

- For linear demand curves, the change in quantity divided by the change in price is constant (equal to the slope of the curve).

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Understanding and Predicting the Effects of Changing Market Conditions

- Substituting the slopes for each into the formula for elasticity, we get:

$$E_D = -b(P^*/Q^*)$$

$$E_S = d(P^*/Q^*)$$

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Understanding and Predicting the Effects of Changing Market Conditions

- Since we will have values for E_D, E_S, P^*, and Q^*, we can solve for *b* & *d*, and *a* & *c*.

$$Q_D^* = a - bP^*$$

$$Q_S^* = c + dP^*$$

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Understanding and Predicting the Effects of Changing Market Conditions

- Deriving the long-run supply and demand for copper:
  - The relevant data are:
    - Q* = 7.5 mmt/yr.
    - P* = 75 cents/pound
    - E_S = 1.6
    - E_D = -0.8

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Understanding and Predicting the Effects of Changing Market Conditions

- $E_s = d(P^*/Q^*)$
- 1.6 = d(75/7.5) = 0.1d
- d = 1.6/0.1 = 16
- $E_d = -b(P^*/Q^*)$
- -0.8 = -b(.75/7.5) = -0.1b
- b = 0.8/0.1 = 8

Understanding and Predicting the Effects of Changing Market Conditions

- Supply = $Q_S^* = c + dP^*$
- 7.5 = c + 16(0.75)
- 7.5 = c + 12
- c = 7.5 - 12
- c = -4.5
- Q = -4.5 + 16P

- Demand = $Q_D^* = a - bP^*$
- 7.5 = a -(8)(.75)
- 7.5 = a - 6
- a = 7.5 + 6
- a =13.5
- Q = 13.5 - 8P

Understanding and Predicting the Effects of Changing Market Conditions

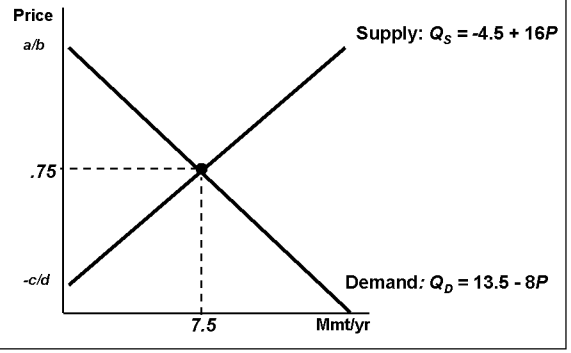
- Setting supply equal to demand gives:

Supply = -4.5 + 16p = 13.5 - 8p = *Demand*

16p + 8p = 13.5 + 4.5

p = 18/24 = .75

Understanding and Predicting the Effects of Changing Market Conditions



Understanding and Predicting the Effects of Changing Market Conditions

- We have written supply and demand so that they only depend upon price.
- Demand could also depend upon income.
- Demand would then be written as:

$$Q = a - bP + fI$$

Understanding and Predicting the Effects of Changing Market Conditions

- We know the following information regarding the copper industry:
  - I = 1.0
  - P^* = 0.75
  - Q^* = 7.5
  - b = 8
  - Income elasticity: E = 1.3

Understanding and Predicting the Effects of Changing Market Conditions

- f can be found by substituting known values into the income elasticity formula:

$$E = (I/Q)(\Delta Q/\Delta I)$$

and

$$f = \Delta Q/\Delta I$$

Understanding and Predicting the Effects of Changing Market Conditions

- Solving for f gives:

1.3 = (1.0/7.5)f

f = (1.3)(7.5)/1.0 = 9.75

Understanding and Predicting the Effects of Changing Market Conditions

- Solving for a gives:

$$Q^* = a - bP^* + fI$$

7.5 = a - 8(0.75) + 9.75(1.0)

a = 3.75

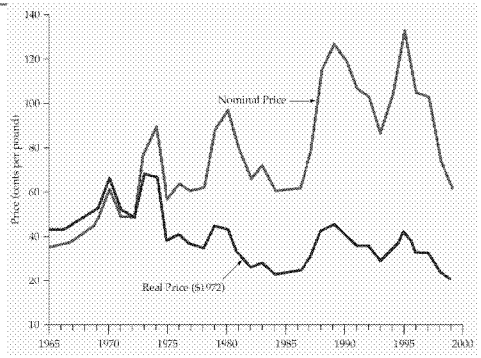
Declining Demand and the Behavior of Copper Prices

- The relevant factors leading to a decrease in the demand for copper are:

1) A decrease in the growth rate of power generation

2) The development of substitutes: fiber optics and aluminum

Real versus Nominal Prices of Copper 1965 - 1999



Real versus Nominal Prices of Copper 1965 - 1999

- We will try to estimate the impact of a 20 percent decrease in the demand for copper.
- Recall the equation for the demand curve:

$$Q = 13.5 - 8P$$

Real versus Nominal Prices of Copper 1965 - 1999

- Multiply this equation by 0.80 to get the new equation. This gives:

$$Q = (0.80)(13.5 - 8P)$$

$$Q = 10.8 - 6.4P$$

- Recall the equation for supply:

$$Q = -4.5 + 16P$$

Real versus Nominal Prices of Copper 1965 - 1999

- The new equilibrium price is:

$$-4.5 + 16P = 10.8 - 6.4P$$

$$-16P + 6.4P = 10.8 + 4.5$$

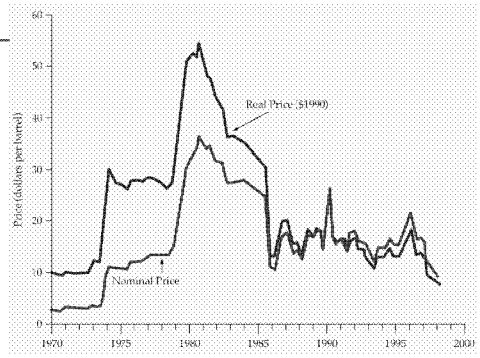
$$P = 15.3/22.4$$

$$P = 68.3 \text{ cents/pound}$$

Real versus Nominal Prices of Copper 1965 - 1999

- The twenty percent decrease in demand resulted in a reduction in the equilibrium price to 68.3 cents from 75 cents, or 10 percent.

Price of Crude Oil



Upheaval in the World Oil Market

- We can predict numerically the impact of a decrease in the supply of OPEC oil.
- In 1995:
  - P^* = $18/barrel
  - World demand and total supply = 23 bb/yr.
  - OPEC supply = 10 bb/yr.
  - Non-OPEC supply = 13 bb/yr

Price Elasticity Estimates

	Short-Run	Long-Run
World Demand:	-0.05	-0.40
Competitive Supply (non-OPEC)	0.10	0.40

Upheaval in the World Oil Market

- Short-Run Impact of a stoppage of Saudi Production equal to 3 bb/yr.
  - Short-run Demand
    - $D = 24.08 - 0.06P$
  - Short-run Competitive Supply
    - $S_C = 11.74 + 0.07P$

Upheaval in the World Oil Market

- Short-Run Impact of a stoppage of Saudi Production equal to 3 bb/yr.
  - Short-run Total Supply--before supply reduction (includes OPEC, 10bb/yr)
    - $S_T = 21.74 + 0.07P$
  - Short-run Total Supply--after supply reduction
    - $S_T = 18.74 + 0.07P$

Upheaval in the World Oil Market

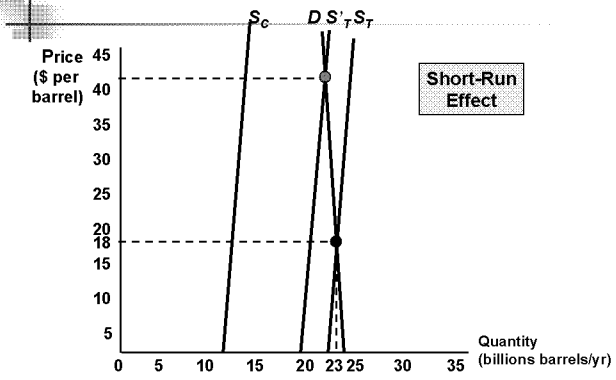
- New Price After Reduction

Demand = Supply

$24.08 - 0.06P = 18.74 + 0.07P$

$P = 41.08$

Impact of Saudi Production Cut



Upheaval in the World Oil Market

- Long-Run Impact of a stoppage Saudi Production equal to 3 bb/yr..
  - Long-run Demand
    - $D = 32.18 - 0.51P$
  - Long-run Total Supply
    - $S = 17.78 + 0.29P$

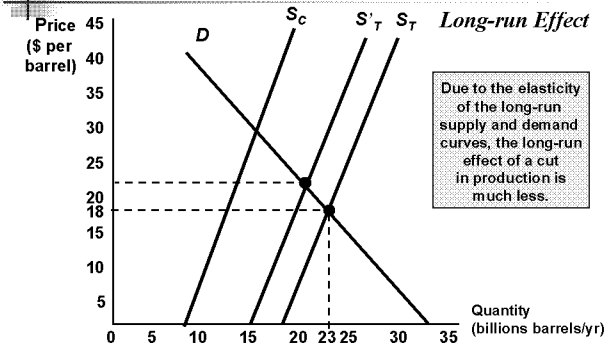
Upheaval in the World Oil Market

- New Price is found setting long-run supply equal to long-run demand:

$32.18 - 0.51P = 14.78 + 0.29P$

$P = 21.75$

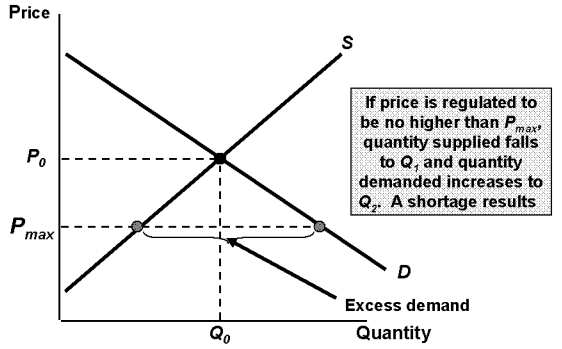
Impact of Saudi Production Cut



Effects of Government Intervention --Price Controls

- If the government decides that the equilibrium price is too high, they may establish a maximum allowable *ceiling price.*

Effects of Price Controls



Price Controls and Natural Gas Shortages

- In 1954, the federal government began regulating the wellhead price of natural gas.
- In 1962, the ceiling prices that were imposed became binding and shortages resulted.

Price Controls and Natural Gas Shortages

- Price controls created an excess demand of 7 trillion cubic feet.
- Price regulation was a major component of U.S. energy policy in the 1960s and 1970s, and it continued to influence the natural gas markets in the 1980s.

Price Controls and Natural Gas Shortages

The Data: Natural Gas

$P_E^S = 0.2$

Cross elasticity of supply for oil = 0.1

$P_E^D = -0.5$

Cross elasticity of demand for oil = 1.5

$Supply: Q = 14 + 2P_G + .25P_O$

$Demand: Q = -5P_G + 3.75P_O$

$Supply = Demand$ @ \$2/TcF

Price Controls and Natural Gas Shortages

The Data: Natural Gas

1975 regulated price = \$1.00

At \$1.00/TcF

Q_S = 18 TcF and Q = 25 TcF

Shortage = 7 TcF/yr

Summary

- Supply-demand analysis is a basic tool of microeconomics.
- The market mechanism is the tendency for supply and demand to equilibrate, so that there is neither excess demand nor excess supply

Summary

- Elasticities describe the responsiveness of supply and demand to changes in price, income, and other variables.
- Elasticities pertain to a time frame.
- If we can estimate the supply and demand curves for a particular market, we can calculate the market clearing price.

Summary

- Simple numerical analysis can often be done by fitting linear supply and demand curves to data on price and quantity and to estimates of elasticities.

End of Chapter 2

The Basics of Supply and Demand

Chapter 3

Consumer Behavior

Topics to be Discussed

- Consumer Preferences
- Budget Constraints
- Consumer Choice
- Revealed Preferences

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Topics to be Discussed

- Marginal Utility and Consumer Choices
- Cost-of-Living Indexes

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Consumer Behavior

- Two applications that illustrate the importance of the economic theory of consumer behavior are:
  - Apple-Cinnamon Cheerios
  - The Food Stamp Program.

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Consumer Behavior

- General Mills had to determine how high a price to charge for Apple-Cinnamon Cheerios before it went to the market.

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Consumer Behavior

- When the food stamp program was established in the early 1960s, the designers had to determine to what extent the food stamps would provide people with more food and not just simply subsidize the food they would have bought anyway.

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Consumer Behavior

- These two problems require an understanding of the economic theory of consumer behavior.

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Consumer Behavior

- There are three steps involved in the study of consumer behavior.

1) We will study *consumer preferences*.
   - To describe how and why people prefer one good to another.

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Consumer Behavior

- There are three steps involved in the study of consumer behavior.

2) Then we will turn to *budget constraints*.
   - People have limited incomes.

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Consumer Behavior

- There are three steps involved in the study of consumer behavior.

3) Finally, we will combine consumer preferences and budget constraints to determine *consumer choices*.
   - What combination of goods will consumers buy to maximize their satisfaction?

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Consumer Preferences

Market Baskets

- A market basket is a collection of one or more commodities.
- One market basket may be preferred over another market basket containing a different combination of goods.

Consumer Preferences

Market Baskets

- Three Basic Assumptions
  1) Preferences are *complete*.
  2) Preferences are *transitive.*
  3) Consumers always prefer more of any good to less.

Consumer Preferences

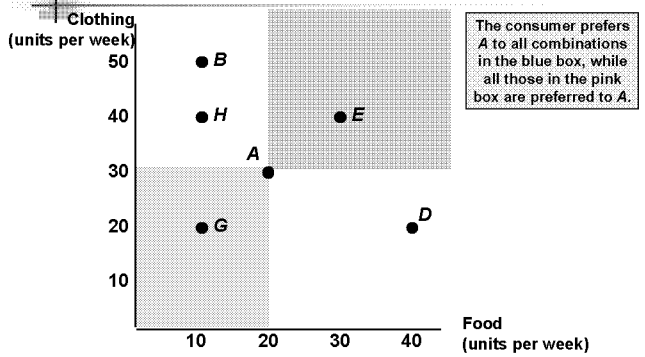
Market Basket	Units of Food	Units of Clothing
A	20	30
B	10	50
D	40	20
E	30	40
G	10	20
H	10	40

Consumer Preferences

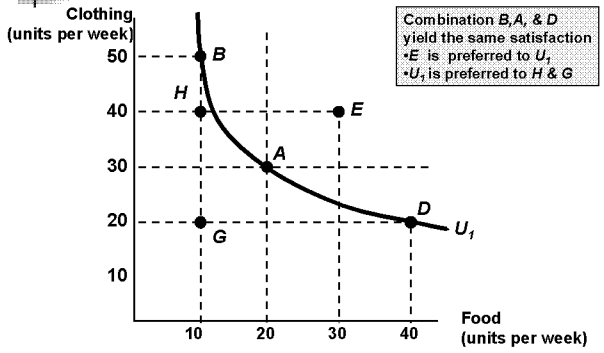
Indifference Curves

- Indifference curves represent all combinations of market baskets that provide the same level of satisfaction to a person.

Consumer Preferences



Consumer Preferences



Consumer Preferences

- Indifference Curves
  - Indifference curves slope downward to the right.
    - If it sloped upward it would violate the assumption that more of any commodity is preferred to less.

Consumer Preferences

- Indifference Curves
  - Any market basket lying above and to the right of an indifference curve is preferred to any market basket that lies on the indifference curve.

Consumer Preferences

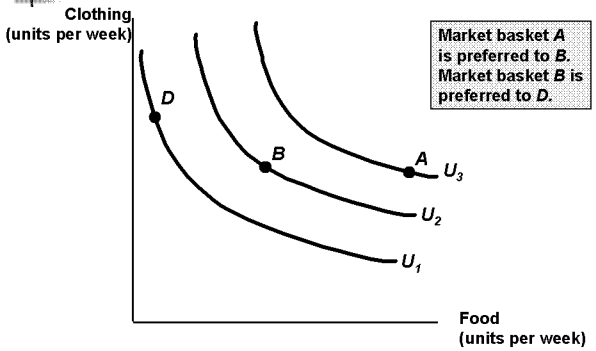
Indifference Maps

- An indifference map is a set of indifference curves that describes a person's preferences for all combinations of two commodities.
  - Each indifference curve in the map shows the market baskets among which the person is indifferent.

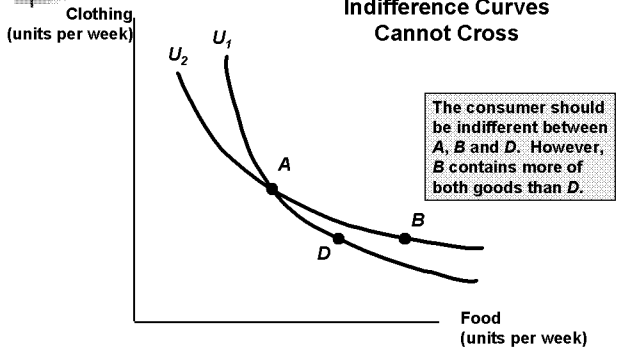
Consumer Preferences

- Indifference Curves
  - Finally, indifference curves cannot cross.
    - This would violate the assumption that more is preferred to less.

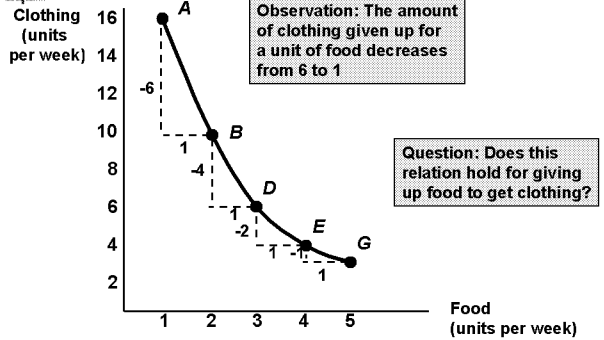
Consumer Preferences



Consumer Preferences



Consumer Preferences

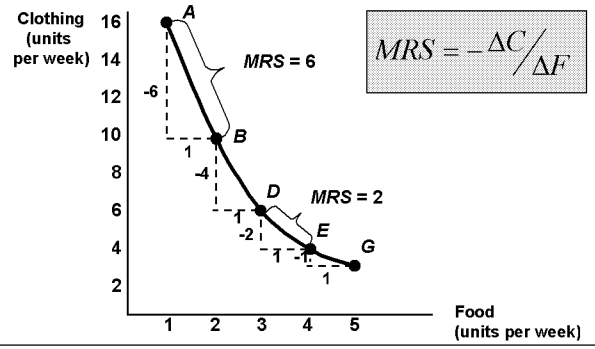


Consumer Preferences

Marginal Rate of Substitution

- The marginal rate of substitution (*MRS*) quantifies the amount of one good a consumer will give up to obtain more of another good.
  - It is measured by the slope of the indifference curve.

Consumer Preferences



$$MRS = -\Delta C / \Delta F$$

Consumer Preferences

Marginal Rate of Substitution

- We will now add a fourth assumption regarding consumer preference:
  - Along an indifference curve there is a *diminishing marginal rate of substitution.*
    - Note the *MRS* for *AB* was 6, while that for *DE* was 2.

Consumer Preferences

Marginal Rate of Substitution

- **Question**
  - What are the first three assumptions?

Consumer Preferences

Marginal Rate of Substitution

- Indifference curves are convex because as more of one good is consumed, a consumer would prefer to give up fewer units of a second good to get additional units of the first one.
- Consumers prefer a balanced market basket

Consumer Preferences

Marginal Rate of Substitution

- Perfect Substitutes and Perfect Complements
  - Two goods are perfect substitutes when the marginal rate of substitution of one good for the other is constant.

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Consumer Preferences

Marginal Rate of Substitution

- Perfect Substitutes and Perfect Complements
  - Two goods are perfect complements when the indifference curves for the goods are shaped as right angles.

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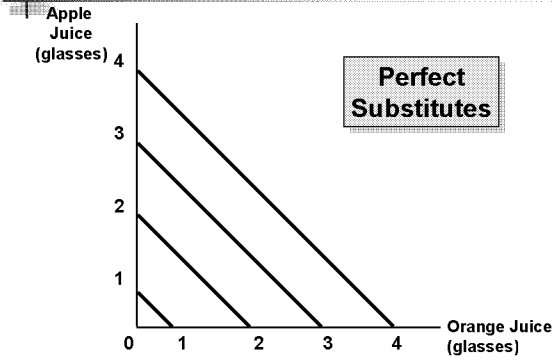
Consumer Preferences



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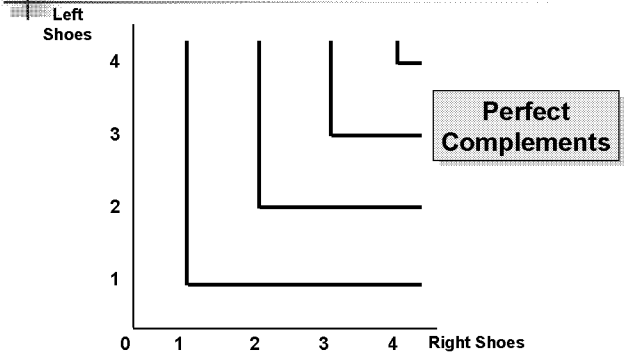
Consumer Preferences



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Consumer Preferences

- BADS
  - Things for which less is preferred to more
- Examples
  - Air pollution
  - Asbestos

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Consumer Preferences

- **What Do You Think?**
  - How can we account for Bads in the analysis of consumer preferences?

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Consumer Preferences

Designing New Automobiles (*I*)

- Automobile executives must regularly decide when to introduce new models and how much money to invest in restyling.

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Consumer Preferences

Designing New Automobiles (*I*)

- An analysis of consumer preferences would help to determine when and if car companies should change the styling of their cars.

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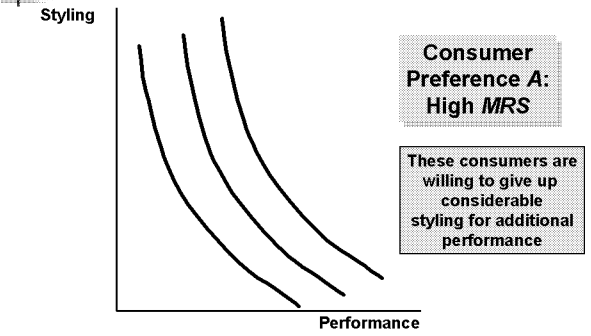
Consumer Preferences



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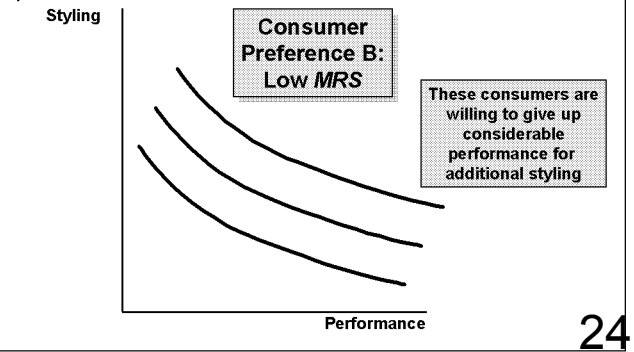
Consumer Preferences



Consumer Preferences

Designing New Automobiles (*I*)

- **What Do You Think?**
  - How can we determine the consumers preference?

Consumer Preferences

Designing New Automobiles (*I*)

- A recent study of automobile demand in the United States shows that over the past two decades most consumers have preferred styling over performance.

Consumer Preferences

Designing New Automobiles (*I*)

- Growth of Japanese Imports
  - 1970's and 1980's
    - 15% of domestic cars underwent a style change each year
    - This compares to 23% for imports

Consumer Preferences

- Utility
  - Utility: Numerical score representing the satisfaction that a consumer gets from a given market basket.

Consumer Preferences

- Utility
  - If buying 3 copies of *Microeconomics* makes you happier than buying one shirt, then we say that the books give you more utility than the shirt.

Consumer Preferences

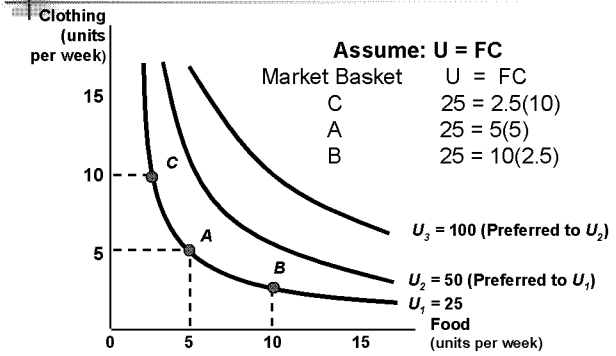
- Utility Functions
  - Assume:
    The utility function for food (F) and clothing (C)
    U(F,C) = F + 2C

Market Baskets:	F units	C units	U(F,C) = F + 2C
A	8	3	8 + 2(3) = 14
B	6	4	6 + 2(4) = 14
C	4	4	4 + 2(4) = 12

The consumer is indifferent to A & B
The consumer prefers A & B to C

Consumer Preferences

Utility Functions & Indifference Curves



Consumer Preferences

- Ordinal Versus Cardinal Utility
  - Ordinal Utility Function: places market baskets in the order of most preferred to least preferred, but it does not indicate how much one market basket is preferred to another.
  - Cardinal Utility Function: utility function describing the extent to which one market basket is preferred to another.

Consumer Preferences

- Ordinal Versus Cardinal Rankings
  - The actual unit of measurement for utility is not important.
  - Therefore, an ordinal ranking is sufficient to explain how most individual decisions are made.

Budget Constraints

- Preferences do not explain all of consumer behavior.
- Budget constraints also limit an individual's ability to consume in light of the prices they must pay for various goods and services.

Budget Constraints

- The Budget Line
  - The budget line indicates all combinations of two commodities for which total money spent equals total income.

Budget Constraints

- The Budget Line
  - Let F equal the amount of food purchased, and C is the amount of clothing.
  - Price of food = P_f and price of clothing = P_c
  - Then $P_f F$ is the amount of money spent on food, and $P_c C$ is the amount of money spent on clothing.

Budget Constraints

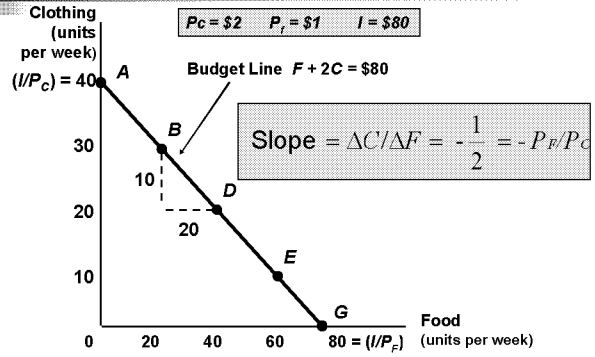
- The budget line then can be written:

$$P_F F + P_C C = I$$

Budget Constraints

Market Basket	Food (F) P_f = ($1)	Clothing (C) P_c = ($2)	Total Spending $P_f F + P_c C = I$
A	0	40	$80
B	20	30	$80
D	40	20	$80
E	60	10	$80
G	80	0	$80

Budget Constraints



Budget Constraints

- The Budget Line
  - As consumption moves along a budget line from the intercept, the consumer spends less on one item and more on the other.
  - The slope of the line measures the relative cost of food and clothing.
  - The slope is the negative of the ratio of the prices of the two goods.

Budget Constraints

- The Budget Line
  - The slope indicates the rate at which the two goods can be substituted without changing the amount of money spent.

Budget Constraints

- The Budget Line
  - The vertical intercept (I/P_C), illustrates the maximum amount of C that can be purchased with income I.
  - The horizontal intercept (I/P_F), illustrates the maximum amount of F that can be purchased with income I.

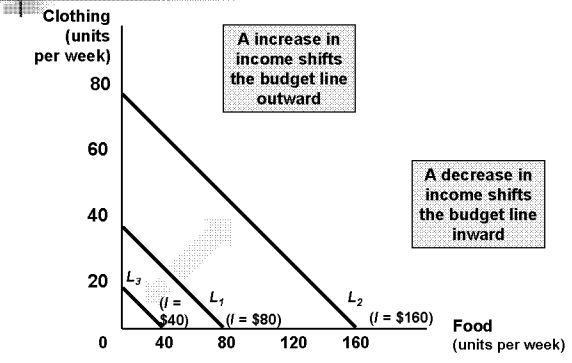
Budget Constraints

- The Effects of Changes in Income and Prices
  - Income Changes
    - An increase in income causes the budget line to shift outward, parallel to the original line (holding prices constant).

Budget Constraints

- The Effects of Changes in Income and Prices
  - Income Changes
    - A decrease in income causes the budget line to shift inward, parallel to the original line (holding prices constant).

Budget Constraints



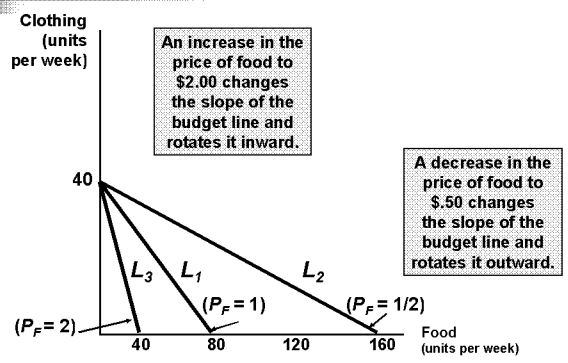
Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - If the price of one good increases, the budget line shifts inward, pivoting from the other good's intercept.

Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - If the price of one good decreases, the budget line shifts outward, pivoting from the other good's intercept.

Budget Constraints



Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - If the two goods increase in price, but the *ratio* of the two prices is unchanged, the slope will not change.

Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - However, the budget line will shift inward to a point parallel to the original budget line.

Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - If the two goods decrease in price, but the *ratio* of the two prices is unchanged, the slope will not change.

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Budget Constraints

- The Effects of Changes in Income and Prices
  - Price Changes
    - However, the budget line will shift outward to a point parallel to the original budget line.

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Consumer Choice

- Consumers choose a combination of goods that will maximize the satisfaction they can achieve, given the limited budget available to them.

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Consumer Choice

- The maximizing market basket must satisfy two conditions:

  1) It must be located on the budget line.

  2) Must give the consumer the most preferred combination of goods and services.

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Consumer Choice

Recall, the slope of an indifference curve is:

$$MRS = -\frac{\Delta C}{\Delta F}$$

Further, the slope of the budget line is:

$$Slope = -\frac{P_F}{P_C}$$

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Consumer Choice

- Therefore, it can be said that satisfaction is maximized where:

$$MRS = \frac{P_F}{P_C}$$

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Consumer Choice

- It can be said that satisfaction is maximized when *marginal rate of substitution (of F and C) is equal to the ratio of the prices (of F and C).*

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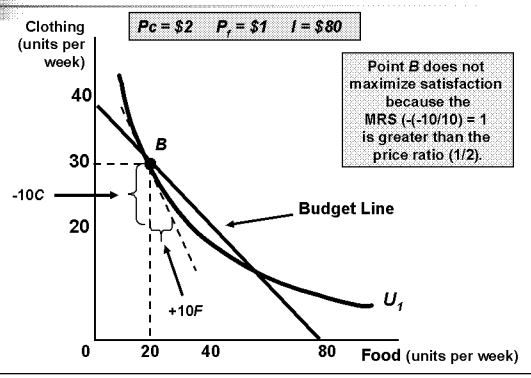
Consumer Choice



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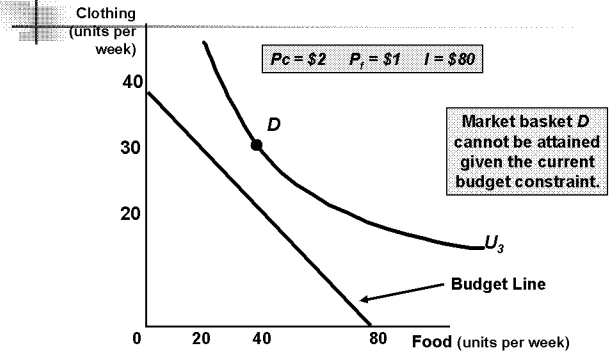
Consumer Choice



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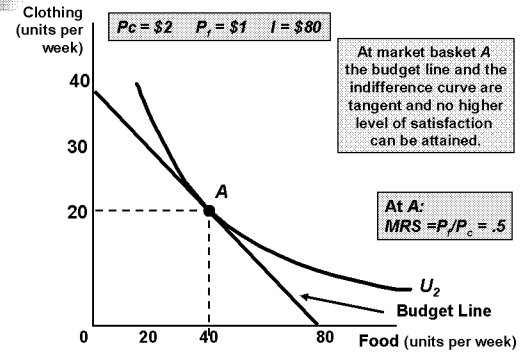
Consumer Choice



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Consumer Choice

Designing New Automobiles (*II*)

- Consider two groups of consumers, each wishing to spend $10,000 on the styling and performance of cars.
- Each group has different preferences.

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Consumer Choice

Designing New Automobiles (*II*)

- By finding the point of tangency between a group's indifference curve and the budget constraint auto companies can design a production and marketing plan.

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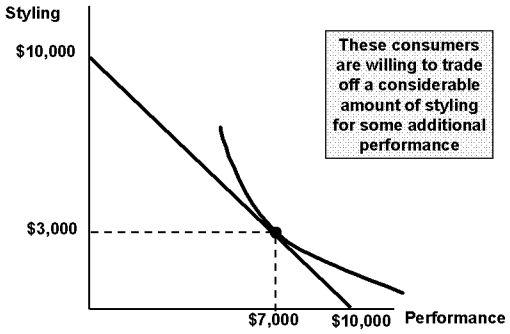
Designing New Automobiles (II)



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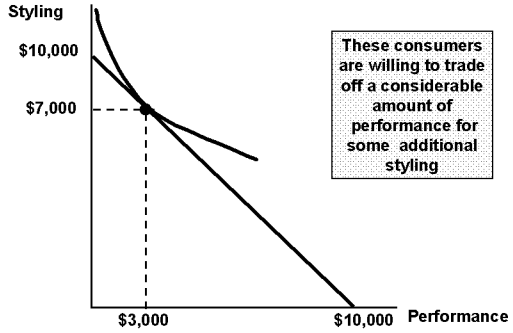
Designing New Automobiles (II)



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Consumer Choice

Decision Making & Public Policy

- Choosing between a non-matching and matching grant to fund police expenditures

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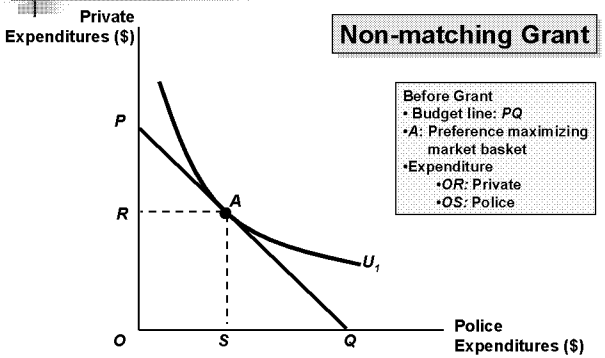
Consumer Choice



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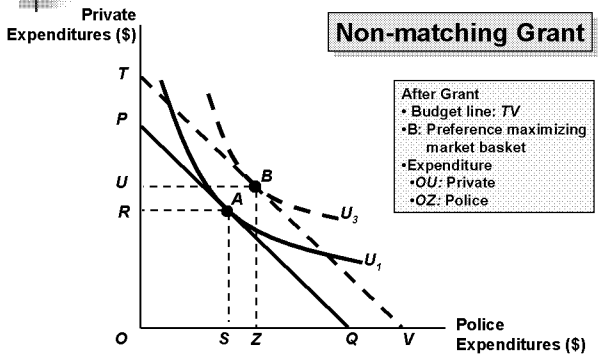
Consumer Choice



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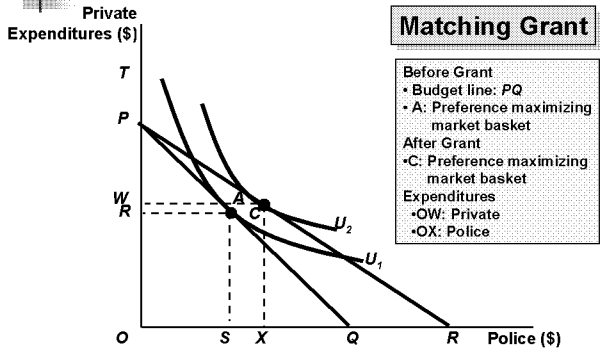
Consumer Choice



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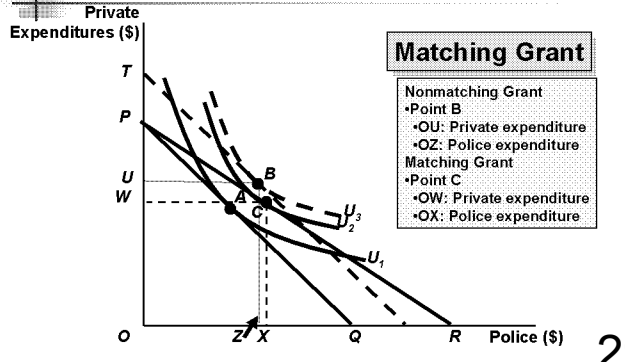
Consumer Choice

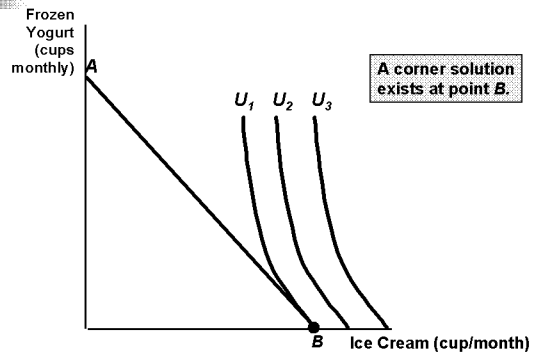


Consumer Choice

A Corner Solution

- A corner solution exists if a consumer buys in extremes, and buys all of one category of good and none of another.
  - This exists where the indifference curves are tangent to the horizontal and vertical axis.
  - *MRS* is *not* equal to P_A/P_B

A Corner Solution



Consumer Choice

- A Corner Solution
  - At point B, the *MRS* of ice cream for frozen yogurt is greater than the slope of the budget line.
  - This suggests that if the consumer could give up more frozen yogurt for ice cream he would do so.
  - However, there is no more frozen yogurt to give up!

Consumer Choice

- A Corner Solution
  - When a corner solution arises, *the consumer's MRS does not necessarily equal the price ratio.*
- In this instance it can be said that:

$$MRS \geq P_{IceCream} / P_{FrozenYogurt}$$

Consumer Choice

- A Corner Solution
  - If the MRS is, in fact, significantly greater than the price ratio, then a small decrease in the price of frozen yogurt *will not* alter the consumer's market basket.

Consumer Choice

A College Trust Fund

- Suppose Jane Doe's parents set up a trust fund for her college education.
- Originally, the money must be used for education.

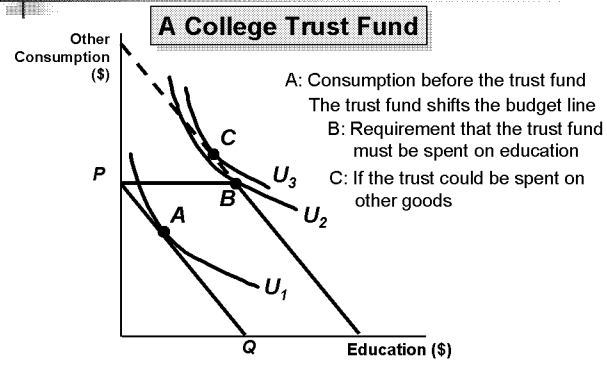
Consumer Choice

A College Trust Fund

- If part of the money could be used for the purchase of other goods, her consumption preferences change.

Consumer Choice

A College Trust Fund



Revealed Preferences

- If we know the choices a consumer has made, we can determine what her preferences are if we have information about a sufficient number of choices that are made when prices and incomes vary.

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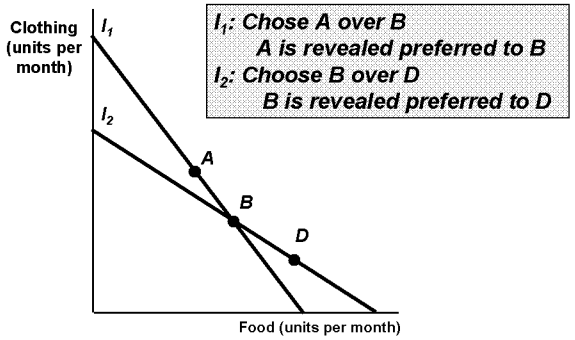
Revealed Preferences--Two Budget Lines



I_1: Chose A over B
A is revealed preferred to B
I_2: Choose B over D
B is revealed preferred to D

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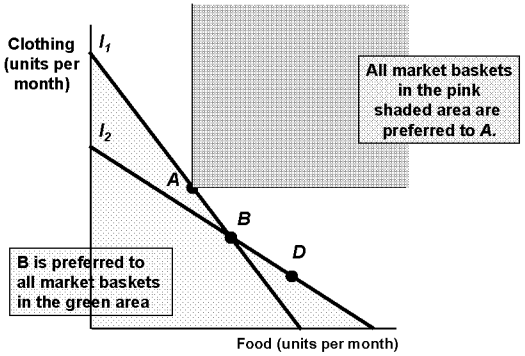
Revealed Preferences--Two Budget Lines



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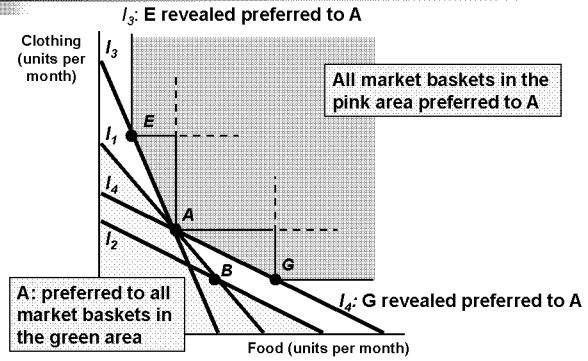
Revealed Preferences--Four Budget Lines



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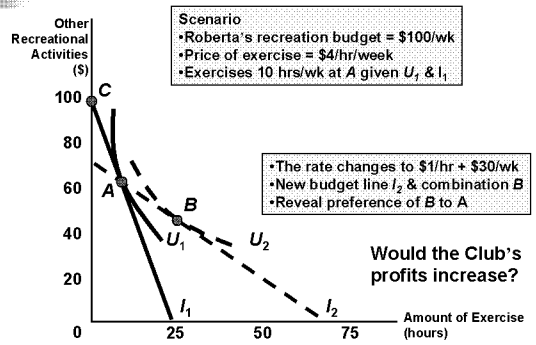
Revealed Preferences for Recreation



Scenario
- Roberta's recreation budget = $100/wk
- Price of exercise = $4/hr/week
- Exercises 10 hrs/wk at *A* given U_1 & I_1

- The rate changes to $1/hr + $30/wk
- New budget line I_2 & combination *B*
- Reveal preference of *B* to A

Would the Club's profits increase?

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Marginal Utility and Consumer Choice

Marginal Utility

- Marginal utility measures the additional satisfaction obtained from consuming one additional unit of a good.

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Marginal Utility and Consumer Choice

Marginal Utility

- Example
  - The marginal utility derived from increasing from 0 to 1 units of food might be 9
  - Increasing from 1 to 2 might be 7
  - Increasing from 2 to 3 might be 5
- Observation: Marginal utility is diminishing

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Marginal Utility and Consumer Choice

Diminishing Marginal Utility

- The principle of diminishing marginal utility states that as more and more of a good is consumed, consuming additional amounts will yield smaller and smaller additions to utility.

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Marginal Utility and Consumer Choice

- Marginal Utility and the Indifference Curve
  - If consumption moves along an indifference curve, the additional utility derived from an increase in the consumption one good, food (F), must balance the loss of utility from the decrease in the consumption in the other good, clothing (C).

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Marginal Utility and Consumer Choice

- Formally:

$$0 = MU_F(\Delta F) + MU_C(\Delta C)$$

Marginal Utility and Consumer Choice

- Rearranging:

$$-(\Delta C / \Delta F) = MU_F / MU_C$$

Marginal Utility and Consumer Choice

$$-(\Delta C / \Delta F) = MU_F / MU_C$$

- Because:

$$-(\Delta C / \Delta F) = MRS \text{ of F for C}$$

$$MRS = MU_F / MU_C$$

Marginal Utility and Consumer Choice

- When consumers maximize satisfaction the:

$$MRS = P_F / P_C$$

- Since the MRS is also equal to the ratio of the marginal utilities of consuming *F* and *C,* it follows that:

$$MU_F / MU_C = P_F / P_C$$

Marginal Utility and Consumer Choice

- Which gives the equation for utility maximization:

$$MU_F / P_F = MU_C / P_C$$

Marginal Utility and Consumer Choice

- Total utility is maximized when the budget is allocated so that *the marginal utility per dollar of expenditure is the same for each good.*
- This is referred to as the equal marginal principle.

Marginal Utility and Consumer Choice

Gasoline Rationing

- In 1974 and again in 1979, the government imposed price controls on gasoline.
- This resulted in shortages and gasoline was rationed.

Marginal Utility and Consumer Choice

Gasoline Rationing

- Nonprice rationing is an alternative to market rationing.
- Under one form everyone has an equal chance to purchase a rationed good.
- Gasoline is rationed by long lines at the gas pumps.

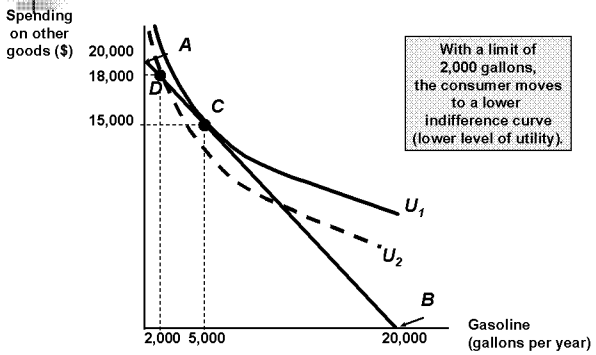
Marginal Utility and Consumer Choice

- Rationing hurts some by limiting the amount of gasoline they can buy.
- This can be seen in the following model.
- It applies to a woman with an annual income of $20,000.

Marginal Utility and Consumer Choice

- The horizontal axis shows her annual consumption of gasoline at $1/gallon.
- The vertical axis shows her remaining income after purchasing gasoline.

Marginal Utility and Consumer Choice



Cost-of-Living Indexes

- The CPI is calculated each year as the ratio of the cost of a typical bundle of consumer goods and services today in comparison to the cost during a base period.

Cost-of-Living Indexes

- **What Do You Think?**
  - Does the CPI accurately reflect the cost of living for retirees?
  - Is it appropriate to use the CPI as a cost-of-living index for other government programs, for private union pensions, and for other private wage agreements?

Cost-of-Living Indexes

- Example
  - Two sisters, Rachel and Sarah, have identical preferences.
  - Sarah began college in 1987 with a $500 discretionary budget.
  - In 1997, Rachel started college and her parents promised her a budget that was equivalent in purchasing power.

Cost-of-Living Indexes

	1987 (Sarah)	1997 (Rachel)
Price of books	$20/book	$100/book
Number of books	15	6
Price of food	$2.00/lb.	$2.20/lb
Pounds of food	100	300
Expenditure	$500	$1,260

Cost-of-Living Indexes

Sarah' Expenditure

$500 = 100 lbs. of food x $2.00/lb. + 15 books x $20/book

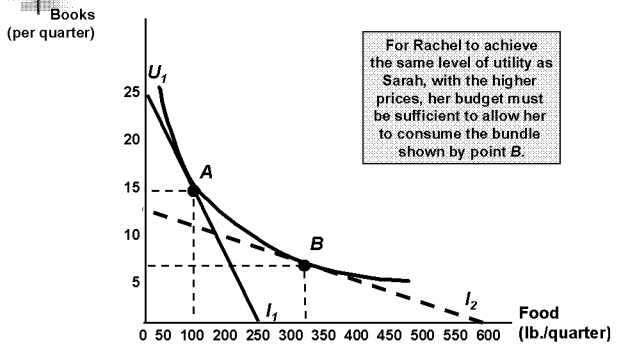
Rachel' Expenditure for Equal Utility

$1,260 = 300 lbs. of food x $2.20/lb. + 6 books x $100/book

Cost-of-Living Indexes

- The ideal *cost-of-living adjustment* for Rachel is $760.
- The ideal *cost-of-living index* is $1,260/$500 = 2.52 or 252.
- This implies a 152% increase in the cost of living.

Cost-of-Living Indexes



Cost-of-Living Indexes

- The ideal cost of living index represents the cost of attaining a given level of utility at current (1997) prices relative to the cost of attaining the same utility at base (1987) prices.

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Cost-of-Living Indexes

- To do this on an economy-wide basis would entail large amounts of information.
- Price indexes, like the CPI, use a fixed consumption bundle in the base period.
  - Called a Laspeyres price index

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Cost-of-Living Indexes

Laspeyres Index

- The Laspeyres index tells us:
  - The amount of money at current year prices that an individual requires to purchase the bundle of goods and services that was chosen in the base year divided by the cost of purchasing the same bundle at base year prices.

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Cost-of-Living Indexes

- Calculating Rachel's Laspeyres cost of living index
  - Setting the quantities of goods in 1997 equal to what were bought by her sister, but setting their prices at their 1997 levels result in an expenditure of $1,720 (100 x 2.20 + 15 x $100)

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Cost-of-Living Indexes

- Her cost of living adjustment would now be $1,220.
- The Laspeyres index is: $1,720/$500 = 344.
- This overstates the true cost-of-living increase.

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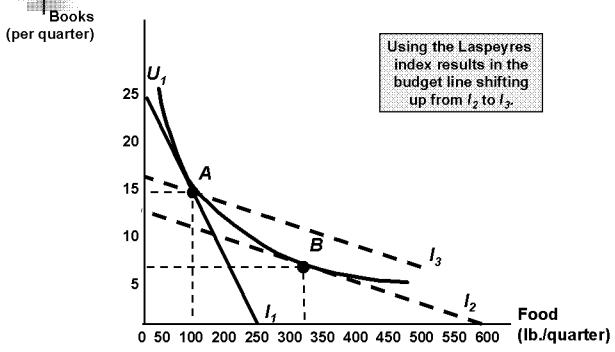
Cost-of-Living Indexes



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Cost-of-Living Indexes

- **What Do You Think?**
  - Does the Laspeyres index always overstate the true cost-of-living index?

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Cost-of-Living Indexes

- Yes!
  - The Laspeyres index assumes that consumers do not alter their consumption patterns as prices change.

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Cost-of-Living Indexes

- Yes!
  - By increasing purchases of those items that have become relatively cheaper, and decreasing purchases of the relatively more expensive items consumers can achieve the same level of utility without having to consume the same bundle of goods.

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Cost-of-Living Indexes

- The Paasche Index
  - Calculates the amount of money at current-year prices that an individual requires to purchase a current bundle of goods and services divided by the cost of purchasing the same bundle in the base year.

Cost-of-Living Indexes

Comparing the Two Indexes

- Both indexes involve ratios that involve today's current year prices, P_{Ft} and P_{Ct}.
- However, the Laspeyres index relies on base year consumption, F_b and C_b.
- Whereas, the Paasche index relies on today's current consumption, F_t and C_t.

Cost-of-Living Indexes

- Then a comparison of the Laspeyres and Paasche indexes gives the following equations:

$$LI = \frac{P_{Ft}F_t + P_{Ct}C_t}{P_{Ft}F_t + P_{Ct}C_t}$$

$$PI = \frac{P_{Fb}F_t + P_{Ct}C_t}{P_{Fb}F_t + P_{Ct}C_t}$$

Cost-of-Living Indexes

Comparing the Two Indexes

- Suppose:
  - Two goods: Food (F) and Clothing (C)

Cost-of-Living Indexes

Comparing the Two Indexes

- Let:
  - P_{Ft} & P_{Ct} be current year prices
  - P_{Fb} & P_{Cb} be base year prices
  - F_t & C_t be current year quantities
  - F_b & C_b be base year quantities

Cost-of-Living Indexes

Comparing the Two Indexes

- Sarah (1990)
  - Cost of base-year bundle at current prices equals \$1,720 (100 lbs x \$2.20/lb + 15 books x \$100/book)
  - Cost of same bundle at base year prices is \$500 (100 lbs x \$2.00/lb + 15 books x \$20/book)

Cost-of-Living Indexes

Comparing the Two Indexes

- Sarah (1990)

$$LI = \frac{\$1{,}720}{\$500} = 344$$

Cost-of-Living Indexes

Comparing the Two Indexes

- Sarah (1990)
  - Cost of buying current year bundle at current year prices is \$1,260 (300 lbs x \$2.20/lb + 6 books x \$100/book)
  - Cost of the same bundle at base year prices is \$720 (300 lbs x \$2/lb + 6 books x \$20/book)

Cost-of-Living Indexes

Comparing the Two Indexes

- Sarah (1990)

$$PI = \frac{\$1{,}260}{\$720} = 175$$

Cost-of-Living Indexes

The Paasche Index

- The Paasche index will understate the cost of living because it assumes that the individual will buy the current year bundle in the base year.

Cost-of-Living Indexes

- In 1995, the government adopted the *chain-weighted* price index to deflate its measure of real GDP.
  - Developed to overcome problems that arose when long-term comparisons of GDP were made using fixed-weight price indexes and prices were rapidly changing.

Cost-of-Living Indexes

The Bias of the CPI

- **What Do You Think?**
  - What is the impact on the Federal budget of using the CPI (a Laspeyres index) to adjust social security and other programs for changes in the cost of living?

Summary

- People behave rationally in an attempt to maximize satisfaction from a particular combination of goods and services.
- Consumer choice has two related parts: the consumer's preferences and the budget line.

Summary

- Consumers make choices by comparing market baskets or bundles of commodities.
- Indifference curves are downward sloping and cannot intersect one another.
- Consumer preferences can be completely described by an indifference map.

Summary

- The marginal rate of substitution of *F* for *C* is the maximum amount of *C* that a person is willing to give up to obtain one additional unit of *F.*
- Budget lines represent all combinations of goods for which consumers expend all their income.

Summary

- Consumers maximize satisfaction subject to budget constraints.
- The theory of revealed preference shows how the choices that individuals make when prices and income vary can be used to determine their preferences.

End of Chapter 3

Consumer Behavior

Chapter 4

Individual and Market Demand

Topics to be Discussed

- Individual Demand
- Income and Substitution Effects
- Market Demand
- Consumer Surplus

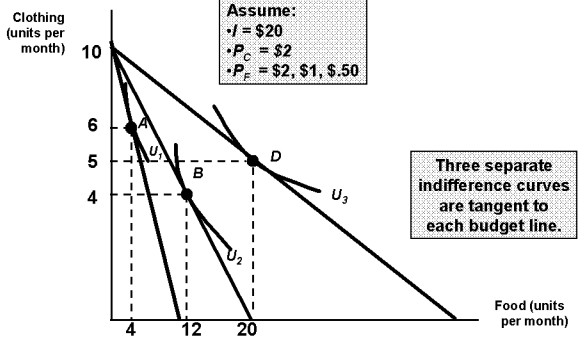
Topics to be Discussed

- Network Externalities
- Empirical Estimation of Demand

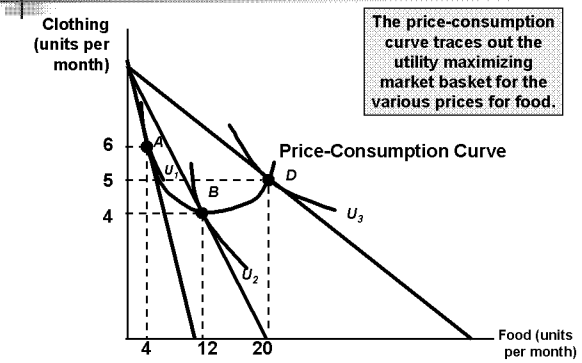
Individual Demand

- Price Changes
  - Using the figures developed in the previous chapter, the impact of a change in the price of food can be illustrated using indifference curves.

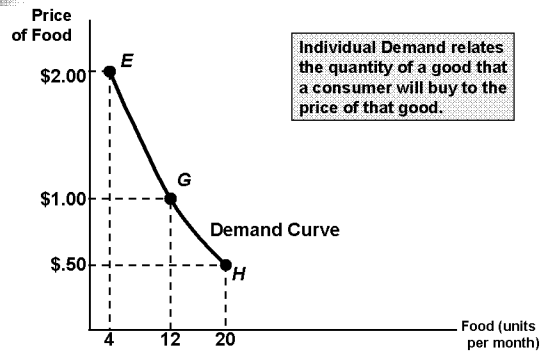
Effect of a Price Change



Effect of a Price Change



Effect of a Price Change



Individual Demand

The Individual Demand Curve

- Two Important Properties of Demand Curves

  1) The level of utility that can be attained changes as we move along the curve.

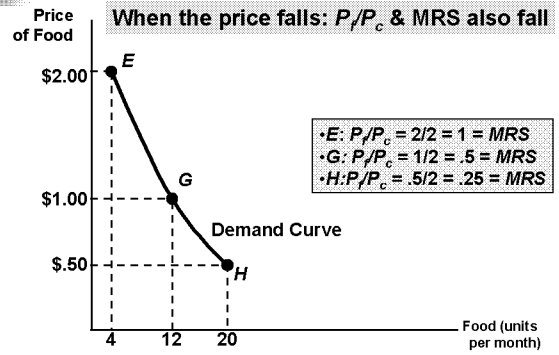
Individual Demand

The Individual Demand Curve

- Two Important Properties of Demand Curves

  2) At every point on the demand curve, the consumer is maximizing utility by satisfying the condition that the *MRS* of food for clothing equals the ratio of the prices of food and clothing.

Effect of a Price Change



Individual Demand

- Income Changes
  - Using the figures developed in the previous chapter, the impact of a change in the income can be illustrated using indifference curves.

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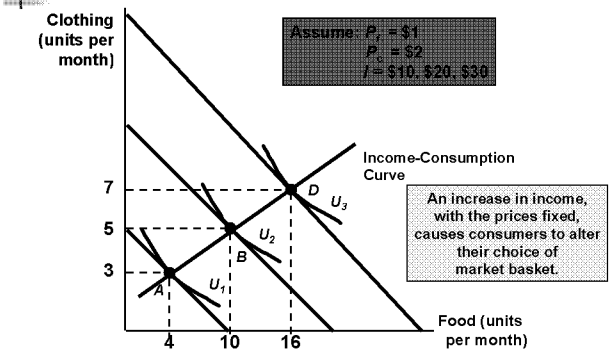
Effects of Income Changes



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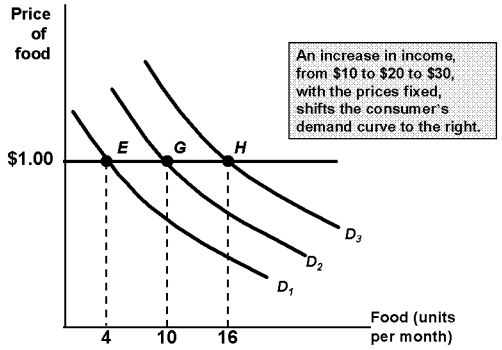
Effects of Income Changes



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Individual Demand

- Income Changes
  - The income-consumption curve traces out the utility-maximizing combinations of food and clothing associated with every income level.

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Individual Demand

- Income Changes
  - An increase in income shifts the budget line to the right, increasing consumption along the income-consumption curve.
  - Simultaneously, the increase in income shifts the demand curve to the right.

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Individual Demand

Normal Good vs. Inferior Good

- Income Changes
  - When the income-consumption curve has a positive slope:
    - The quantity demanded increases with income.
    - The income elasticity of demand is positive.
    - The good is a normal good.

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Individual Demand

Normal Good vs. Inferior Good

- Income Changes
  - When the income-consumption curve has a negative slope:
    - The quantity demanded decreases with income.
    - The income elasticity of demand is negative.
    - The good is an inferior good.

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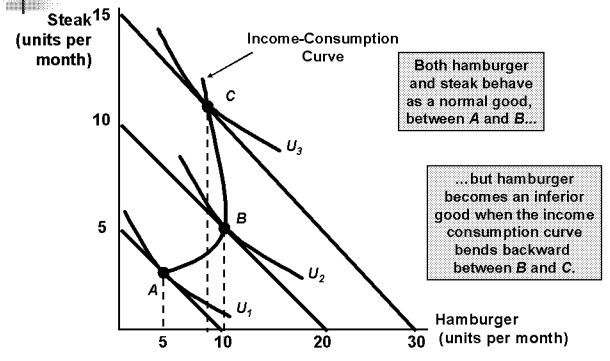
An Inferior Good



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Individual Demand

- Engel Curves
  - Engel curves relate the quantity of good consumed to income.
  - If the good is a normal good, the Engel curve is upward sloping.
  - If the good is an inferior good, the Engel curve is downward sloping.

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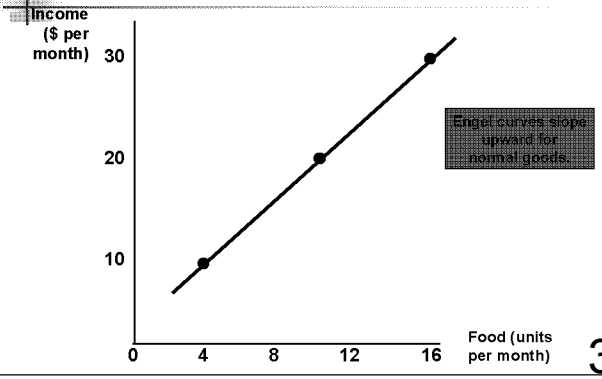
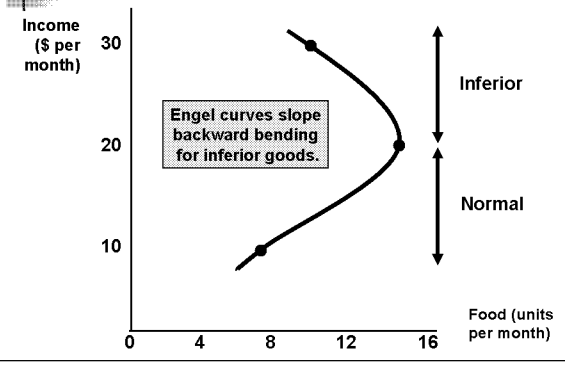
Engel Curves



Engel Curves



Consumer Expenditures in the United States

	Income Group (1997 $)						
Expenditure ($) on:	Less than $10,000	1,000-19,000	20,000-29,000	30,000-39,000	40,000-49,000	50,000-69,000	70,000- and above
Entertainment	700	947	1274	1514	2054	2654	4300
Owned Dwellings	1116	1725	2253	3243	4454	5793	9898
Rented Dwellings	1957	2170	2371	2536	2137	1540	1266
Health Care	1031	1697	1918	1820	2052	2214	2642
Food	2656	3385	4109	4888	5429	6220	8279
Clothing	859	978	1363	1772	1778	2614	3442

Individual Demand

Substitutes and Complements

1) Two goods are considered substitutes if an increase (decrease) in the price of one leads to an increase (decrease) in the quantity demanded of the other.
   - e.g. movie tickets and video rentals

Individual Demand

Substitutes and Complements

2) Two goods are considered complements if an increase (decrease) in the price of one leads to a decrease (increase) in the quantity demanded of the other.
   - e.g. gasoline and motor oil

Individual Demand

Substitutes and Complements

3) Two goods are independent when a change in the price of one good has no effect on the quantity demanded of the other

Individual Demand

- Substitutes and Complements
  - If the price consumption curve is downward-sloping, the two goods are considered substitutes.
  - If the price consumption curve is upward-sloping, the two goods are considered complements.
- They could be both!

Income and Substitution Effects

- A fall in the price of a good has two effects: *Substitution & Income*
  - Substitution Effect
    - Consumers will tend to buy more of the good that has become relatively cheaper, and less of the good that is now relatively more expensive.

Income and Substitution Effects

- A fall in the price of a good has two effects: *Substitution & Income*
  - Income Effect
    - Consumers experience an increase in real purchasing power when the price of one good falls.

Income and Substitution Effects

- Substitution Effect
  - The substitution effect is the change in an item's consumption associated with a change in the price of the item, *with the level of utility held constant.*
  - When the price of an item declines, the substitution effect always leads to an increase in the quantity of the item demanded.

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Income and Substitution Effects

- Income Effect
  - The income effect is the change in an item's consumption brought about by the increase in purchasing power, *with the price of the item held constant.*
  - When a person's income increases, the quantity demanded for the product may increase or decrease.

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Income and Substitution Effects

- Income Effect
  - Even with inferior goods, the income effect is rarely large enough to outweigh the substitution effect.

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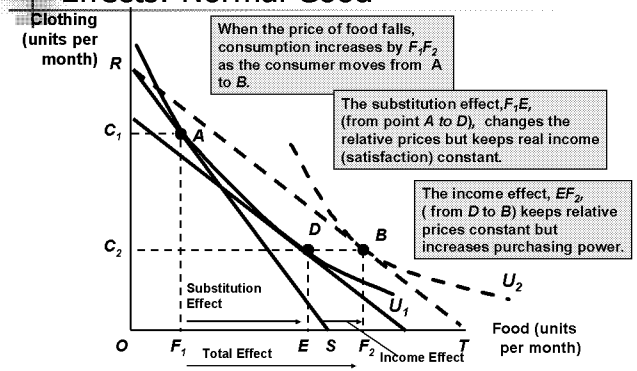
Income and Substitution Effects: Normal Good



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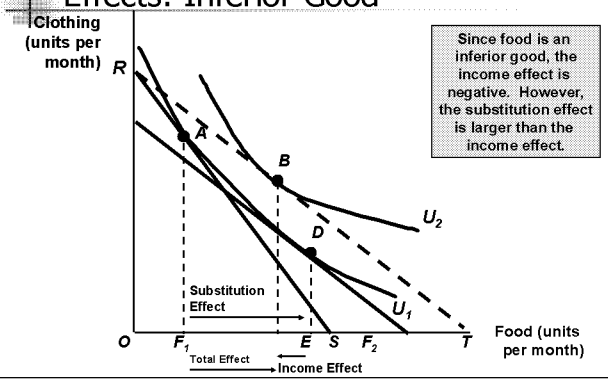
Income and Substitution Effects: Inferior Good



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Income and Substitution Effects

- A Special Case--The Giffen Good
  - The income effect may theoretically be large enough to cause the demand curve for a good to slope upward.
  - This rarely occurs and is of little practical interest.

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Effect of a Gasoline Tax With a Rebate

- Assume
  - $P_e^d = -0.5$
  - Income = $9,000
  - Price of gasoline = $1

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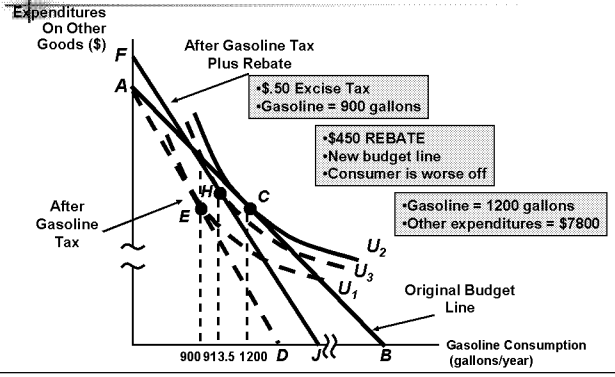
Effect of a Gasoline Tax With a Rebate



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Market Demand

From Individual to Market Demand

- Market Demand Curves
  - A curve that relates the quantity of a good that all consumers in a market buy to the price of that good.

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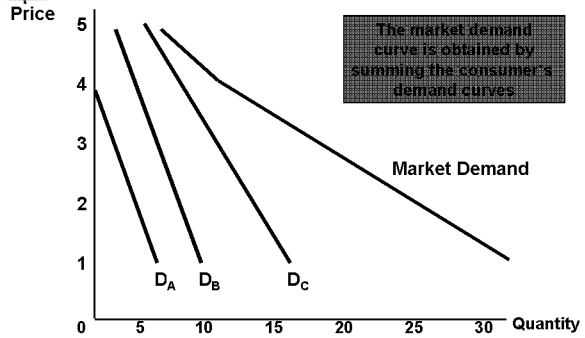
Determining the Market Demand Curve

Price ($)	Individual *A* (units)	Individual B (units)	Individual C (units)	Market (units)
1	6	10	16	32
2	4	8	13	25
3	2	6	10	18
4	0	4	7	11
5	0	2	4	6

Summing to Obtain a Market Demand Curve



Market Demand

- Two Important Points

1) The market demand will shift to the right as more consumers enter the market.

2) Factors that influence the demands of many consumers will also affect the market demand.

Market Demand

- Elasticity of Demand

Recall: Price elasticity of demand measures the percentage change in the quantity demanded resulting from a 1-percent change in price.

$$E_P = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q/\Delta P}{Q/P}$$

Price Elasticity and Consumer Expenditure

Demand	*If Price Increases, Expenditures:*	*If Price Decreases, Expenditures:*
Inelastic (E_p <1)	**Increase**	**Decrease**
Unit Elastic (E_p = 1)	**Are unchanged**	**Are unchanged**
Elastic (E_p >1)	**Decrease**	**Increase**

Market Demand

- Point Elasticity of Demand
  - For large price changes (e.g. 20%), the value of elasticity will depend upon where the price and quantity lie on the demand curve.

Market Demand

- Point Elasticity of Demand
  - Point elasticity measures elasticity at a point on the demand curve.
  - Its formula is:

$$E_P = (P/Q)(1/slope)$$

Market Demand

- Problems Using Point Elasticity
  - We may need to calculate price elasticity over portion of the demand curve rather than at a single point.
  - The price and quantity used as the base will alter the price elasticity of demand.

Market Demand

Point Elasticity of Demand (An Example)

- Assume
  - Price increases from 8$ to $10 quantity demanded falls from 6 to 4
  - Percent change in price equals: $2/$8 = 25% or $2/$10 = 20%
  - Percent change in quantity equals: -2/6 = -33.33% or -2/4 = -50%

Market Demand

Point Elasticity of Demand (An Example)

- Elasticity equals:

  -33.33/.25 = -1.33 or -.50/.20 = -2.54

- **Which one is correct?**

Market Demand

- Arc Elasticity of Demand
  - Arc elasticity calculates elasticity over a range of prices
  - Its formula is:

$$E_P = (\Delta Q/\Delta P)(\overline{P}/\overline{Q})$$
$$\overline{P} = \text{the average price}$$
$$\overline{Q} = \text{the average quantity}$$

Market Demand

- Arc Elasticity of Demand (An Example)

$$E_P = (\Delta Q/\Delta P)(\overline{P}/\overline{Q})$$
$$P_1 = 8, P_2 = 10, Q_1 = 6, Q_2 = 4$$
$$\overline{P} = 18/2 = 9 \;\&\; \overline{Q} = 10/2 = 5$$
$$E_p = (-2/\$2)(\$9/5) = -1.8$$

An Example:

The Aggregate Demand For Wheat

- The demand for U.S. wheat is comprised of domestic demand and export demand.

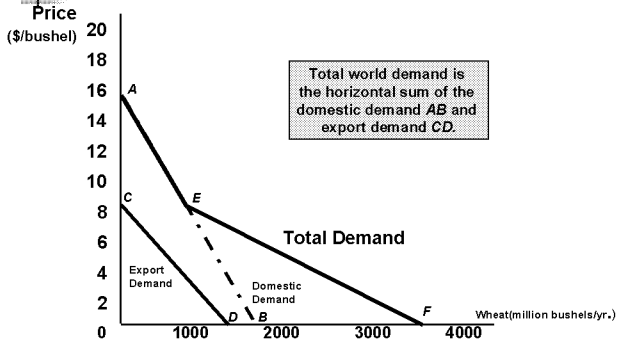
The Aggregate Demand For Wheat

- The domestic demand for wheat is given by the equation:
  - $Q_{DD} = 1700 - 107P$
- The export demand for wheat is given by the equation:
  - $Q_{DE} = 1544 - 176P$

The Aggregate Demand For Wheat

- Domestic demand is relatively price inelastic (-0.2), while export demand is more price elastic (-0.4).

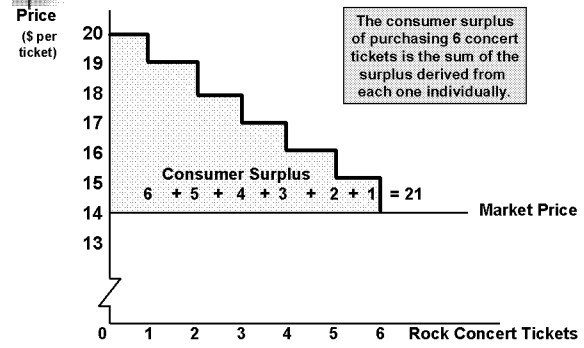
The Aggregate Demand For Wheat



Consumer Surplus

- Consumer Surplus
  - The difference between the maximum amount a consumer is willing to pay for a good and the amount actually paid.

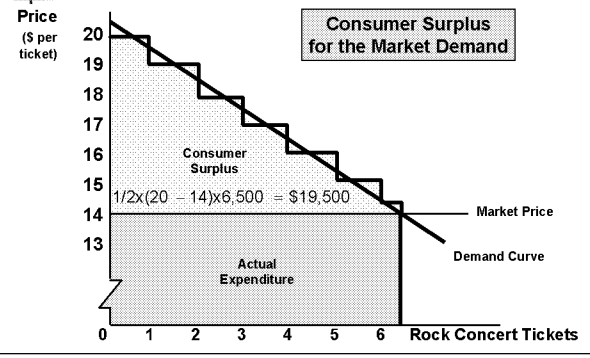
Consumer Surplus



Consumer Surplus

- The stepladder demand curve can be converted into a straight-line demand curve by making the units of the good smaller.

Consumer Surplus



Consumer Surplus

- Combining consumer surplus with the aggregate profits that producers obtain we can evaluate:
  1) Costs and benefits of different market structures
  2) Public policies that alter the behavior of consumers and firms

An Example:

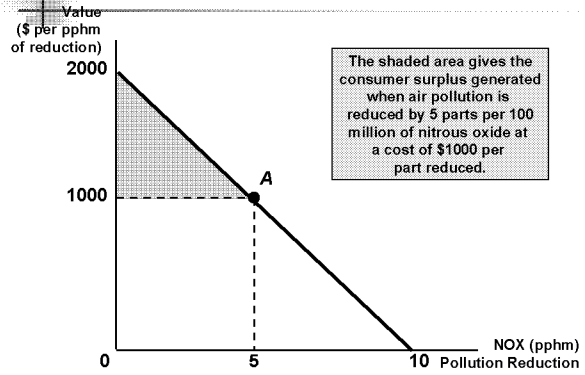
The Value of Clean Air

- Air is free in the sense that we don't pay to breathe it.
- The Clean Air Act was amended in 1970.
- Question: Were the benefits of cleaning up the air worth the costs?

The Value of Clean Air

- People pay more to buy houses where the air is clean.
- Data for house prices among neighborhoods of Boston and Los Angeles were compared with the various air pollutants.

Valuing Cleaner Air



Network Externalities

- Up to this point we have assumed that people's demands for a good are independent of one another.
- If fact, a person's demand may be affected by the number of other people who have purchased the good.

Network Externalities

- If this is the case, a network externality exists.
- Network externalities can be positive or negative.

Network Externalities

- A *positive network externality* exists if the quantity of a good demanded by a consumer increases in response to an increase in purchases by other consumers.
- *Negative* network externalities are just the opposite.

Network Externalities

- The Bandwagon Effect
  - This is the desire to be in style, to have a good because almost everyone else has it, or to indulge in a fad.
  - This is the major objective of marketing and advertising campaigns (e.g. toys, clothing).

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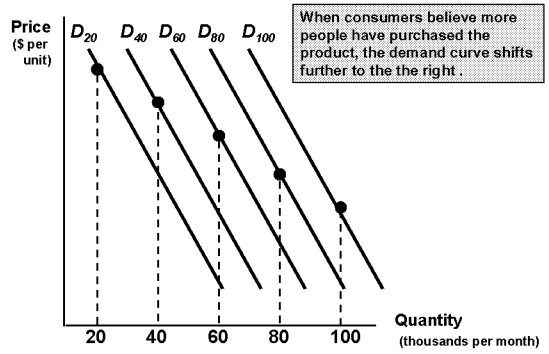
Positive Network Externality: Bandwagon Effect



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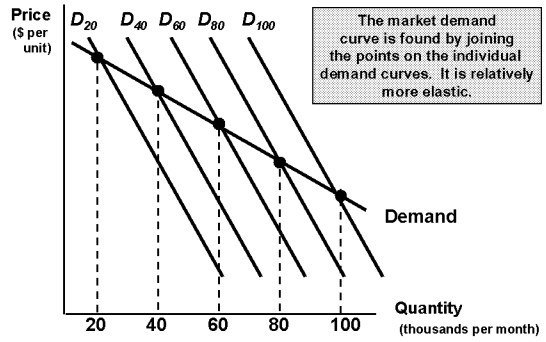
Positive Network Externality: Bandwagon Effect



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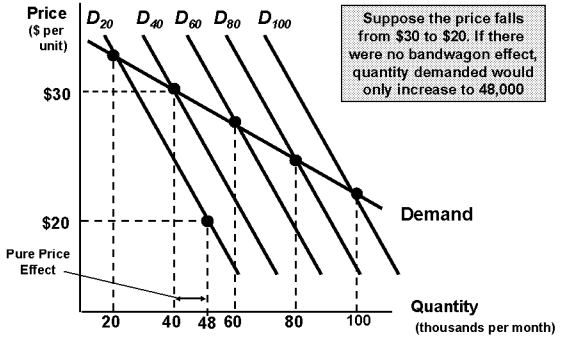
Positive Network Externality: Bandwagon Effect



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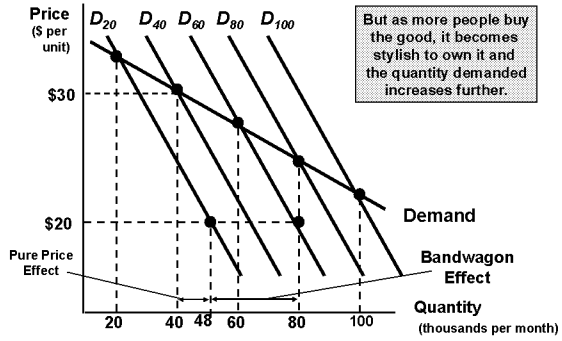
Positive Network Externality: Bandwagon Effect



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Network Externalities

- The Snob Effect
  - If the network externality is negative, a snob effect exists.
- The snob effect refers to the desire to own exclusive or unique goods.
- The quantity demanded of a "snob" good is higher the *fewer* the people who own it.

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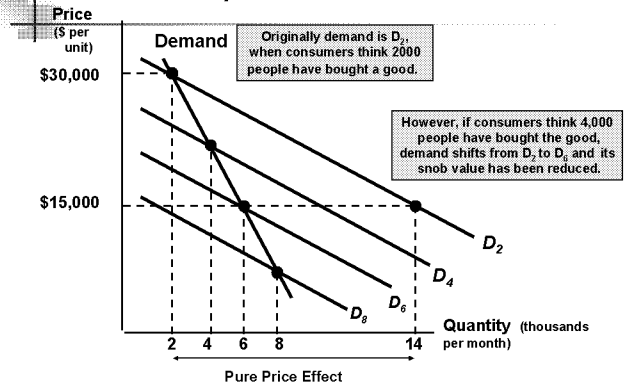
Negative Network Externality: Snob Effect



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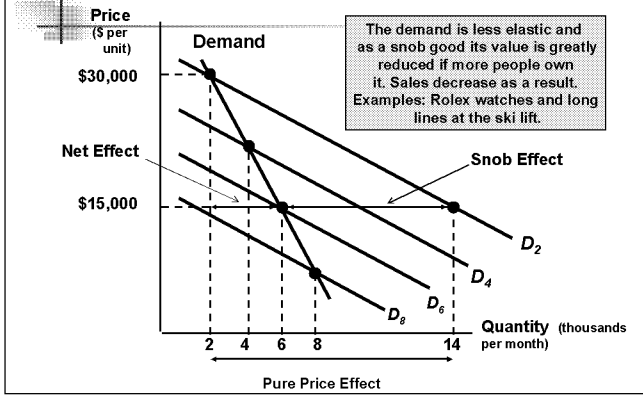
Negative Network Externality: Snob Effect



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Network Externalities and the Demands for Computers and Fax Machines

- Examples of Positive Feedback Externalities
  - Mainframe computers: 1954 - 1965
  - Microsoft Windows PC operating system
  - Fax-machines and e-mail

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Empirical Estimation of Demand

- The most direct way to obtain information about demand is through interviews where consumers are asked how much of a product they would be willing to buy at a given price.

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Empirical Estimation of Demand

- Problem
  - Consumers may lack information or interest, or be mislead by the interviewer.

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Empirical Estimation of Demand

- In *direct marketing experiments*, actual sales offers are posed to potential customers and the responses of customers are observed.

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Empirical Estimation of Demand

- The Statistical Approach to Demand Estimation
  - Properly applied, the statistical approach to demand estimation can enable one to sort out the effects of variables on the quantity demanded of a product.
  - "Least-squares" regression is one approach.

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Demand Data for Raspberries

Year	Quantity (Q)	Price (P)	Income(I)
1988	4	24	10
1989	7	20	10
1990	8	17	10
1991	13	17	17
1992	16	10	17
1993	15	15	17
1994	19	12	20
1995	20	9	20
1996	22	5	20

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Empirical Estimation of Demand

- Assuming only price determines demand:
  - $Q = a - bP$
  - $Q = 28.2 - 1.00P$

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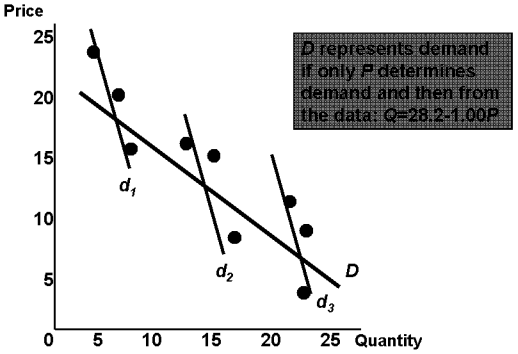
Estimating Demand



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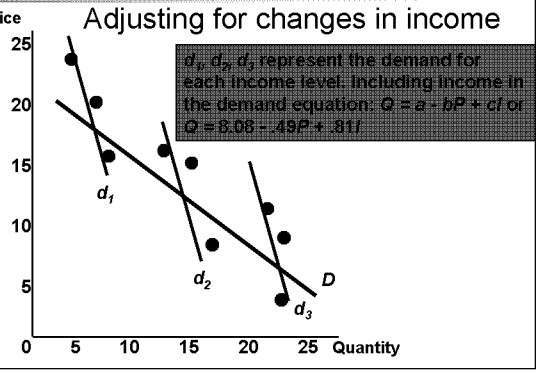
Estimating Demand

Adjusting for changes in income



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Empirical Estimation of Demand

Estimating Elasticities

- For the demand equation: $Q = a - bP$
- Elasticity: $E_P = (\Delta Q / \Delta P)(P / Q) = -b(P / Q)$

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Empirical Estimation of Demand

Estimating Elasticities

- Assuming: Price & income elasticity are constant
  - The isoelastic demand = $\log(Q) = a - b\log(P) + c\log(I)$
  - The slope, $-b$ = price elasticity of demand
  - Constant, c = income elasticity

Empirical Estimation of Demand

Estimating Elasticities

- Using the Raspberry data:

$$\log(Q) = -0.81 - 2.4\log(P) + 1.46\log(I)$$

  - Price elasticity = -0.24 (Inelastic)
  - Income elasticity = 1.46

Empirical Estimation of Demand

Estimating Complements and Substitutes

$$\log(Q) = a - b\log(P) + b_2 \log P_2 + c\log(I)$$

- Substitutes: b_2 is positive
- Complements: b_2 is negative

The Demand for Ready-to-Eat Cereal

- What Do You Think?
  - Are Grape Nuts & Spoon Size Shredded Wheat good substitutes?

The Demand for Ready-to-Eat Cereal

- Answer
  - Estimated demand for Grape Nuts (GN)

$$\log(Q_{GN}) = 1.998a - 2.085\log(P_{GN}) + 0.62\log(I) + .014\log(P_{SW})$$

  - Price elasticity = -2.0
  - Income elasticity = 0.62
  - Cross elasticity = 0.14

Summary

- Individual consumers' demand curves for a commodity can be derived from information about their tastes for all goods and services and from their budget constraints.
- Engel curves describe the relationship between the quantity of a good consumed and income.

Summary

- Two goods are substitutes if an increase in the price of one good leads to an increase in the quantity demanded of the other. They are complements if the quantity demanded of the other declines.

Summary

- Two goods are substitutes if an increase in the price of one good leads to an increase in the quantity demanded of the other. They are complements if the quantity demanded of the other declines.
- The effect of a price change on the quantity demanded can be broken into a substitution effect and an income effect.

Summary

- The market demand curve is the horizontal summation of the individual demand curves for all consumers.
- The percent change in quantity demanded that results from a one percent change in price determines elasticity of demand.

Summary

- There is a network externality when one person's demand is affected directly by the purchasing decisions of other consumers.
- A number of methods can be used to obtain information about consumer demand.

End of Chapter 4

Individual and Market Demand

Chapter 5

Choice Under Uncertainty

Topics to be Discussed

- Describing Risk
- Preferences Toward Risk
- Reducing Risk
- The Demand for Risky Assets

Introduction

- Choice with certainty is reasonably straightforward.
- How do we choose when certain variables such as income and prices are uncertain (i.e. making choices with risk)?

Describing Risk

- To measure risk we must know:

  1) All of the possible outcomes.

  2) The likelihood that each outcome will occur (its probability).

Describing Risk

- Interpreting Probability
  - The likelihood that a given outcome will occur

Describing Risk

- Interpreting Probability
  - Objective Interpretation
    - Based on the observed frequency of past events

Describing Risk

- Interpreting Probability
  - Subjective
    - Based on perception or experience with or without an observed frequency
      - Different information or different abilities to process the same information can influence the subjective probability

Describing Risk

- Expected Value
  - The weighted average of the payoffs or values resulting from all possible outcomes.
    - The probabilities of each outcome are used as weights
    - Expected value measures the *central tendency*, the payoff or value expected on average

Describing Risk

- An Example
  - Investment in offshore drilling exploration:
  - Two outcomes are possible
    - Success -- the stock price increase from $30 to $40/share
    - Failure -- the stock price falls from $30 to $20/share

Describing Risk

- An Example
  - Objective Probability
    - 100 explorations, 25 successes and 75 failures
    - Probability (Pr) of success = 1/4 and the probability of failure = 3/4

Describing Risk

- An Example:

Expected Value (EV)

$$EV = \Pr(\text{success})(\$40/\text{share}) + \Pr(\text{failure})(\$20/\text{share})$$
$$EV = 1/4(\$40/\text{share}) + 3/4(\$20/\text{share})$$
$$EV = \$25/\text{share}$$

Describing Risk

- Given:
  - Two possible outcomes having payoffs X_1 and X_2
  - Probabilities of each outcome is given by Pr_1 & Pr_2

Describing Risk

- Generally, expected value is written as:

$$E(X) = \Pr_1 X_1 + \Pr_2 X_2 + \ldots + \Pr_n X_n$$

Describing Risk

- Variability
  - The extent to which possible outcomes of an uncertain even may differ

Describing Risk

Variability

- A Scenario
  - Suppose you are choosing between two part-time sales jobs that have the same expected income ($1,500)
  - The first job is based entirely on commission.
  - The second is a salaried position.

Describing Risk

Variability

- A Scenario
  - There are two equally likely outcomes in the first job--$2,000 for a good sales job and $1,000 for a modestly successful one.
  - The second pays $1,510 most of the time (.99 probability), but you will earn $510 if the company goes out of business (.01 probability).

Describing Risk

Income from Sales Jobs

	Outcome 1		Outcome 2		Expected Income
	Probability	Income ($)	Probability	Income ($)	
Job 1: Commission	.5	2000	.5	1000	1500
Job 2: Fixed salary	.99	1510	.01	510	1500

Describing Risk

Income from Sales Jobs

- Job 1 Expected Income

$$E(X_1) = .5(\$2000) + .5(\$1000) = \$1500$$

- Job 2 Expected Income

$$E(X_2) = .99(\$1510) + .01(\$510) = \$1500$$

Describing Risk

- While the expected values are the same, the variability is not.
- Greater variability from expected values signals greater risk.
- Deviation
  - Difference between expected payoff and actual payoff

Describing Risk

Deviations from Expected Income ($)

	Outcome 1	Deviation	Outcome 2	Deviation
Job 1	$2,000	$500	$1,000	-$500
Job 2	1,510	10	510	-900

Describing Risk

Variability

- Adjusting for negative numbers
- The standard deviation measures the square root of the average of the *squares* of the deviations of the payoffs associated with each outcome from their expected value.

Describing Risk

Variability

- The standard deviation is written:

$$\sigma = \sqrt{\Pr_1\left[X_1 - E(X)^2\right] + \Pr_2\left[X_2 - E(X)^2\right]}$$

Describing Risk

Calculating Variance ($)

	Outcome 1	Deviation Squared	Outcome 2	Deviation Squared	Deviation Squared	Standard Deviation
Job 1	$2,000	$250,000	$1,000	$250,000	$250,000	$500.00
Job 2	1,510	100	510	980,100	9,900	99.50

Describing Risk

- The standard deviations of the two jobs are:

$$\sigma_1 = \sqrt{.5(\$250{,}000) + .5(\$250{,}000}$$

$$\sigma_1 = \sqrt{\$250{,}000}$$

$$\sigma_1 = 500$$ ***Greater Risk**

$$\sigma_2 = \sqrt{.99(\$100) + .01(\$980{,}100)}$$

$$\sigma_2 = \sqrt{\$9{,}900}$$

$$\sigma_2 = 99.50$$

Describing Risk

- The standard deviation can be used when there are many outcomes instead of only two.

Describing Risk

Example

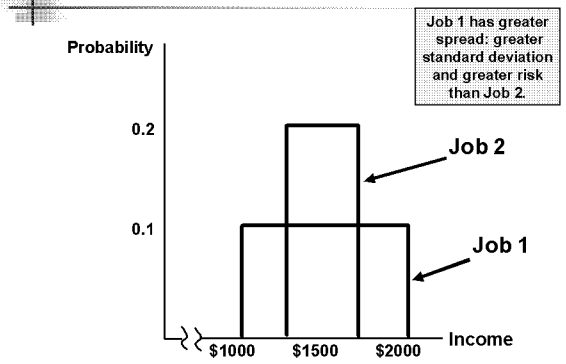
- Job 1 is a job in which the income ranges from $1000 to $2000 in increments of $100 that are all equally likely.

Describing Risk

Example

- Job 2 is a job in which the income ranges from $1300 to $1700 in increments of $100 that, also, are all equally likely.

Outcome Probabilities for Two Jobs



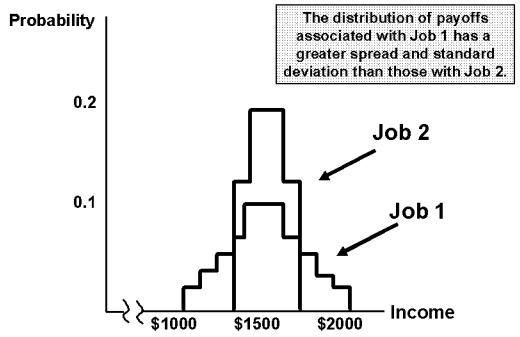
Describing Risk

- Outcome Probabilities of Two Jobs (unequal probability of outcomes)
  - Job 1: greater spread & standard deviation
  - Peaked distribution: extreme payoffs are less likely

Describing Risk

- Decision Making
  - A risk avoider would choose Job 2: same expected income as Job 1 with less risk.
  - Suppose we add $100 to each payoff in Job 1 which makes the expected payoff = $1600.

Unequal Probability Outcomes



Income from Sales Jobs--Modified ($)

	Outcome 1	Deviation Squared	Outcome 2	Deviation Squared	Expected Income	Standard Deviation
Job 1	$2,100	$250,000	$1,100	$250,000	$1,600	$500
Job 2	1510	100	510	980,100	1,500	99.50

Recall: The standard deviation is the square root of the deviation squared.

Describing Risk

Decision Making

- Job 1: expected income $1,600 and a standard deviation of $500.
- Job 2: expected income of $1,500 and a standard deviation of $99.50
- Which job?
  - Greater value or less risk?

Describing Risk

Example

- Suppose a city wants to deter people from double parking.
- The alternatives ……

Describing Risk

Example

- Assumptions:

1) Double-parking saves a person $5 in terms of time spent searching for a parking space.
2) The driver is risk neutral.
3) Cost of apprehension is zero.

Describing Risk

Example

- A fine of $5.01 would deter the driver from double parking.
  - Benefit of double parking ($5) is less than the cost ($5.01) equals a net benefit that is less than 0.

Describing Risk

Example

- Increasing the fine can reduce enforcement cost:
  - A $50 fine with a .1 probability of being caught results in an expected penalty of $5.
  - A $500 fine with a .01 probability of being caught results in an expected penalty of $5.

Describing Risk

Example

- The more risk averse drivers are, the lower the fine needs to be in order to be effective.

Preferences Toward Risk

- Choosing Among Risky Alternatives
  - Assume
    - Consumption of a single commodity
    - The consumer knows all probabilities
    - Payoffs measured in terms of utility
    - Utility function given

Preferences Toward Risk

Example

- A person is earning $15,000 and receiving 13 units of utility from the job.
- She is considering a new, but risky job.

Preferences Toward Risk

Example

- She has a .50 chance of increasing her income to $30,000 and a .50 chance of decreasing her income to $10,000.
- She will evaluate the position by calculating the expected value (utility) of the resulting income.

Preferences Toward Risk

Example

- The expected utility of the new position is the sum of the utilities associated with all her possible incomes weighted by the probability that each income will occur.

Preferences Toward Risk

Example

- The expected utility can be written:
  - $E(u) = (1/2)u(\$10,000) + (1/2)u(\$30,000)$
    $= 0.5(10) + 0.5(18)$
    $= 14$
  - $E(u)$ of new job is 14 which is greater than the current utility of 13 and therefore preferred.

Preferences Toward Risk

- Different Preferences Toward Risk
  - People can be *risk averse, risk neutral,* or *risk loving.*

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Preferences Toward Risk

- Different Preferences Toward Risk
  - Risk Averse: A person who prefers a certain given income to a risky income with the same expected value.
  - A person is considered risk averse if they have a diminishing marginal utility of income
    - The use of insurance demonstrates risk aversive behavior.

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Preferences Toward Risk

Risk Averse

- A Scenario
  - A person can have a $20,000 job with 100% probability and receive a utility level of 16.
  - The person could have a job with a .5 chance of earning $30,000 and a .5 chance of earning $10,000.

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Preferences Toward Risk

Risk Averse

- Expected Income = (0.5)($30,000) +
  (0.5)($10,000)
  = $20,000

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Preferences Toward Risk

Risk Averse

- Expected income from both jobs is the same -- risk averse may choose current job

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Preferences Toward Risk

Risk Averse

- The expected utility from the new job is found:
  - E(u) = (1/2)u ($10,000) + (1/2)$u$($30,000)
  - E(u) = (0.5)(10) + (0.5)(18) = 14
    - E(u) of Job 1 is 16 which is greater than the E(u) of Job 2 which is 14.

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Preferences Toward Risk

Risk Averse

- This individual would keep their present job since it provides them with more utility than the risky job.
- They are said to be *risk averse*.

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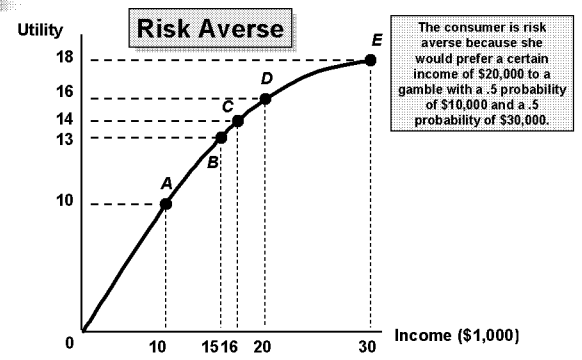
Preferences Toward Risk



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Preferences Toward Risk

Risk Neutral

- A person is said to be risk neutral if they show no preference between a certain income, and an uncertain one with the same expected value.

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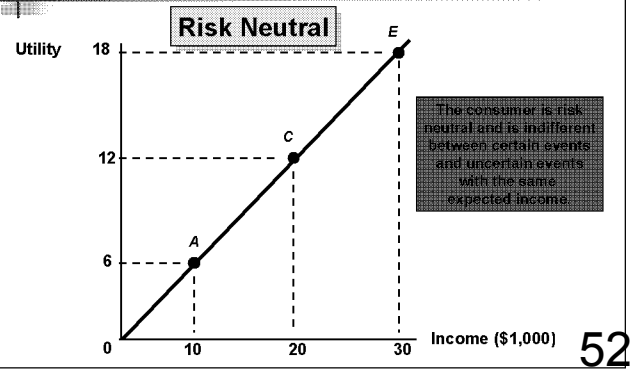
Preferences Toward Risk

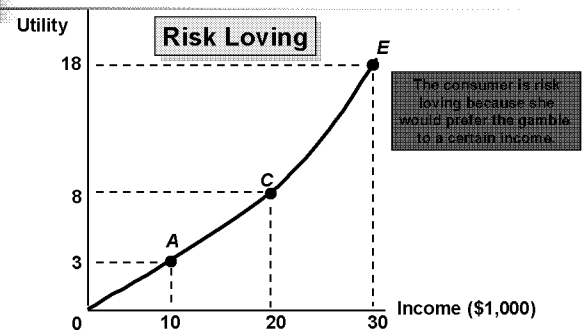


Preferences Toward Risk

Risk Loving

- A person is said to be risk loving if they show a preference toward an uncertain income over a certain income with the same expected value.
  - Examples: Gambling, some criminal activity

Preferences Toward Risk



Preferences Toward Risk

Risk Premium

- The risk premium is the amount of money that a risk-averse person would pay to avoid taking a risk.

Preferences Toward Risk

Risk Premium

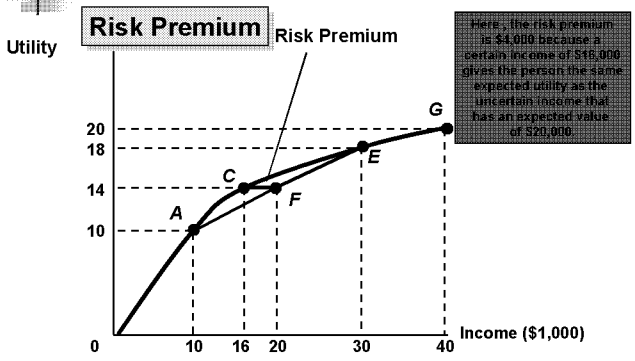
- A Scenario
  - The person has a .5 probability of earning $30,000 and a .5 probability of earning $10,000 (expected income = $20,000).
  - The expected utility of these two outcomes can be found:
    - $E(u) = .5(18) + .5(10) = 14$

Preferences Toward Risk

Risk Premium

- Question
  - How much would the person pay to avoid risk?

Preferences Toward Risk



Preferences Toward Risk

Risk Aversion and Income

- Variability in potential payoffs increase the risk premium.
- Example:
  - A job has a .5 probability of paying $40,000 (utility of 20) and a .5 chance of paying 0 (utility of 0).

Preferences Toward Risk

Risk Aversion and Income

- Example:
  - The expected income is still $20,000, but the expected utility falls to 10.
  - Expected utility = $.5u(\$) + .5u(\$40{,}000)$
    $= 0 + .5(20) = 10$

Preferences Toward Risk

Risk Aversion and Income

- Example:
  - The certain income of $20,000 has a utility of 16.
  - If the person is required to take the new position, their utility will fall by 6.

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Preferences Toward Risk

Risk Aversion and Income

- Example:
  - The risk premium is $10,000 (i.e. they would be willing to give up $10,000 of the $20,000 and have the same E(*u*) as the risky job.

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Preferences Toward Risk

Risk Aversion and Income

- Therefore, it can be said that *the greater the variability, the greater the risk premium.*

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Preferences Toward Risk

Indifference Curve

- Combinations of expected income & standard deviation of income that yield the same utility

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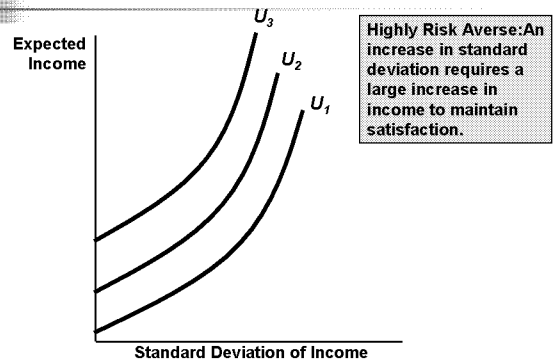
Risk Aversion and Indifference Curves



Highly Risk Averse:An increase in standard deviation requires a large increase in income to maintain satisfaction.

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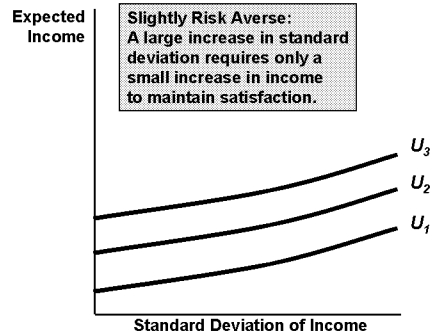
Risk Aversion and Indifference Curves



Slightly Risk Averse: A large increase in standard deviation requires only a small increase in income to maintain satisfaction.

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Business Executives and the Choice of Risk

Example

- Study of 464 executives found that:
  - 20% were risk neutral
  - 40% were risk takers
  - 20% were risk adverse
  - 20% did not respond

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Business Executives and the Choice of Risk

Example

- Those who liked risky situations did so when losses were involved.
- When risks involved gains the same, executives opted for less risky situations.

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Business Executives and the Choice of Risk

Example

- The executives made substantial efforts to reduce or eliminate risk by delaying decisions and collecting more information.

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Reducing Risk

- Three ways consumers attempt to reduce risk are:

  1) Diversification

  2) Insurance

  3) Obtaining more information

Reducing Risk

- Diversification
  - Suppose a firm has a choice of selling air conditioners, heaters, or both.
  - The probability of it being hot or cold is 0.5.
  - The firm would probably be better off by diversification.

Income from Sales of Appliances

	Hot Weather	Cold Weather
Air conditioner sales	**$30,000**	**$12,000**
Heater sales	**12,000**	**30,000**

*** 0.5 probability of hot or cold weather**

Reducing Risk

Diversification

- If the firms sells only heaters or air conditioners their income will be either $12,000 or $30,000.
- Their expected income would be:
  - 1/2($12,000) + 1/2($30,000) = $21,000

Reducing Risk

Diversification

- If the firm divides their time evenly between appliances their air conditioning and heating sales would be half their original values.

Reducing Risk

Diversification

- If it were hot, their expected income would be $15,000 from air conditioners and $6,000 from heaters, or $21,000.
- If it were cold, their expected income would be $6,000 from air conditioners and $15,000 from heaters, or $21,000.

Reducing Risk

Diversification

- With diversification, expected income is $21,000 with no risk.

Reducing Risk

Diversification

- Firms can reduce risk by diversifying among a variety of activities that are not closely related.

Reducing Risk

The Stock Market

- Discussion Questions
  - How can diversification reduce the risk of investing in the stock market?
  - Can diversification eliminate the risk of investing in the stock market?

Reducing Risk

Insurance

- Risk averse are willing to pay to avoid risk.
- If the cost of insurance equals the expected loss, risk averse people will buy enough insurance to recover fully from a potential financial loss.

The Decision to Insure

Insurance	Burglary (Pr = .1)	No Burglary (Pr = .9)	Expected Wealth	Standard Deviation
No	**$40,000**	**$50,000**	**$49,000**	**$9,055**
Yes	**49,000**	**49,000**	**49,000**	**0**

Reducing Risk

Insurance

- While the expected wealth is the same, the expected utility with insurance is greater because the marginal utility in the event of the loss is greater than if no loss occurs.
- Purchases of insurance transfers wealth and increases expected utility.

Reducing Risk

The Law of Large Numbers

- Although single events are random and largely unpredictable, the average outcome of many similar events can be predicted.

Reducing Risk

The Law of Large Numbers

- Examples
  - A single coin toss vs. large number of coins
  - Whom will have a car wreck vs. the number of wrecks for a large group of drivers

Reducing Risk

Actuarial Fairness

- Assume:
  - 10% chance of a $10,000 loss from a home burglary
  - Expected loss = .10 x $10,000 = $1,000 with a high risk (10% chance of a $10,000 loss)
  - 100 people face the same risk

Reducing Risk

Actuarial Fairness

- Then:
  - $1,000 premium generates a $100,000 fund to cover losses
  - Actual Fairness
    - When the insurance premium = expected payout

The Value of Title Insurance When Buying a House

Example

- A Scenario:
  - Price of a house is $200,000
  - 5% chance that the seller does not own the house

The Value of Title Insurance When Buying a House

Example

- Risk neutral buyer would pay:

$$(.95[200{,}000] + .05[0] = 190{,}000$$

The Value of Title Insurance When Buying a House

Example

- Risk averse buyer would pay much less
- By reducing risk, title insurance increases the value of the house by an amount far greater than the premium.

Reducing Risk

The Value of Information

- Value of Complete Information
  - The difference between the expected value of a choice with complete information and the expected value when information is incomplete.

Reducing Risk

The Value of Information

- Suppose a store manager must determine how many fall suits to order:
  - 100 suits cost $180/suit
  - 50 suits cost $200/suit
  - The price of the suits is $300

Reducing Risk

The Value of Information

- Suppose a store manager must determine how many fall suits to order:
  - Unsold suits can be returned for half cost.
  - The probability of selling each quantity is .50.

The Decision to Insure

	Sale of 50	Sale of 100	Expected Profit
1. Buy 50 suits	**$5,000**	**$5,000**	**$5,000**
2. Buy 100 suits	**1,500**	**12,000**	**6,750**

Reducing Risk

- With incomplete information:
  - Risk Neutral: Buy 100 suits
  - Risk Averse: Buy 50 suits

Reducing Risk

The Value of Information

- The expected value with complete information is $8,500.
  - 8,500 = .5(5,000) + .5(12,000)
- The expected value with uncertainty (buy 100 suits) is $6,750.

Reducing Risk

The Value of Information

- The value of complete information is $1,750, or the difference between the two (the amount the store owner would be willing to pay for a marketing study).

Reducing Risk

The Value of Information: Example

- Per capita milk consumption has fallen over the years
- The milk producers engaged in market research to develop new sales strategies to encourage the consumption of milk.

Reducing Risk

The Value of Information: Example

- Findings
  - Milk demand is seasonal with the greatest demand in the spring
  - E_p is negative and small
  - E_I is positive and large

Reducing Risk

The Value of Information: Example

- Milk advertising increases sales most in the spring.
- Allocating advertising based on this information in New York increased sales by $4,046,557 and profits by 9%.
- The cost of the information was relatively low, while the value was substantial.

The Demand for Risky Assets

- Assets
  - Something that provides a flow of money or services to its owner.
    - The flow of money or services can be explicit (dividends) or implicit (capital gain).

The Demand for Risky Assets

- Capital Gain
  - An increase in the value of an asset, while a decrease is a capital loss.

The Demand for Risky Assets

Risky & Riskless Assets

- Risky Asset
  - Provides an uncertain flow of money or services to its owner.
  - Examples
    - apartment rent, capital gains, corporate bonds, stock prices

The Demand for Risky Assets

Risky & Riskless Assets

- Riskless Asset
  - Provides a flow of money or services that is known with certainty.
  - Examples
    - short-term government bonds, short-term certificates of deposit

The Demand for Risky Assets

- Asset Returns
  - Return on an Asset
    - The total monetary flow of an asset as a fraction of its price.
  - Real Return of an Asset
    - The simple (or nominal) return *less* the rate of inflation.

The Demand for Risky Assets

- Asset Returns

$$\text{Asset Return} = \frac{\text{Monetary Flow}}{\text{Purchase Price}}$$

$$\text{Asset Return} = \frac{\text{Flow}}{\text{Bond Price}} = \frac{\$100/\text{yr.}}{\$1{,}000} = 10\%$$

The Demand for Risky Assets

Expected vs. Actual Returns

- Expected Return
  - Return that an asset should earn on average

The Demand for Risky Assets

Expected vs. Actual Returns

- Actual Return
  - Return that an asset earns

Investments--Risk and Return (1926-1999)

	Real Rate of Return (%)	Risk (standard deviation,%)
Common stocks (S&P 500)	**9.5**	**20.2**
Long-term corporate bonds	**2.7**	**8.3**
U.S. Treasury bills	**0.6**	**3.2**

The Demand for Risky Assets

Expected vs. Actual Returns

- Higher returns are associated with greater risk.
- The risk-averse investor must balance risk relative to return

The Demand for Risky Assets

The Trade-Off Between Risk and Return

- An investor is choosing between T-Bills and stocks:
  - T-bills (riskless) versus Stocks (risky)
  - R_f = the return on risk free T-bills
    - Expected return equals actual return when there is no risk

The Demand for Risky Assets

The Trade-Off Between Risk and Return

- An investor is choosing between T-Bills and stocks:
  - R_m = the expected return on stocks
  - r_m = the actual returns on stock

The Demand for Risky Assets

The Trade-Off Between Risk and Return

- At the time of the investment decision, we know the set of possible outcomes and the likelihood of each, but we do not know what particular outcome will occur.

The Demand for Risky Assets

The Trade-Off Between Risk and Return

- The risky asset will have a higher expected return than the risk free asset ($R_m > R_f$).
- Otherwise, risk-averse investors would buy only T-bills.

The Demand for Risky Assets

The Investment Portfolio

- How to allocate savings:

  b = fraction of savings in the stock market

  1 - b = fraction in T-bills

The Demand for Risky Assets

The Investment Portfolio

- Expected Return:

  R_p: weighted average of the expected return on the two assets

  $R_p = bR_m + (1-b)R_f$

The Demand for Risky Assets

The Investment Portfolio

- Expected Return:

  If $R_m = 12\%$, $R_f = 4\%$, and $b = 1/2$

  $R_p = 1/2(.12) + 1/2(.04) = 8\%$

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The Demand for Risky Assets

The Investment Portfolio

- **Question**
  - How risky is their portfolio?

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The Demand for Risky Assets

The Investment Portfolio

- Risk (standard deviation) of the portfolio is the fraction of the portfolio invested in the risky asset times the standard deviation of that asset:

$$\sigma_p = b\sigma_m$$

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The Demand for Risky Assets

The Investor's Choice Problem

- Determining *b:*

$$R_p = bR_m + (1-b)R_f$$

$$R_p = R_f + b(R_m - R_f)$$

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The Demand for Risky Assets

The Investor's Choice Problem

- Determining *b:*

$$b = \sigma_p / \sigma_m$$

$$R_p = R_f + \frac{(R_m - R_f)}{\sigma_m}\sigma_p$$

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The Demand for Risky Assets

Risk and the Budget Line

- Observations
  1) The final equation $R_p = R_f + \frac{(R_m - R_f)}{\sigma_m}\sigma_p$ is a budget line describing the trade-off between risk (σ_p) and expected return (R_p).

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The Demand for Risky Assets

Risk and the Budget Line

- Observations: $R_p = R_f + \frac{(R_m - R_f)}{\sigma_m}\sigma_p$
  2) Is an equation for a straight line: R_m, R_f, and σ_m are constants
  3) Slope = $(R_m - R_f)/\sigma_m$

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The Demand for Risky Assets

Risk and the Budget Line

- Observations
  3) Expected return, R_P, increases as risk increases.
  4) The slope is the price of risk or the risk-return trade-off.

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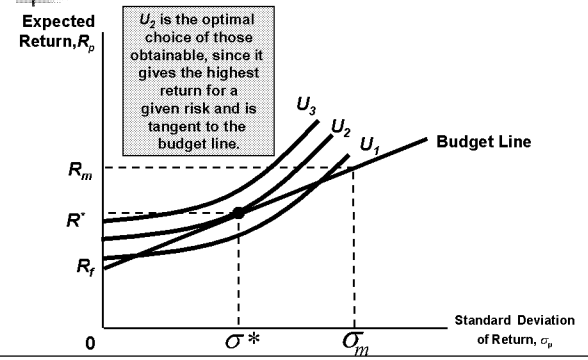
Choosing Between Risk and Return



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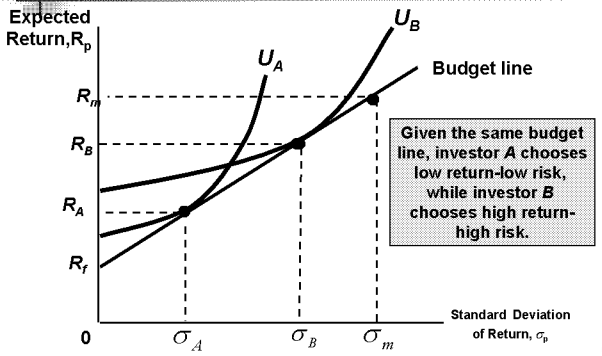
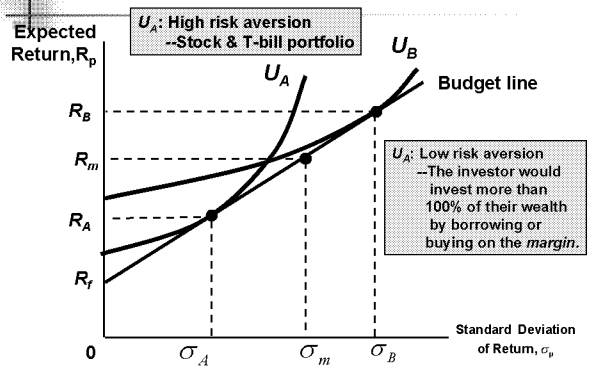
The Choices of Two Different Investors



Buying Stocks on Margin



Investing in the Stock Market

- Observations
  - Percent of American families who had directly or indirectly invested in the stock market
    - 1989 = 32%
    - 1995 = 41%

Investing in the Stock Market

- Observations
  - Share of wealth in the stock market
    - 1989 = 26%
    - 1995 = 40%

Investing in the Stock Market

- Observations
  - Participation in the stock market by age
    - Less than 35
      - 1989 = 23%
      - 1995 = 29%
    - More than 35
      - Small increase

Investing in the Stock Market

- What Do You Think?
  - Why are more people investing in the stock market?

Summary

- Consumers and managers frequently make decisions in which there is uncertainty about the future.
- Consumers and investors are concerned about the expected value and the variability of uncertain outcomes.

Summary

- Facing uncertain choices, consumers maximize their expected utility, and average of the utility associated with each outcome, with the associated probabilities serving as weights.
- A person may be risk averse, risk neutral or risk loving.

Summary

- The maximum amount of money that a risk-averse person would pay to avoid risk is the risk premium.
- Risk can be reduced by diversification, purchasing insurance, and obtaining additional information.

Summary

- The law of large numbers enables insurance companies to provide actuarially fair insurance for which the premium paid equals the expected value of the loss being insured against.
- Consumer theory can be applied to decisions to invest in risky assets.

End of Chapter 5

Choice Under Uncertainty

Chapter 6

Production

Topics to be Discussed

- The Technology of Production
- Isoquants
- Production with One Variable Input (Labor)
- Production with Two Variable Inputs
- Returns to Scale

Introduction

- Our focus is the *supply side*.
- **The theory of the firm** will address:
  - How a firm makes cost-minimizing production decisions
  - How cost varies with output
  - Characteristics of market supply
  - Issues of business regulation

The Technology of Production

- The Production Process
  - Combining inputs or factors of production to achieve an output
- Categories of Inputs (factors of production)
  - Labor
  - Materials
  - Capital

The Technology of Production

- Production Function:
  - Indicates the highest output that a firm can produce for every specified combination of inputs given the state of technology.
  - Shows what is *technically feasible* when the firm operates *efficiently*.

The Technology of Production

- The production function for two inputs:

  $Q = F(K,L)$

  Q = Output, K = Capital, L = Labor
- For a given technology

Isoquants

- Assumptions
  - Food producer has two inputs
    - Labor (L) & Capital (K)

Isoquants

- Observations:
  1) For any level of K, output increases with more L.
  2) For any level of L, output increases with more K.
  3) Various combinations of inputs produce the same output.

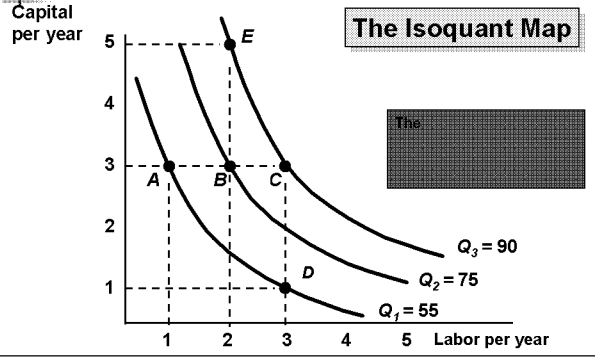
Isoquants

- Isoquants
  - Curves showing all possible combinations of inputs that yield the same output

Production Function for Food

	Labor Input				
Capital Input	**1**	**2**	**3**	**4**	**5**
1	20	40	55	65	75
2	40	60	75	85	90
3	55	75	90	100	105
4	65	85	100	110	115
5	75	90	105	115	120

Production with Two Variable Inputs (*L*,*K*)



Isoquants

Input Flexibility

- The isoquants emphasize how different input combinations can be used to produce the same output.
- This information allows the producer to respond efficiently to changes in the markets for inputs.

Isoquants

The Short Run versus the Long Run

- Short-run:
  - Period of time in which quantities of one or more production factors cannot be changed.
  - These inputs are called fixed inputs.

Isoquants

The Short Run versus the Long Run

- Long-run
  - Amount of time needed to make all production inputs variable.

Production with One Variable Input (Labor)

Amount of Labor (*L*)	Amount of Capital (*K*)	Total Output (*Q*)	Average Product	Marginal Product
0	10	0	---	---
1	10	10	10	10
2	10	30	15	20
3	10	60	20	30
4	10	80	20	20
5	10	95	19	15
6	10	108	18	13
7	10	112	16	4
8	10	112	14	0
9	10	108	12	-4
10	10	100	10	-8

Production with One Variable Input (Labor)

- Observations:
  1) With additional workers, output (*Q*) increases, reaches a maximum, and then decreases.

Production with One Variable Input (Labor)

- Observations:
  2) The average product of labor (*AP*), or output per worker, increases and then decreases.

$$AP = \frac{Output}{Labor\ Input} = \frac{Q}{L}$$

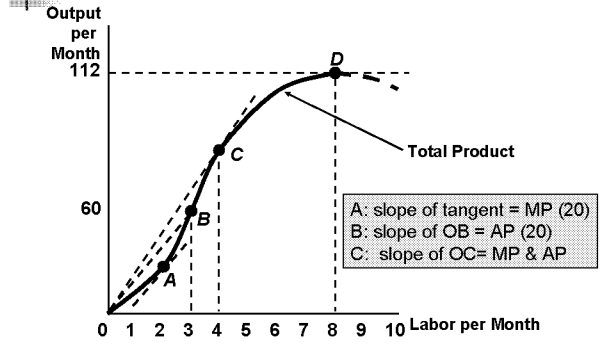
Production with One Variable Input (Labor)

- Observations:

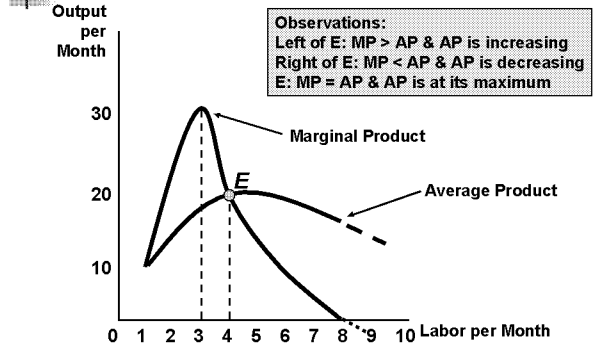
3) The marginal product of labor (M*P*), or output of the additional worker, increases rapidly initially and then decreases and becomes negative..

$$MP_L = \frac{\Delta Output}{\Delta Labor\ Input} = \frac{\Delta Q}{\Delta L}$$

Production with One Variable Input (Labor)



Production with One Variable Input (Labor)

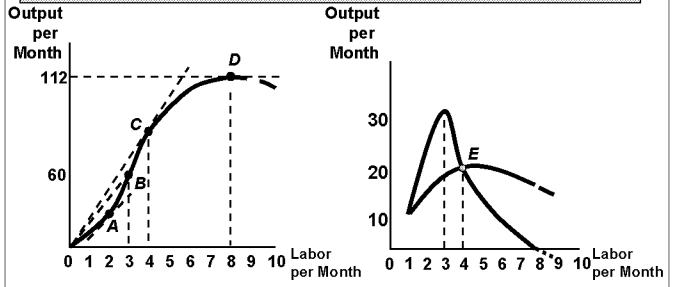


Production with One Variable Input (Labor)

- Observations:
  - When *MP* = 0, *TP* is at its maximum
  - When *MP* > *AP*, *AP* is increasing
  - When *MP* < *AP*, *AP* is decreasing
  - When *MP* = *AP*, *AP* is at its maximum

Production with One Variable Input (Labor)

AP = slope of line from origin to a point on *TP*, lines *b, & c.*
MP = slope of a tangent to any point on the *TP* line, lines a & c.



Production with One Variable Input (Labor)

The Law of Diminishing Marginal Returns

- As the use of an input increases in equal increments, a point will be reached at which the resulting additions to output decreases (i.e. *MP* declines).

Production with One Variable Input (Labor)

The Law of Diminishing Marginal Returns

- When the labor input is small, *MP* increases due to specialization.
- When the labor input is large, *MP* decreases due to inefficiencies.

Production with One Variable Input (Labor)

The Law of Diminishing Marginal Returns

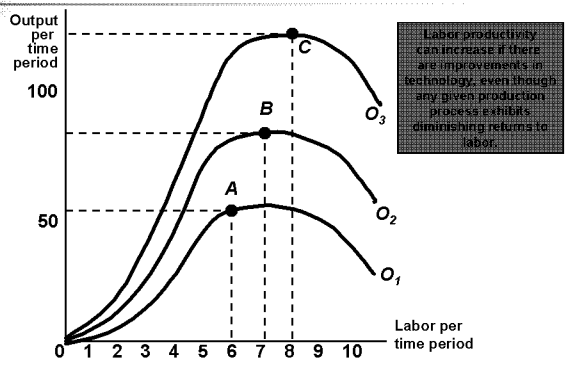
- Can be used for long-run decisions to evaluate the trade-offs of different plant configurations
- Assumes the quality of the variable input is constant

Production with One Variable Input (Labor)

The Law of Diminishing Marginal Returns

- Explains a declining *MP*, not necessarily a negative one
- Assumes a constant technology

The Effect of Technological Improvement



Malthus and the Food Crisis

- Malthus predicted mass hunger and starvation as diminishing returns limited agricultural output and the population continued to grow.
- Why did Malthus' prediction fail?

Index of World Food Consumption Per Capita

Year	Index
1948-1952	100
1960	115
1970	123
1980	128
1990	137
1995	135
1998	140

Malthus and the Food Crisis

- The data show that production increases have exceeded population growth.
- Malthus did not take into consideration the potential impact of technology which has allowed the supply of food to grow faster than demand.

Malthus and the Food Crisis

- Technology has created surpluses and driven the price down.
- Question
  - If food surpluses exist, why is there hunger?

Malthus and the Food Crisis

- Answer
  - The cost of distributing food from productive regions to unproductive regions and the low income levels of the non-productive regions.

Production with One Variable Input (Labor)

- Labor Productivity

$$\text{Average Productivity} = \frac{\text{Total Output}}{\text{Total Labor Input}}$$

Production with One Variable Input (Labor)

- Labor Productivity and the Standard of Living
  - Consumption can increase only if productivity increases.
  - Determinants of Productivity
    - Stock of capital
    - Technological change

Labor Productivity in Developed Countries

	France	Germany	Japan	United Kingdom	United States
	Output per Employed Person (1997)				
	$54,507	$55,644	$46,048	$42,630	$60,915
	Annual Rate of Growth of Labor Productivity (%)				
1960-19734.75	**4.04**	**8.30**	**2.89**	**2.36**	
1974-19862.10	**1.85**	**2.50**	**1.69**	**0.71**	
1987-19971.48	**2.00**	**1.94**	**1.02**	**1.09**	

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Production with One Variable Input (Labor)

- Trends in Productivity
  1) U.S. productivity is growing at a slower rate than other countries.
  2) Productivity growth in developed countries has been decreasing.

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Production with One Variable Input (Labor)

- Explanations for Productivity Growth Slowdown
  1) Growth in the stock of capital is the primary determinant of the growth in productivity.

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Production with One Variable Input (Labor)

- Explanations for Productivity Growth Slowdown
  2) Rate of capital accumulation in the U.S. was slower than other developed countries because the others were rebuilding after WWII.

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Production with One Variable Input (Labor)

- Explanations for Productivity Growth Slowdown
  3) Depletion of natural resources
  4) Environment regulations

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Production with One Variable Input (Labor)

- Observation
  - U.S. productivity has increased in recent years
- What Do You Think?
  - Is it a short-term aberration or a new long-run trend?

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Production with Two Variable Inputs

- There is a relationship between production and productivity.
- Long-run production *K& L* are variable.
- Isoquants analyze and compare the different combinations of *K & L* and output

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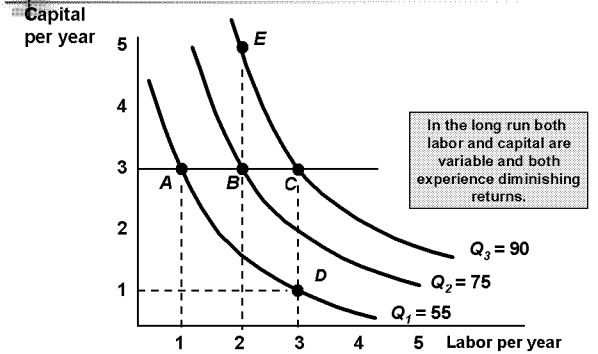
The Shape of Isoquants



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Production with Two Variable Inputs

Diminishing Marginal Rate of Substitution

- Reading the Isoquant Model
  1) Assume capital is 3 and labor increases from 0 to 1 to 2 to 3.
     - Notice output increases at a decreasing rate (55, 20, 15) illustrating diminishing returns from labor in the short-run and long-run.

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Production with Two Variable Inputs

Diminishing Marginal Rate of Substitution

- Reading the Isoquant Model
  2) Assume labor is 3 and capital increases from 0 to 1 to 2 to 3.
     - Output also increases at a decreasing rate (55, 20, 15) due to diminishing returns from capital.

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Production with Two Variable Inputs

- Substituting Among Inputs
  - Managers want to determine what combination if inputs to use.
  - They must deal with the trade-off between inputs.

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Production with Two Variable Inputs

- Substituting Among Inputs
  - The slope of each isoquant gives the trade-off between two inputs while keeping output constant.

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Production with Two Variable Inputs

- Substituting Among Inputs
  - The marginal rate of technical substitution equals:

$$MRTS = \text{- Change in capital/Change in labor input}$$
$$MRTS = -\Delta K/\Delta L \text{ (for a fixed level of } Q)$$

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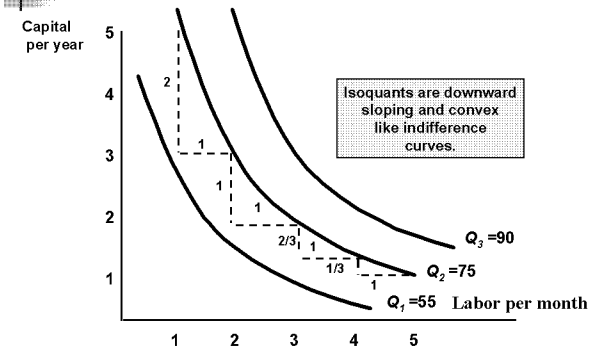
Marginal Rate of Technical Substitution



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Production with Two Variable Inputs

- Observations:
  1) Increasing labor in one unit increments from 1 to 5 results in a decreasing *MRTS* from 1 to 1/2.
  2) Diminishing *MRTS* occurs because of diminishing returns and implies isoquants are convex.

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Production with Two Variable Inputs

- Observations:
  3) *MRTS* and Marginal Productivity
     - The change in output from a change in labor equals:

$$(MP_L)(\Delta L)$$

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Production with Two Variable Inputs

- Observations:
  3) *MRTS* and Marginal Productivity
     - The change in output from a change in capital equals:

$$(MP_K)(\Delta K)$$

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Production with Two Variable Inputs

- Observations:
  3) *MRTS* and Marginal Productivity
     - If output is constant and labor is increased, then:

$$(MP_L)(\Delta L) + (MP_K)(\Delta K) = 0$$
$$(MP_L)(MP_K) = -(\Delta K/\Delta L) = MRTS$$

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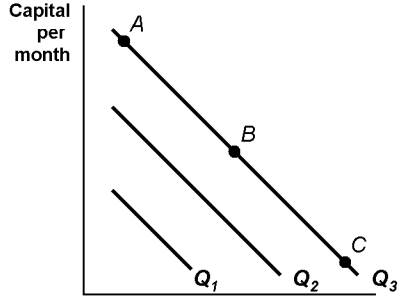
Isoquants When Inputs are Perfectly Substitutable



Production with Two Variable Inputs

Perfect Substitutes

- Observations when inputs are perfectly substitutable:

1) The MRTS is constant at all points on the isoquant.

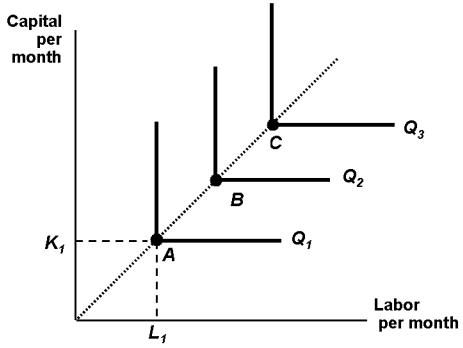
Production with Two Variable Inputs

Perfect Substitutes

- Observations when inputs are perfectly substitutable:

2) For a given output, any combination of inputs can be chosen (*A, B, or C)* to generate the same level of output (e.g. toll booths & musical instruments)

Fixed-Proportions Production Function



Production with Two Variable Inputs

Fixed-Proportions Production Function

- Observations when inputs must be in a fixed-proportion:

1) No substitution is possible.Each output requires a specific amount of each input (e.g. labor and jackhammers).

Production with Two Variable Inputs

Fixed-Proportions Production Function

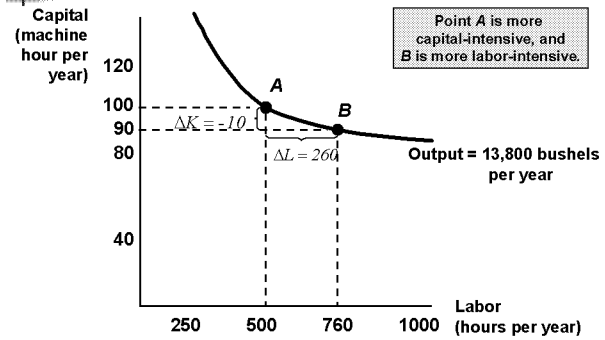
- Observations when inputs must be in a fixed-proportion:

2) To increase output requires more labor and capital (i.e. moving from *A* to *B* to *C* which is technically efficient).

A Production Function for Wheat

- Farmers must choose between a capital intensive or labor intensive technique of production.

Isoquant Describing the Production of Wheat



Isoquant Describing the Production of Wheat

- Observations:

1) Operating at *A:*
   - $L = 500$ hours and $K = 100$ machine hours.

Isoquant Describing the Production of Wheat

- Observations:

2) Operating at B
   - Increase L to 760 and decrease K to 90 the MRTS < 1:

$$MRTS = -\Delta K / \Delta L = -(10/260) = 0.04$$

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Isoquant Describing the Production of Wheat

- Observations:

  3) *MRTS* < 1, therefore the cost of labor must be less than capital in order for the farmer substitute labor for capital.

  4) If labor is expensive, the farmer would use more capital (e.g. U.S.).

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Isoquant Describing the Production of Wheat

- Observations:

  5) If labor is inexpensive, the farmer would use more labor (e.g. India).

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Returns to Scale

- Measuring the relationship between the scale (size) of a firm and output

  1) Increasing returns to scale: output more than doubles when all inputs are doubled
     - Larger output associated with lower cost (autos)
     - One firm is more efficient than many (utilities)
     - The isoquants get closer together

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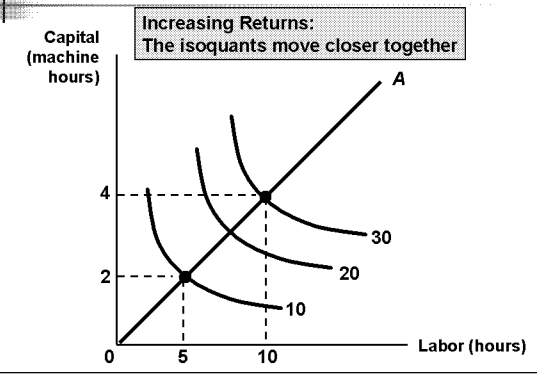
Returns to Scale



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Returns to Scale

- Measuring the relationship between the scale (size) of a firm and output

  2) Constant returns to scale: output doubles when all inputs are doubled
     - Size does not affect productivity
     - May have a large number of producers
     - Isoquants are equidistant apart

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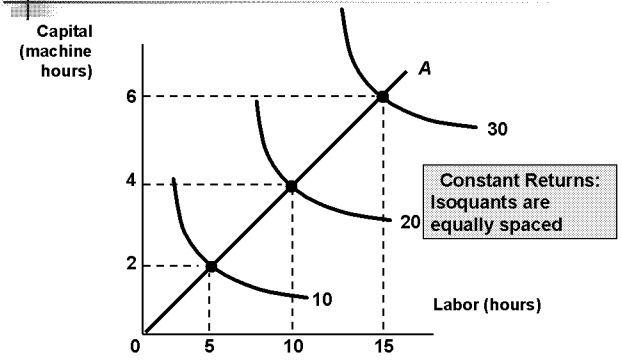
Returns to Scale



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Returns to Scale

- Measuring the relationship between the scale (size) of a firm and output

  3) Decreasing returns to scale: output less than doubles when all inputs are doubled
     - Decreasing efficiency with large size
     - Reduction of entrepreneurial abilities
     - Isoquants become farther apart

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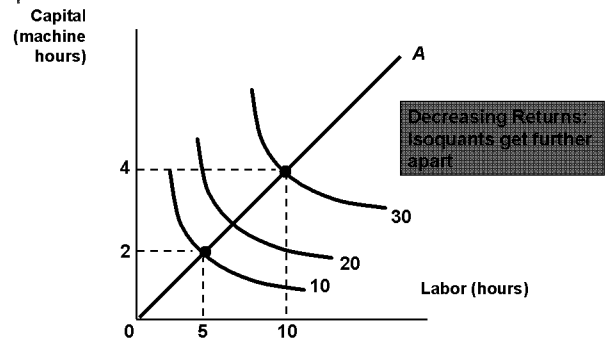
Returns to Scale



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Returns to Scale in the Carpet Industry

- The carpet industry has grown from a small industry to a large industry with some very large firms.

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Returns to Scale in the Carpet Industry

- Question
  - Can the growth be explained by the presence of economies to scale?

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The U.S. Carpet Industry

Carpet Shipments, 1996
(Millions of Dollars per Year)

1. Shaw Industries	**$3,202**	**6. World Carpets**	**$475**
2. Mohawk Industries	**1,795**	**7. Burlington Industries**	**450**
3. Beaulieu of America	**1,006**	**8. Collins & Aikman**	**418**
4. Interface Flooring	**820**	**9. Masland Industries**	**380**
5. Queen Carpet	**775**	**10. Dixied Yarns**	**280**

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Returns to Scale in the Carpet Industry

- Are there economies of scale?
  - Costs (percent of cost)
    - Capital -- 77%
    - Labor -- 23%

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Returns to Scale in the Carpet Industry

- Large Manufacturers
  - Increased in machinery & labor
  - Doubling inputs has more than doubled output
  - Economies of scale exist for large producers

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Returns to Scale in the Carpet Industry

- Small Manufacturers
  - Small increases in scale have little or no impact on output
  - Proportional increases in inputs increase output proportionally
  - Constant returns to scale for small producers

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Summary

- A *production function* describes the maximum output a firm can produce for each specified combination of inputs.
- An *isoquant* is a curve that shows all combinations of inputs that yield a given level of output.

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Summary

- *Average product of labor* measures the productivity of the average worker, whereas *marginal product of labor* measures the productivity of the last worker added.

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Summary

- The *law of diminishing returns* explains that the marginal product of an input eventually diminishes as its quantity is increased.

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Summary

- Isoquants always slope downward because the marginal product of all inputs is positive.
- The standard of living that a country can attain for its citizens is closely related to its level of productivity.

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Summary

- In long-run analysis, we tend to focus on the firm's choice of its scale or size of operation.

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End of Chapter 6

Production

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Chapter 7

The Cost of Production

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Topics to be Discussed

- Measuring Cost: Which Costs Matter?
- Cost in the Short Run
- Cost in the Long Run
- Long-Run Versus Short-Run Cost Curves

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Topics to be Discussed

- Production with Two Outputs--Economies of Scope
- Dynamic Changes in Costs--The Learning Curve
- Estimating and Predicting Cost

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Introduction

- The production technology measures the relationship between input and output.
- Given the production technology, managers must choose *how* to produce.

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Introduction

- To determine the optimal level of output and the input combinations, we must convert from the unit measurements of the production technology to dollar measurements or costs.

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Measuring Cost: Which Costs Matter?

Economic Cost vs. Accounting Cost

- Accounting Cost
  - Actual expenses plus depreciation charges for capital equipment
- Economic Cost
  - Cost to a firm of utilizing economic resources in production, including opportunity cost

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Measuring Cost: Which Costs Matter?

- Opportunity cost.
  - Cost associated with opportunities that are foregone when a firm's resources are not put to their highest-value use.

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Measuring Cost: Which Costs Matter?

- An Example
  - A firm owns its own building and pays no rent for office space
  - Does this mean the cost of office space is zero?

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Measuring Cost: Which Costs Matter?

- Sunk Cost
  - Expenditure that has been made and cannot be recovered
  - Should not influence a firm's decisions.

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Measuring Cost: Which Costs Matter?

- An Example
  - A firm pays $500,000 for an option to buy a building.
  - The cost of the building is $5 million or a total of $5.5 million.
  - The firm finds another building for $5.25 million.
  - Which building should the firm buy?

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Choosing the Location for a New Law School Building

- Northwestern University Law School
  1) Current location in downtown Chicago
  2) Alternative location in Evanston with the main campus

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Choosing the Location for a New Law School Building

- Northwestern University Law School
  3) Choosing a Site
     - Land owned in Chicago
     - Must purchase land in Evanston
     - Chicago location might appear cheaper without considering the opportunity cost of the downtown land (i.e. what it could be sold for)

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Choosing the Location for a New Law School Building

- Northwestern University Law School
  3) Choosing a Site
     - Chicago location chosen--very costly
     - Justified only if there is some intrinsic values associated with being in Chicago
     - If not, it was an inefficient decision if it was based on the assumption that the downtown land was "free"

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Measuring Cost: Which Costs Matter?

Fixed and Variable Costs

- Total output is a function of variable inputs and fixed inputs.
- Therefore, the total cost of production equals the fixed cost (the cost of the fixed inputs) plus the variable cost (the cost of the variable inputs), or…

$$TC = FC + VC$$

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Measuring Cost: Which Costs Matter?

Fixed and Variable Costs

- Fixed Cost
  - Does not vary with the level of output
- Variable Cost
  - Cost that varies as output varies

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Measuring Cost: Which Costs Matter?

- Fixed Cost
  - Cost paid by a firm that is in business regardless of the level of output
- Sunk Cost
  - Cost that have been incurred and cannot be recovered

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Measuring Cost: Which Costs Matter?

- Personal Computers: most costs are variable
  - Components, labor
- Software: most costs are sunk
  - Cost of developing the software

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Measuring Cost: Which Costs Matter?

- Pizza
  - Largest cost component is fixed

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A Firm's Short-Run Costs ($)

Rate of Output	Fixed Cost (FC)	Variable Cost (VC)	Total Cost (TC)	Marginal Cost (MC)	Average Fixed Cost (AFC)	Average Variable Cost (AVC)	Average Total Cost (ATC)
0	50	0	50	---	---	---	---
1	50	50	100	50	50	50	100
2	50	78	128	28	25	39	64
3	50	98	148	20	16.7	32.7	49.3
4	50	112	162	14	12.5	28	40.5
5	50	130	180	18	10	26	36
6	50	150	200	20	8.3	25	33.3
7	50	175	225	25	7.1	25	32.1
8	50	204	254	29	6.3	25.5	31.8
9	50	242	292	38	5.6	26.9	32.4
10	50	300	350	58	5	30	35
11	50	385	435	85	4.5	35	39.5

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Cost in the Short Run

- Marginal Cost (*MC*) is the cost of expanding output by one unit. Since fixed cost have no impact on marginal cost, it can be written as:

$$MC = \frac{\Delta VC}{\Delta Q} = \frac{\Delta TC}{\Delta Q}$$

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Cost in the Short Run

- Average Total Cost (ATC) is the cost per unit of output, or average fixed cost (AFC) plus average variable cost (AVC). This can be written:

$$ATC = \frac{TFC}{Q} + \frac{TVC}{Q}$$

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Cost in the Short Run

- Average Total Cost (ATC) is the cost per unit of output, or average fixed cost (AFC) plus average variable cost (AVC). This can be written:

$$ATC = AFC + AVC \text{ or } \frac{TC}{Q}$$

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Cost in the Short Run

- The Determinants of Short-Run Cost
  - *The relationship between the production function and cost* can be exemplified by either increasing returns and cost or decreasing returns and cost.

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Cost in the Short Run

- The Determinants of Short-Run Cost
  - Increasing returns and cost
    - With increasing returns, output is increasing relative to input and variable cost and total cost will fall relative to output.
  - Decreasing returns and cost
    - With decreasing returns, output is decreasing relative to input and variable cost and total cost will rise relative to output.

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Cost in the Short Run

- For Example: Assume the wage rate (w) is fixed relative to the number of workers hired. Then:

$$MC = \frac{\Delta VC}{\Delta Q}$$

$$VC = wL$$

Cost in the Short Run

- Continuing:

$$\Delta VC = w\Delta L$$

$$MC = \frac{w\Delta L}{\Delta Q}$$

Cost in the Short Run

- Continuing:

$$\Delta MP_L = \frac{\Delta Q}{\Delta L}$$

$$\Delta L \text{ for a 1 unit } \Delta Q = \frac{\Delta L}{\Delta Q} = \frac{1}{\Delta MP_L}$$

Cost in the Short Run

- In conclusion:

$$MC = \frac{w}{MP_L}$$

- …and a low marginal product (MP) leads to a high marginal cost (MC) and vise versa.

Cost in the Short Run

- Consequently (from the table):
  - MC decreases initially with increasing returns
    - 0 through 4 units of output
  - MC increases with decreasing returns
    - 5 through 11 units of output

A Firm's Short-Run Costs ($)

Rate of Output	Fixed Cost (FC)	Variable Cost (VC)	Total Cost (TC)	Marginal Cost (MC)	Average Fixed Cost (AFC)	Average Variable Cost (AVC)	Average Total Cost (ATC)
0	50	0	50	---	---	---	---
1	50	50	100	50	50	50	100
2	50	78	128	28	25	39	64
3	50	98	148	20	16.7	32.7	49.3
4	50	112	162	14	12.5	28	40.5
5	50	130	180	18	10	26	36
6	50	150	200	20	8.3	25	33.3
7	50	175	225	25	7.1	25	32.1
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10	50	300	350	58	5	30	35
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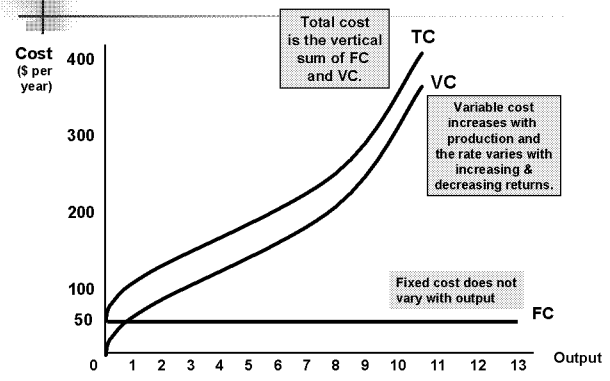
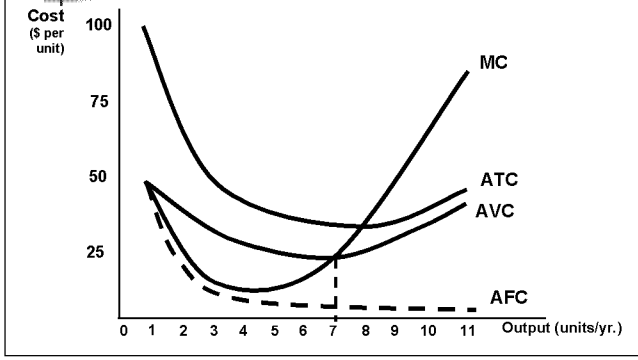
Cost Curves for a Firm

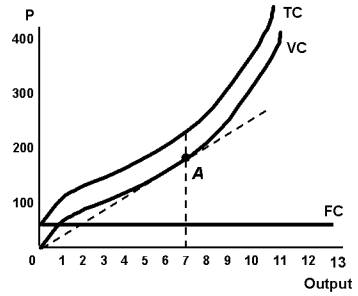


Cost Curves for a Firm



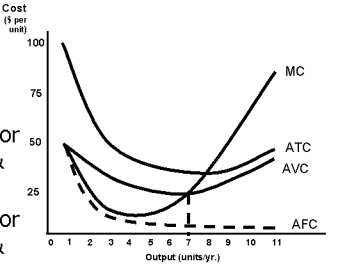
Cost Curves for a Firm

- The line drawn from the origin to the tangent of the variable cost curve:
  - Its slope equals AVC
  - The slope of a point on VC equals MC
  - Therefore, MC = AVC at 7 units of output (point *A*)



Cost Curves for a Firm

- Unit Costs
  - AFC falls continuously
  - When MC < AVC or MC < ATC, AVC & ATC decrease
  - When MC > AVC or MC > ATC, AVC & ATC increase



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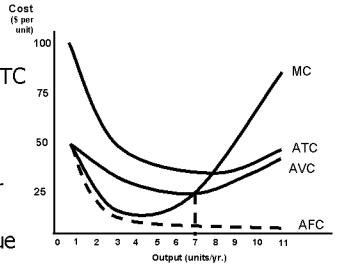
Cost Curves for a Firm

- Unit Costs
  - MC = AVC and ATC at minimum AVC and ATC
  - Minimum AVC occurs at a lower output than minimum ATC due to FC



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Operating Costs for Aluminum Smelting ($/Ton - based on an output of 600 tons/day)

Variable costs that are constant at all output levels

Electricity	**$316**
Alumina	**369**
Other raw materials	**125**
Plant power and fuel	**10**
Subtotal	**$820**

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Operating Costs for Aluminum Smelting ($/Ton - based on an output of 600 tons/day)

Variable costs that increase when output exceeds 600 tons/day

Labor	**$150**
Maintenance	**120**
Freight	**50**
Subtotal	**$320**
Total operating costs	**$1140**

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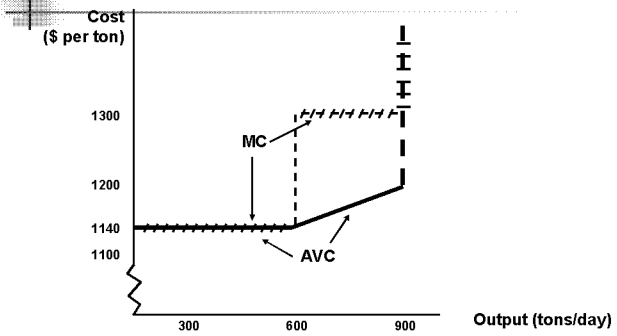
The Short-Run Variable Costs of Aluminum Smelting



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Cost in the Long Run

The User Cost of Capital

- User Cost of Capital = Economic Depreciation + (Interest Rate)(Value of Capital)

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Cost in the Long Run

The User Cost of Capital

- Example
  - Delta buys a Boeing 737 for $150 million with an expected life of 30 years
    - Annual economic depreciation = $150 million/30 = $5 million
    - Interest rate = 10%

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Cost in the Long Run

The User Cost of Capital

- Example
  - User Cost of Capital = $5 million + (.10)($150 million – depreciation)
    - Year 1 = $5 million + (.10)($150 million) = $20 million
    - Year 10 = $5 million + (.10)($100 million) = $15 million

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Cost in the Long Run

The User Cost of Capital

- Rate per dollar of capital
  - r = Depreciation Rate + Interest Rate

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Cost in the Long Run

The User Cost of Capital

- Airline Example
  - Depreciation Rate = 1/30 = 3.33/yr
  - Rate of Return = 10%/yr
- User Cost of Capital
  - r = 3.33 + 10 = 13.33%/yr

Cost in the Long Run

The Cost Minimizing Input Choice

- Assumptions
  - Two Inputs: Labor (L) & capital (K)
  - Price of labor: wage rate (w)
  - The price of capital
    - R = depreciation rate + interest rate

Cost in the Long Run

The User Cost of Capital

- Question
  - If capital was rented, would it change the value of r?

Cost in the Long Run

The Cost Minimizing Input Choice

- The Isocost Line
  - $C = wL + rK$
  - Isocost: A line showing all combinations of L & K that can be purchased for the same cost

Cost in the Long Run

The Isocost Line

- Rewriting C as linear:
  - $K = C/r - (w/r)L$
  - Slope of the isocost:

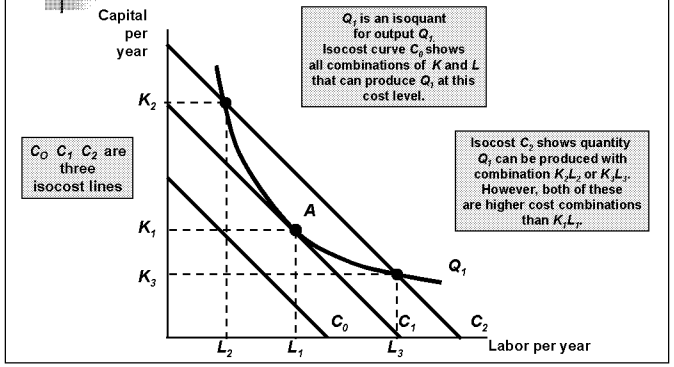
$$\Delta K/\Delta L = -(w/r)$$

    - is the ratio of the wage rate to rental cost of capital.
    - This shows the rate at which capital can be substituted for labor with no change in cost.

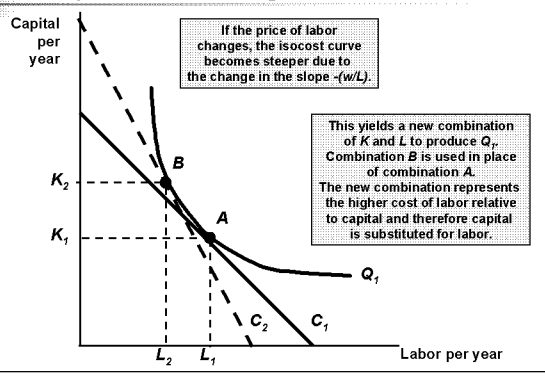
Choosing Inputs

- We will address how to minimize cost for a given level of output.
  - We will do so by combining isocosts with isoquants

Producing a Given Output at Minimum Cost



Input Substitution When an Input Price Change



Cost in the Long Run

- Isoquants and Isocosts and the Production Function

$$MRTS = -\Delta K/\Delta L = MP_L/MP_K$$

$$\text{Slope of isocost line} = \Delta K/\Delta L = -w/r$$

$$\text{and} = MP_L/MP_K = w/r$$

Cost in the Long Run

- The minimum cost combination can then be written as:

$$MP_L/w = MP_K/r$$

  - Minimum cost for a given output will occur when each dollar of input added to the production process will add an equivalent amount of output.

Cost in the Long Run

- Question
  - If w = \$10, r = \$2, and $MP_L = MP_K$, which input would the producer use more of? Why?

The Effect of Effluent Fees on Firms' Input Choices

- Firms that have a by-product to production produce an *effluent.*
- An effluent fee is a per-unit fee that firms must pay for the effluent that they emit.
- How would a producer respond to an effluent fee on production?

The Effect of Effluent Fees on Firms' Input Choices

- The Scenario: Steel Producer

1) Located on a river: Low cost transportation and emission disposal (effluent).

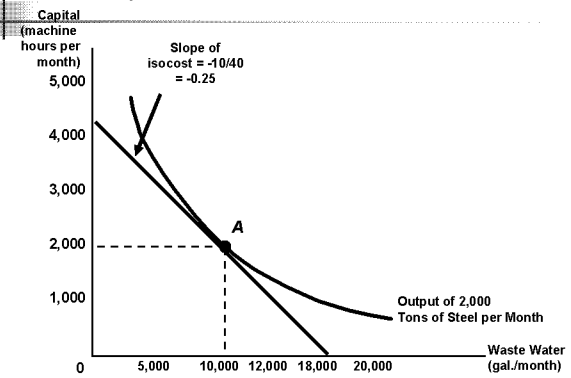
2) EPA imposes a per unit effluent fee to reduce the environmentally harmful effluent.

The Effect of Effluent Fees on Firms' Input Choices

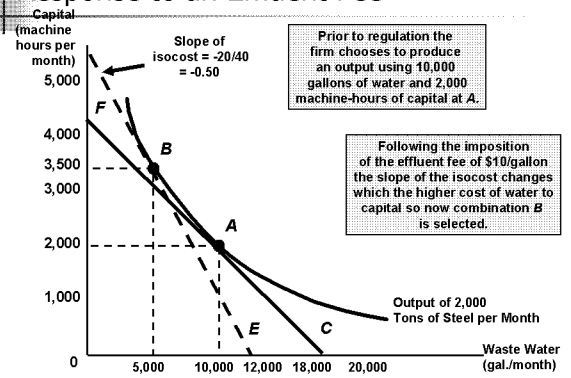
- The Scenario: Steel Producer

3) How should the firm respond?

The Cost-Minimizing Response to an Effluent Fee



The Cost-Minimizing Response to an Effluent Fee



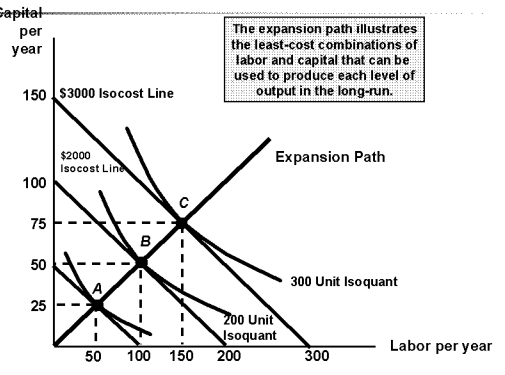
The Effect of Effluent Fees on Firms' Input Choices

- Observations:
  - The more easily factors can be substituted, the more effective the fee is in reducing the effluent.
  - The greater the degree of substitutes, the less the firm will have to pay (for example: \$50,000 with combination *B* instead of \$100,000 with combination *A*)

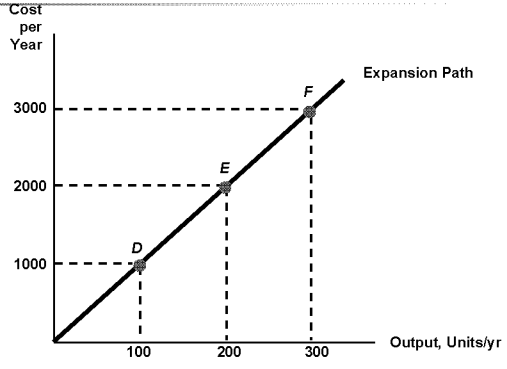
Cost in the Long Run

- Cost minimization with Varying Output Levels
  - A firm's expansion path shows the minimum cost combinations of labor and capital at each level of output.

A Firm's Expansion Path



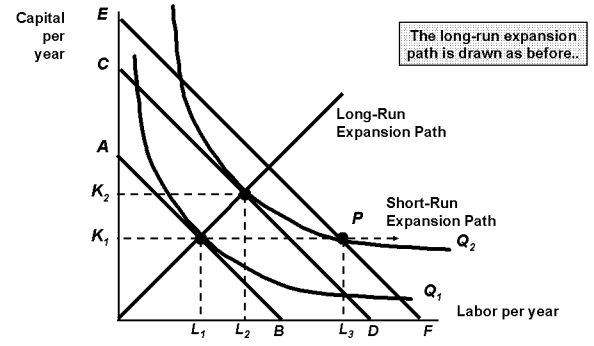
A Firm's Long-Run Total Cost Curve



Long-Run Versus Short-Run Cost Curves

- What happens to average costs when both inputs are variable (long run) versus only having one input that is variable (short run)?

The Inflexibility of Short-Run Production



Long-Run Versus Short-Run Cost Curves

- Long-Run Average Cost (LAC)
  - Constant Returns to Scale
    - If input is doubled, output will double and average cost is constant at all levels of output.

Long-Run Versus Short-Run Cost Curves

- Long-Run Average Cost (LAC)
  - Increasing Returns to Scale
    - If input is doubled, output will more than double and average cost decreases at all levels of output.

Long-Run Versus Short-Run Cost Curves

- Long-Run Average Cost (LAC)
  - Decreasing Returns to Scale
    - If input is doubled, the increase in output is less than twice as large and average cost increases with output.

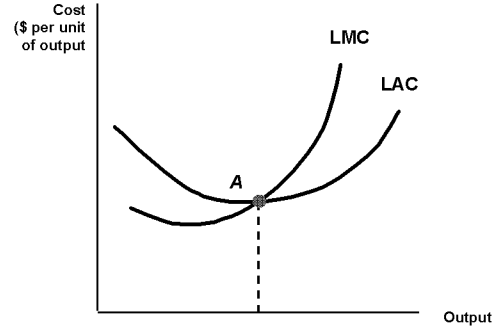
Long-Run Versus Short-Run Cost Curves

- Long-Run Average Cost (LAC)
  - In the long-run:
    - Firms experience increasing and decreasing returns to scale and therefore long-run average cost is "U" shaped.

Long-Run Versus Short-Run Cost Curves

- Long-Run Average Cost (LAC)
  - Long-run marginal cost leads long-run average cost:
    - If LMC < LAC, LAC will fall
    - If LMC > LAC, LAC will rise
    - Therefore, LMC = LAC at the minimum of LAC

Long-Run Average and Marginal Cost



Long-Run Versus Short-Run Cost Curves

- Question
  - What is the relationship between long-run average cost and long-run marginal cost when long-run average cost is constant?

Long-Run Versus Short-Run Cost Curves

- Economies and Diseconomies of Scale
  - Economies of Scale
    - Increase in output is greater than the increase in inputs.
  - Diseconomies of Scale
    - Increase in output is less than the increase in inputs.

Long-Run Versus Short-Run Cost Curves

- Measuring Economies of Scale

$$E_C = \text{Cost} - \text{output elasticity}$$
$$= \%\Delta \text{ in cost from a 1\% increase in output}$$

Long-Run Versus Short-Run Cost Curves

- Measuring Economies of Scale

$$E_c = (\Delta C / C) / (\Delta Q / Q)$$

$$E_c = (\Delta C / \Delta Q) / (C / Q) = \text{MC/AC}$$

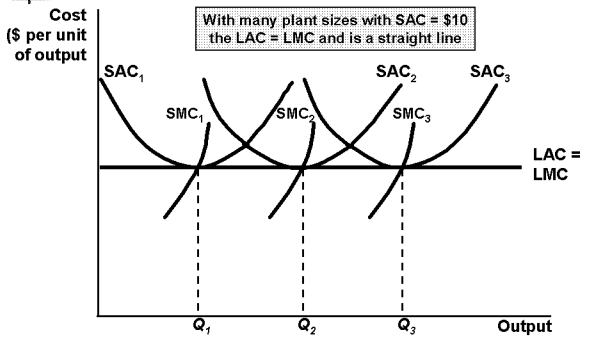
Long-Run Versus Short-Run Cost Curves

- Therefore, the following is true:
  - $E_C < 1$: MC < AC
    - Average cost indicate decreasing economies of scale
  - $E_C = 1$: MC = AC
    - Average cost indicate constant economies of scale
  - $E_C > 1$: MC > AC
    - Average cost indicate increasing diseconomies of scale

Long-Run Versus Short-Run Cost Curves

- The Relationship Between Short-Run and Long-Run Cost
  - We will use short and long-run cost to determine the optimal plant size

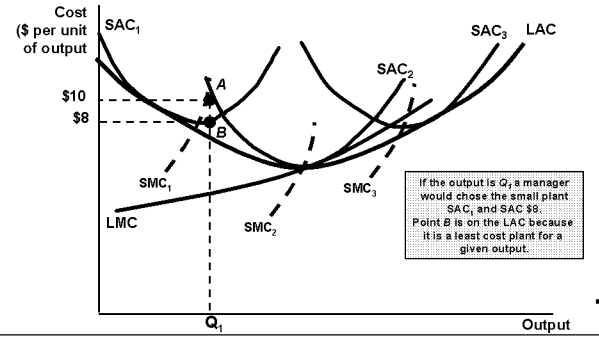
Long-Run Cost with Constant Returns to Scale



Long-Run Cost with Constant Returns to Scale

- Observation
  - The optimal plant size will depend on the anticipated output (e.g. Q_1 choose SAC_1,etc).
  - The long-run average cost curve is the *envelope* of the firm's short-run average cost curves.
- Question
  - What would happen to average cost if an output level other than that shown is chosen?

Long-Run Cost with Economies and Diseconomies of Scale



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Long-Run Cost with Constant Returns to Scale

- What is the firms' long-run cost curve?
  - Firms can change scale to change output in the long-run.
  - The long-run cost curve is the dark blue portion of the SAC curve which represents the minimum cost for any level of output.

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Long-Run Cost with Constant Returns to Scale

- Observations
  - The LAC does not include the minimum points of small and large size plants? Why not?
  - LMC is not the envelope of the short-run marginal cost. Why not?

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Production with Two Outputs--Economies of Scope

- Examples:
  - Chicken farm--poultry and eggs
  - Automobile company--cars and trucks
  - University--Teaching and research

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Production with Two Outputs--Economies of Scope

- Economies of scope exist when the joint output of a single firm is greater than the output that could be achieved by two different firms each producing a single output.
- What are the advantages of joint production?
  - Consider an automobile company producing cars and tractors

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Production with Two Outputs--Economies of Scope

- Advantages
  1) Both use capital and labor.
  2) The firms share management resources.
  3) Both use the same labor skills and type of machinery.

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Production with Two Outputs--Economies of Scope

- Production:
  - Firms must choose how much of each to produce.
  - The alternative quantities can be illustrated using product transformation curves.

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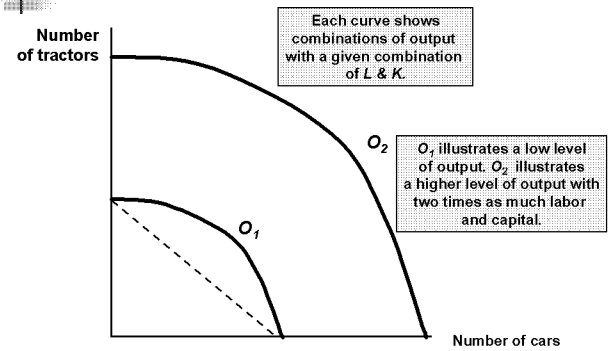
Product Transformation Curve



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Production with Two Outputs--Economies of Scope

- Observations
  - Product transformation curves are negatively sloped
  - Constant returns exist in this example
  - Since the production transformation curve is concave is joint production desirable?

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Production with Two Outputs--Economies of Scope

- Observations
  - There is no direct relationship between economies of scope and economies of scale.
    - May experience economies of scope and diseconomies of scale
    - May have economies of scale and not have economies of scope

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Production with Two Outputs--Economies of Scope

- The *degree of economies of scope* measures the savings in cost and can be written:

$$SC = \frac{C(Q_1) + C(Q_2) - C(Q_1, Q_2)}{C(Q_1, Q_2)}$$

- $C(Q_1)$ is the cost of producing Q_1
- $C(Q_2)$ is the cost of producing Q_2
- $C(Q_1Q_2)$ is the joint cost of producing both products

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Production with Two Outputs--Economies of Scope

- Interpretation:
  - If SC > 0 -- Economies of scope
  - If SC < 0 -- Diseconomies of scope

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Economies of Scope in the Trucking Industry

- Issues
  - Truckload versus less than truck load
  - Direct versus indirect routing
  - Length of haul

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Economies of Scope in the Trucking Industry

- Questions:
  - Economies of Scale
    - Are large-scale, direct hauls cheaper and more profitable than individual hauls by small trucks?
    - Are there cost advantages from operating both direct and indirect hauls?

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Economies of Scope in the Trucking Industry

- Empirical Findings
  - An analysis of 105 trucking firms examined four distinct outputs.
    - Short hauls with partial loads
    - Intermediate hauls with partial loads
    - Long hauls with partial loads
    - Hauls with total loads

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Economies of Scope in the Trucking Industry

- Empirical Findings
  - Results
    - SC = 1.576 for reasonably large firm
    - SC = 0.104 for very large firms
  - Interpretation
    - Combining partial loads at an intermediate location lowers cost management difficulties with very large firms.

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Dynamic Changes in Costs--The Learning Curve

- The learning curve measures the impact of worker's experience on the costs of production.
- It describes the relationship between a firm's cumulative output and amount of inputs needed to produce a unit of output.

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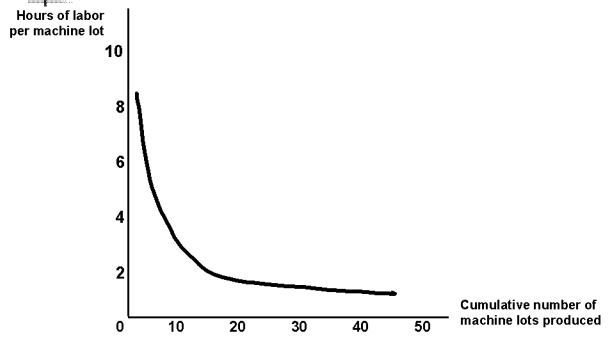
The Learning Curve



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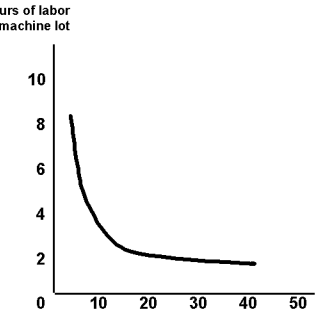
The Learning Curve

- The horizontal axis measures the cumulative number of hours of machine tools the firm has produced
- The vertical axis measures the number of hours of labor needed to produce each lot.



Dynamic Changes in Costs--The Learning Curve

- The learning curve in the figure is based on the relationship:

$$L = BN^{-\beta}$$

N = cumulative units of output produced

L = labor input per unit of output

A, B and β are constants

A & B are positive and β is between 0 and 1

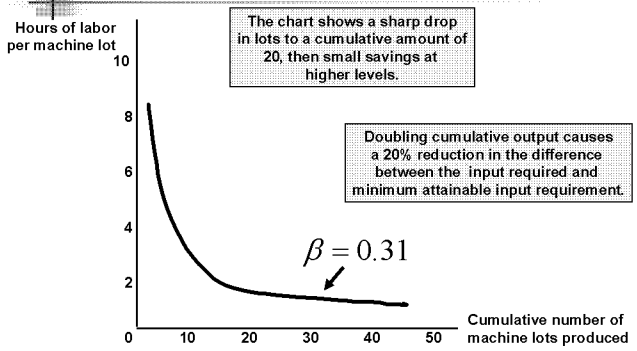
Dynamic Changes in Costs--The Learning Curve

- *If* $N = 1$:
  - L equals $A + B$ and this measures labor input to produce the first unit of output
- *If* $\beta = 0$:
  - Labor input remains constant as the cumulative level of output increases, so there is no learning

Dynamic Changes in Costs--The Learning Curve

- *If* $\beta > 0$ and N increases:
  - L approaches A, and A represent minimum labor input/unit of output after all learning has taken place.
- The larger β:
  - The more important the learning effect.

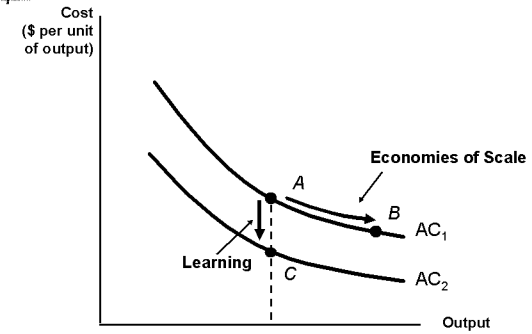
The Learning Curve



Dynamic Changes in Costs--The Learning Curve

- Observations
  1) New firms may experience a learning curve, not economies of scale.
  2) Older firms have relatively small gains from learning.

Economies of Scale Versus Learning



Predicting the Labor Requirements of Producing a Given Output

Cumulative Output (N)	Per-Unit Labor Requirement for each 10 units of Output (L)	Total Labor Requirement
10	1.00	10.0
20	.80	18.0 (10.0 + 8.0)
30	.70	25.0 (18.0 + 7.0)
40	.64	31.4 (25.0 + 6.4)
50	.60	37.4 (31.4 + 6.0)
60	.56	43.0 (37.4 + 5.6)
70	.53	48.3 (43.0 + 5.3)
80 and over	.51	53.4 (48.3 + 5.1)

Dynamic Changes in Costs--The Learning Curve

- The learning curve implies:
  1) The labor requirement falls per unit.
  2) Costs will be high at first and then will fall with learning.
  3) After 8 years the labor requirement will be 0.51 and per unit cost will be half what it was in the first year of production.

The Learning Curve in Practice

- Scenario
  - A new firm enters the chemical processing industry.
- Do they:
  1) Produce a low level of output and sell at a high price?
  2) Produce a high level of output and sell at a low price?

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The Learning Curve in Practice

- How would the learning curve influence your decision?

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The Learning Curve in Practice

- The Empirical Findings
  - Study of 37 chemical products
    - Average cost fell 5.5% per year
    - For each doubling of plant size, average production costs fall by 11%
    - For each doubling of cumulative output, the average cost of production falls by 27%
- Which is more important, the economies of scale or learning effects?

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The Learning Curve in Practice

- Other Empirical Findings
  - In the semi-conductor industry a study of seven generations of DRAM semiconductors from 1974-1992 found learning rates averaged 20%.
  - In the aircraft industry the learning rates are as high as 40%.

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The Learning Curve in Practice

- Applying Learning Curves
  1) To determine if it is profitable to enter an industry.
  2) To determine when profits will occur based on plant size and cumulative output.

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Estimating and Predicting Cost

- Estimates of future costs can be obtained from a *cost function,* which relates the cost of production to the level of output and other variables that the firm can control.
- Suppose we wanted to derive the total cost curve for automobile production.

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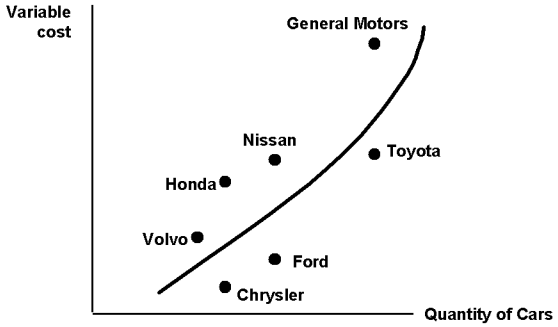
Total Cost Curve for the Automobile Industry



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Estimating and Predicting Cost

- A *linear* cost function (does not show the U-shaped characteristics) might be:

$$VC = \beta Q$$

- The linear cost function is applicable only if marginal cost is constant.
  - Marginal cost is represented by β .

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Estimating and Predicting Cost

- If we wish to allow for a U-shaped average cost curve and a marginal cost that is not constant, we might use the *quadratic* cost function:

$$VC = \beta Q + \gamma Q^2$$

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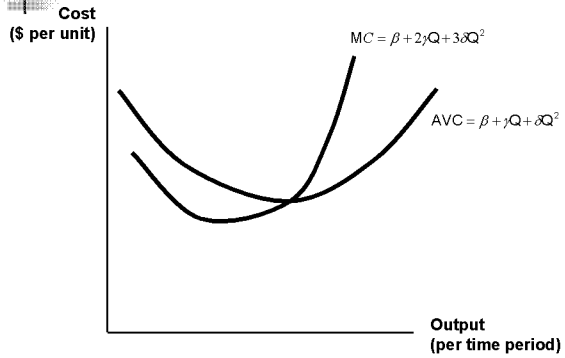
Estimating and Predicting Cost

- If the marginal cost curve is not linear, we might use a *cubic* cost function:

$$VC = \beta Q + \gamma Q^2 + \delta Q^3$$

Cubic Cost Function



Estimating and Predicting Cost

- Difficulties in Measuring Cost
  1) Output data may represent an aggregate of different type of products.
  2) Cost data may not include opportunity cost.
  3) Allocating cost to a particular product may be difficult when there is more than one product line.

Estimating and Predicting Cost

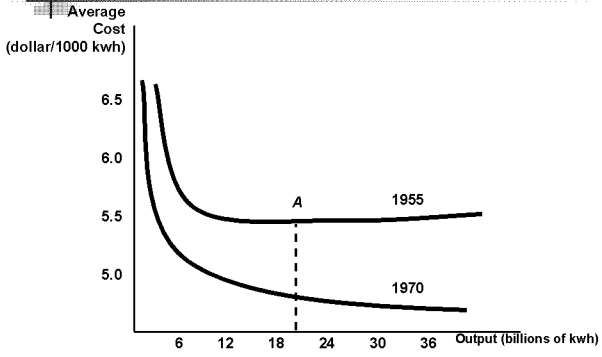
- Cost Functions and the Measurement of Scale Economies
  - Scale Economy Index (SCI)
    - $E_C = 1$, SCI = 0: no economies or diseconomies of scale
    - $E_C > 1$, SCI is negative: diseconomies of scale
    - $E_C < 1$, SCI is positive: economies of scale

Cost Functions for Electric Power

Scale Economies in the Electric Power Industry

Output (million kwh)	43	338	1109	2226	5819
Value of SCI, 1955	.41	.26	.16	.10	.04

Average Cost of Production in the Electric Power Industry



Cost Functions for Electric Power

- Findings
  - Decline in cost
    - Not due to economies of scale
    - Was caused by:
      - Lower input cost (coal & oil)
      - Improvements in technology

A Cost Function for the Savings and Loan Industry

- The empirical estimation of a long-run cost function can be useful in the restructuring of the savings and loan industry in the wake of the savings and loan collapse in the 1980s.

A Cost Function for the Savings and Loan Industry

- Data for 86 savings and loans for 1975 & 1976 in six western states
  - Q = total assets of each S&L
  - LAC = average operating expense
  - Q & TC are measured in hundreds of millions of dollars
  - Average operating cost are measured as a percentage of total assets.

A Cost Function for the Savings and Loan Industry

- A quadratic long-run average cost function was estimated for 1975:

$$LAC = 2.38 - 0.6153Q + 0.0536Q^2$$

- Minimum long-run average cost reaches its point of minimum average total cost when total assets of the savings and loan reach $574 million.

A Cost Function for the Savings and Loan Industry

- Average operating expenses are 0.61% of total assets.
- Almost all of the savings and loans in the region being studied had substantially less than $574 million in assets.

A Cost Function for the Savings and Loan Industry

- Questions
  1) What are the implications of the analysis for expansion and mergers?
  2) What are the limitations of using these results?

Summary

- Managers, investors, and economists must take into account the opportunity cost associated with the use of the firm's resources.
- Firms are faced with both fixed and variable costs in the short-run.

Summary

- When there is a single variable input, as in the short run, the presence of diminishing returns determines the shape of the cost curves.
- In the long run, all inputs to the production process are variable.

Summary

- The firm's expansion path describes how its cost-minimizing input choices vary as the scale or output of its operation increases.
- The long-run average cost curve is the envelope of the short-run average cost curves.

Summary

- A firm enjoys economies of scale when it can double its output at less than twice the cost.
- Economies of scope arise when the firm can produce any combination of the two outputs more cheaply than could two independent firms that each produced a single product.

Summary

- A firm's average cost of production can fall over time if the firm "learns" how to produce more effectively.
- Cost functions relate the cost of production to the level of output of the firm.

End of Chapter 7

The Cost of Production

Chapter 8

Profit Maximization and Competitive Supply

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Topics to be Discussed

- Perfectly Competitive Markets
- Profit Maximization
- Marginal Revenue, Marginal Cost, and Profit Maximization
- Choosing Output in the Short-Run

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Topics to be Discussed

- The Competitive Firm's Short-Run Supply Curve
- Short-Run Market Supply
- Choosing Output in the Long-Run
- The Industry's Long-Run Supply Curve

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Perfectly Competitive Markets

- Characteristics of Perfectly Competitive Markets
  1) Price taking
  2) Product homogeneity
  3) Free entry and exit

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Perfectly Competitive Markets

- Price Taking
  - The individual firm sells a very small share of the total market output and, therefore, cannot influence market price.
  - The individual consumer buys too small a share of industry output to have any impact on market price.

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Perfectly Competitive Markets

- Product Homogeneity
  - The products of all firms are perfect substitutes.
  - Examples
    - Agricultural products, oil, copper, iron, lumber

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Perfectly Competitive Markets

- Free Entry and Exit
  - Buyers can easily switch from one supplier to another.
  - Suppliers can easily enter or exit a market.

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Perfectly Competitive Markets

- Discussion Questions
  - What are some barriers to entry and exit?
  - Are all markets competitive?
  - When is a market highly competitive?

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Profit Maximization

- Do firms maximize profits?
  - Possibility of other objectives
    - Revenue maximization
    - Dividend maximization
    - Short-run profit maximization

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Profit Maximization

- Do firms maximize profits?
  - Implications of non-profit objective
    - Over the long-run investors would not support the company
    - Without profits, survival unlikely

Profit Maximization

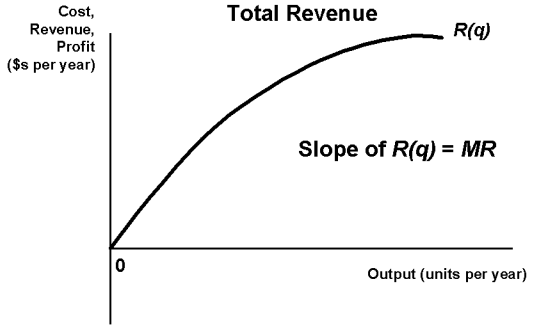
- Do firms maximize profits?
  - Long-run profit maximization is valid and does not exclude the possibility of altruistic behavior.

Marginal Revenue, Marginal Cost, and Profit Maximization

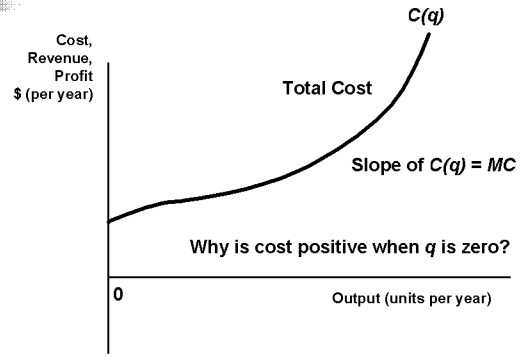
- Determining the profit maximizing level of output
  - Profit (π) = Total Revenue - Total Cost
  - Total Revenue (R) = Pq
  - Total Cost (C) = Cq
  - Therefore:

$$\pi(q) = R(q) - C(q)$$

Profit Maximization in the Short Run



Profit Maximization in the Short Run

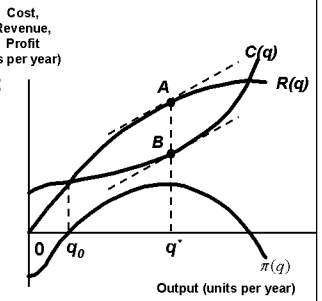


Marginal Revenue, Marginal Cost, and Profit Maximization

- Marginal revenue is the additional revenue from producing one more unit of output.
- Marginal cost is the additional cost from producing one more unit of output.

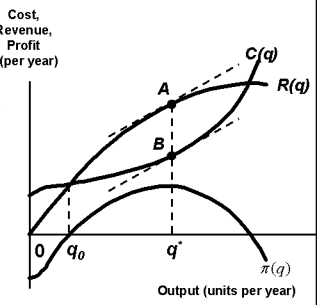
Marginal Revenue, Marginal Cost, and Profit Maximization

- Comparing $R(q)$ and $C(q)$
  - Output levels: 0- q_0:
    - $C(q) > R(q)$
      - Negative profit
    - FC + VC > $R(q)$
    - MR > MC
      - Indicates higher profit at higher output



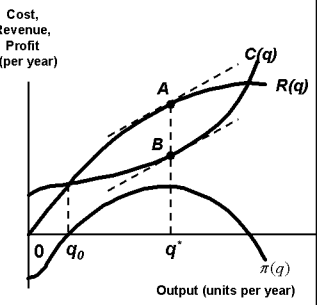
Marginal Revenue, Marginal Cost, and Profit Maximization

- Comparing $R(q)$ and $C(q)$
  - Question: Why is profit negative when output is zero?



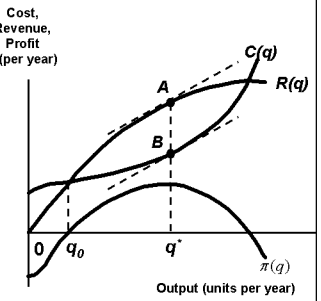
Marginal Revenue, Marginal Cost, and Profit Maximization

- Comparing $R(q)$ and $C(q)$
  - Output levels: q_0 - q^*
    - $R(q) > C(q)$
    - MR > MC
      - Indicates higher profit at higher output
      - Profit is increasing



Marginal Revenue, Marginal Cost, and Profit Maximization

- Comparing $R(q)$ and $C(q)$
  - Output level: q^*
    - $R(q) = C(q)$
    - MR = MC
    - Profit is maximized



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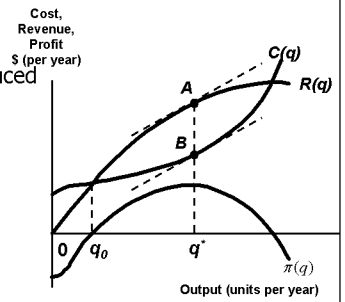
Marginal Revenue, Marginal Cost, and Profit Maximization

- Question
  - Why is profit reduced when producing more or less than **q*?**



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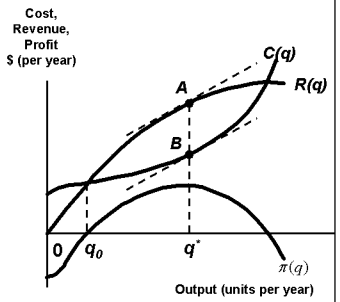
Marginal Revenue, Marginal Cost, and Profit Maximization

- Comparing *R(q)* and *C(q)*
  - Output levels beyond q^*:
    - *R(q)> C(q)*
    - MC > MR
    - Profit is decreasing



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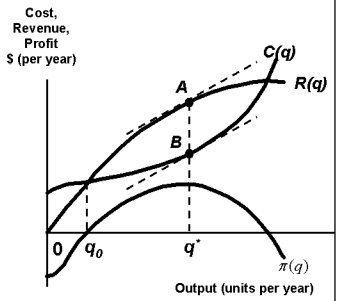
Marginal Revenue, Marginal Cost, and Profit Maximization

- Therefore, it can be said:
  - **Profits are maximized when MC = MR.**



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Marginal Revenue, Marginal Cost, and Profit Maximization

$$\pi = R - C$$

$$MR = \frac{\Delta R}{\Delta q}$$

$$MC = \frac{\Delta C}{\Delta q}$$

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Marginal Revenue, Marginal Cost, and Profit Maximization

Profits are maximized when:

$$\frac{\Delta \pi}{\Delta q} = \frac{\Delta R}{\Delta q} - \frac{\Delta C}{\Delta q} = 0 \text{ or}$$

$$MR - MC = 0 \text{ so that}$$

$$MR(q) = MC(q)$$

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Marginal Revenue, Marginal Cost, and Profit Maximization

- The Competitive Firm
  - Price taker
  - Market output (*Q*) and firm output (*q*)
  - Market demand (*D*) and firm demand (*d*)
  - *R(q)* is a straight line

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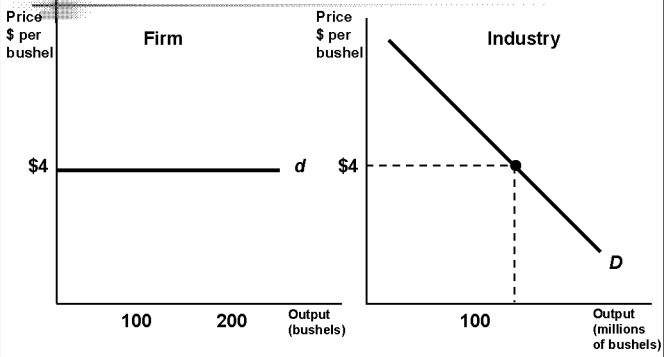
Demand and Marginal Revenue Faced by a Competitive Firm



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Marginal Revenue, Marginal Cost, and Profit Maximization

- The Competitive Firm
  - The competitive firm's demand
    - Individual producer sells all units for $4 regardless of the producer's level of output.
    - If the producer tries to raise price, sales are zero.

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Marginal Revenue, Marginal Cost, and Profit Maximization

- The Competitive Firm
  - The competitive firm's demand
    - If the producers tries to lower price he cannot increase sales
    - *P = D = MR = AR*

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Marginal Revenue, Marginal Cost, and Profit Maximization

- The Competitive Firm
  - Profit Maximization
    - *MC(q) = MR = P*

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Choosing Output in the Short Run

- We will combine production and cost analysis with demand to determine output and profitability.

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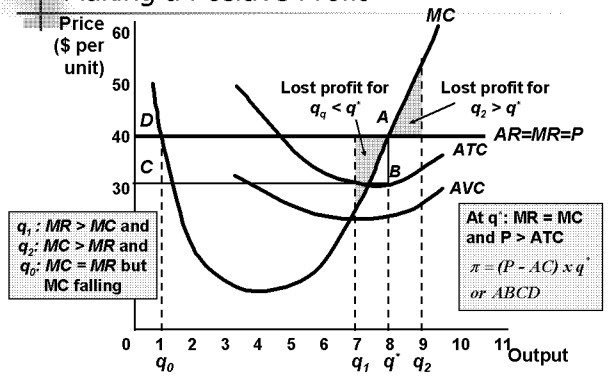
A Competitive Firm Making a Positive Profit



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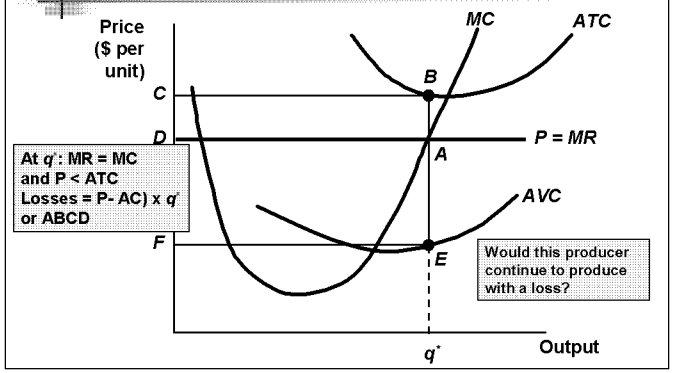
A Competitive Firm Incurring Losses



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Choosing Output in the Short Run

- Summary of Production Decisions
  - Profit is maximized when *MC = MR*
  - If *P > ATC* the firm is making profits.
  - If *AVC < P < ATC* the firm should produce at a loss.
  - If *P < AVC < ATC* the firm should shut-down.

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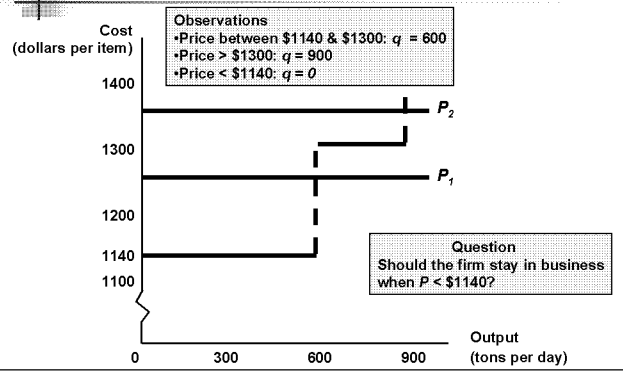
The Short-Run Output of an Aluminum Smelting Plant



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Some Cost Considerations for Managers

- Three guidelines for estimating marginal cost:
  1) Average variable cost should not be used as a substitute for marginal cost.

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Some Cost Considerations for Managers

- Three guidelines for estimating marginal cost:
  2) A single item on a firm's accounting ledger may have two components, only one of which involves marginal cost.

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Some Cost Considerations for Managers

- Three guidelines for estimating marginal cost:
  3) All opportunity cost should be included in determining marginal cost.

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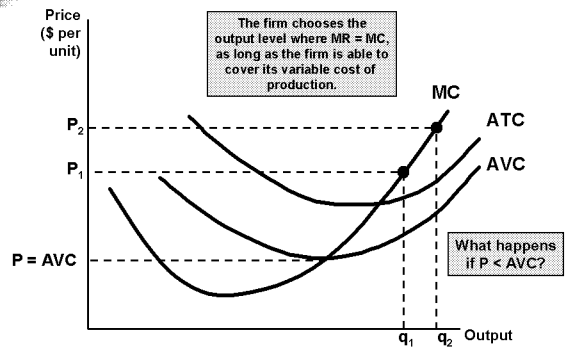
A Competitive Firm's Short-Run Supply Curve



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A Competitive Firm's Short-Run Supply Curve

- Observations:
  - $P = MR$
  - $MR = MC$
  - $P = MC$
- Supply is the amount of output for every possible price. Therefore:
  - If $P = P_1$, then $q = q_1$
  - If $P = P_2$, then $q = q_2$

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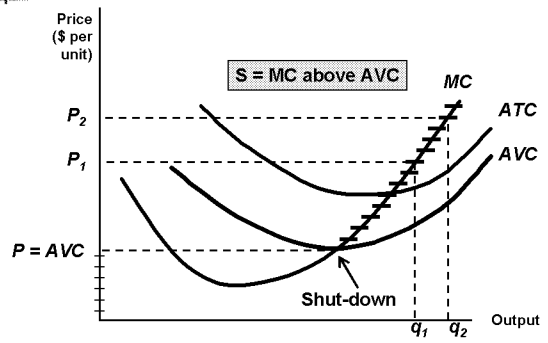
A Competitive Firm's Short-Run Supply Curve



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A Competitive Firm's Short-Run Supply Curve

- Observations:
  - Supply is upward sloping due to diminishing returns.
  - Higher price compensates the firm for higher cost of additional output and increases total profit because it applies to all units.

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A Competitive Firm's Short-Run Supply Curve

- Firm's Response to an Input Price Change
  - When the price of a firm's product changes, the firm changes its output level, so that the marginal cost of production remains equal to the price.

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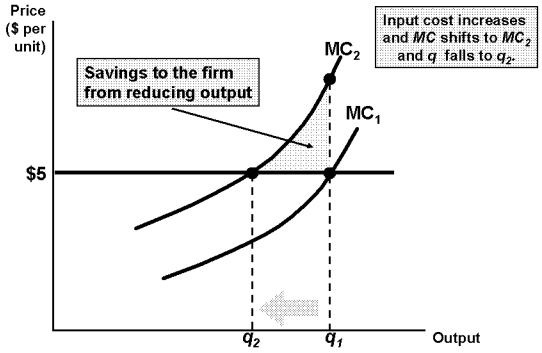
The Response of a Firm to a Change in Input Price



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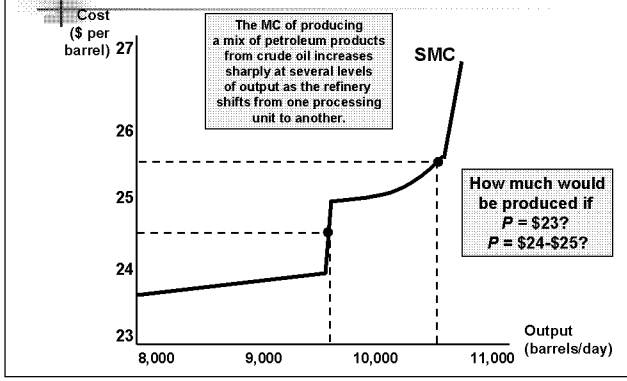
The Short-Run Production of Petroleum Products



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The Short-Run Production of Petroleum Products

- Stepped SMC indicates a different production (cost) process at various capacity levels.
- Observation:
  - With a stepped MC function, small changes in price may not trigger a change in output.

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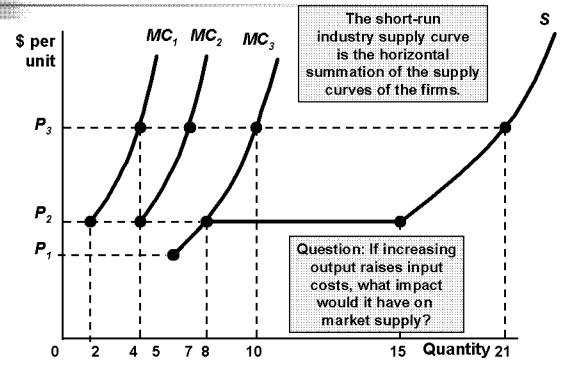
The Short-Run Production of Petroleum Products

- The *short-run market supply curve* shows the amount of output that the industry will produce in the short-run for every possible price.
- Consider, for simplicity, a competitive market with three firms:

Industry Supply in the Short Run



The Short-Run Market Supply Curve

- Elasticity of Market Supply

$$E_S = (\Delta Q / Q)/(\Delta P / P)$$

The Short-Run Market Supply Curve

- Perfectly inelastic short-run supply arises when the industry's plant and equipment are so fully utilized that new plants must be built to achieve greater output.
- Perfectly elastic short-run supply arises when marginal costs are constant.

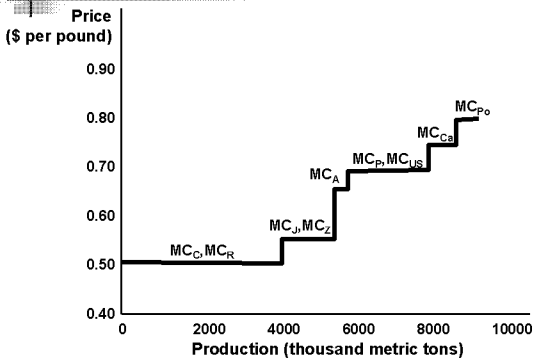
The Short-Run Market Supply Curve

- Questions
  1) Give an example of a perfectly inelastic supply.
  2) If *MC* rises rapidly, would the supply be more or less elastic?

The World Copper Industry (1999)

Country	Annual Production (thousand metric tons)	Marginal Cost (dollars/pound)
Australia	600	0.65
Canada	710	0.75
Chile	3660	0.50
Indonesia	750	0.55
Peru	450	0.70
Poland	420	0.80
Russia	450	0.50
United States	1850	0.70
Zambia	280	0.55

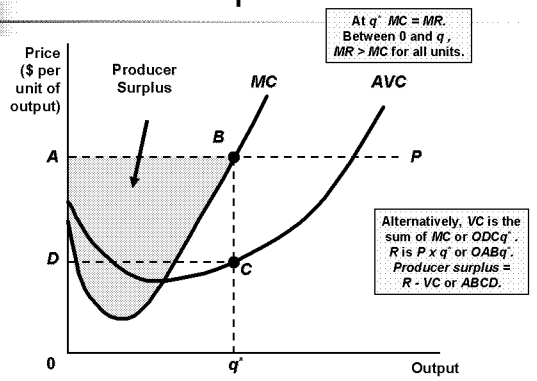
The Short-Run World Supply of Copper



The Short-Run Market Supply Curve

- Producer Surplus in the Short Run
  - Firms earn a surplus on all but the last unit of output.
  - The producer surplus is the sum over all units produced of the difference between the market price of the good and the marginal cost of production.

Producer Surplus for a Firm



The Short-Run Market Supply Curve

- Producer Surplus in the Short-Run

$$\text{Producer Surplus} = \text{PS} = \text{R} - \text{VC}$$

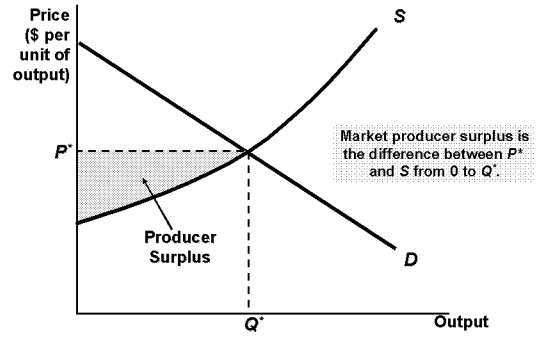
$$\text{Profit} = \pi - \text{R} - \text{VC} - \text{FC}$$

The Short-Run Market Supply Curve

- Observation
  - Short-run with positive fixed cost

$$PS > \pi$$

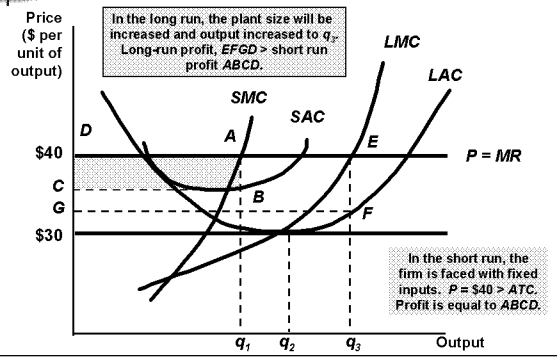
Producer Surplus for a Market



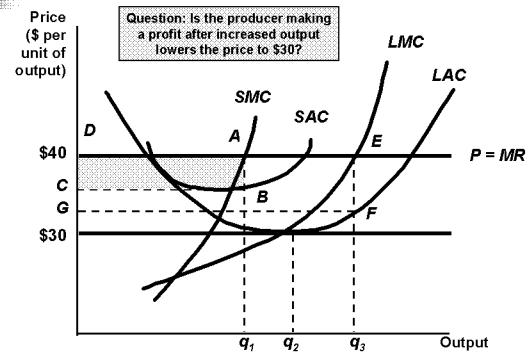
Choosing Output in the Long Run

- In the long run, a firm can alter all its inputs, including the size of the plant.
- We assume *free entry* and *free exit.*

Output Choice in the Long Run



Output Choice in the Long Run



Choosing Output in the Long Run

- Accounting Profit & Economic Profit
  - Accounting profit $(\pi) = R - wL$
  - Economic profit $(\pi) = R = wL - rK$
    - $w/$ = labor cost
    - rk = opportunity cost of capital

Choosing Output in the Long Run

Long-Run Competitive Equilibrium

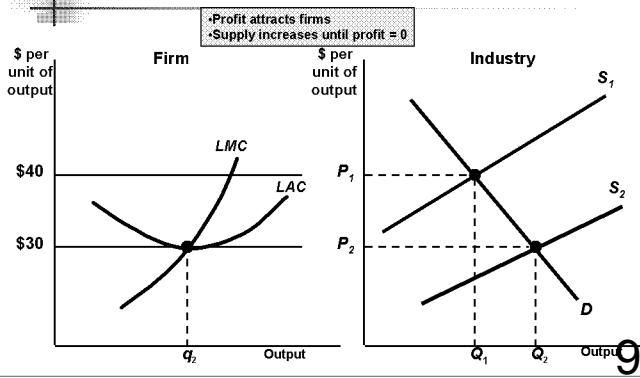
- Zero-Profit
  - If $R > wL + rk$, economic profits are positive
  - If $R = wL + rk$, zero economic profits, but the firms is earning a normal rate of return; indicating the industry is competitive
  - If $R < wl + rk$, consider going out of business

Choosing Output in the Long Run

Long-Run Competitive Equilibrium

- Entry and Exit
  - The long-run response to short-run profits is to increase output and profits.
  - Profits will attract other producers.
  - More producers increase industry supply which lowers the market price.

Long-Run Competitive Equilibrium



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Choosing Output in the Long Run

- Long-Run Competitive Equilibrium
  1) *MC = MR*
  2) *P = LAC*
     - No incentive to leave or enter
     - Profit = 0
  3) Equilibrium Market Price

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Choosing Output in the Long Run

- Questions
  1) Explain the market adjustment when *P < LAC* and firms have identical costs.
  2) Explain the market adjustment when firms have different costs.
  3) What is the opportunity cost of land?

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Choosing Output in the Long Run

- Economic Rent
  - Economic rent is the difference between what firms are willing to pay for an input less the minimum amount necessary to obtain it.

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Choosing Output in the Long Run

- An Example
  - Two firms *A* & *B*
  - Both own their land
  - *A* is located on a river which lowers *A's* shipping cost by $10,000 compared to *B.*
  - The demand for *A's* river location will increase the price of *A's* land to $10,000

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Choosing Output in the Long Run

- An Example
  - Economic rent = $10,000
    - $10,000 - zero cost for the land
  - Economic rent increases
  - Economic profit of *A* = 0

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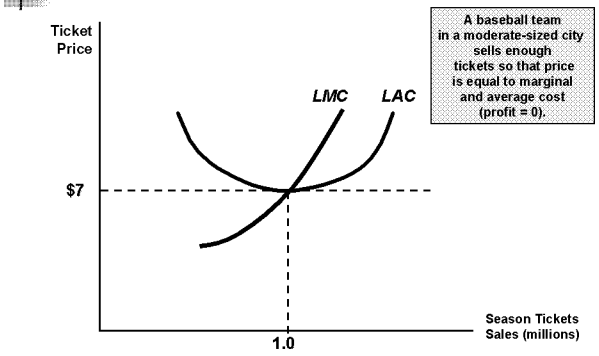
Firms Earn Zero Profit in Long-Run Equilibrium



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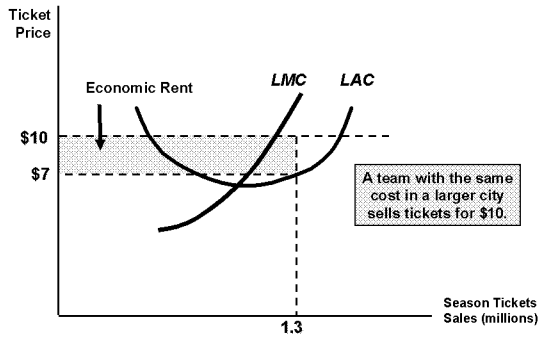
Firms Earn Zero Profit in Long-Run Equilibrium



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Firms Earn Zero Profit in Long-Run Equilibrium

- With a fixed input such as a unique location, the difference between the cost of production (*LAC* = 7) and price ($10) is the value or opportunity cost of the input (location) and represents the economic rent from the input.

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Firms Earn Zero Profit in Long-Run Equilibrium

- If the opportunity cost of the input (rent) is not taken into consideration it may appear that economic profits exist in the long-run.

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The Industry's Long-Run Supply Curve

- The shape of the long-run supply curve depends on the extent to which changes in industry output affect the prices the firms must pay for inputs.

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The Industry's Long-Run Supply Curve

- To determine long-run supply, we assume:
  - All firms have access to the available production technology.
  - Output is increased by using more inputs, not by invention.

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The Industry's Long-Run Supply Curve

- To determine long-run supply, we assume:
  - The market for inputs does not change with expansions and contractions of the industry.

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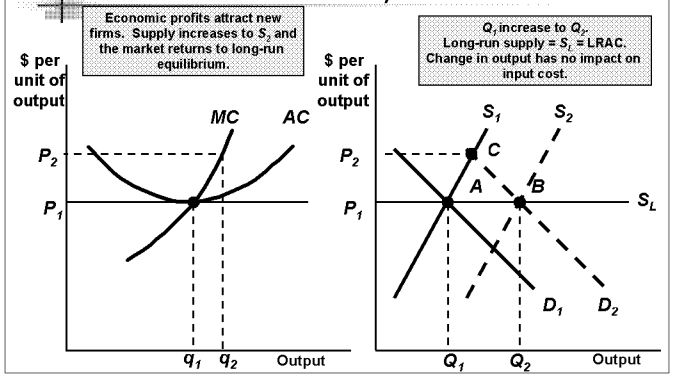
Long-Run Supply in a Constant-Cost Industry



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Long-Run Supply in a Constant-Cost Industry

- In a constant-cost industry, long-run supply is a horizontal line at a price that is equal to the minimum average cost of production.

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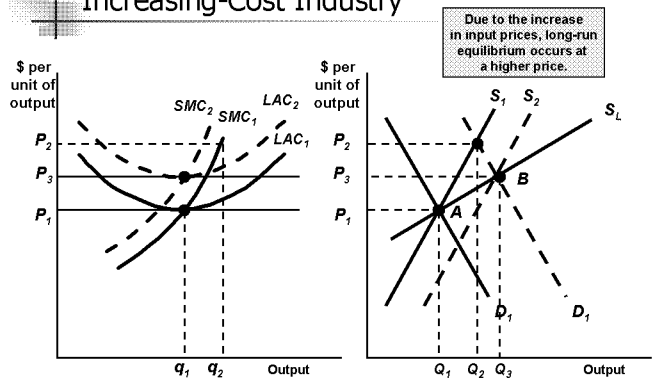
Long-Run Supply in an Increasing-Cost Industry



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Long-Run Supply in a Increasing-Cost Industry

- In a increasing-cost industry, long-run supply curve is upward sloping.

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The Industry's Long-Run Supply Curve

- Questions
  1) Explain how decreasing-cost is possible.
  2) Illustrate a decreasing cost industry.
  3) What is the slope of the S_L in a decreasing-cost industry?

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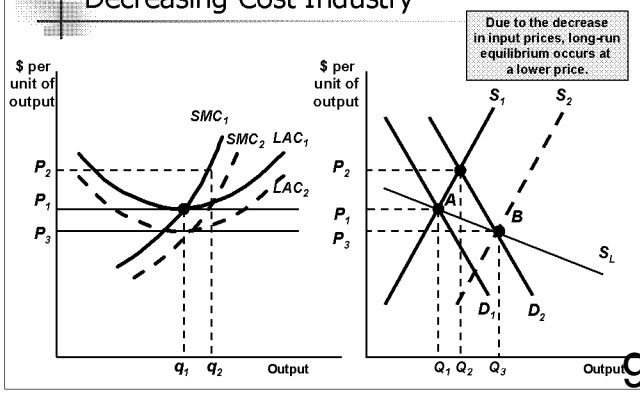
Long-Run Supply in an Decreasing-Cost Industry



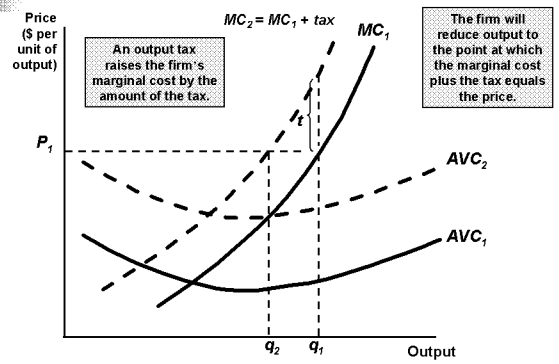
Long-Run Supply in a Increasing-Cost Industry

- In a decreasing-cost industry, long-run supply curve is downward sloping.

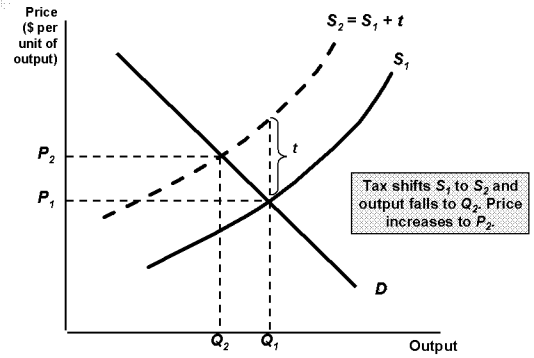
The Industry's Long-Run Supply Curve

- The Effects of a Tax
  - In an earlier chapter we studied how firms respond to taxes on an input.
  - Now, we will consider how a firm responds to a tax on its output.

Effect of an Output Tax on a Competitive Firm's Output



Effect of an Output Tax on Industry Output



The Industry's Long-Run Supply Curve

- Long-Run Elasticity of Supply

1) Constant-cost industry
   - Long-run supply is horizontal
   - Small increase in price will induce an extremely large output increase

The Industry's Long-Run Supply Curve

- Long-Run Elasticity of Supply

1) Constant-cost industry
   - Long-run supply elasticity is infinitely large
   - Inputs would be readily available

The Industry's Long-Run Supply Curve

- Long-Run Elasticity of Supply

2) Increasing-cost industry
   - Long-run supply is upward-sloping and elasticity is positive
   - The slope (elasticity) will depend on the rate of increase in input cost
   - Long-run elasticity will generally be greater than short-run elasticity of supply

The Industry's Long-Run Supply Curve

- Question:
  - Describe the long-run elasticity of supply in a decreasing -cost industry.

The Long-Run Supply of Housing

- Scenario 1: Owner-occupied housing
  - Suburban or rural areas
  - National market for inputs

The Long-Run Supply of Housing

- Questions
  - Is this an increasing or a constant-cost industry?
  - What would you predict about the elasticity of supply?

The Long-Run Supply of Housing

- Scenario 2: Rental property
  - Zoning restrictions apply
  - Urban location
  - High-rise construction cost

The Long-Run Supply of Housing

- Questions
  - Is this an increasing or a constant-cost industry?
  - What would you predict about the elasticity of supply?

Summary

- The managers of firms can operate in accordance with a complex set of objectives and under various constraints.
- A competitive market makes its output choice under the assumption that the demand for its own output is horizontal.

Summary

- In the short run, a competitive firm maximizes its profit by choosing an output at which price is equal to (short-run) marginal cost.
- The short-run market supply curve is the horizontal summation of the supply curves of the firms in an industry.

Summary

- The producer surplus for a firm is the difference between revenue of a firm and the minimum cost that would be necessary to produce the profit-maximizing output.
- Economic rent is the payment for a scarce resource of production less the minimum amount necessary to hire that factor.

Summary

- In the long-run, profit-maximizing competitive firms choose the output at which price is equal to long-run marginal cost.
- The long-run supply curve for a firm can be horizontal, upward sloping, or downward sloping.

End of Chapter 8

Profit Maximization and Competitive Supply

Chapter 9

The Analysis of Competitive Markets

Topics to be Discussed

- Evaluating the Gains and Losses from Government Policies--Consumer and Producer Surplus
- The Efficiency of a Competitive Market
- Minimum Prices

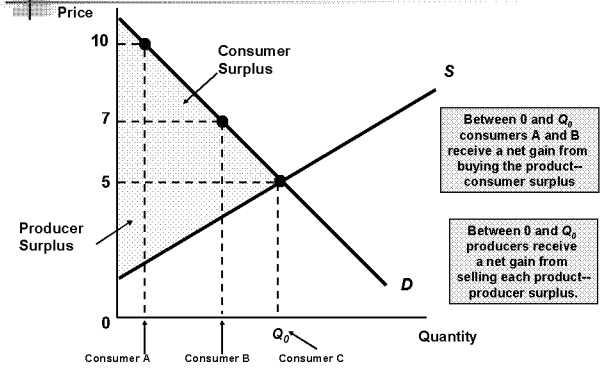
Topics to be Discussed

- Price Supports and Production Quotas
- Import Quotas and Tariffs
- The Impact of a Tax or Subsidy

Evaluating the Gains and Losses from Government Policies--Consumer and Producer Surplus

- Review
  - Consumer surplus is the total benefit or value that consumers receive beyond what they pay for the good.
  - Producer surplus is the total benefit or revenue that producers receive beyond what it cost to produce a good.

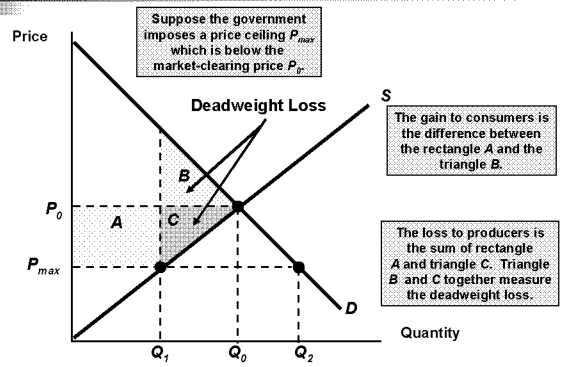
Consumer and Producer Surplus



Evaluating the Gains and Losses from Government Policies--Consumer and Producer Surplus

- To determine the *welfare effect* of a governmental policy we can measure the gain or loss in consumer and producer surplus.
- Welfare Effects
  - Gains and losses caused by government intervention in the market.

Change in Consumer and Producer Surplus from Price Controls



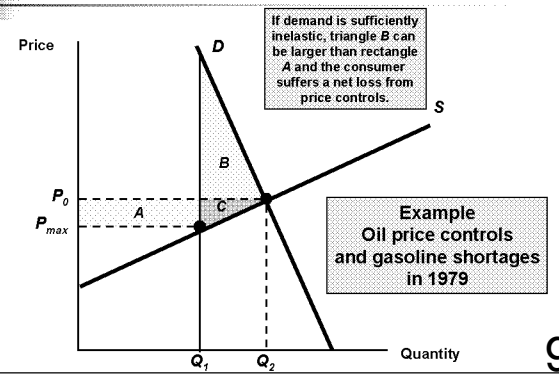
Change in Consumer and Producer Surplus from Price Controls

- Observations:
  - The total loss is equal to area B + C.
  - The total change in surplus =
    (A - B) + (-A - C) = -B - C
  - The deadweight loss is the inefficiency of the price controls or the loss of the producer surplus exceeds the gain from consumer surplus.

Change in Consumer and Producer Surplus from Price Controls

- Observation
  - Consumers can experience a net loss in consumer surplus when the demand is sufficiently inelastic

Effect of Price Controls When Demand Is Inelastic



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Price Controls and Natural Gas Shortages

- 1975 Price controls created a shortage of natural gas.
- What was the deadweight loss?

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Price Controls and Natural Gas Shortages

Data for 1975

- Supply: $Q^S = 14 + 2P_G + 0.25P_O$
  - Quantity supplied in trillion cubic feet (Tcf)
- Demand: $Q^D = -5P_G + 3.75P_O$
  - Quantity demanded (Tcf)
- P_G = price of natural gas in \$/mcf and P_O = price of oil in \$/b.

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Price Controls and Natural Gas Shortages

Data for 1975

- P_O = \$8/b
- Equilibrium P_G = \$2/mcf and Q = 20 Tcf
- Price ceiling set at \$1
- This information can be seen graphically:

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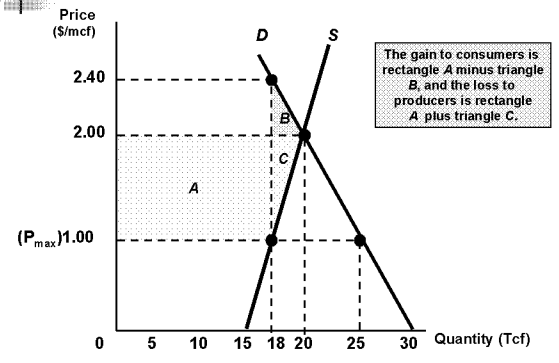
Price Controls and Natural Gas Shortages



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Price Controls and Natural Gas Shortages

- Measuring the Impact of Price Controls
  - 1 Tcf = 1 billion mcf
  - If Q^D = 18, then P = \$2.40
    - [$18 = -5P_G + 3.75(8)$]
  - A = (18 billion mcf) x (\$1/mcf) = \$18 billion
  - B = (1/2) x (2 b. mcf) x (\$0.40/mcf) = \$0.4 billion
  - C = (1/2) x (2 b. mcf) x (\$1/mcf) = \$1 billion

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Price Controls and Natural Gas Shortages

- Measuring the Impact of Price Controls
  - 1975
    - Change in consumer surplus
      - = $A - B$ = 18 - 0.04 = \$17.6 billion
    - Change in producer surplus
      - = $-A - C$ = -18-1 = -\$19.0 billion

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Price Controls and Natural Gas Shortages

- Measuring the Impact of Price Controls
  - 1975 dollars, deadweight loss
    - = $-B - C$ = -0.4 - 1 = -\$1.4 billion
    - In 2000 dollars, the deadweight loss is more than \$4 billion per year.

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The Efficiency of a Competitive Market

- When do competitive markets generate an inefficient allocation of resources or *market failure?*

1) Externalities
   - Costs or benefits that do not show up as part of the market price (e.g. pollution)

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The Efficiency of a Competitive Market

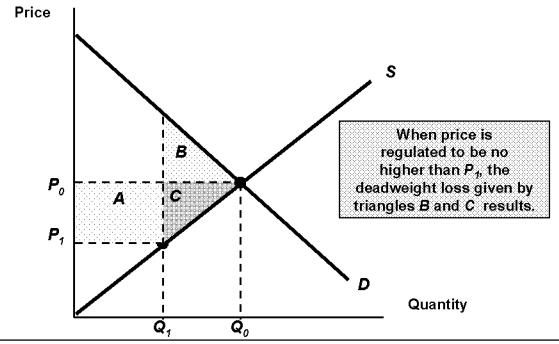
- When do competitive markets generate an inefficient allocation of resources or *market failure?*

2) Lack of Information
   - Imperfect information prevents consumers from making utility-maximizing decisions.

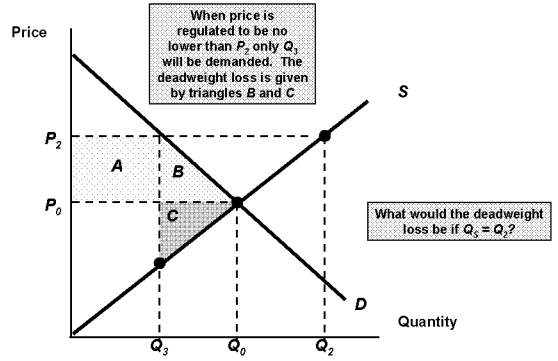
The Efficiency of a Competitive Market

- Government intervention in these markets can increase efficiency.
- Government intervention without a market failure creates inefficiency or deadweight loss.

Welfare Loss When Price Is Held Below Market-Clearing Level



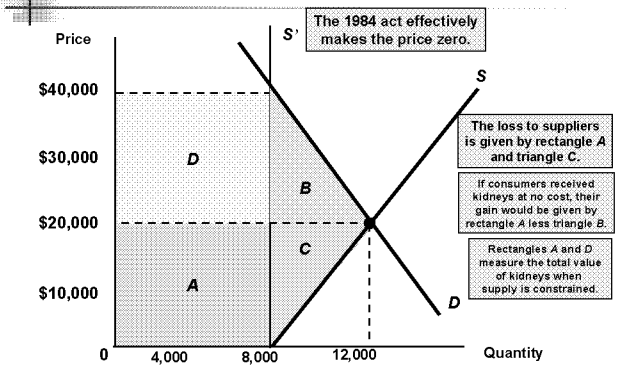
Welfare Loss When Price Is Held Above Market-Clearing Level



The Market for Human Kidneys

- The 1984 National Organ Transplantation Act prohibits the sale of organs for transplantation.
- Analyzing the Impact of the Act
  - Supply: $Q^S = 8{,}000 + 0.2P$
    - If $P = \$20{,}000$, $Q = 12{,}000$
  - Demand: $Q^D = 16{,}000 - 0.2P$

The Market for Kidneys, and Effects of the 1984 Organ Transplantation Act



The Market for Human Kidneys

- The act limits the quantity supplied (donations) to 8,000.
- Loss to supplier surplus:
  - $A + C =$

    (8,000)($20,000) + (1/2)(4,000)($20,000) = $200/m.

The Market for Human Kidneys

- Gain to recipients:
  - $A - B =$

    (8,000)($20,000) - (1/2)(4,000)($20,000) = $120/m.
- Deadweight loss:
  - B + C or

    $200 million - $120 million = $80 million

The Market for Human Kidneys

- Other Inefficiency Cost
  1) Allocation is not necessarily to those who value the kidney's the most.
  2) Price may increase to $40,000, the equilibrium price, with hospitals getting the price.

The Market for Human Kidneys

- Arguments in favor of prohibiting the sale of organs:
  1) Imperfect information about donor's health and screening

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The Market for Human Kidneys

- Arguments in favor of prohibiting the sale of organs:
  2) Unfair to allocate according to the ability to pay
     - Holding price below equilibrium will create shortages
     - Organs versus artificial substitutes

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Minimum Prices

- Periodically government policy seeks to raise prices above market-clearing levels.
- We will investigate this by looking at a price floor and the minimum wage.

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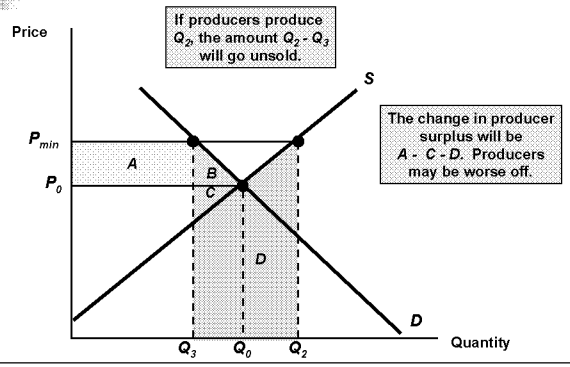
Price Minimum



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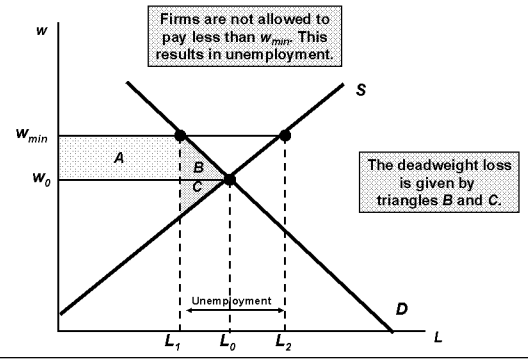
The Minimum Wage



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Airline Regulation

- During 1976-1981 the airline industry in the U.S. changed dramatically.
- Deregulation lead to major changes in the industry.
- Some airlines merged or went out of business as new airlines entered the industry.

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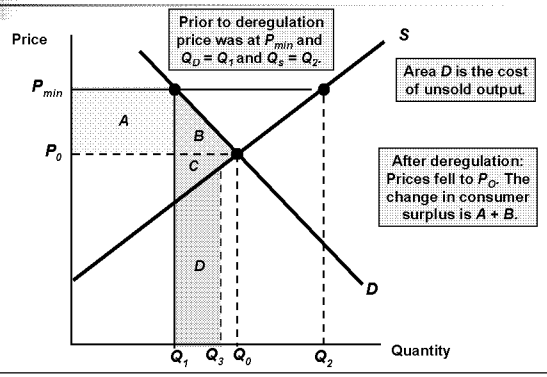
Effect of Airline Regulation by the Civil Aeronautics Board



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Airline Industry Data

	1975	1980	1985	1990	1995	1996
Number of carriers	33	72	86	60	86	96
Passenger load factor(%)	54	59	61	62	67	69
Passenger-mile rate (constant 1995 dollars)	.218	.210	.166	.150	.129	.126
Real cost index (1995=100)	101	122	111	107	100	99
Real cost index corrected for fuel cost increases	94	98	98	100	100	98

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Airline Industry Data

- Airline industry data show:
  1) Long-run adjustment as the number of carriers increased and prices decreased
  2) Higher load factors indicating more efficiency

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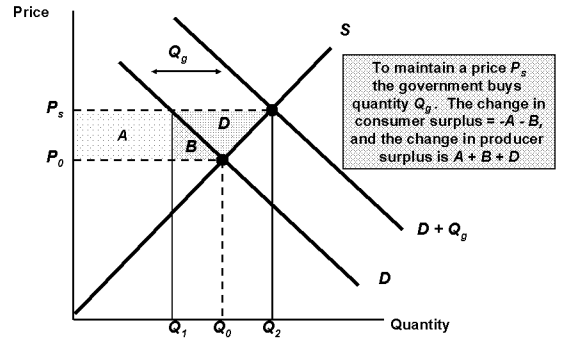
Airline Industry Data

- Airline industry data show:
  3) Falling rates
  4) Real cost increased slightly (adjusted fuel cost)
  5) Large welfare gain

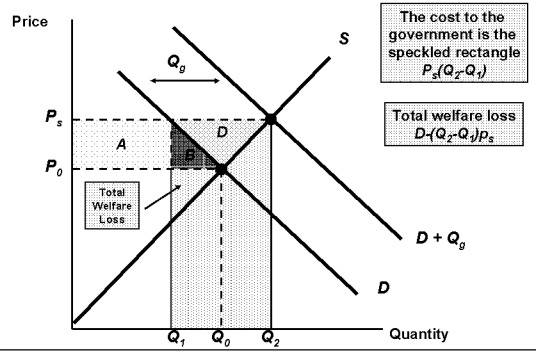
Price Supports and Production Quotas

- Much of agricultural policy is based on a system of price supports.
  - This is support price is set above the equilibrium price and the government buys the surplus.
- This is often combined with incentives to reduce or restrict production

Price Supports



Price Supports



Price Supports

- Question:
  - Is there a more efficient way to increase farmer's income by *A + B + D?*

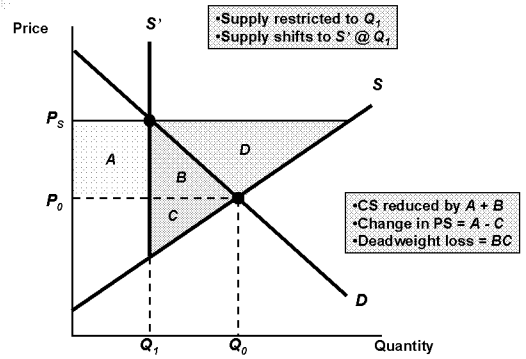
Price Supports and Production Quotas

- Production Quotas
  - The government can also cause the price of a good to rise by *reducing supply.*

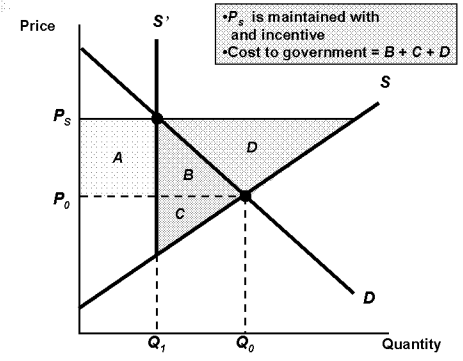
Price Supports and Production Quotas

- What is the impact of:
  1) Controlling entry into the taxicab market?
  2) Controlling the number of liquor licenses?

Supply Restrictions

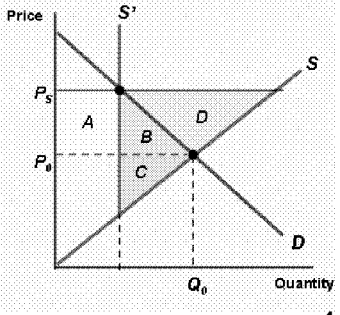


Supply Restrictions



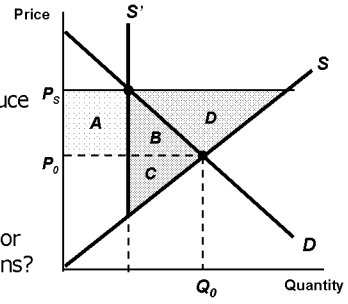
Supply Restrictions

- ΔPS = *A - C + B + C + D = A + B + D.*
- The change in consumer and producer surplus is the same as with price supports.
- Δwelfare = *-A - B + A + B + D - B - C - D = -B - C.*



Supply Restrictions

- Questions:
  - How could the government reduce the cost and still subsidize the farmer?
  - Which is more costly: supports or acreage limitations?



Supporting the Price of Wheat

- 1981
  - Supply: $Q_s = 1{,}800 + 240P$
  - Demand: $Q_D = 3{,}550 - 266P$
  - Equilibrium price and quantity was $3.46 and 2,630 million bushels

Supporting the Price of Wheat

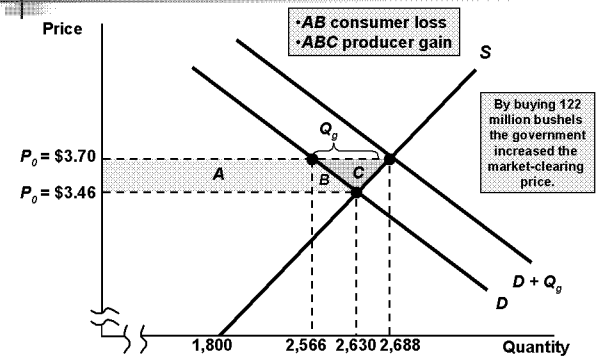
- 1981
  - Price support was set at $3.70
  - $Q_D + Q_G = Q_{DT} = 3{,}440 - 266P + Q_G$
  - $Q_S = Q_D$

    $1{,}800 + 240P = 3{,}550 - 266P + Q_G$

    $Q_G = 506P - 1{,}750$

    $Q_G = (506)(3.70) - 175 = 122$ million bushels

The Wheat Market in 1981



Supporting the Price of Wheat

- 1981
  - The change in consumer surplus = $(-A - B)$

    $A = (3.70 - 3.46)(2{,}566) = \$616$ million

    $B = (1/2)(3.70 - 3.46)(2{,}630 - 2{,}566) = \$8$ million
  - Change in consumer surplus: -$624 million.

Supporting the Price of Wheat

- 1981
  - Cost to the government:

    $3.70 x 122 million bushels = $452 million
  - Total cost = $624 + 452 = $1,076 million
  - Total gain = $A + B + C$ = $638 million
  - Government also paid 30 cents/bushel = $806 million

Supporting the Price of Wheat

- In 1985, export demand fell and the market clearing price of wheat fell to $1.80/bushel.

Supporting the Price of Wheat

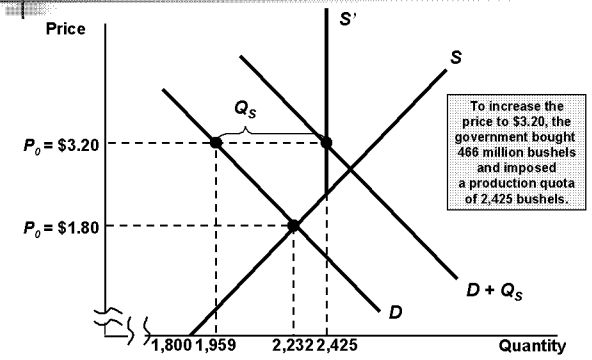
- 1985 Supply: $Q_S = 1{,}800 + 240P$
- 1986 Demand: $Q_D = 2580 - 194P$
  - $Q_S = Q_D$ at $1.80 and 2,232 million bushels
  - P_S = $3.20
    - To maintain $3.20/bushel a production quota of 2,425 bushels was imposed

Supporting the Price of Wheat

- 1985
  - Government Purchase:

    $2{,}425 = 2{,}580 - 194P + Q_G$
    - $Q_G = -155 + 194P$
    - P = $3.20 -- the support price
    - $Q_G = -155 + 194(\$3.20) = 466$ million bushels

The Wheat Market in 1985



Supporting the Price of Wheat

- 1985
  - Government Purchase:
    - Government cost = $3.20 x 466 = $1,491million
    - 80 cent subsidy = .80 x 2,425 = $1,940 million
    - Total cost = $3.5 billion

Supporting the Price of Wheat

- Question:
  - What is the change in consumer and producer surplus?

Supporting the Price of Wheat

- 1996 Freedom to Farm
  - Reduces price supports and quotas until 2003 when they go back into effect under the 1996 law.

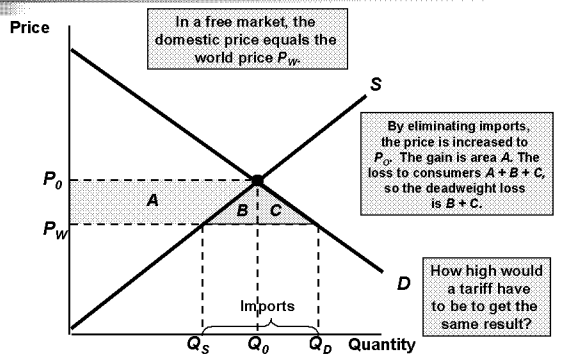
Supporting the Price of Wheat

- 1998 Wheat Market
  - $P = \$2.65$
  - $Q_D = 3244 - 283P$
  - $Q_S = 1944 + 207P$
  - $Q = 2493$
  - Government subsidy of .66/bushel or $1.6 billion

Import Quotas and Tariffs

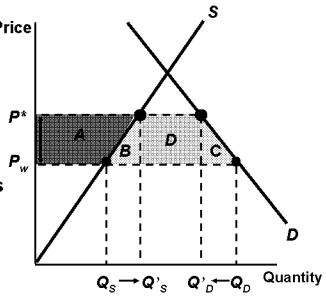
- Many countries use import quotas and tariffs to keep the domestic price of a product above world levels

Import Tariff or Quota That Eliminates Imports



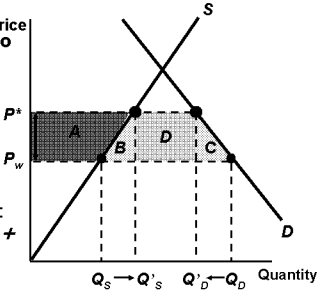
Import Tariff or Quota (general case)

- **The increase in price can be achieved by a quota or a tariff.**
- **Area *A* is again the gain to domestic producers.**
- **The loss to consumers is *A + B + C + D.***



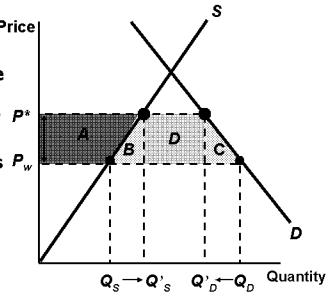
Import Tariff or Quota (general case)

- **If a tariff is used the government gains *D*, so the net domestic product loss is *B + C.***
- **If a quota is used instead, rectangle *D* becomes part of the profits of foreign producers, and the net domestic loss is *B + C + D.***



Import Tariff or Quota (general case)

- Question:
  - **Would the U.S. be better off or worse off with a quota instead of a tariff? (e.g. Japanese import restrictions in the 1980s)**



The Sugar Quota

- The world price of sugar has been as low as 4 cents per pound, while in the U.S. the price has been 20-25 cents per pound.

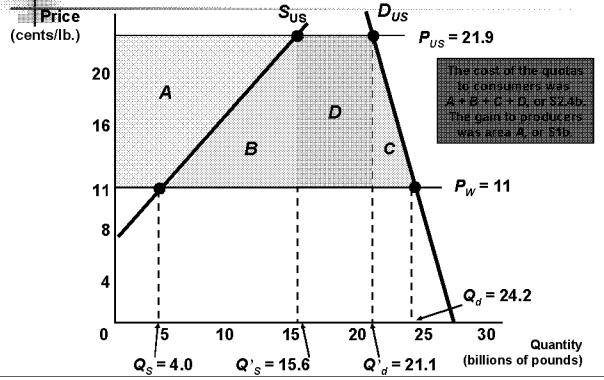
The Sugar Quota

- The Impact of a Restricted Market (1997)
  - U.S. production = 15.6 billion pounds
  - U.S. consumption = 21.1 billion pounds
  - U.S. price = 22 cents/pound
  - World price = 11 cents/pound

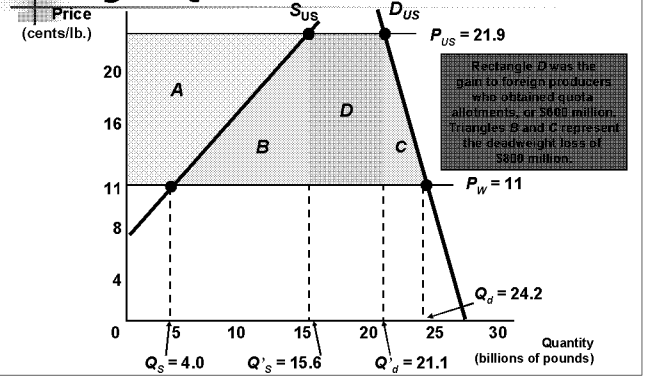
The Sugar Quota

- The Impact of a Restricted Market
  - U.S. E_S = 1.54
  - U.S. E_D = -0.3
  - U.S. supply: Q_S = -7.83+ 1.07P
  - U.S. demand: Q_D = 27.45 - 0.29P
  - P = .23 and Q = 13.7 billion pounds

Sugar Quota in 1997



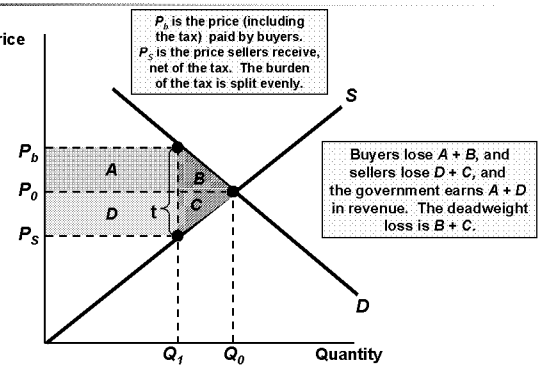
Sugar Quota in 1997



The Impact of a Tax or Subsidy

- The burden of a tax (or the benefit of a subsidy) falls partly on the consumer and partly on the producer.
- We will consider a *specific tax* which is a tax of a certain amount of money *per unit sold.*

Incidence of a SpecificTax



Incidence of a Specific Tax

- Four conditions that must be satisfied after the tax is in place:
  1) Quantity sold and P_b must be on the demand line: $Q^D = Q^D(P_b)$
  2) Quantity sold and P_S must be on the supply line: $Q^S = Q^S(P_S)$

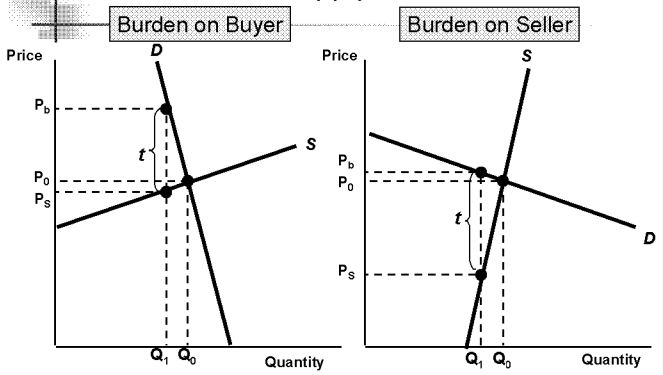
Incidence of a Specific Tax

- Four conditions that must be satisfied after the tax is in place:

  3) $Q^D = Q^S$

  4) $P_b - P_S = tax$

Impact of a Tax Depends on Elasticities of Supply and Demand



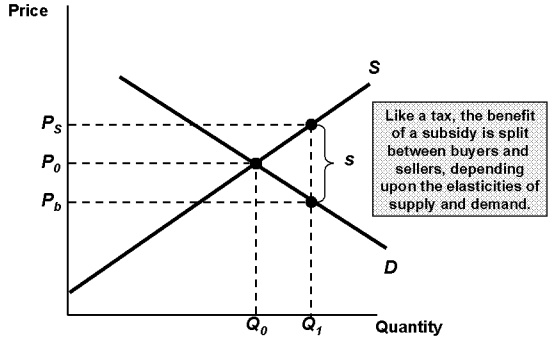
The Impact of a Tax or Subsidy

- Pass-through fraction
  - $E_S/(E_S - E_d)$
  - For example, when demand is perfectly inelastic ($E_d = 0$), the pass-through fraction is 1, and all the tax is borne by the consumer.

The Effects of a Tax or Subsidy

- A *subsidy* can be analyzed in much the same way as a tax.
- It can be treated as a negative tax.
- The seller's price exceeds the buyer's price.

Subsidy



Subsidy

- With a subsidy (s), the selling price P_b is below the subsidized price P_S so that:
  - $s = P_S - P_b$

Subsidy

- The benefit of the subsidy depends upon E_d/E_S.
  - If the ratio is small, most of the benefit accrues to the consumer.
  - If the ratio is large, the producer benefits most.

A Tax on Gasoline

- Measuring the Impact of a 50 Cent Gasoline Tax
  - Intermediate-run E_P of demand = -0.5
    $Q^D = 150 - 50P$
  - E_P of supply = 0.4
    $Q^S = 60 + 40P$
  - $Q^S = Q^D$ at \$1 and 100 billion gallons per year (bg/yr)

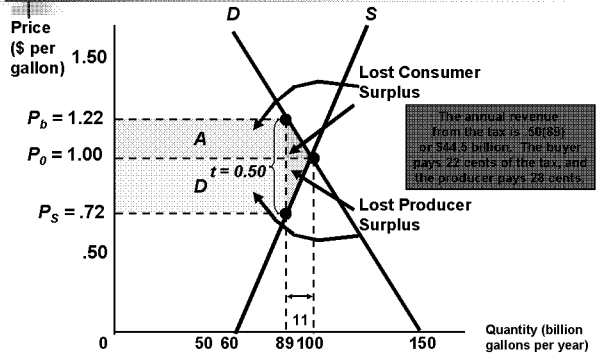
A Tax on Gasoline

- With a 50 cent tax
  - $Q_D = 150 - 50P_b = 60 + 40P_S = Q_S$
  - $150 - 50(P_S + .50) = 60 + 40P_S$
  - $P_S = .72$
  - $P_b = .5 + P_S$
  - $P_b = \$1.22$

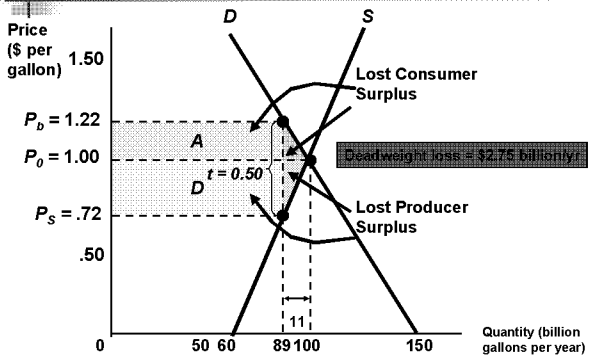
A Tax on Gasoline

- With a 50 cent tax
  - Q = 150 -(50)(1.22) = 89 bg/yr
  - Q falls by 11%

Impact of a 50 Cent Gasoline Tax



Impact of a 50 Cent Gasoline Tax



Summary

- Simple models of supply and demand can be used to analyze a wide variety of government policies.
- In each case, consumer and producer surplus are used to evaluate the gains and losses to consumers and producers.

Summary

- When government imposes a tax or subsidy, price usually does not rise or fall by the full amount of the tax or subsidy.
- Government intervention generally leads to a deadweight loss.

Summary

- Government intervention in a competitive market is not always a bad thing.

End of Chapter 9

The Analysis of Competitive Markets

Chapter 10

Market Power: Monopoly and Monopsony

Topics to be Discussed

- Monopoly
- Monopoly Power
- Sources of Monopoly Power
- The Social Costs of Monopoly Power

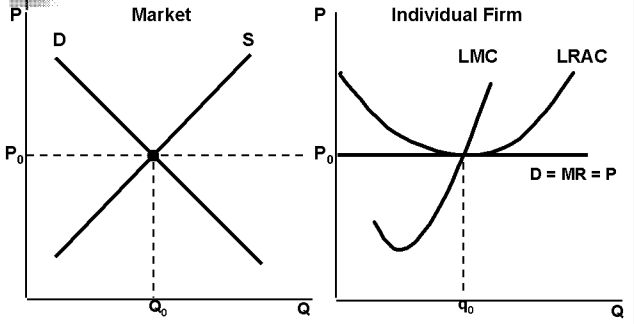
Topics to be Discussed

- Monopsony
- Monopsony Power
- Limiting Market Power: The Antitrust Laws

Perfect Competition

- Review of Perfect Competition
  - *P = LMC = LRAC*
  - Normal profits or zero economic profits in the long run
  - Large number of buyers and sellers
  - Homogenous product
  - Perfect information
  - Firm is a price taker

Perfect Competition



Monopoly

- Monopoly
  1) One seller - many buyers
  2) One product (no good substitutes)
  3) Barriers to entry

Monopoly

- The monopolist is the supply-side of the market and has complete control over the amount offered for sale.
- Profits will be maximized at the level of output where marginal revenue equals marginal cost.

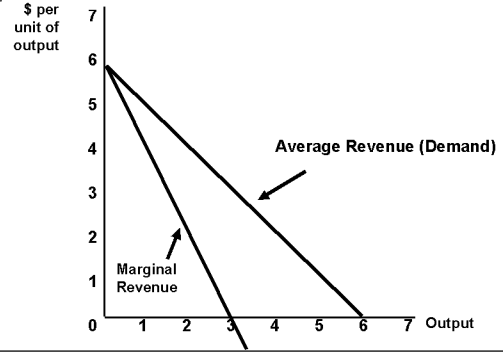
Monopoly

- Finding Marginal Revenue
  - As the sole producer, the monopolist works with the market demand to determine output and price.
  - Assume a firm with demand:
    - *P = 6 - Q*

Total, Marginal, and Average Revenue

Price *P*	Quantity *Q*	Total Revenue *R*	Marginal Revenue *MR*	Average Revenue *AR*
$6	0	$0	---	---
5	1	5	$5	$5
4	2	8	3	4
3	3	9	1	3
2	4	8	-1	2
1	5	5	-3	1

Average and Marginal Revenue



Monopoly

- Observations
  1) To increase sales the price must fall
  2) *MR < P*
  3) Compared to perfect competition
     - No change in price to change sales
     - *MR = P*

Monopoly

- Monopolist's Output Decision

1) Profits maximized at the output level where *MR = MC*

2) Cost functions are the same

$$\pi(Q) = R(Q) - C(Q)$$

$$\Delta\pi / \Delta Q = \Delta R / \Delta Q - \Delta C / \Delta Q = 0 = MC - MR$$

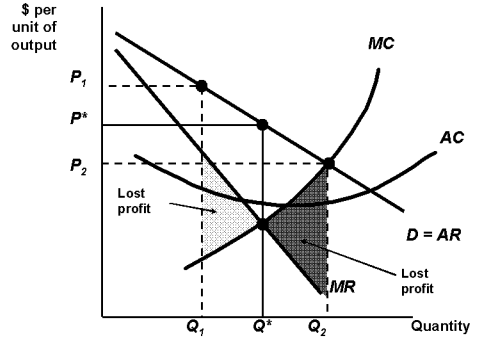
$$or\ MC = MR$$

Maximizing Profit When Marginal Revenue Equals Marginal Cost

The Monopolist's Output Decision

- At output levels below *MR = MC* the decrease in revenue is greater than the decrease in cost (MR > MC).
- At output levels above *MR = MC* the increase in cost is greater than the decrease in revenue (MR < MC)

Maximizing Profit When Marginal Revenue Equals Marginal Cost



Monopoly

The Monopolist's Output Decision

- An Example

$$Cost = C(Q) = 50 + Q^2$$

$$MC = \frac{\Delta C}{\Delta Q} = 2Q$$

Monopoly

The Monopolist's Output Decision

- An Example

$$Demand = P(Q) = 40 - Q$$

$$R(Q) = P(Q)Q = 40Q - Q^2$$

$$MR = \frac{\Delta R}{\Delta Q} = 40 - 2Q$$

Monopoly

The Monopolist's Output Decision

- An Example

$$MR = MC\ or\ 40 - 2Q = 2Q$$

$$Q = 10$$

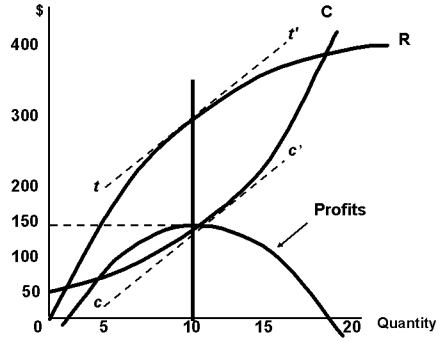
$$\text{When } Q = 10,\ P = 30$$

Monopoly

The Monopolist's Output Decision

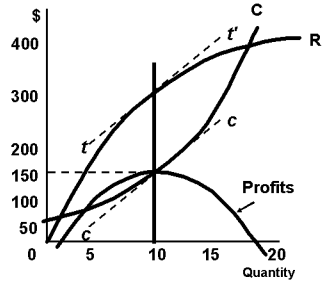
- An Example
  - By setting marginal revenue equal to marginal cost, it can be verified that profit is maximized at *P* = $30 and *Q* = 10.
  - This can be seen graphically:

Example of Profit Maximization

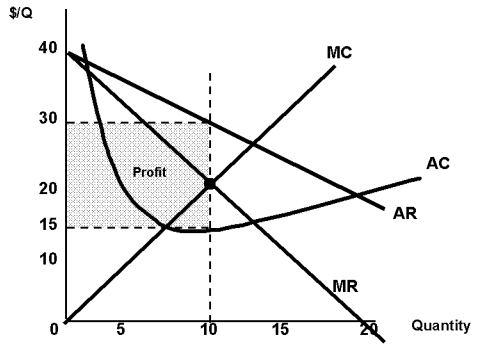


Example of Profit Maximization

- Observations
  - Slope of *rr'* = slope *cc'* and they are parallel at 10 units
  - Profits are maximized at 10 units
  - P = $30, Q = 10, TR = P x Q = $300
  - AC = $15, Q = 10, TC = AC x Q = 150
  - Profit = TR - TC
    - $150 = $300 - $150

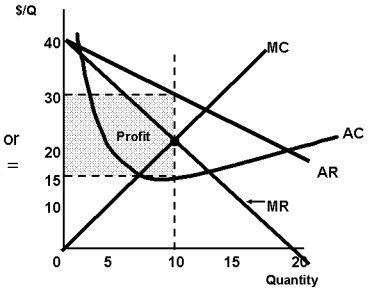


Example of Profit Maximization



Example of Profit Maximization

- Observations
  - AC = $15, Q = 10, TC = AC x Q = 150
  - Profit = TR = TC = $300 - $150 = $150 or
  - Profit = (P - AC) x Q = ($30 - $15)(10) = $150



Monopoly

- A Rule of Thumb for Pricing
  - We want to translate the condition that marginal revenue should equal marginal cost into a rule of thumb that can be more easily applied in practice.
  - This can be demonstrated using the following steps:

A Rule of Thumb for Pricing

$$1.\ MR = \frac{\Delta R}{\Delta Q} = \frac{\Delta (PQ)}{\Delta Q}$$

$$2.\ MR = P + Q\frac{\Delta P}{\Delta Q} = P + P\left(\frac{Q}{P}\right)\left(\frac{\Delta P}{\Delta Q}\right)$$

$$3.\ E_d = \left(P/Q\right)\left(\Delta Q/\Delta P\right)$$

A Rule of Thumb for Pricing

$$4.\ \left(Q/P\right)\left(\Delta P/\Delta Q\right) = \frac{1}{E_d}$$

$$5.\ MR = P + P\left(\frac{1}{E_d}\right)$$

A Rule of Thumb for Pricing

$$6.\ \pi \text{ is maximized} \quad @\ \text{MR} = \text{MC}$$

$$P + P\left[\frac{1}{E_D}\right] = -\frac{1}{E_D}$$

$$P = \frac{MC}{1 + (1/E_D)}$$

A Rule of Thumb for Pricing

$$7.\ -\frac{1}{E_d}$$ = the markup over MC as a percentage of price (P-MC)/P

8. The markup should equal the inverse of the elasticity of demand.

A Rule of Thumb for Pricing

$$9.\ P = \frac{MC}{1 + \left(1/E_d\right)}$$

Assume

$$E_d = -4 \qquad MC = 9$$

$$P = \frac{9}{1 + \left(1/-4\right)} = \frac{9}{.75} = \$12$$

Monopoly

- Monopoly pricing compared to perfect competition pricing:
  - Monopoly
    P > MC
  - Perfect Competition
    P = MC

Monopoly

- Monopoly pricing compared to perfect competition pricing:
  - The more elastic the demand the closer price is to marginal cost.
  - If E_d is a large negative number, price is close to marginal cost and vice versa.

Astra-Merck Prices Prilosec

The Monopolist's Output Decision

- 1995
  - Price of Prilosec = $3.50/daily dose
  - Price of Tagamet and Zantac = $1.50 - $2.25/daily dose
  - *MC* of Prolosec = 30 - 40 cents/daily dose

Astra-Merck Prices Prilosec

The Monopolist's Output Decision

$$P = \frac{MC}{1+[1/E_D]} = \frac{.35}{1+[1/-1.1]} =$$

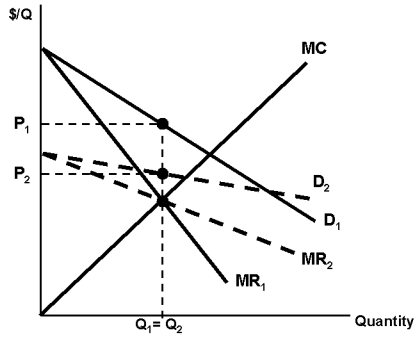
$$\frac{MC}{1+(-.91)} = \frac{.35}{.09} = \$3.89$$

•Price of $3.50 is consistent with "the rule of thumb pricing"

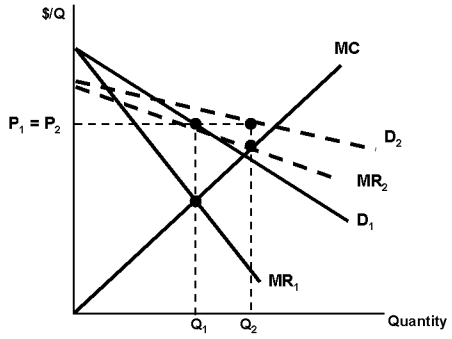
Monopoly

- Shifts in Demand
  - In perfect competition, the market supply curve is determined by marginal cost.
  - For a monopoly, output is determined by marginal cost and the shape of the demand curve.

Shift in Demand Leads to Change in Price but Same Output



Shift in Demand Leads to Change in Output but Same Price



Monopoly

- Observations
  - Shifts in demand usually cause a change in both price and quantity.
  - A monopolistic market has no supply curve.

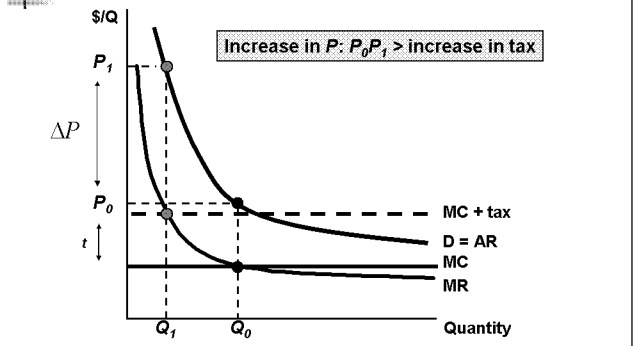
Monopoly

- Observations
  - Monopolist may supply many different quantities at the same price.
  - Monopolist may supply the same quantity at different prices.

Monopoly

- The Effect of a Tax
  - Under monopoly price can sometimes rise by *more* than the amount of the tax.
- To determine the impact of a tax:
  - t = specific tax
  - MC = MC + t
  - MR = MC + t : optimal production decision

Effect of Excise Tax on Monopolist



Effect of Excise Tax on Monopolist

- **Question**
  - Suppose: E_d = -2
  - How much would the price change?

Effect of Excise Tax on Monopolist

- Answer

$$P = \frac{MC}{1 + \left(1/E_d\right)}$$

If $E_d = -2 \rightarrow P = 2MC$

If MC increases to $MC + t$

$\Delta P = 2(MC + t) = 2MC + 2t$

Price increases by twice the tax.

- What would happen to profits?

Monopoly

- The Multiplant Firm
  - For many firms, production takes place in two or more different plants whose operating cost can differ.

Monopoly

- The Multiplant Firm
  - Choosing total output and the output for each plant:
    - The marginal cost in each plant should be equal.
    - The marginal cost should equal the marginal revenue for each plant.

Monopoly

The Multiplant Firm

- Algebraically:

Q_1 & $C_1 \Rightarrow$ Output & Cost for Plant 1

Q_2 & $C_2 \Rightarrow$ Output & Cost for Plant 2

Total Output $= Q_T = Q_1 + Q_2$

Monopoly

The Multiplant Firm

- Algebraically:

$$\pi = PQ_T - C_1(Q_1) - C_2(Q_2)$$

$$\frac{\Delta\pi}{\Delta Q_1} = \frac{\Delta(PQ_T)}{\Delta Q_1} - \frac{\Delta C_1}{\Delta Q_1} = 0$$

Monopoly

The Multiplant Firm

- Algebraically:

$$(MR)\frac{\Delta(PQ_T)}{\Delta Q_1} - (MC)\frac{\Delta C_1}{\Delta Q_1} = 0$$

$$MR = MC_1$$

Monopoly

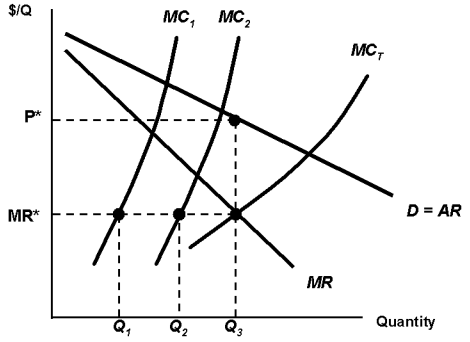
- Algebraically:

$$MR - MC_1$$

$$MR = MC_2$$

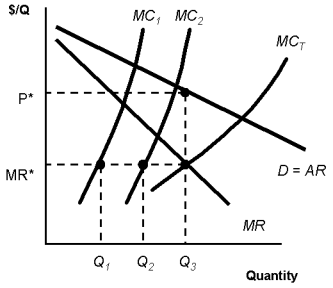
$$MR = MC_1 = MC_2$$

Production with Two Plants



Production with Two Plants

- Observations:
  1) $MC_T = MC_1 + MC_2$
  2) Profit maximizing output:
     - $MC_T = MR$ at Q_T and P^*
     - $MR = MR^*$
     - $MR^* = MC_1$ at Q_1, $MC^* = MC_2$ at Q_2
     - $MC_1 + MC_2 = MC_T$, $Q_1 + Q_2 = Q_T$, and $MR = MC_1 + MC_2$



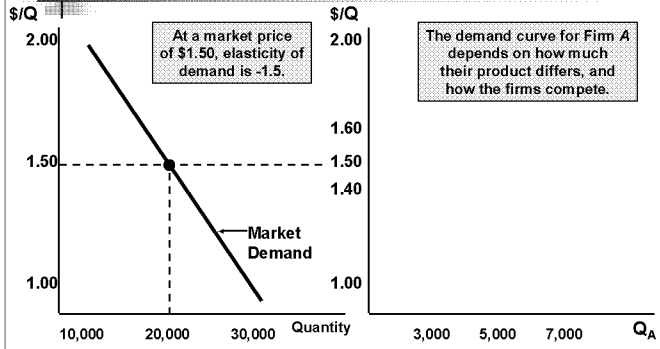
Monopoly Power

- Monopoly is rare.
- However, a market with several firms, each facing a downward sloping demand curve will produce so that price exceeds marginal cost.

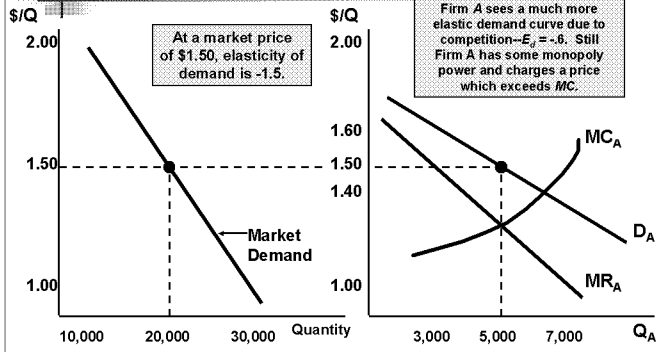
Monopoly Power

- Scenario:
  - Four firms with equal share (5,000) of a market for 20,000 toothbrushes at a price of $1.50.

The Demand for Toothbrushes



The Demand for Toothbrushes



Monopoly Power

- Measuring Monopoly Power
  - In perfect competition: $P = MR = MC$
  - Monopoly power: $P > MC$

Monopoly Power

- Lerner's Index of Monopoly Power
  - $L = (P - MC)/P$
    - The larger the value of L (between 0 and 1) the greater the monopoly power.
  - L is expressed in terms of E_d
    - $L = (P - MC)/P = -1/E_d$
    - E_d is elasticity of demand for a firm, not the market

Monopoly Power

- Monopoly power does not guarantee profits.
- Profit depends on average cost relative to price.
- Question:
  - Can you identify any difficulties in using the Lerner Index (L) for public policy?

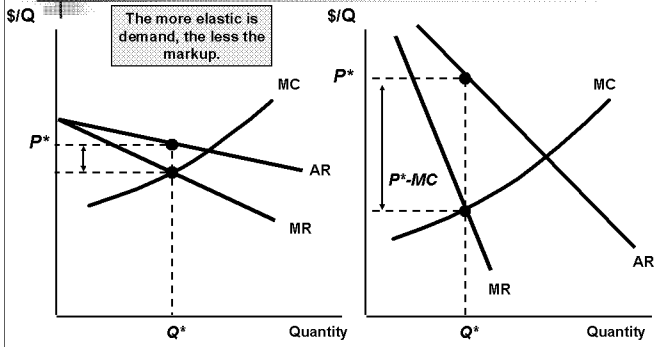
Monopoly Power

- The Rule of Thumb for Pricing

$$P = \frac{MC}{1 + (1/E_d)}$$

  - Pricing for any firm with monopoly power
    - If E_d is large, markup is small
    - If E_d is small, markup is large

Elasticity of Demand and Price Markup



Markup Pricing: Supermarkets to Designer Jeans

- Supermarkets

1. Several firms
2. Similar product
3. $E_d = -10$ for individual stores
4. $P = \frac{MC}{1 + (1/-.1)} = \frac{MC}{0.9} = 1.11(MC)$
5. Prices set about 10 - 11% above MC.

Markup Pricing: Supermarkets to Designer Jeans

- Convenience Stores

1. Higher prices than supermarkets
2. Convenience differentiates them
3. $E_d = -5$
4. $P = \frac{MC}{1 + (1/-5)} = \frac{MC}{0.8} = 1.25(MC)$
5. Prices set about 25% above MC.

Markup Pricing: Supermarkets to Designer Jeans

Convenience Stores

- Convenience stores have more monopoly power.
- Question:
  - Do convenience stores have higher profits than supermarkets?

Markup Pricing: Supermarkets to Designer Jeans

Designer Jeans

- Designer jeans
  - E_d = -3 to -4
  - Price 33 - 50% > *MC*
  - *MC* = $12 - $18/pair
  - Wholesale price = $18 - $27

The Pricing of Prerecorded Videocassettes

1985		1999	
Title	***Retail Price($)***	***Title***	***Retail Price($)***
Purple Rain	$29.98	Austin Powers	$10.49
Raiders of the Lost Ark	24.95	A Bug's Life	17.99
Jane Fonda Workout	59.95	There's Something about Mary	13.99
The Empire Strikes Back	79.98	Tae-Bo Workout	24.47
An Officer and a Gentleman	24.95	Lethal Weapon 4	16.99
Star Trek: The Motion Picture	24.95	Men in Black	12.99
Star Wars	39.98	Armageddon	15.86

The Pricing of Prerecorded Videocassettes

- What Do You Think?
  - Should producers lower the price of videocassettes to increase sales and revenue?

Sources of Monopoly Power

- Why do some firm's have considerable monopoly power, and others have little or none?
- A firm's monopoly power is determined by the firm's elasticity of demand.

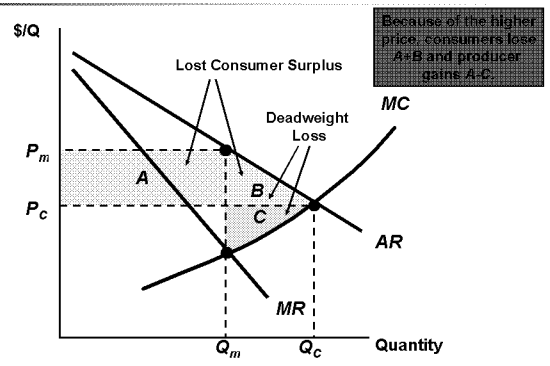
Sources of Monopoly Power

- The firm's elasticity of demand is determined by:
  1) Elasticity of market demand
  2) Number of firms
  3) The interaction among firms

The Social Costs of Monopoly Power

- Monopoly power results in higher prices and lower quantities.
- However, does monopoly power make consumers and producers in the aggregate better or worse off?

Deadweight Loss from Monopoly Power



The Social Costs of Monopoly Power

- Rent Seeking
  - Firms may spend to gain monopoly power
    - Lobbying
    - Advertising
    - Building excess capacity

The Social Costs of Monopoly Power

- The incentive to engage in monopoly practices is determined by the profit to be gained.
- The larger the transfer from consumers to the firm, the larger the social cost of monopoly.

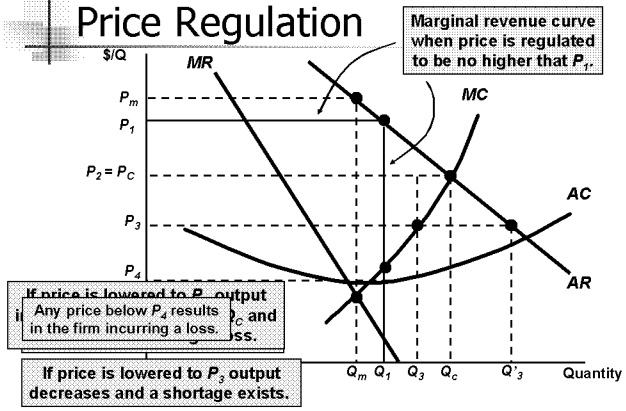
The Social Costs of Monopoly Power

- Example
  - 1996 Archer Daniels Midland (ADM) successfully lobbied for regulations requiring ethanol be produced from corn
- Question
  - Why only corn?

The Social Costs of Monopoly Power

- Price Regulation
  - Recall that in competitive markets, price regulation created a deadweight loss.
- Question:
  - What about a monopoly?

Price Regulation



The Social Costs of Monopoly Power

- Natural Monopoly
  - A firm that can produce the entire output of an industry at a cost lower than what it would be if there were several firms.

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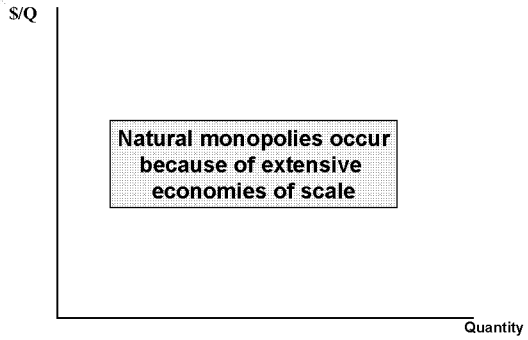
Regulating the Price of a Natural Monopoly



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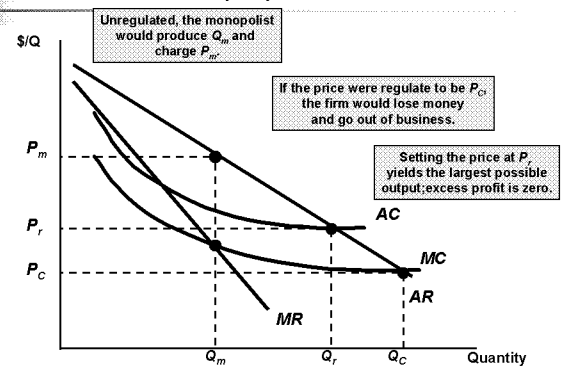
Regulating the Price of a Natural Monopoly



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The Social Costs of Monopoly Power

- Regulation in Practice
  - It is very difficult to estimate the firm's cost and demand functions because they change with evolving market conditions

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The Social Costs of Monopoly Power

- Regulation in Practice
  - An alternative pricing technique---*rate-of-return regulation* allows the firms to set a maximum price based on the expected rate or return that the firm will earn.
    - $P = AVC + (D + T + sK)/Q$, where
      - P = price, AVC = average variable cost
      - D = depreciation, T = taxes
      - s = allowed rate of return, K = firm's capital stock

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The Social Costs of Monopoly Power

- Regulation in Practice
  - Using this technique requires hearings to arrive at the respective figures.
  - The hearing process creates a regulatory lag that may benefit producers (1950s & 60s) or consumers (1970s & 80s).
- Question
  - Who is benefiting in the 1990s?

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Monopsony

- A monopsony is a market in which there is a single buyer.
- An oligopsony is a market with only a few buyers.
- Monopsony power is the ability of the buyer to affect the price of the good and pay less than the price that would exist in a competitive market.

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Monopsony

- Competitive Buyer
  - Price taker
  - *P = Marginal expenditure = Average expenditure*
  - *D = Marginal value*

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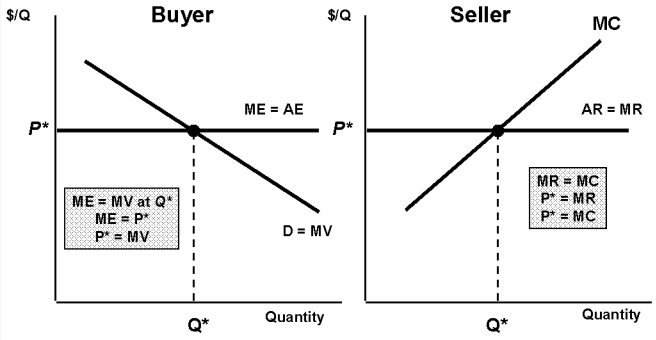
Competitive Buyer Compared to Competitive Seller



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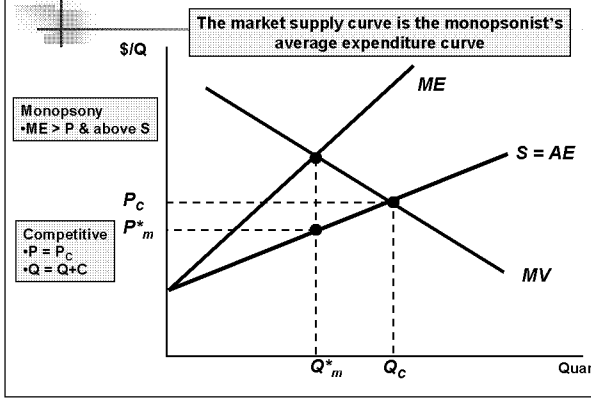
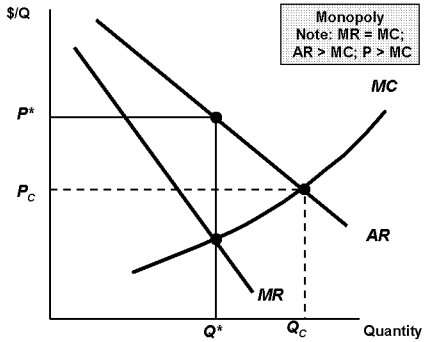
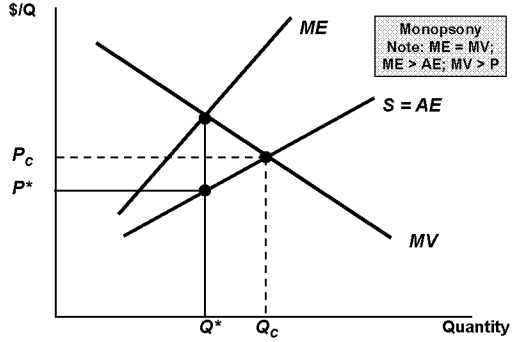
Monopsonist Buyer



Monopoly and Monopsony



Monopoly and Monopsony



Monopoly and Monopsony

- Monopoly
  - $MR < P$
  - $P > MC$
  - $Q_m < Q_C$
  - $P_m > PC$
- Monopsony
  - $ME > P$
  - $P < MV$
  - $Q_m < Q_C$
  - $P_m < P_C$

Monopsony Power

- A few buyers can influence price (e.g. automobile industry).
- Monopsony power gives them the ability to pay a price that is less than marginal value.

Monopsony Power

- The degree of monopsony power depends on three similar factors.
  1) Elasticity of market supply
     - The less elastic the market supply, the greater the monopsony power.

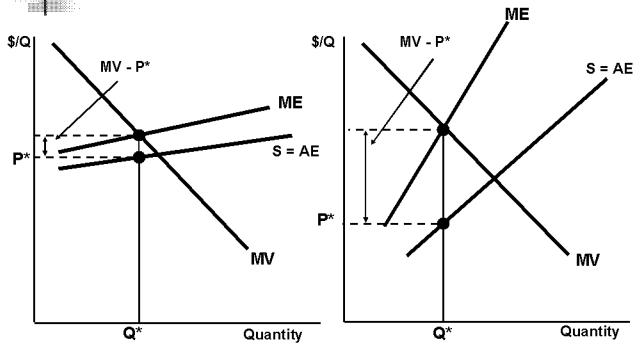
Monopsony Power

- The degree of monopsony power depends on three similar factors.
  2) Number of buyers
     - The fewer the number of buyers, the less elastic the supply and the greater the monopsony power.

Monopsony Power

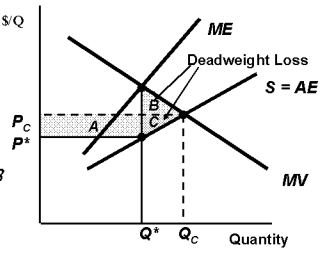
- The degree of monopsony power depends on three similar factors.
  3) Interaction Among Buyers
     - The less the buyers compete, the greater the monopsony power.

Monopsony Power: Elastic versus Inelastic Supply



Deadweight Loss from Monopsony Power

- Determining the deadweight loss in monopsony
  - Change in seller's surplus = $-A-C$
  - Change in buyer's surplus = $A - B$
  - Change in welfare = $-A - C + A - B = -C - B$
  - Inefficiency occurs because less is purchased



Monopsony Power

The Social Costs of Monopsony Power

- Bilateral Monopoly
  - Bilateral monopoly is rare, however, markets with a small number of sellers with monopoly power selling to a market with few buyers with monopsony power is more common.

Monopsony Power

The Social Costs of Monopsony Power

- Question
  - In this case, what is likely to happen to price?

Limiting Market Power: The Antitrust Laws

- Antitrust Laws:
  - Promote a competitive economy
  - Rules and regulations designed to promote a competitive economy by:
    - Prohibiting actions that restrain or are likely to restrain competition
    - Restricting the forms of market structures that are allowable

Limiting Market Power: The Antitrust Laws

- Sherman Act (1890)
  - Section 1
    - Prohibits contracts, combinations, or conspiracies in restraint of trade
      - Explicit agreement to restrict output or fix prices
      - Implicit collusion through parallel conduct

Limiting Market Power: The Antitrust Laws

Examples of Illegal Combinations

- 1983
  - Six companies and six executives indicted for price of copper tubing
- 1996
  - Archer Daniels Midland (ADM) pleaded guilty to price fixing for lysine -- three sentenced to prison in 1999

Limiting Market Power: The Antitrust Laws

Examples of Illegal Combinations

- 1999
  - Roche A.G., BASF A.G., Rhone-Poulenc and Takeda pleaded guilty to price fixing of vitamins -- fined more than $1 billion.

Limiting Market Power: The Antitrust Laws

- Sherman Act (1890)
  - Section 2
    - Makes it illegal to monopolize or attempt to monopolize a market and prohibits conspiracies that result in monopolization.

Limiting Market Power: The Antitrust Laws

- Clayton Act (1914)
  1) Makes it unlawful to require a buyer or lessor not to buy from a competitor
  2) Prohibits predatory pricing

Limiting Market Power: The Antitrust Laws

- Clayton Act (1914)
  3) Prohibits mergers and acquisitions if they "substantially lessen competition" or "tend to create a monopoly"

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Limiting Market Power: The Antitrust Laws

- Robinson-Patman Act (1936)
  - Prohibits price discrimination if it is likely to injure the competition

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Limiting Market Power: The Antitrust Laws

- Federal Trade Commission Act (1914, amended 1938, 1973, 1975)
  1) Created the Federal Trade Commission (FTC)
  2) Prohibitions against deceptive advertising, labeling, agreements with retailer to exclude competing brands

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Limiting Market Power: The Antitrust Laws

- Antitrust laws are enforced three ways:
  1) Antitrust Division of the Department of Justice
     - A part of the executive branch--the administration can influence enforcement
     - Fines levied on businesses; fines and imprisonment levied on individuals

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Limiting Market Power: The Antitrust Laws

- Antitrust laws are enforced three ways:
  2) Federal Trade Commission
     - Enforces through voluntary understanding or formal commission order

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Limiting Market Power: The Antitrust Laws

- Antitrust laws are enforced three ways:
  3) Private Proceedings
     - Lawsuits for damages
     - Plaintiff can receive *treble* damages

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Limiting Market Power: The Antitrust Laws

- Two Examples
  - American Airlines -- Price fixing
  - Microsoft
    - Monopoly power
    - Predatory actions
    - Collusion

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Summary

- Market power is the ability of sellers or buyers to affect the price of a good.
- Market power can be in two forms: monopoly power and monopsony power.

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Summary

- Monopoly power is determined in part by the number of firms competing in the market.
- Monopsony power is determined in part by the number of buyers in the market.

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Summary

- Market power can impose costs on society.
- Sometimes, scale economies make pure monopoly desirable.
- We rely on the antitrust laws to prevent firms from obtaining excessive market power.

End of Chapter 10

Market Power: Monopoly and Monopsony

Chapter 11

Pricing with Market Power

Topics to be Discussed

- Capturing Consumer Surplus
- Price Discrimination
- Intertemporal Price Discrimination and Peak-Load Pricing

Topics to be Discussed

- The Two-Part Tariff
- Bundling
- Advertising

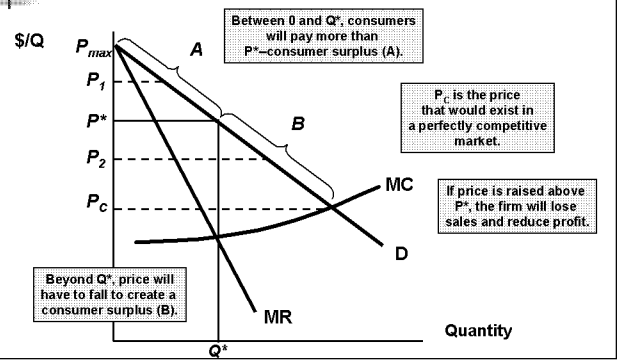
Introduction

- Pricing without market power (perfect competition) is determined by market supply and demand.
- The individual producer must be able to forecast the market and then concentrate on managing production (cost) to maximize profits.

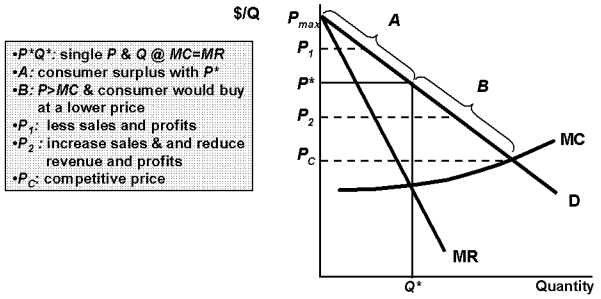
Introduction

- Pricing with market power (imperfect competition) requires the individual producer to know much more about the characteristics of demand as well as manage production.

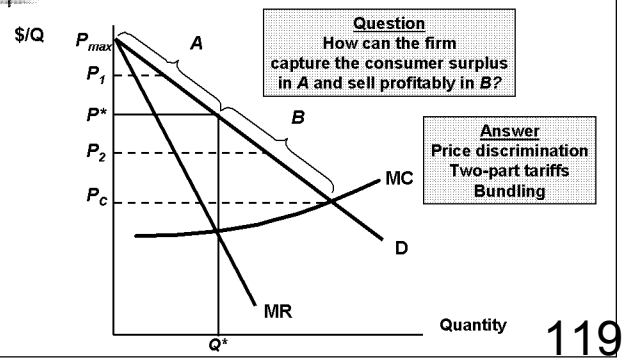
Capturing Consumer Surplus



Capturing Consumer Surplus



Capturing Consumer Surplus



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Capturing Consumer Surplus

- Price discrimination is the charging of different prices to different consumers for similar goods.

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Price Discrimination

- First Degree Price Discrimination
  - Charge a separate price to each customer: the maximum or *reservation price* they are willing to pay.

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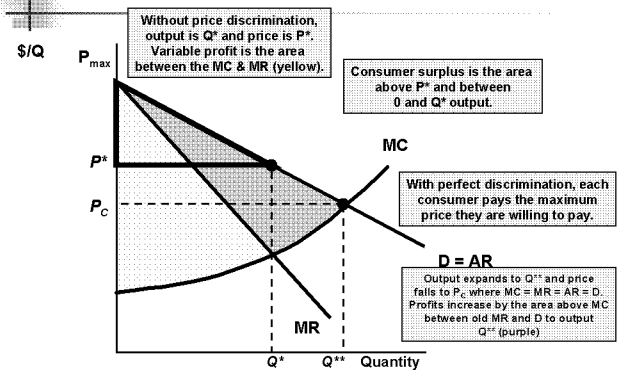
Additional Profit From Perfect First-Degree Price Discrimination



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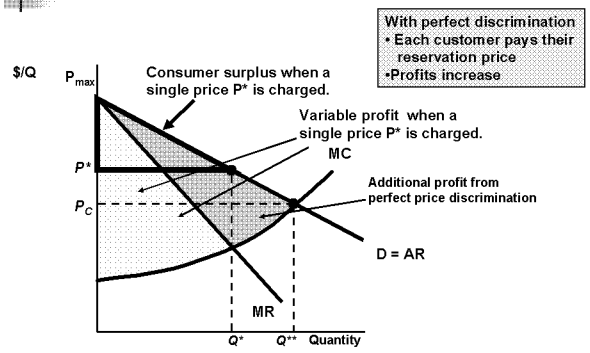
Additional Profit From Perfect First-Degree Price Discrimination



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Additional Profit From Perfect First-Degree Price Discrimination

- Question
  - Why would a producer have difficulty in achieving first-degree price discrimination?
- Answer

  1) Too many customers (impractical)

  2) Could not estimate the reservation price for each customer

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Price Discrimination

- First Degree Price Discrimination
  - The model does demonstrate the potential profit (incentive) of practicing price discrimination to some degree.

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Price Discrimination

- First Degree Price Discrimination
  - Examples of imperfect price discrimination where the seller has the ability to segregate the market to some extent and charge different prices for the same product:
    - Lawyers, doctors, accountants
    - Car salesperson (15% profit margin)
    - Colleges and universities

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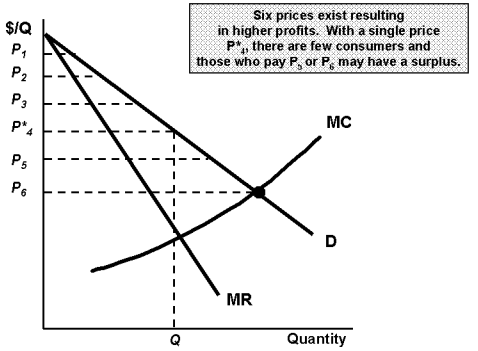
First-Degree Price Discrimination in Practice



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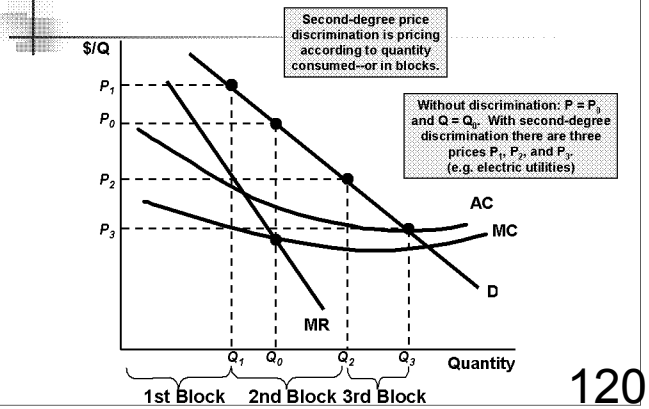
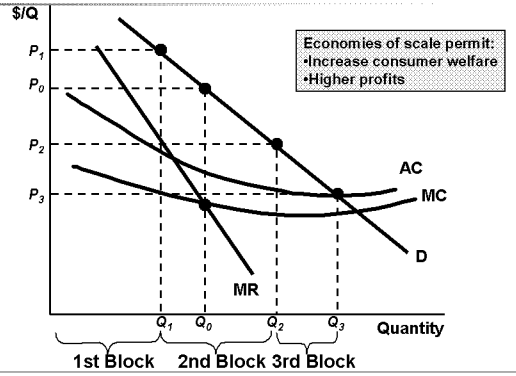
Second-Degree Price Discrimination



Second-Degree Price Discrimination



Price Discrimination

- Third Degree Price Discrimination

1) Divides the market into two-groups.

2) Each group has its own demand function.

Price Discrimination

- Third Degree Price Discrimination

3) Most common type of price discrimination.
   - Examples: airlines, liquor, vegetables, discounts to students and senior citizens.

Price Discrimination

- Third Degree Price Discrimination

4) Third-degree price discrimination is feasible when the seller can separate his/her market into groups who have different price elasticities of demand (e.g. business air travelers versus vacation air travelers)

Price Discrimination

- Third Degree Price Discrimination
  - Objectives
    - $MR_1 = MR_2$
    - $MC_1 = MR_1$ *and* $MC_2 = MR_2$
    - $MR_1 = MR_2 = MC$

Price Discrimination

- Third Degree Price Discrimination
  - P_1: price first group
  - P_2: price second group
  - $C(Q_T)$ = total cost of $Q_T = Q_1 + Q_2$
  - Profit (π) = $P_1Q_1 + P_2Q_2 - C(Q_T)$

Price Discrimination

- Third Degree Price Discrimination
  - Set incremental π for sales to group 1 = 0
  - $\frac{\Delta\pi}{\Delta Q_1} = \frac{\Delta(P_1Q_{1)}}{\Delta Q_1} - \frac{\Delta C}{\Delta Q_1} = 0$
  - $\frac{\Delta(P_1Q_1)}{\Delta Q_1} = MR_1 - \frac{\Delta C}{\Delta Q_1} = MC$

Price Discrimination

- Third Degree Price Discrimination
  - Second group of customers: $MR_2 = MC$
  - $MR_1 = MR_2 = MC$

Price Discrimination

- Third Degree Price Discrimination
  - Determining relative prices

Recall : $MR = P\left(1+1/E_d\right)$

- Then : $MR_1 = P_1(1+1/E_1) = MR_2 = P_2(1+1/E_2)$

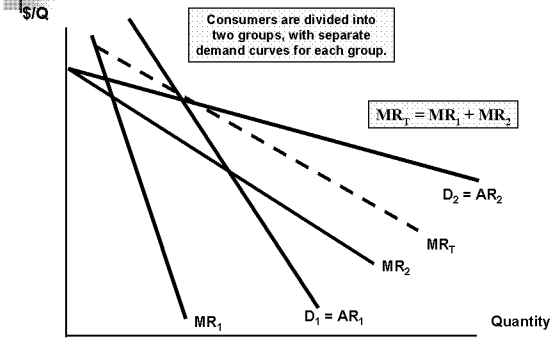
Price Discrimination

- Third Degree Price Discrimination
  - Determining relative prices
  - And : $\frac{P_1}{P_2} = \frac{(1+1/E_2)}{(1+1/E_1)}$
  - Pricing: Charge higher price to group with a low demand elasticity

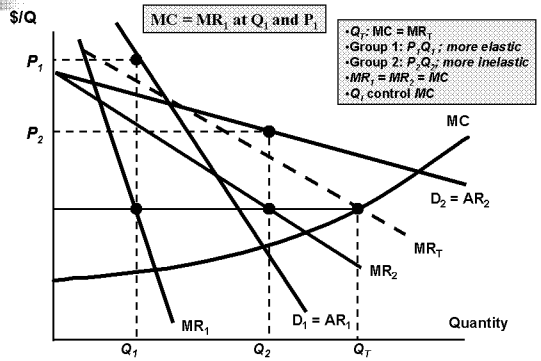
Price Discrimination

- Third Degree Price Discrimination
  - Example: $E_1 = -2$ & $E_2 = -4$
  - $\frac{P_1}{P_2} = \frac{(1-1/4)}{(1-1/2)} = 3/4/1/2 = 1.5$
  - P_1 should be 1.5 times as high as P_2

Third-Degree Price Discrimination



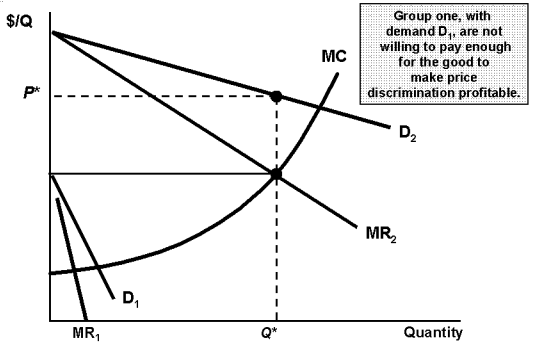
Third-Degree Price Discrimination



No Sales to Smaller Market

Even if third-degree price discrimination is feasible, it doesn't always pay to sell to both groups of consumers if marginal cost is rising.

No Sales to Smaller Market



The Economics of Coupons and Rebates

Price Discrimination

- Those consumers who are more price elastic will tend to use the coupon/rebate more often when they purchase the product than those consumers with a less elastic demand.
- Coupons and rebate programs allow firms to price discriminate.

Price Elasticities of Demand for Users Versus Nonusers of Coupons

	Price Elasticity	
Product	**Nonusers**	**Users**
Toilet tissue	**-0.60**	**-0.66**
Stuffing/dressing	**-0.71**	**-0.96**
Shampoo	**-0.84**	**-1.04**
Cooking/salad oil	**-1.22**	**-1.32**
Dry mix dinner	**-0.88**	**-1.09**
Cake mix	**-0.21**	**-0.43**

Price Elasticities of Demand for Users Versus Nonusers of Coupons

	Price Elasticity	
Product	**Nonusers**	**Users**
Cat food	**-0.49**	**-1.13**
Frozen entrée	**-0.60**	**-0.95**
Gelatin	**-0.97**	**-1.25**
Spaghetti sauce	**-1.65**	**-1.81**
Crème rinse/conditioner	**-0.82**	**-1.12**
Soup	**-1.05**	**-1.22**
Hot dogs	**-0.59**	**-0.77**

The Economics of Coupons and Rebates

- Cake Mix
  - Nonusers of coupons: P_E = -0.21
  - Users: P_E = -0.43

The Economics of Coupons and Rebates

- Cake Mix Brand (Pillsbury)
  - P_E: 8 to 10 times cake mix P_E
- Example
  - P_E Users: -4
  - P_E Nonusers: -2

The Economics of Coupons and Rebates

- Using: $\frac{P_1}{P_2} = \frac{(1+1/E_2)}{(1+1/E_1)}$
- Price of nonusers should be 1.5 times users
  - *Or,* if cake mix sells for $1.50, coupons should be 50 cents

Airline Fares

- Differences in elasticities imply that some customers will pay a higher fare than others.
- Business travelers have few choices and their demand is less elastic.
- Casual travelers have choices and are more price sensitive.

Elasticities of Demand for Air Travel

	Fare Category		
Elasticity	**First-Class**	**Unrestricted Coach**	**Discount**
Price	**-0.3**	**-0.4**	**-0.9**
Income	**1.2**	**1.2**	**1.8**

Airline Fares

- The airlines separate the market by setting various restrictions on the tickets.
  - Less expensive: notice, stay over the weekend, no refund
  - Most expensive: no restrictions

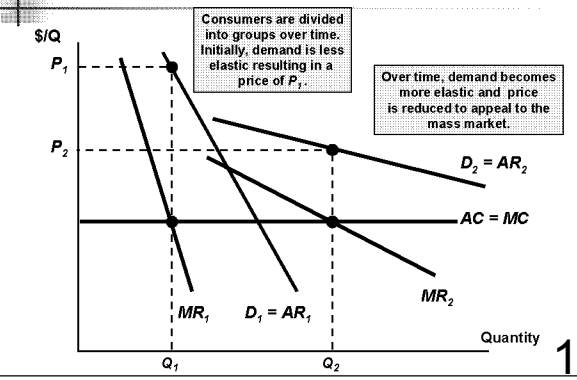
Intertemporal Price Discrimination and Peak-Load Pricing

- Separating the Market With Time
  - Initial release of a product, the demand is inelastic
    - Book
    - Movie
    - Computer

Intertemporal Price Discrimination and Peak-Load Pricing

- Separating the Market With Time
  - Once this market has yielded a maximum profit, firms lower the price to appeal to a general market with a more elastic demand
    - Paper back books
    - Dollar Movies
    - Discount computers

Intertemporal Price Discrimination



Intertemporal Price Discrimination and Peak-Load Pricing

Peak-Load Pricing

- Demand for some products may peak at particular times.
  - Rush hour traffic
  - Electricity - late summer afternoons
  - Ski resorts on weekends

Intertemporal Price Discrimination and Peak-Load Pricing

Peak-Load Pricing

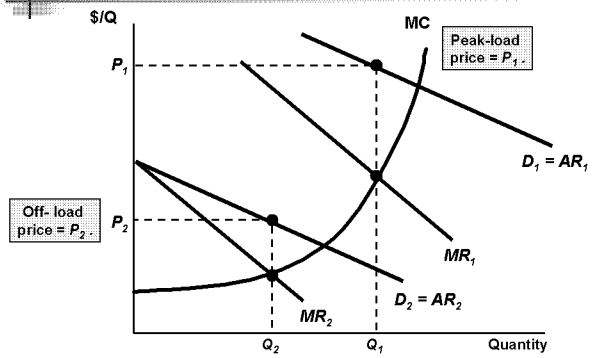
- Capacity restraints will also increase MC.
- Increased MR and MC would indicate a higher price.

Intertemporal Price Discrimination and Peak-Load Pricing

Peak-Load Pricing

- MR is not equal for each market because one market does not impact the other market.

Peak-Load Pricing



How to Price a Best Selling Novel

- What Do You Think?

  1) How would you arrive at the price for the initial release of the hardbound edition of a book?

How to Price a Best Selling Novel

- What Do You Think?

  2) How long do you wait to release the paperback edition? Could the popularity of the book impact your decision?

How to Price a Best Selling Novel

- What Do You Think?

  3) How do you determine the price for the paperback edition?

The Two-Part Tariff

- The purchase of some products and services can be separated into two decisions, and therefore, two prices.

The Two-Part Tariff

- Examples
  1) Amusement Park
     - Pay to enter
     - Pay for rides and food within the park
  2) Tennis Club
     - Pay to join
     - Pay to play

The Two-Part Tariff

- Examples
  3) Rental of Mainframe Computers
     - Flat Fee
     - Processing Time
  4) Safety Razor
     - Pay for razor
     - Pay for blades

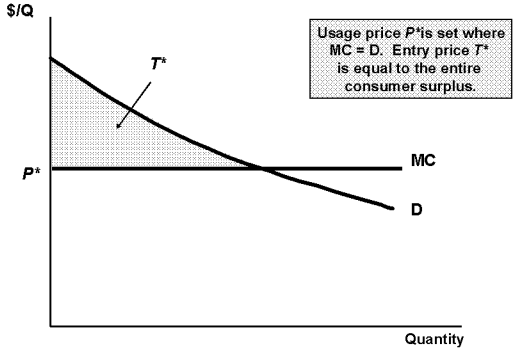
The Two-Part Tariff

- Examples
  5) Polaroid Film
     - Pay for the camera
     - Pay for the film

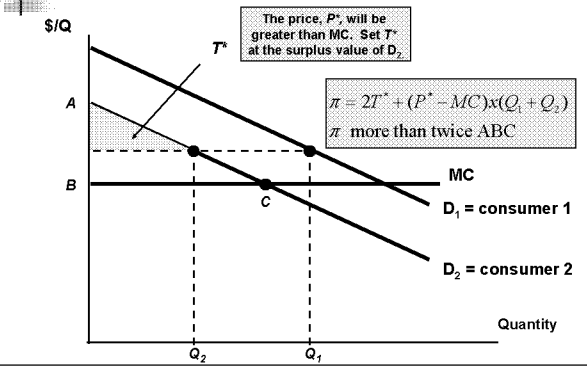
The Two-Part Tariff

- Pricing decision is setting the entry fee *(T)* and the usage fee (*P*).
- Choosing the trade-off between free-entry and high use prices or high-entry and zero use prices.

Two-Part Tariff with a Single Consumer



Two-Part Tariff with Two Consumers



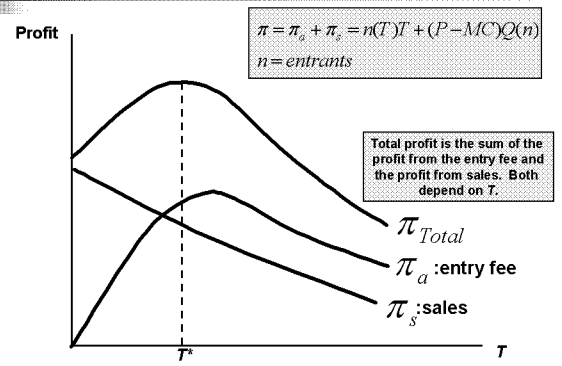
The Two-Part Tariff

- The Two-Part Tariff With Many Different Consumers
  - No exact way to determine *P** and *T**.
  - Must consider the trade-off between the entry fee *T** and the use fee P*.
    - Low entry fee: High sales and falling profit with lower price and more entrants.

The Two-Part Tariff

- The Two-Part Tariff With Many Different Consumers
  - To find optimum combination, choose several combinations of *P, T*.
  - Choose the combination that maximizes profit.

Two-Part Tariff with Many Different Consumers



The Two-Part Tariff

- Rule of Thumb
  - Similar demand: Choose *P* close to MC and high *T*
  - Dissimilar demand: Choose high *P* and low *T*.

The Two-Part Tariff

- Two-Part Tariff With A Twist
  - Entry price *(T)* entitles the buyer to a certain number of free units
    - Gillette razors with several blades
    - Amusement parks with some tokens
    - On-line with free time

Polaroid Cameras

- 1971 Polaroid introduced the SX-70 camera
- What Do You Think?
  - How would you price the camera and film?

Polaroid Cameras

- Hint

$\pi = PQ + nT - C_1(Q) - C_2(n)$

P = price of film

T = price of camera

Q = quantity of film sold

n = number of cameras sold

$C_1(Q)$ = cost of producing film

$C_2(n)$ = cost of producing cameras

Pricing Cellular Phone Service

- Question
  - Why do cellular phone providers offer several different plans instead of a single two-part tariff with an access fee and per-unit charge?

Bundling

- Bundling is packaging two or more products to gain a pricing advantage.
- Conditions necessary for bundling
  - Heterogeneous customers
  - Price discrimination is not possible
  - Demands must be negatively correlated

Bundling

- An example: Leasing "Gone with the Wind" & "Getting Gerties Garter."
  - The reservation prices for each theater and movie are:

	Gone with the Wind	Getting Gertie's Garter
Theater *A*	**$12,000**	**$3,000**
Theater *B*	**$10,000**	**$4,000**

Bundling

- Renting the movies separately would result in each theater paying the lowest reservation price for each movie:
  - Maximum price *Wind* = $10,000
  - Maximum price *Gertie* = $3,000
- Total Revenue = $26,000

Bundling

- If the movies are bundled:
  - Theater *A* will pay $15,000 for both
  - Theater *B* will pay $14,000 for both
- If each were charged the lower of the two prices, total revenue will be $28,000.

Bundling

Relative Valuations

- Negative Correlated: Profitable to Bundle
  - *A* pays more for *Wind* ($12,000) than *B* ($10,000).
  - *B* pays more for *Gertie* ($4,000) than *A* ($3,000).

Bundling

Relative Valuations

- If the demands were *positively correlated* (Theater *A* would pay more for both films as shown) bundling would not result in an increase in revenue.

	Gone with the Wind	Getting Gertie's Garter
Theater *A*	**$12,000**	**$4,000**
Theater *B*	**$10,000**	**$3,000**

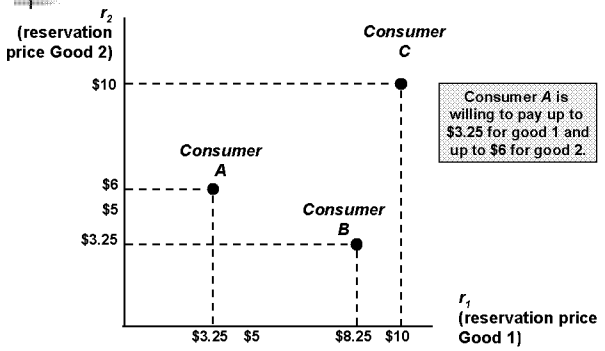
Bundling

- If the movies are bundled:
  - Theater *A* will pay $16,000 for both
  - Theater *B* will pay $13,000 for both
- If each were charged the lower of the two prices, total revenue will be $26,000, the same as by selling the films separately.

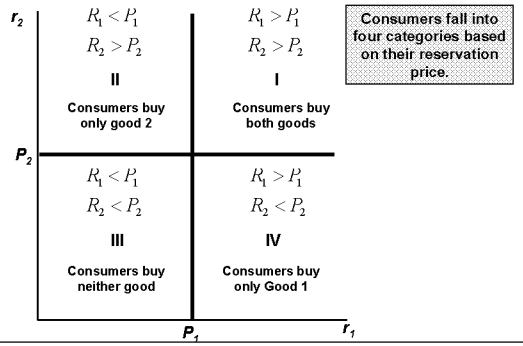
Bundling

- Bundling Scenario: Two different goods and many consumers
  - Many consumers with different reservation price combinations for two goods

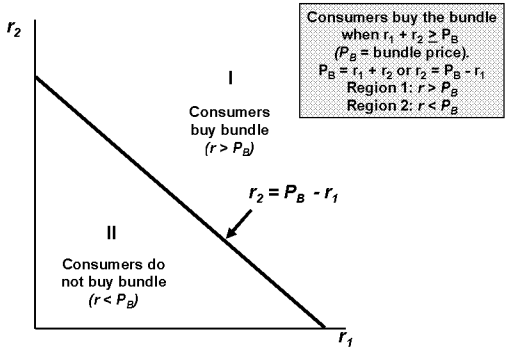
Reservation Prices



Consumption Decisions When Products are Sold Separately



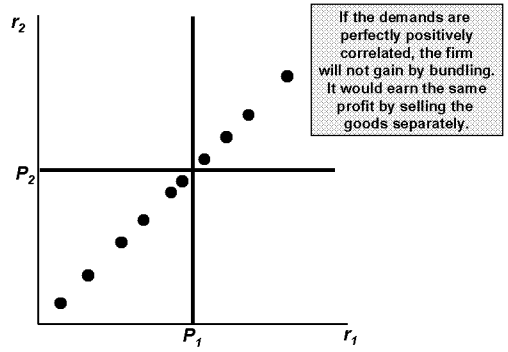
Consumption Decisions When Products are Bundled



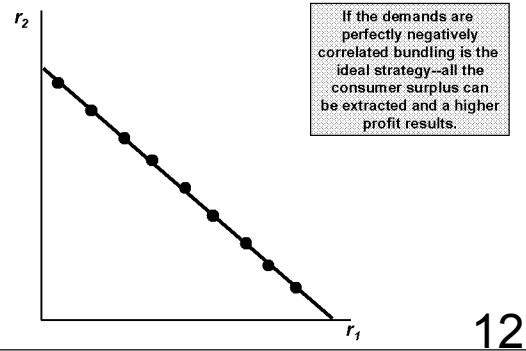
Consumption Decisions When Products are Bundled

- The effectiveness of bundling depends upon the degree of negative correlation between the two demands.

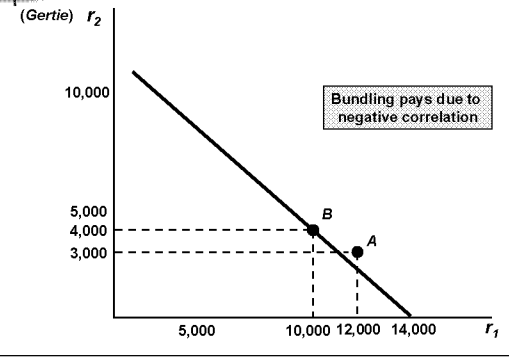
Reservation Prices



Reservation Prices



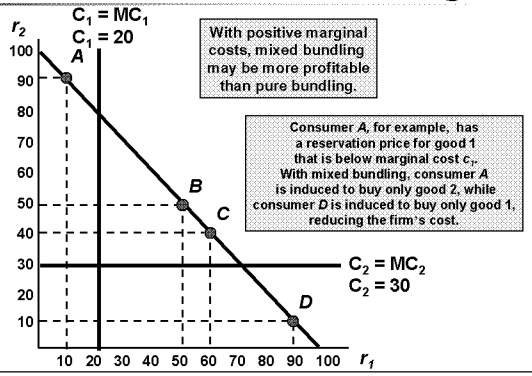
Movie Example



Bundling

- Mixed Bundling
  - Selling both as a bundle and separately
- Pure Bundling
  - Selling only a package

Mixed Versus Pure Bundling



Bundling

Mixed vs. Pure Bundling

- Scenario
  - Perfect negative correlation
  - Significant marginal cost

Bundling

Mixed vs. Pure Bundling

- Observations
  - Reservation price is below MC for some consumers
  - Mixed bundling induces the consumers to buy only goods for which their reservation price is greater than MC

Bundling Example

- Sell Separately
  - Consumers *B,C,* and *D* buy 1 and *A* buys 2
- Pure Bundling
  - Consumers *A, B, C,* and *D* buy the bundle
- Mixed Bundling
  - Consumer *D* buys 1, *A* buys 2, and *B & C* buys the bundle

Bundling Example

	P_1	P_2	P_B	Profit
Sell separately	**$50**	**$90**	**----**	**$150**
Pure bundling	**----**	**----**	**$100**	**$200**
Mixed bundling	**$89.95**	**$89.95**	**$100**	**$229.90**

$C_1 = \$20$

$C_2 = \$30$

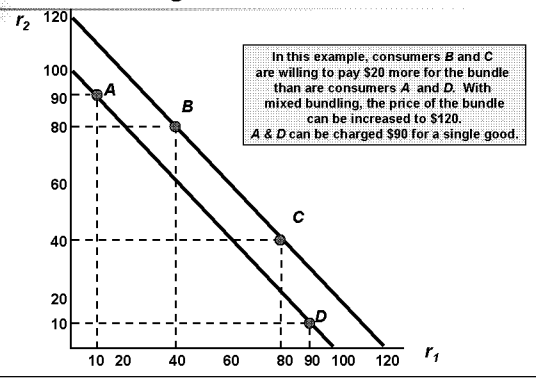
Bundling

- Sell Separately
  - 3($50 - $20) + 1($90 - $30) = $150
- Pure Bundling
  - 4($100 - $20 - $30) = $200
- Mixed Bundling
  - ($89.95 - $20) + ($89.95 - $30) - 2($100 - $20 - $30) = $229.90
  - **$C_1 = \$20$ $C_2 = \$30$**

Bundling

- Question
  - If MC = 0, would mixed bundling still be the most profitable strategy with perfect negative correlation?

Mixed Bundling with Zero Marginal Costs



Mixed Bundling with Zero Marginal Costs

	P_1	P_2	P_B	Profit
Sell separately	**$80**	**$80**	**----**	**$320**
Pure bundling	**----**	**----**	**$100**	**$400**
Mixed bundling	**$90**	**$90**	**$120**	**$420**

Bundling

- Question
  - Why is mixed bundling more profitable with MC = 0?

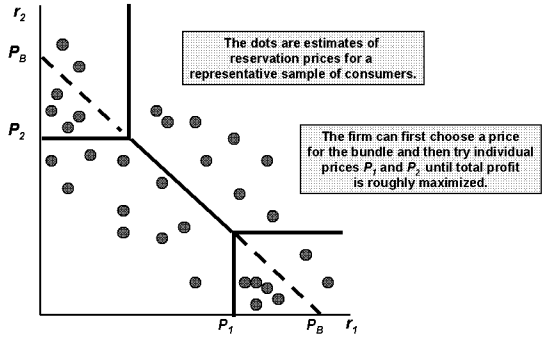
Bundling

- Bundling in Practice
  - Automobile option packages
  - Vacation travel
  - Cable television

Bundling

- Mixed Bundling in Practice
  - Use of market surveys to determine reservation prices
  - Design a pricing strategy from the survey results

Mixed Bundling in Practice



The Complete Dinner Versus a la Carte: A Restaurant's Pricing Problem

- Pricing to match consumer preferences for various selections
- Mixed bundling allows the customer to get maximum utility from a given expenditure by allowing a greater number of choices.

Bundling

- Tying
  - Practice of requiring a customer to purchase one good in order to purchase another.
  - Examples
    - Xerox machines and the paper
    - IBM mainframe and computer cards

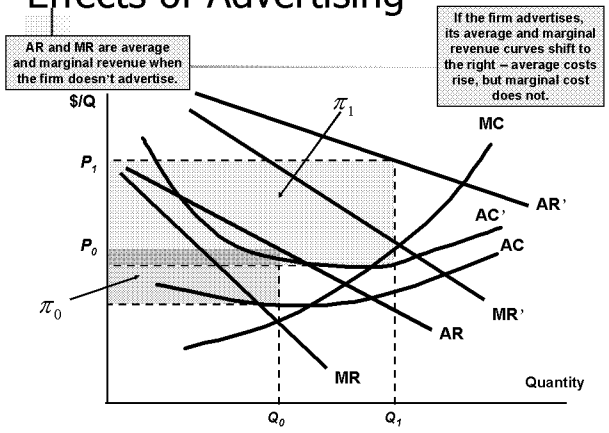
Bundling

- Tying
  - Allows the seller to meter the customer and use a two-part tariff to discriminate against the heavy user
  - McDonald's
    - Allows them to protect their brand name.

Advertising

- Assumptions
  - Firm sets only one price
  - Firm knows Q(P,A)
    - How quantity demanded depends on price and advertising

Effects of Advertising



Advertising

- Choosing Price and Advertising Expenditure

$$\pi = PQ(P,A) - C(Q) - A$$

$$MR_{Ads} = P\frac{\Delta Q}{\Delta A} = 1 + MC\frac{\Delta Q}{\Delta A} = \text{full MC of adv.}$$

Advertising

- A Rule of Thumb for Advertising

$$(P - MC)/P = -1/E_P \text{ for pricing}$$

$$(P\text{-}MC)\frac{\Delta Q}{\Delta A} = 1$$

$$\frac{P - MC}{P}\left[\frac{A}{Q}\frac{\Delta Q}{\Delta A}\right] = \frac{A}{PQ} = \text{Adv. to sales ratio}$$

Advertising

- A Rule of Thumb for Advertising

$$(A/Q)(\Delta Q/\Delta A) = E_A = \text{Adv. elasticity of demand}$$

$$(P - MC)/P = -1/E_P$$

$$A/PQ = -(E_A/E_P) = \text{Rule of Thumb}$$

Advertising

- A Rule of Thumb for Advertising
  - To maximize profit, the firm's advertising-to-sales ratio should be equal to minus the ratio of the advertising and price elasticities of demand.

Advertising

- An Example
  - $R(Q)$ = \$1 million/yr
  - \$10,000 budget for A (advertising--1% of revenues)
  - E_A = .2 (increase budget \$20,000, sales increase by 20%
  - E_P = -4 (markup price over MC is substantial)

Advertising

- Question
  - Should the firm increase advertising?

Advertising

- YES
  - A/PQ = -(2/-.4) = 5%
  - Increase budget to \$50,000

Advertising

- Questions
  - When E_A is large, do you advertise more or less?
  - When E_P is large, do you advertise more or less?

Advertising

- Advertising: In Practice
  - Estimate the level of advertising for each of the firms
    - Supermarkets $(E_P = -10; E_A = 0.1 \text{ to } 0.3)$
    - Convenience stores $(E_P = -5; E_A = \text{very small})$
    - Designer jeans $(E_P = -3 \text{ to } -4; E_A = .3 \text{ to } 1)$
    - Laundry detergents $(E_P = -3 \text{ to } -4; E_A = \text{very large})$

Summary

- Firms with market power are in an enviable position because they have the potential to earn large profits, but realizing that potential may depend critically on the firm's pricing strategy.
- A pricing strategy aims to enlarge the customer base that the firm can sell to, and capture as much consumer surplus as possible.

Summary

- Ideally, the firm would like to perfectly price discriminate.
- The two-part tariff is another means of capturing consumer surplus.
- When demands are heterogeneous and negatively correlated, bundling can increase profits.

Summary

- Bundling is a special case of tying, a requirement that products be bought or sold in some combination.
- Advertising can further increase profits.

End of Chapter 11

Pricing with Market Power

Chapter 12

Monopolistic Competition and Oligopoly

Topics to be Discussed

- Monopolistic Competition
- Oligopoly
- Price Competition
- Competition Versus Collusion: The Prisoners' Dilemma

Topics to be Discussed

- Implications of the Prisoners' Dilemma for Oligopolistic Pricing
- Cartels

Monopolistic Competition

- Characteristics
  1) Many firms
  2) Free entry and exit
  3) Differentiated product

Monopolistic Competition

- The amount of monopoly power depends on the degree of differentiation.
- Examples of this very common market structure include:
  - Toothpaste
  - Soap
  - Cold remedies

Monopolistic Competition

- Toothpaste
  - Crest and monopoly power
    - Procter & Gamble is the sole producer of Crest
    - Consumers can have a preference for Crest---taste, reputation, decay preventing efficacy
    - The greater the preference (differentiation) the higher the price.

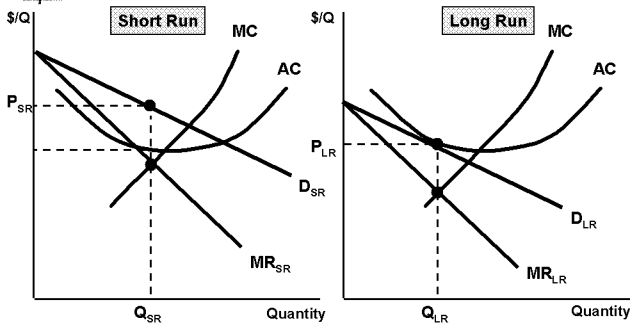
Monopolistic Competition

- Question
  - Does Procter & Gamble have much monopoly power in the market for Crest?

Monopolistic Competition

- The Makings of Monopolistic Competition
  - Two important characteristics
    - Differentiated but highly substitutable products
    - Free entry and exit

A Monopolistically Competitive Firm in the Short and Long Run



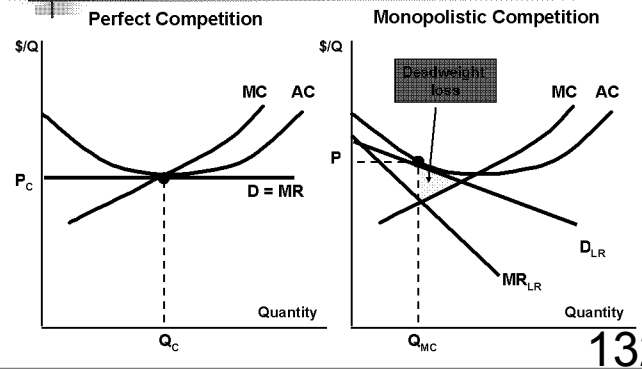
A Monopolistically Competitive Firm in the Short and Long Run

- Observations (short-run)
  - Downward sloping demand--differentiated product
  - Demand is relatively elastic--good substitutes
  - $MR < P$
  - Profits are maximized when $MR = MC$
  - This firm is making economic profits

A Monopolistically Competitive Firm in the Short and Long Run

- Observations (long-run)
  - Profits will attract new firms to the industry (no barriers to entry)
  - The old firm's demand will decrease to D_{LR}
  - Firm's output and price will fall
  - Industry output will rise
  - No economic profit ($P = AC$)
  - $P >$ MC -- some monopoly power

Comparison of Monopolistically Competitive Equilibrium and Perfectly Competitive Equilibrium



Monopolistic Competition

- Monopolistic Competition and Economic Efficiency
  - The monopoly power (differentiation) yields a higher price than perfect competition. If price was lowered to the point where $MC = D$, consumer surplus would increase by the yellow triangle.

Monopolistic Competition

- Monopolistic Competition and Economic Efficiency
  - With no economic profits in the long run, the firm is still not producing at minimum AC and excess capacity exists.

Monopolistic Competition

- Questions
  1) If the market became competitive, what would happen to output and price?
  2) Should monopolistic competition be regulated?

Monopolistic Competition

- Questions
  3) What is the degree of monopoly power?
  4) What is the benefit of product diversity?

Monopolistic Competition in the Market for Colas and Coffee

- The markets for soft drinks and coffee illustrate the characteristics of monopolistic competition.

Elasticities of Demand for Brands of Colas and Coffee

	Brand	Elasticity of Demand
Colas:	Royal Crown	-2.4
	Coke	-5.2 to -5.7
Ground Coffee:	Hills Brothers	-7.1
	Maxwell House	-8.9
	Chase and Sanborn	-5.6

Elasticities of Demand for Brands of Colas and Coffee

- Questions
  1) Why is the demand for Royal Crown more price inelastic than for Coke?
  2) Is there much monopoly power in these two markets?
  3) Define the relationship between elasticity and monopoly power.

Oligopoly

- Characteristics
  - Small number of firms
  - Product differentiation may or may not exist
  - Barriers to entry

Oligopoly

- Examples
  - Automobiles
  - Steel
  - Aluminum
  - Petrochemicals
  - Electrical equipment
  - Computers

Oligopoly

- The barriers to entry are:
  - Natural
    - Scale economies
    - Patents
    - Technology
    - Name recognition

Oligopoly

- The barriers to entry are:
  - Strategic action
    - Flooding the market
    - Controlling an essential input

Oligopoly

- Management Challenges
  - Strategic actions
  - Rival behavior
- Question
  - What are the possible rival responses to a 10% price cut by Ford?

Oligopoly

- Equilibrium in an Oligopolistic Market
  - In perfect competition, monopoly, and monopolistic competition the producers did not have to consider a rival's response when choosing output and price.
  - In oligopoly the producers must consider the response of competitors when choosing output and price.

Oligopoly

- Equilibrium in an Oligopolistic Market
  - Defining Equilibrium
    - Firms doing the best they can and have no incentive to change their output or price
    - All firms assume competitors are taking rival decisions into account.

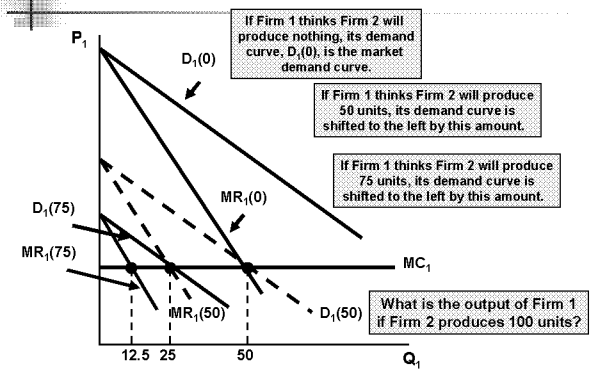
Oligopoly

- Nash Equilibrium
  - Each firm is doing the best it can given what its competitors are doing.

Oligopoly

- The Cournot Model
  - Duopoly
    - Two firms competing with each other
    - Homogenous good
    - The output of the other firm is assumed to be fixed

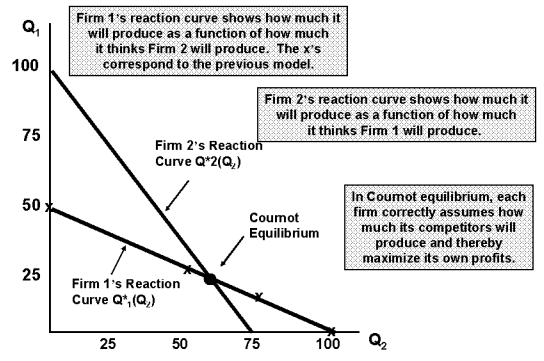
Firm 1's Output Decision



Oligopoly

- The Reaction Curve
  - A firm's profit-maximizing output is a decreasing schedule of the expected output of Firm 2.

Reaction Curves and Cournot Equilibrium



Oligopoly

- Questions
  1) If the firms are not producing at the Cournot equilibrium, will they adjust until the Cournot equilibrium is reached?
  2) When is it rational to assume that its competitor's output is fixed?

Oligopoly

The Linear Demand Curve

- An Example of the Cournot Equilibrium
  - Duopoly
    - Market demand is $P = 30 - Q$ where $Q = Q_1 + Q_2$
    - $MC_1 = MC_2 = 0$

Oligopoly

The Linear Demand Curve

- An Example of the Cournot Equilibrium
  - Firm 1's Reaction Curve

Total Revenue, $R_1 = PQ_1 = (30 - Q)Q_1$

$= 30Q_1 - (Q_1 + Q_2)Q_1$

$= 30Q_1 - Q_1^2 - Q_2Q_1$

Oligopoly

The Linear Demand Curve

- An Example of the Cournot Equilibrium

$MR_1 = \Delta R_1 / \Delta Q_1 = 30 - 2Q_1 - Q_2$

$MR_1 = 0 = MC_1$

Firm 1's Reaction Curve

$Q_1 = 15 - 1/2 Q_2$

Firm 2's Reaction Curve

$Q_2 = 15 - 1/2 Q_1$

Oligopoly

The Linear Demand Curve

- An Example of the Cournot Equilibrium

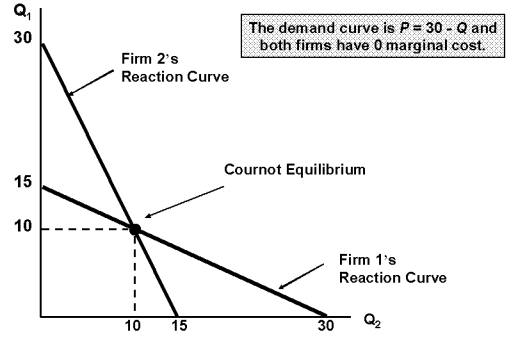
Cournot Equilibrium: $Q_1 = Q_2$

$15 - 1/2(15 - 1/2 Q_1) = 10$

$Q = Q_1 + Q_2 = 20$

$P = 30 - Q = 10$

Duopoly Example



Oligopoly

Profit Maximization with Collusion

$R = PQ = (30 - Q)Q = 30Q - Q^2$

$MR = \Delta R / \Delta Q = 30 - 2Q$

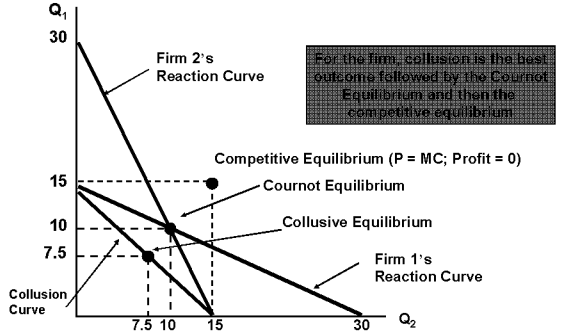
$MR = 0$ when $Q = 15$ and $MR = MC$

Oligopoly

Profit Maximization with Collusion

- Contract Curve
  - $Q_1 + Q_2 = 15$
    - Shows all pairs of output Q_1 and Q_2 that maximizes total profits
  - $Q_1 = Q_2 = 7.5$
    - Less output and higher profits than the Cournot equilibrium

Duopoly Example



First Mover Advantage-- The Stackelberg Model

- Assumptions
  - One firm can set output first
  - MC = 0
  - Market demand is P = 30 - Q where Q = total output
  - Firm 1 sets output first and Firm 2 then makes an output decision

First Mover Advantage-- The Stackelberg Model

- Firm 1
  - Must consider the reaction of Firm 2
- Firm 2
  - Takes Firm 1's output as fixed and therefore determines output with the Cournot reaction curve: $Q_2 = 15 - 1/2 Q_1$

First Mover Advantage-- The Stackelberg Model

- Firm 1
  - Choose Q_1 so that:

$MR = MC, MC = 0$ therefore MR = 0

$R_1 = PQ_1 = 30Q_1 - Q_1^2 - Q_2Q_1$

First Mover Advantage-- The Stackelberg Model

- Substituting Firm 2's Reaction Curve for Q_2:

$$R_1 = 30Q_1 - Q_1^2 - Q_1(15 - 1/2Q_1)$$
$$= 15Q_1 - 1/2\,Q_1^2$$

$$MR_1 = \Delta R_1 / \Delta Q_1 = 15 - Q_1$$

$$MR = 0 : Q_1 = 15 \text{ and } Q_2 = 7.5$$

First Mover Advantage-- The Stackelberg Model

- Conclusion
  - Firm 1's output is twice as large as firm 2's
  - Firm 1's profit is twice as large as firm 2's
- Questions
  - Why is it more profitable to be the first mover?
  - Which model (Cournot or Shackelberg) is more appropriate?

Price Competition

- Competition in an oligopolistic industry may occur with price instead of output.
- The Bertrand Model is used to illustrate price competition in an oligopolistic industry with homogenous goods.

Price Competition

Bertrand Model

- Assumptions
  - Homogenous good
  - Market demand is P = 30 - Q where $Q = Q_1 + Q_2$
  - MC = \$3 for both firms and $MC_1 = MC_2 =$ \$3

Price Competition

Bertrand Model

- Assumptions
  - The Cournot equilibrium:
    - $P = \$12$
    - π for both firms = \$81
  - Assume the firms compete with price, not quantity.

Price Competition

Bertrand Model

- How will consumers respond to a price differential? (Hint: Consider homogeneity)
  - The Nash equilibrium:
    - *P = MC; $P_1 = P_2 = \$3$*
    - *Q = 27; Q_1 & $Q_2 = 13.5$*
    - $\pi = 0$

Price Competition

Bertrand Model

- Why not charge a higher price to raise profits?
- How does the Bertrand outcome compare to the Cournot outcome?
- The Bertrand model demonstrates the importance of the strategic variable (price versus output).

Price Competition

Bertrand Model

- Criticisms
  - When firms produce a homogenous good, it is more natural to compete by setting quantities rather than prices.
  - Even if the firms do set prices and choose the same price, what share of total sales will go to each one?
    - It may not be equally divided.

Price Competition

- Price Competition with Differentiated Products
  - Market shares are now determined not just by prices, but by differences in the design, performance, and durability of each firm's product.

Price Competition

Differentiated Products

- Assumptions
  - Duopoly
  - FC = \$20
  - VC = 0

Price Competition

Differentiated Products

- Assumptions
  - Firm 1's demand is $Q_1 = 12 - 2P_1 + P_2$
  - Firm 2's demand is $Q_2 = 12 - 2P_1 + P_1$
    - P_1 and P_2 are prices firms 1 and 2 charge respectively
    - Q_1 and Q_2 are the resulting quantities they sell

Price Competition

Differentiated Products

- Determining Prices and Output
  - Set prices at the same time

$$\text{Firm 1}: \pi_1 = P_1Q_1 - \$20$$
$$= P_1(12 - 2P_1 + P_2) - 20$$
$$= 12P_1 - 2P_1^2 + P_1P_2 - 20$$

Price Competition

Differentiated Products

- Determining Prices and Output
  - Firm 1: If P_2 is fixed:

Firm 1's profit maximizing price =

$$\Delta\pi_1/\Delta P_1 = 12 - 4P_1 + P_2 = 0$$

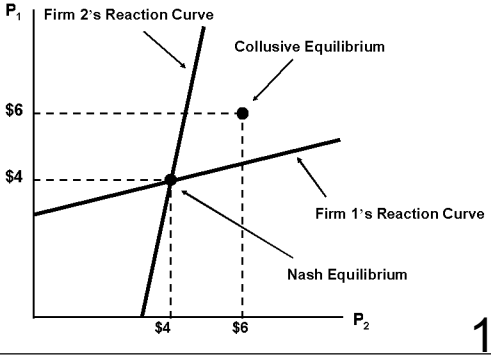
Firm 1's reaction curve =

$$P_1 = 3 + 1/4P_2$$

Firm 2's reaction curve =

$$P_2 = 3 + 1/4\,P_1$$

Nash Equilibrium in Prices



Nash Equilibrium in Prices

- Does the Stackelberg model prediction for first mover hold when price is the variable instead of quantity?
  - Hint: Would you want to set price first?

A Pricing Problem for Procter & Gamble

Differentiated Products

- Scenario

1) Procter & Gamble, Kao Soap, Ltd., and Unilever, Ltd were entering the market for Gypsy Moth Tape.

2) All three would be choosing their prices at the same time.

A Pricing Problem for Procter & Gamble

Differentiated Products

- Scenario

3) Procter & Gamble had to consider competitors prices when setting their price.

4) FC = \$480,000/month and VC = \$1/unit for all firms

A Pricing Problem for Procter & Gamble

Differentiated Products

- Scenario

5) P&G's demand curve was:

$$Q = 3{,}375P^{3.5}(P_U)^{.25}(P_K)^{.25}$$

  - Where P, P_U, P_K are P&G's, Unilever's, and Kao's prices respectively

A Pricing Problem for Procter & Gamble

Differentiated Products

- Problem
  - What price should P&G choose and what is the expected profit?

P&G's Profit (in thousands of \$ per month)

P&G's Price (\$)	Competitor's (Equal) Prices (\$)							
	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80
1.10	-226	-215	-204	-194	-183	-174	-165	-155
1.20	-106	-89	-73	-58	-43	-28	-15	-2
1.30	-56	-37	-19	2	15	31	47	62
1.40	-44	-25	-6	12	29	46	62	78
1.50	-52	-32	-15	3	20	36	52	68
1.60	-70	-51	-34	-18	-1	14	30	44
1.70	-93	-76	-59	-44	-28	-13	1	15
1.80	-118	-102	-87	-72	-57	-44	-30	-17

A Pricing Problem for Procter & Gamble

- What Do You Think?

1) Why would each firm choose a price of \$1.40? Hint: Think Nash Equilibrium

2) What is the profit maximizing price with collusion?

Competition Versus Collusion: The Prisoners' Dilemma

- Why wouldn't each firm set the collusion price independently and earn the higher profits that occur with explicit collusion?

Competition Versus Collusion: The Prisoners' Dilemma

- Assume:

$FC = \$20$ and $VC = \$0$

Firm 1's demand: $Q = 12 - 2P_1 + P_2$

Firm 2's demand: $Q = 12 - 2P_2 + P_1$

Nash Equilibrium: $P = \$4 \quad \pi = \$12$

Collusion: $P = \$6 \quad \pi = \$16$

Competition Versus Collusion: The Prisoners' Dilemma

- Possible Pricing Outcomes:

$$\text{Firm 1: } P = \$6 \qquad \text{Firm 2: } P = \$6 \qquad \pi = \$16$$
$$P = \$6 \qquad P = \$4$$
$$\pi_2 = P_2Q_2 - 20$$
$$= (4)[12 - (2)(4) + 6] - 20 = \$20$$
$$\pi_1 = P_1Q_1 - 20$$
$$= (6)[12 - (2)(6) + 4] - 20 = \$4$$

Payoff Matrix for Pricing Game

Firm 1 \ Firm 2	Charge $4	Charge $6
Charge $4	$12, $12	$20, $4
Charge $6	$4, $20	$16, $16

Competition Versus Collusion: The Prisoners' Dilemma

- These two firms are playing a *noncooperative game.*
  - Each firm independently does the best it can taking its competitor into account.
- Question
  - Why will both firms both choose $4 when $6 will yield higher profits?

Competition Versus Collusion: The Prisoners' Dilemma

- An example in game theory, called the *Prisoners' Dilemma*, illustrates the problem oligopolistic firms face.

Competition Versus Collusion: The Prisoners' Dilemma

- Scenario
  - Two prisoners have been accused of collaborating in a crime.
  - They are in separate jail cells and cannot communicate.
  - Each has been asked to confess to the crime.

Payoff Matrix for Prisoners' Dilemma

Prisoner A \ Prisoner B	Confess	Don't confess
Confess	-5, -5	-1, -10
Don't confess	-10, -1	-2, -2

Would you choose to confess?

Payoff Matrix for the *P & G* Prisoners' Dilemma

- Conclusions: Oligipolistic Markets
  1) Collusion will lead to greater profits
  2) Explicit and implicit collusion is possible
  3) Once collusion exists, the profit motive to break and lower price is significant

Payoff Matrix for the P&G Pricing Problem

P&G \ Unilever and Kao	Charge $1.40	Charge $1.50
Charge $1.40	$12, $12	$29, $11
Charge $1.50	$3, $21	$20, $20

What price should *P & G* choose?

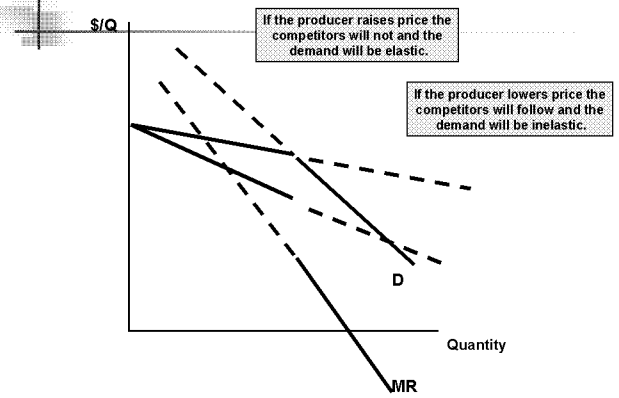
Implications of the Prisoners' Dilemma for Oligipolistic Pricing

- Observations of Oligopoly Behavior
  1) In some oligopoly markets, pricing behavior in time can create a predictable pricing environment and implied collusion may occur.

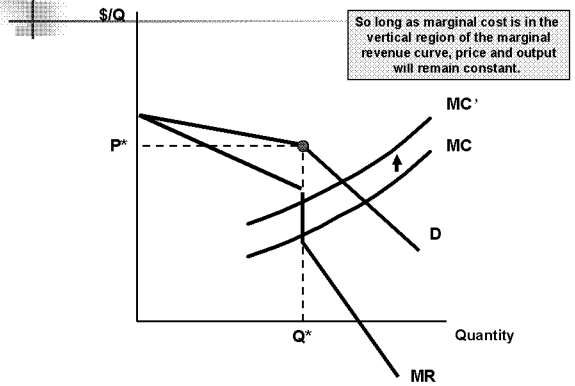
Implications of the Prisoners' Dilemma for Oligipolistic Pricing

- Observations of Oligopoly Behavior
  2) In other oligopoly markets, the firms are very aggressive and collusion is not possible.
     - Firms are reluctant to change price because of the likely response of their competitors.
     - In this case prices tend to be relatively rigid.

The Kinked Demand Curve



The Kinked Demand Curve



Implications of the Prisoners' Dilemma for Oligopolistic Pricing

Price Signaling & Price Leadership

- Price Signaling
  - Implicit collusion in which a firm announces a price increase in the hope that other firms will follow suit

Implications of the Prisoners' Dilemma for Oligopolistic Pricing

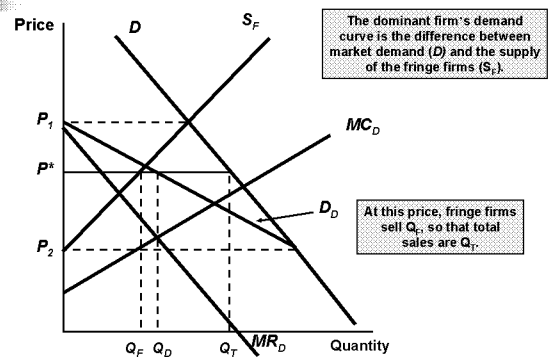
Price Signaling & Price Leadership

- Price Leadership
  - Pattern of pricing in which one firm regularly announces price changes that other firms then match

Implications of the Prisoners' Dilemma for Oligopolistic Pricing

- The Dominant Firm Model
  - In some oligopolistic markets, one large firm has a major share of total sales, and a group of smaller firms supplies the remainder of the market.
  - The large firm might then act as the *dominant firm*, setting a price that maximized its own profits.

Price Setting by a Dominant Firm



Cartels

- Characteristics

  1) Explicit agreements to set output and price

  2) May not include all firms

Cartels

- Characteristics

  3) Most often international

  - Examples of successful cartels
    - OPEC
    - International Bauxite Association
    - Mercurio Europeo
  - Examples of unsuccessful cartels
    - Copper
    - Tin
    - Coffee
    - Tea
    - Cocoa

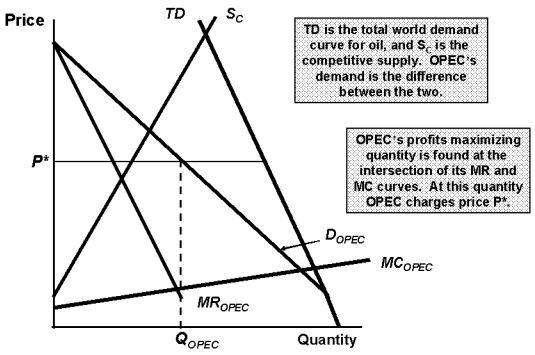
Cartels

- Characteristics
  4) Conditions for success
     - Competitive alternative sufficiently deters cheating
     - Potential of monopoly power--inelastic demand

Cartels

- Comparing OPEC to CIPEC
  - Most cartels involve a portion of the market which then behaves as the dominant firm

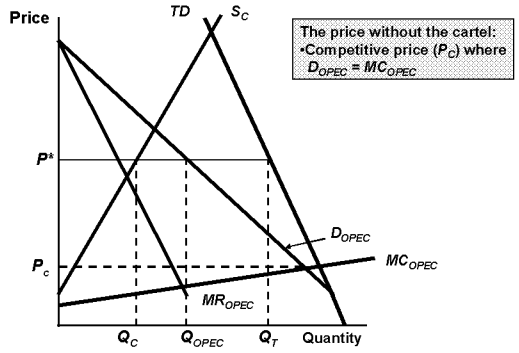
The OPEC Oil Cartel



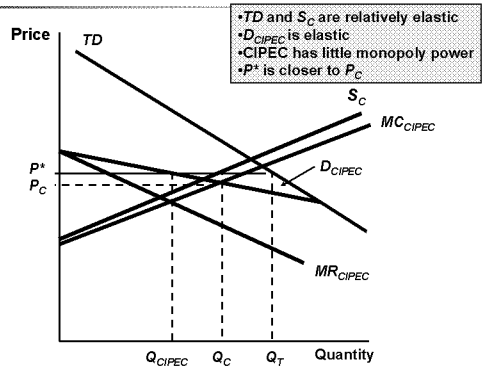
Cartels

- About OPEC
  - Very low *MC*
  - *TD* is inelastic
  - Non-OPEC supply is inelastic
  - D_{OPEC} is relatively inelastic

The OPEC Oil Cartel



The CIPEC Copper Cartel



Cartels

- Observations
  - To be successful:
    - Total demand must not be very price elastic
    - Either the cartel must control nearly all of the world's supply or the supply of noncartel producers must not be price elastic

The Cartelization of Intercollegiate Athletics

- Observations
  1) Large number of firms (colleges)
  2) Large number of consumers (fans)
  3) Very high profits

The Cartelization of Intercollegiate Athletics

- Question
  - How can we explain high profits in a competitive market? (Hint: Think cartel and the NCAA)

The Milk Cartel

- 1990s with less government support, the price of milk fluctuated more widely
- In response, the government permitted six New England states to form a milk cartel (Northeast Interstate Dairy Compact -- NIDC)

The Milk Cartel

- 1999 legislation allowed dairy farmers in Northeastern states surrounding NIDC to join NIDC, 7 in 16 Southern states to form a new regional cartel.
- Soy milk may become more popular.

Summary

- In a monopolistically competitive market, firms compete by selling differentiated products, which are highly substitutable.
- In an oligopolistic market, only a few firms account for most or all of production.

Summary

- In the Cournot model of oligopoly, firms make their output decisions at the same time, each taking the other's output as fixed.
- In the Stackelberg model, one firm sets its output first.

Summary

- The Nash equilibrium concept can also be applied to markets in which firms produce substitute goods and compete by setting price.
- Firms would earn higher profits by collusively agreeing to raise prices, but the antitrust laws usually prohibit this.

Summary

- The Prisoners' Dilemma creates price rigidity in oligopolistic markets.
- Price leadership is a form of implicit collusion that sometimes gets around the Prisoners Dilemma.
- In a cartel, producers explicitly collude in setting prices and output levels.

End of Chapter 12

Monopolistic Competition and Oligopoly

Chapter 13

Game Theory and Competitive Strategy

Topics to be Discussed

- Gaming and Strategic Decisions
- Dominant Strategies
- The Nash Equilibrium Revisited
- Repeated Games

Topics to be Discussed

- Sequential Games
- Threats, Commitments, and Credibility
- Entry Deterrence
- Bargaining Strategy
- Auctions

Gaming and Strategic Decisions

- "*If I believe that my competitors are rational and act to maximize their own profits, how should I take their behavior into account when making my own profit-maximizing decisions?*"

Gaming and Strategic Decisions

- Noncooperative versus Cooperative Games
  - Cooperative Game
    - Players negotiate binding contracts that allow them to plan joint strategies
      - Example: Buyer and seller negotiating the price of a good or service or a joint venture by two firms (i.e. Microsoft and Apple)
      - Binding contracts are possible

Gaming and Strategic Decisions

- Noncooperative versus Cooperative Games
  - Noncooperative Game
    - Negotiation and enforcement of a binding contract are not possible
      - Example: Two competing firms assuming the others behavior determine, independently, pricing and advertising strategy to gain market share
      - Binding contracts are not possible

Gaming and Strategic Decisions

- Noncooperative versus Cooperative Games
  - "*The strategy design is based on understanding your opponent's point of view, and (assuming you opponent is rational) deducing how he or she is likely to respond to your actions*"

Gaming and Strategic Decisions

- An Example: How to buy a dollar bill
  1) Auction a dollar bill
  2) Highest bidder receives the dollar in return for the amount bid

Gaming and Strategic Decisions

- An Example
  3) Second highest bidder must pay the amount he or she bid
  4) How much would you bid for a dollar?

Acquiring a Company

- Scenario
  - Company *A*: The Acquirer
  - Company *T*: The Target
  - *A* will offer cash for all of *T*'s shares
- What price to offer?

Acquiring a Company

- Scenario
  - The value of *T* depends on the outcome of a current oil exploration project.
    - Failure: *T*'s value = $0
    - Success: *T*'s value = $100/share
    - All outcomes are equally likely

Acquiring a Company

- Scenario
  - *T*'s value will be 50% greater with *A*'s management.
  - *A,* must submit the proposal before the exploration outcome is known.
  - *T* will not choose to accept or reject until after the outcome is known only to *T*.
- How much should *A* offer?

Dominant Strategies

- Dominant Strategy
  - One that is optimal no matter what an opponent does.
  - An Example
    - *A & B* sell competing products
    - They are deciding whether to undertake advertising campaigns

Payoff Matrix for Advertising Game

		Firm B: Advertise	Firm B: Don't Advertise
Firm A	Advertise	10, 5	15, 0
	Don't Advertise	6, 8	10, 2

Payoff Matrix for Advertising Game

- Observations
  - *A:* regardless of *B,* advertising is the best
  - *B:* regardless of *A,* advertising is best

		Firm B: Advertise	Firm B: Don't Advertise
Firm A	Advertise	10, 5	15, 0
	Don't Advertise	6, 8	10, 2

Payoff Matrix for Advertising Game

- Observations
  - Dominant strategy for *A & B* is to advertise
  - Do not worry about the other player
  - Equilibrium in dominant strategy

		Firm B: Advertise	Firm B: Don't Advertise
Firm A	Advertise	10, 5	15, 0
	Don't Advertise	6, 8	10, 2

Dominant Strategies

- Game Without Dominant Strategy
  - The optimal decision of a player without a dominant strategy will depend on what the other player does.

Modified Advertising Game

		Firm B: Advertise	Firm B: Don't Advertise
Firm A	Advertise	10, 5	15, 0
	Don't Advertise	6, 8	20, 2

Modified Advertising Game

- Observations
  - *A:* No dominant strategy; depends on *B*'s actions
  - *B:* Advertise
- Question
  - What should *A* do? (Hint: consider *B*'s decision

		Firm B: Advertise	Firm B: Don't Advertise
Firm A	Advertise	10, 5	15, 0
	Don't Advertise	6, 8	20, 2

The Nash Equilibrium Revisited

- *Dominant Strategies*
  - "I'm doing the best I can *no matter what you do."*
  - "You're doing the best you can *no matter what I do."*

The Nash Equilibrium Revisited

- Nash Equilibrium
  - "I'm doing the best I can *given what you are doing*"
  - "You're doing the best you can *given what I am doing.*"

The Nash Equilibrium Revisited

Product Choice Problem

- Examples With A Nash Equilibrium
  - Two cereal companies
  - Market for one producer of crispy cereal
  - Market for one producer of sweet cereal
  - Each firm only has the resources to introduce one cereal
  - Noncooperative

Product Choice Problem

Firm 1 \ *Firm 2*	Crispy	Sweet
Crispy	-5, -5	10, 10
Sweet	10, 10	-5, -5

Product Choice Problem

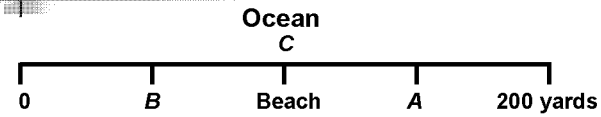
- Question
  - Is there a Nash equilibrium?
  - If not, why?
  - If so, how can it be reached

Firm 1 \ *Firm 2*	Crispy	Sweet
Crispy	-5, -5	10, 10
Sweet	10, 10	-5, -5

Beach Location Game

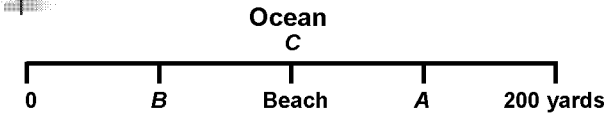
- Scenario
  - Two competitors, *Y* and *C*, selling soft drinks
  - Beach 200 yards long
  - Sunbathers are spread evenly along the beach
  - Price *Y* = Price *C*
  - Customer will buy from the closest vendor

Beach Location Game



Where will the competitors locate (i.e. where is the Nash equilibrium)?

Beach Location Game



2) Examples of this decision problem include:
   - Locating a gas station
   - Presidential elections

The Nash Equilibrium Revisited

- Maximin Strategies
  - Scenario
    - Two firms compete selling file-encryption software
    - They both use the same encryption standard (files encrypted by one software can be read by the other - advantage to consumers)

The Nash Equilibrium Revisited

- Maximin Strategies
  - Scenario
    - *Firm 1* has a much larger market share than *Firm 2*
    - Both are considering investing in a new encryption standard

Maximin Strategy

Firm 1 \ Firm 2	Don't invest	Invest
Don't invest	0, 0	-10, 10
Invest	-100, 0	20, 10

Maximin Strategy

- Observations
  - Dominant strategy *Firm 2:* Invest
  - Nash equilibrium
    - *Firm 1:* invest
    - *Firm 2:* Invest

Firm 1 \ Firm 2	Don't invest	Invest
Don't invest	0, 0	-10, 10
Invest	-100, 0	20, 10

Maximin Strategy

- Observations
  - If *Firm* 2 does not invest, *Firm 1* incurs significant losses
  - *Firm 1* might play don't invest
    - Minimize losses to 10 -- maximin strategy

Firm 1 \ Firm 2	Don't invest	Invest
Don't invest	0, 0	-10, 10
Invest	-100, 0	20, 10

The Nash Equilibrium Revisited

Maximin Strategy

- If both are rational and informed
  - Both firms invest
  - Nash equilibrium

The Nash Equilibrium Revisited

Maximin Strategy

- Consider
  - If Player 2 is not rational or completely informed
    - *Firm 1's* maximin strategy is to not invest
    - *Firm 2's* maximin strategy is to invest.
    - If *1* knows *2* is using a maximin strategy, *1* would invest

Prisoners' Dilemma

Prisoner A \ Prisoner B	Confess	Don't Confess
Confess	-5, -5	-1, -10
Don't Confess	-10, -1	-2, -2

Prisoners' Dilemma

- What is the:
  - Dominant strategy
  - Nash equilibrium
  - Maximin solution

Prisoner A \ Prisoner B	Confess	Don't Confess
Confess	-5, -5	-1, -10
Don't Confess	-10, -1	-2, -2

The Nash Equilibrium Revisited

Mixed Strategy

- Pure Strategy
  - Player makes a specific choice
- Mixed Strategy
  - Player makes a random choice among two or more possible actions based on a set of chosen probabilities

Matching Pennies

Player A \ Player B	Heads	Tails
Heads	1, -1	-1, 1
Tails	-1, 1	1, -1

Matching Pennies

- Observations
  - Pure strategy: No Nash equilibrium
  - Mixed strategy: Random choice is a Nash equilibrium
  - Would a firm set price based on random choice assumption?

		Player B: Heads	Player B: Tails
Player A	Heads	1, -1	-1, 1
	Tails	-1, 1	1, -1

The Battle of the Sexes

		Joan: Wrestling	Joan: Opera
Jim	Wrestling	2,1	0,0
	Opera	0,0	1,2

The Battle of the Sexes

- Pure Strategy
  - Both watch wrestling
  - Both watch opera
- Mixed Strategy
  - Jim chooses wrestling
  - Joan chooses wrestling

		Joan: Wrestling	Joan: Opera
Jim	Wrestling	2,1	0,0
	Opera	0,0	1,2

Repeated Games

- Oligopolistic firms play a *repeated game.*
- With each repetition of the Prisoners' Dilemma, firms can develop reputations about their behavior and study the behavior of their competitors.

Pricing Problem

		Firm 2: Low Price	Firm 2: High Price
Firm 1	Low Price	10, 10	100, -50
	High Price	-50, 100	50, 50

Pricing Problem

- Non-repeated game
  - Strategy is Low_1, Low_2
- Repeated game
  - Tit-for-tat strategy is the most profitable

		Firm 2: Low Price	Firm 2: High Price
Firm 1	Low Price	10, 10	100, -50
	High Price	-50, 100	50, 50

Repeated Games

- Conclusion:
  - With repeated game
    - The Prisoners' Dilemma can have a cooperative outcome with tit-for-tat strategy

Repeated Games

- Conclusion:
  - This is most likely to occur in a market with:
    - Few firms
    - Stable demand
    - Stable cost

Repeated Games

- Conclusion
  - Cooperation is difficult at best since these factors may change in the long-run.

Oligopolistic Cooperation in the Water Meter Industry

- Characteristics of the Market
  - Four Producers
    - Rockwell International (35%), Badger Meter, Neptune Water Meter Company, and Hersey Products (Badger, Neptune, and Hersey combined have about a 50 to 55% share)

Oligopolistic Cooperation in the Water Meter Industry

- Characteristics of the Market
  - Very inelastic demand
    - Not a significant part of the budget

Oligopolistic Cooperation in the Water Meter Industry

- Characteristics of the Market
  - Stable demand
  - Long standing relationship between consumer and producer
    - Barrier
  - Economies of scale
    - Barrier

Oligopolistic Cooperation in the Water Meter Industry

- Characteristics of the Market
  - This is a Prisoners' Dilemma
    - Lower price to a competitive level
    - Cooperate
  - Repeated Game
- Question
  - Why has cooperation prevailed?

Competition and Collusion in the Airline Industry

- What Do You Think?
  - Is there cooperation & collusion in the airline industry?

Sequential Games

- Players move in turn
- Players must think through the possible actions and rational reactions of each player

Sequential Games

- Examples
  - Responding to a competitor's ad campaign
  - Entry decisions
  - Responding to regulatory policy

Sequential Games

The Extensive Form of a Game

- Scenario
  - Two new (sweet, crispy) cereals
  - Successful only if each firm produces one cereal
  - Sweet will sell better
  - Both still profitable with only one producer

Modified Product Choice Problem

		Firm 2	
		Crispy	**Sweet**
Firm 1	**Crispy**	**-5, -5**	**10, 20**
	Sweet	**20, 10**	**-5, -5**

Modified Product Choice Problem

- Question
  - What is the likely outcome if both make their decisions independently, simultaneously, and without knowledge of the other's intentions?

Firm 1 \ Firm 2	Crispy	Sweet
Crispy	-5, -5	10, 20
Sweet	20, 10	-5, -5

Modified Product Choice Problem

The Extensive Form of a Game

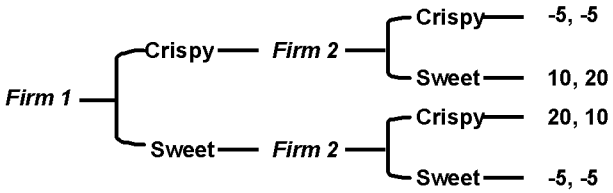
- Assume that Firm 1 will introduce its new cereal first (a sequential game).
- Question
  - What will be the outcome of this game?

Sequential Games

The Extensive Form of a Game

- The Extensive Form of a Game
  - Using a decision tree
    - Work backward from the best outcome for Firm 1

Product Choice Game in Extensive Form



Sequential Games

- The Advantage of Moving First
  - In this product-choice game, there is a clear advantage to moving first.

Sequential Games

The Advantage of Moving First

- Assume: Duopoly

$$P = 30 - Q$$

$$Q = \text{Total Production} = Q_1 + Q_2$$

$$MC = 0$$

$$Q_1 + Q_2 = 10 \text{ and } P = 10 \quad \pi = 100/\text{Firm}$$

Sequential Games

The Advantage of Moving First

- Duopoly

With Collusion

$$Q_1 = Q_2 = 7.5 \text{ and } P = 15 \quad \pi = 112.50/\text{Firm}$$

Firm Moves First (Stackelberg)

$$Q_1 = 15 \quad Q_2 = 7.5 \text{ and } P = 7.50$$

$$\pi_1 = 112.50 \quad \pi_2 = 56.25$$

Choosing Output

Firm 1 \ Firm 2	7.5	10	15
7.5	112.50, 112.50	93.75, 125	56.25, 112.50
10	125, 93.75	100, 100	50, 75
15	112.50, 56.25	75, 50	0, 0

Choosing Output

- This payoff matrix illustrates various outcomes
  - Move together, both produce 10
  - Question
    - What if Firm 1 moves first?

Firm 1 \ Firm 2	7.5	10	15
7.5	112.50, 112.50	93.75, 125	56.25, 112.50
10	125, 93.75	100, 100	50, 75
15	112.50, 56.25	75, 50	0, 0

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Threats, Commitments, and Credibility

- Strategic Moves
  - What actions can a firm take to gain advantage in the marketplace?
    - Deter entry
    - Induce competitors to reduce output, leave, raise price
    - Implicit agreements that benefit one firm

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Threats, Commitments, and Credibility

- How To Make the First Move
  - Demonstrate Commitment
  - *Firm 1* must constrain his behavior to the extent *Firm 2* is convinced that he is committed

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Threats, Commitments, and Credibility

- Empty Threats
  - If a firm will be worse off if it charges a low price, the threat of a low price is not credible in the eyes of the competitors.

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Pricing of Computers and Word Processors

		Firm 2	
		High Price	**Low Price**
Firm 1	**High Price**	**100, 80**	**80, 100**
	Low Price	**20, 0**	**10, 20**

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Pricing of Computers and Word Processors

- Question
  - Can *Firm 1* force *Firm 2* to charge a high price by threatening to lower its price?

		Firm 2	
		High Price	**Low Price**
Firm 1	**High Price**	**100, 80**	**80, 100**
	Low Price	**20, 0**	**10, 20**

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Threats, Commitments, and Credibility

- Scenario
  - Race Car Motors, Inc. (*RCM*) produces cars
  - Far Out Engines (*FOE*) produces specialty car engines and sells most of them to *RCM*
  - Sequential game with *RCM* as the leader
  - *FOE* has no power to threaten to build big since *RCM* controls output.

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Production Choice Problem

		Race Car Motors	
		Small cars	**Big cars**
Far Out Engines	**Small engines**	**3, 6**	**3, 0**
	Big engines	**1, 1**	**8, 3**

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Threats, Commitments, and Credibility

- Question
  - How could FOE force RCM to shift to big cars?

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Modified Production Choice Problem

		Race Car Motors	
		Small cars	**Big cars**
Far Out Engines	**Small engines**	**0, 6**	**0, 0**
	Big engines	**1, 1**	**8, 3**

Modified Production Choice Problem

- Questions
  1) What is the risk of this strategy?
  2) How could irrational behavior give *FOE* some power to control output?

Wal-Mart Stores' Preemptive Investment Strategy

- Question
  - How did Wal-Mart become the largest retailer in the U.S. when many established retail chains were closing their doors?
    - Hint
      - How did Wal-Mart gain monopoly power?
      - Preemptive game with Nash equilibrium

The Discount Store Preemption Game

		Company X	
		Enter	Don't enter
Wal-Mart	Enter	-10, -10	20, 0
	Don't enter	0, 20	0, 0

The Discount Store Preemption Game

- Two Nash equilibrium
  - Low left
  - Upper right
- Must be preemptive to win

		Company X	
		Enter	Don't enter
Wal-Mart	Enter	-10, -10	20, 0
	Don't enter	0, 20	0, 0

Entry Deterrence

- To deter entry, the incumbent firm must convince any potential competitor that entry will be unprofitable.

Entry Possibilities

		Potential Entrant	
		Enter	Stay out
Incumbent	High price (accommodation)	100, 20	200, 0
	Low Price (warfare)	70, -10	130, 0

Entry Deterrence

- Scenario
  - Incumbent monopolist (*I*) and prospective entrant (*X*)
  - *X* single cost = $80 million to build plant

Entry Deterrence

- Scenario
  - If *X* does not enter *I* makes a profit of $200 million.
  - If *X* enters and charges a high price *I* earns a profit of $100 million and *X* earns $20 million.
  - *If* X enters and charges a low price *I* earns a profit of $70 million and X earns $-10 million.

Entry Deterrence

- Question
  - How could *I* keep *X* out?
    - Is the threat credible?

Entry Deterrence

- How could *I* keep *X* out?
  1) Make an investment before entry (irrevocable commitment)
  2) Irrational behavior

Entry Deterrence

After $50 million Early Investment

		Potential Entrant	
		Enter	**Stay out**
Incumbent	**High price (accommodation)**	**50, 20**	**150, 0**
	Low Price (warfare)	**70, -10**	**130, 0**

Entry Deterrence

After $50 million Early Investment

- Warfare likely
- *X* will stay out

		Potential Entrant	
		Enter	**Stay out**
Incumbent	**High price (accommodation)**	**50, 20**	**150, 0**
	Low Price (warfare)	**70, -10**	**130, 0**

Entry Deterrence

- Airbus vs. Boeing
  - Without Airbus being subsidized, the payoff matrix for the two firms would differ significantly from one showing subsidization.

Development of a New Aircraft

		Airbus	
		Produce	**Don't produce**
Boeing	**Produce**	**-10, -10**	**100, 0**
	Don't produce	**0, 120**	**0, 0**

Development of a New Aircraft

- Boeing will produce
- Airbus will not produce

		Airbus	
		Produce	**Don't produce**
Boeing	**Produce**	**-10, -10**	**100, 0**
	Don't produce	**0, 120**	**0, 0**

Development of a Aircraft After European Subsidy

		Airbus	
		Produce	**Don't produce**
Boeing	**Produce**	**-10, 10**	**100, 0**
	Don't produce	**0, 120**	**0, 0**

Development of a Aircraft After European Subsidy

- Airbus will produce
- Boeing will not produce

		Airbus	
		Produce	**Don't produce**
Boeing	**Produce**	**-10, 10**	**100, 0**
	Don't produce	**0, 120**	**0, 0**

Diaper Wars

- Even though there are only two major firms, competition is intense.
- The competition occurs mostly in the form of *cost-reducing innovation*.

Competing Through R & D

P&G \ Kimberly-Clark	R&D	No R&D
R&D	40, 20	80, -20
No R&D	-20, 60	60, 40

Competing Through R & D

- Both spend on R&D
- Question
  - Why not cooperate

P&G \ Kimberly-Clark	R&D	No R&D
R&D	40, 20	80, -20
No R&D	-20, 60	60, 40

Bargaining Strategy

- Alternative outcomes are possible if firms or individuals can make promises that can be enforced.

Bargaining Strategy

- Consider:
  - Two firms introducing one of two complementary goods.

Bargaining Strategy

Firm 1 \ Firm 2	Produce A	Produce B
Produce A	40, 5	50, 50
Produce B	60, 40	5, 45

Bargaining Strategy

- With collusion:
  - Produce A_1B_2
- Without collusion:
  - Produce A_1B_2
  - Nash equilibrium

Firm 1 \ Firm 2	Produce A	Produce B
Produce A	40, 5	50, 50
Produce B	60, 40	5, 45

Bargaining Strategy

- Suppose
  - Each firm is also bargaining on the decision to join in a research consortium with a third firm.

Bargaining Strategy

Firm 1 \ Firm 2	Work alone	Enter consortium
Work alone	10, 10	10, 20
Enter consortium	20, 10	40, 40

Bargaining Strategy

- Dominant strategy
  - Both enter

Firm 1 \ Firm 2	Work alone	Enter consortium
Work alone	10, 10	10, 20
Enter consortium	20, 10	40, 40

Bargaining Strategy

- Linking the Bargain Problem
  - *Firm 1* announces it will join the consortium only if *Firm 2* agrees to produce *A* and *Firm 1* will produce *B.*
    - *Firm 1*'s profit increases from 50 to 60

Bargaining Strategy

- Strengthening Bargaining Power
  - Credibility
  - Reducing flexibility

Auctions

- Auction Formats
  - Traditional English (oral)
  - Dutch auction
  - Sealed-bid
    - First price
    - Second price

Auctions

Valuation and Information

- How to choose an auction format
  - Private-value auction: bidders uncertain about the other bidders reservation price
  - Common-value auction: bidders uncertain what the value is

Auctions

Private Value Auction

- Second-price sealed auction: bid your reservation price
- English auction: Bid in small increments until you reach your reservation price

Auctions

Private Value Auction

- The winning bids in both auctions is the reservation price of the second highest bidder

Auctions

Private Value Auction

- Sealed-bid auction
  - First-price auction: lowers the bid
  - Second-price auction: bid just above the second highest reservation price
- Both yield the same revenue

Auctions

Common Value Auction

- Winner's Curse
  - The winner is worse off than those who did not win

Auctions

Common Value Auction

- Examples
  - Bidding on a construction job
  - Bidding on offshore oil reserves

Auctions

Common Value Auction

- Question
  - How can you avoid the winner's curse?

Auctions

Maximizing Auction Revenue

- Private-value Auction
  - Have as many bidders as possible
- Common-value Auction
  - Use open-bid format
  - Release information about value

Internet Auctions

- A Few Caveats
  - Now quality control function
  - Poor seller feedback
  - Bid manipulation may occur

Summary

- A game is cooperative if the players can communicate and arrange binding contracts; otherwise it is noncooperative.
- A Nash equilibrium is a set of strategies such that all players are doing their best, given the strategies of the other players.

Summary

- Some games have no Nash equilibrium in pure strategies, but have one or more equilibria in mixed strategies.
- Strategies that are not optimal for a one-shot game may be optimal for a repeated game.
- In a sequential game, the players move in turn.

Summary

- An empty threat is a threat that one would have no incentive to carry out.
- To deter entry, an incumbent firm must convince any potential competitor that entry will be unprofitable.
- Bargaining situations are examples of cooperative games.

Summary

- Auctions can be conducted in a number of formats which influence the revenue raised and the price paid by the buyer.

End of Chapter 13

Game Theory and Competitive Strategy

Chapter 14

Markets for Factor Inputs

Topics to be Discussed

- Competitive Factor Markets
- Equilibrium in a Competitive Factor Market
- Factor Markets with Monopsony Power
- Factor Markets with Monopoly Power

Competitive Factor Markets

- Characteristics
  1) Large number of sellers of the factor of production
  2) Large number of buyers of the factor of production
  3) The buyers and sellers of the factor of production are price takers

Competitive Factor Markets

- Demand for a Factor Input When Only One Input Is Variable
  - Demand for factor inputs is a derived demand…
    - derived from factor cost and output demand

Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

Assume

- Two inputs: Capital (K) and Labor (L)
- Cost of K is r and the cost of labor is w
- K is fixed and L is variable

Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

- Problem
  - How much labor to hire

Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

- Measuring the Value of a Worker's Output
  - Marginal Revenue Product of Labor (MRP_L)
  - $MRP_L = (MP_L)(MR)$

Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

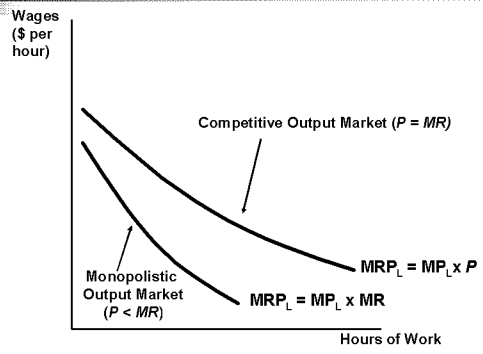
- Assume perfect competition in the product market
  - Then $MR = P$

Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

- Question
  - What will happen to the value of MRP_L when more workers are hired?

Marginal Revenue Product

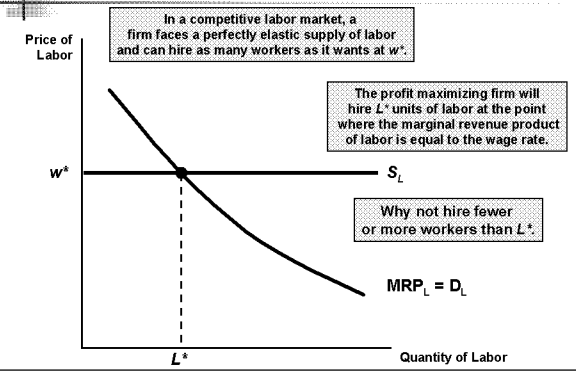


Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

- Choosing the profit-maximizing amount of labor
  - If $MRP_L > w$ (the marginal cost of hiring a worker): hire the worker
  - If $MRP_L < w$: hire less labor
  - If $MRP_L = w$: profit maximizing amount of labor

Hiring by a Firm in the Labor Market (with Capital Fixed)

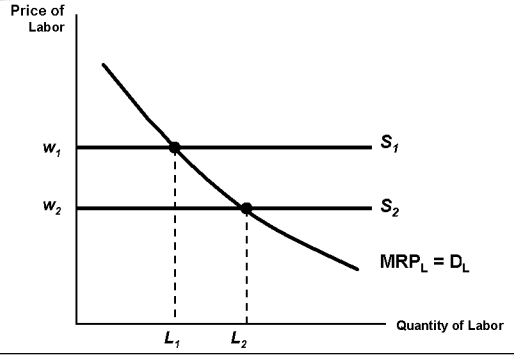


Competitive Factor Markets

Demand for a Factor Input When Only One Input Is Variable

- If the market supply of labor increased relative to demand (baby boomers or female entry), a surplus of labor would exist and the wage rate would fall.
- Question
  - How would this impact the quantity demanded for labor?

A Shift in the Supply of Labor



Competitive Factor Markets

- Comparing Input and Output Markets

$$MRP_L = (MP_L)(MR)$$

and at profit maximizing number of workers $MRP_L = w$

$$(MP_L)(MR) = w$$

$$MR = w/MP_L$$

w/MP_L = MC of production

Competitive Factor Markets

- Comparing Input and Output Markets
  - In both markets, input and output choices occur where MR = MC
    - MR from the sale of the output
    - MC from the purchase of the input

Competitive Factor Markets

Demand for a Factor Input When Several Inputs Are Variable

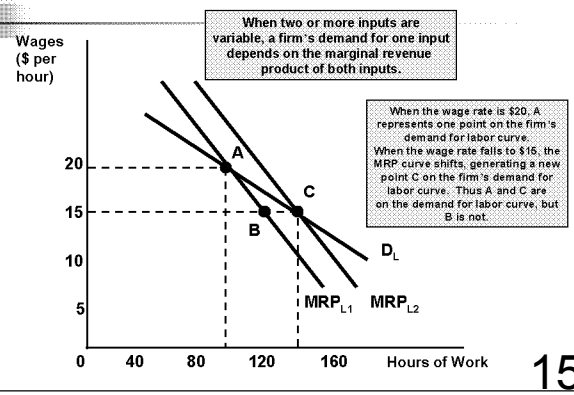
- Scenario
  - Producing farm equipment with two variable inputs:
    - Labor
    - Assembly-line machinery
  - Assume the wage rate falls

Competitive Factor Markets

Demand for a Factor Input When Several Inputs Are Variable

- Question
  - How will the decrease in the wage rate impact the demand for labor?

Firm's Demand Curve for Labor (with Variable Capital)

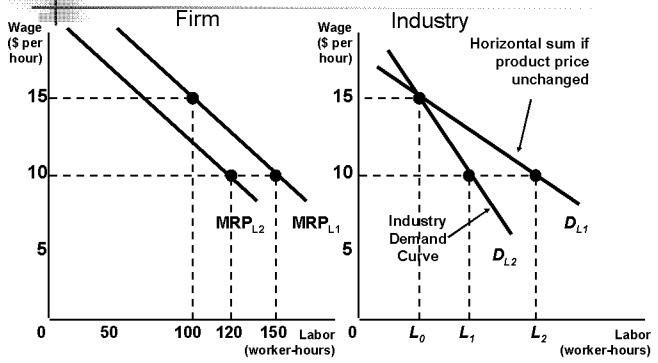


Competitive Factor Markets

Industry Demand for Labor

- Assume that all firms respond to a lower wage
  - All firms would hire more workers.
  - Market supply would increase.
  - The market price will fall.
  - The quantity demanded for labor by the firm will be smaller.

The Industry Demand for Labor



The Industry Demand for Labor

- Question
  - How would a change to a non-competitive market impact the derivation of the market demand for labor?

The Demand for Jet Fuel

- Observations
  - Jet fuel is a factor (input) cost
  - Cost of jet fuel
    - 1971--Jet fuel cost equaled 12.4% of total operating cost
    - 1980--Jet fuel cost equaled 30.0% of total operating cost
    - 1990's--Jet fuel cost equaled 15.0% of total operating cost

The Demand for Jet Fuel

- Observations
  - Airlines responded to higher prices in the 1970's by reducing the quantity of jet fuel used
  - Ton-miles increased by 29.6% & jet fuel consumed rose by 8.8%

The Demand for Jet Fuel

- Observations
  - The demand for jet fuel impacts the airlines and refineries alike
  - The short-run price elasticity of demand for jet-fuel is very inelastic

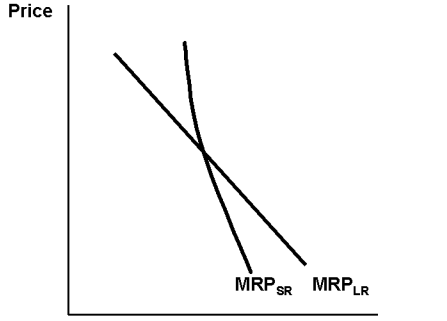
Short-run Price Elasticity of Demand for Jet Fuel

Airline	Elasticity	Airline	Elasticity
American	**-.06**	**Delta**	**-.15**
Continental	**-.09**	**TWA**	**-.10**
Northwest	**-.07**	**United**	**-.10**

The Demand for Jet Fuel

- Question
  - How would the long-run price elasticity of demand compare to the short-run?

The Short- and Long-Run Demand for Jet Fuel



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Competitive Factor Markets

- The Supply of Inputs to a Firm
  - Determining how much of an input to purchase
    - Assume a perfectly competitive factor market

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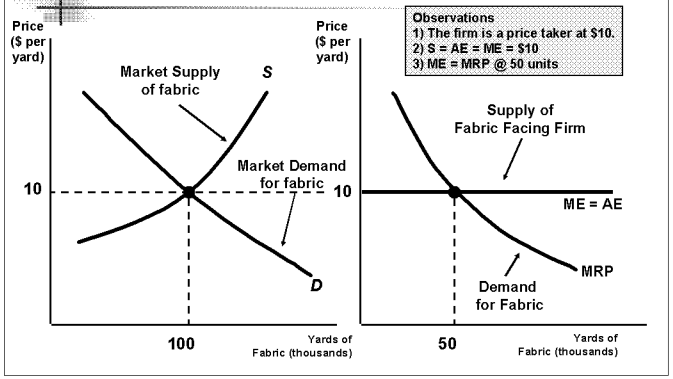
A Firm's Input Supply in a Competitive Factor Market



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Competitive Factor Markets

- The Market Supply of Inputs
  - The market supply for physical inputs is upward sloping
    - Examples: jet fuel, fabric, steel
  - The market supply for labor may be upward sloping and backward bending

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Competitive Factor Markets

- The Supply of Labor
  - The choice to supply labor is based on utility maximization
  - Leisure competes with labor for utility
  - Wage rate measures the price of leisure
  - Higher wage rate causes the price of leisure to increase

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Competitive Factor Markets

- The Supply of Labor
  - Higher wages encourage workers to substitute work for leisure (i.e. the substitution effect)
  - Higher wages allow the worker to purchase more goods, including leisure which reduces work hours (i.e. the income effect)

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Competitive Factor Markets

- The Supply of Labor
  - If the income effect exceeds the substitution effect the supply curve is backward bending

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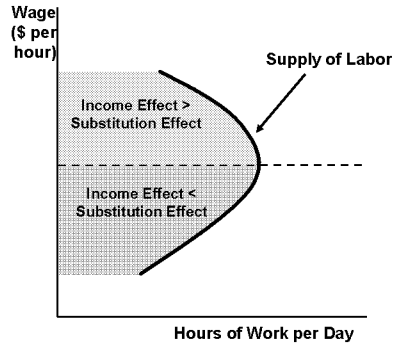
Backward-Bending Supply of Labor



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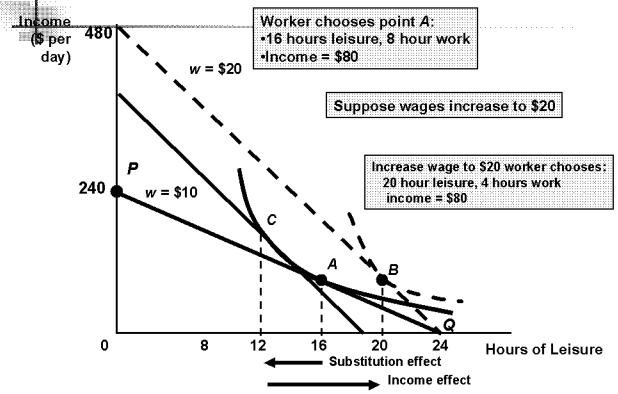
Substitution and Income Effects of a Wage Increase



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Labor Supply for One- and Two-Earner Households

- Female Percent of Labor Force
  - 1950 -- 29%
  - 1999 -- 60%

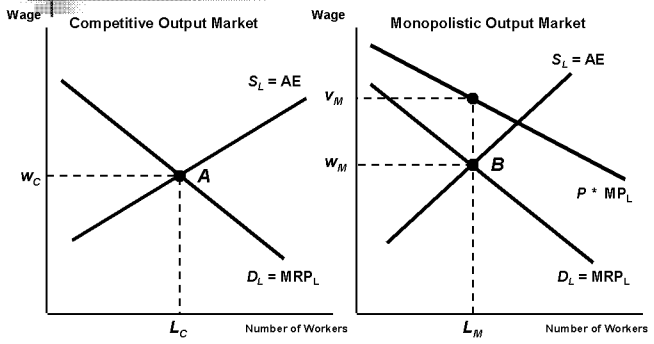
Elasticities of Labor Supply (Hours Worked)

Group	Head's Hours with Respect to Head's Wage	Spouse's Hours with Respect to Spouse's Wage	Head's Hours with Respect to Spouse's Wage
Unmarried males (no children)	.026		
Unmarried females (with children)	.106		
Unmarried females (no children)	.011		
One-earner family (with children)	-.078		
One-earner family (no children)	.007		
Two-earner family (with children)	-.002	-.086	-.004
Two-earner family (no children)	-.107	-.028	-.059

Equilibrium in a Competitive Factor Market

- A competitive factor market is in equilibrium when the price of the input equates the quantity demanded to the quantity supplied.

Labor Market Equilibrium



Labor Market Equilibrium

- Equilibrium in a Competitive Output Market
  - $D_L(MRP_L) = S_L$
  - $w_C = MRP_L$
  - $MRP_L = (P)(MP_L)$
  - Markets are efficient
- Equilibrium in a Monopolistic Output Market
  - $MR < P$
  - $MRP = (MR)(MP_L)$
  - Hire L_M at wage w_M
  - v_M = marginal benefit to consumers
  - w_M = marginal cost to the firm

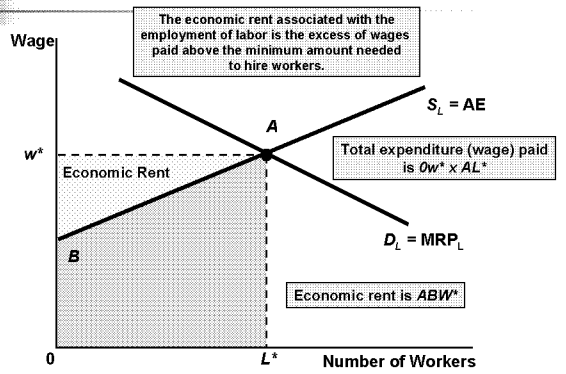
Labor Market Equilibrium

- Equilibrium in a Competitive Output Market
  - $D_L(MRP_L) = S_L$
  - $w_C = MRP_L$
  - $MRP_L = (P)(MP_L)$
  - Markets are efficient
- Equilibrium in a Monopolistic Output Market
  - Profits maximized
  - Using less than the efficient level of input

Equilibrium in a Competitive Factor Market

- Economic Rent
  - For a factor market, *economic rent is the difference between the payments made to a factor of production and the minimum amount that must be spent to obtain the use of that factor.*

Economic Rent



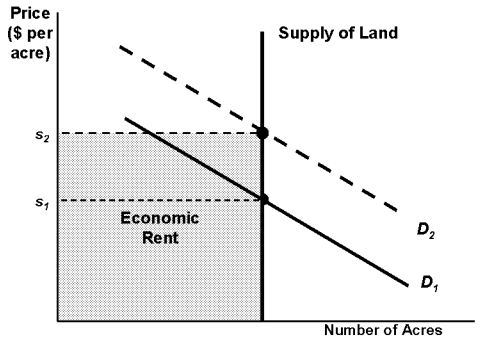
Economic Rent

- Question
  - What would be the economic rent if S_L is perfectly elastic or perfectly inelastic?

Equilibrium in a Competitive Factor Market

- Land: A Perfectly Inelastic Supply
  - With land inelastically supplied, its price is determined entirely by demand, at least in the short run.

Land Rent



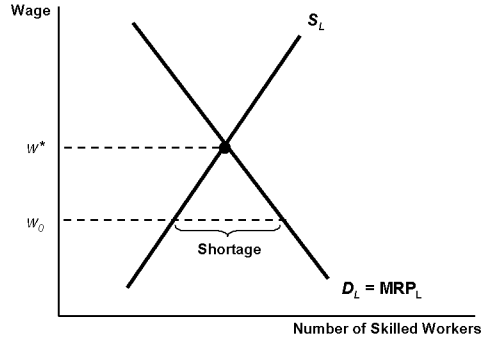
Pay in the Military

- During the Civil War 90% of the armed forces were unskilled workers involved in ground combat.
- Today, only 16% are unskilled workers involved in ground combat.

Pay in the Military

- Shortages of skilled personnel has occurred? Why?
  - Hint: If there is a shortage, the wage must be below the…?

The Shortage of Skilled Military Personnel



Pay in the Military

- Military pay is based on years of service not *MRP*.
- *MRP* increases and the private sector pay is greater than military pay.
- Many leave the military.

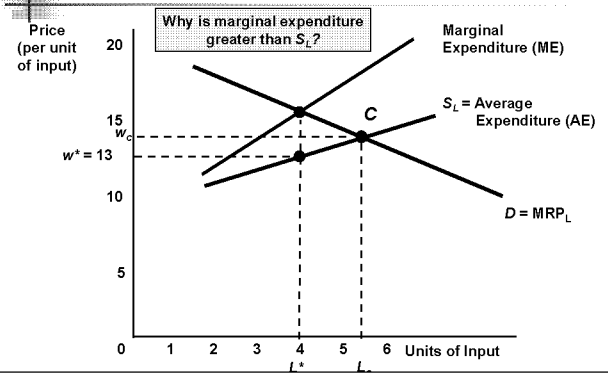
Pay in the Military

- Solution
  - Selective reenlistment bonuses
  - Base pay on *MRP*

Factor Markets with Monopsony Power

- Assume
  - The output market is perfectly competitive.
  - Input market is pure monopsony.

Marginal and Average Expenditure



Factor Markets with Monopsony Power

- Examples of Monopsony Power
  - Government
    - Soldiers
    - Missiles
    - B2 Bombers
  - NASA
    - Astronauts
  - Company town

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Monopsony Power in the Market for Baseball Players

- Baseball owners created a monopsonistic cartel
  - Reserve clause prevented competition for players
  - 1975--Free agency after six years
  - 1969--Average salary was $42,000 ($200,000 in 1999 dollars)
  - 1997--Average salary was $1,383,578

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Monopsony Power in the Market for Baseball Players

- Baseball owners created a monopolistic cartel
  - 1975 salaries were 25% of team expenditures
  - 1980 salaries were 40% of team expenditures

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Teenage Labor Markets and the Minimum Wage

- When the minimum wage rose in New Jersey in 1992 from $4.25 to $5.05, a survey conducted found a 13% increase in employment.

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Teenage Labor Markets and the Minimum Wage

- Explanations
  - Reduction in fringe benefits
  - Lower pay for more productive workers
  - Monopsony market

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Teenage Labor Markets and the Minimum Wage

- Findings
  - None of the explanations are validated by the survey results
  - Indicates of the need for further study

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Factor Markets with Monopoly Power

- Just as buyers of inputs can have monopsony power, sellers of inputs can have monopoly power.
- The most important example of monopoly power in factor markets involves labor unions.

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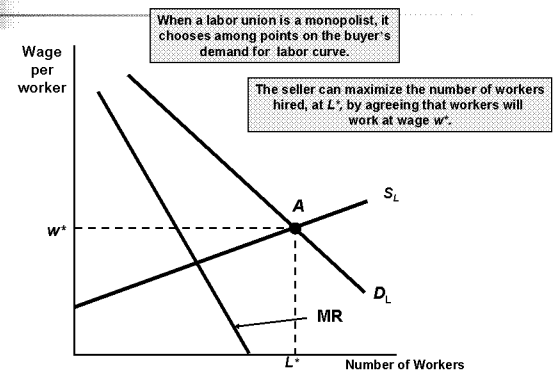
Monopoly Power of Sellers of Labor



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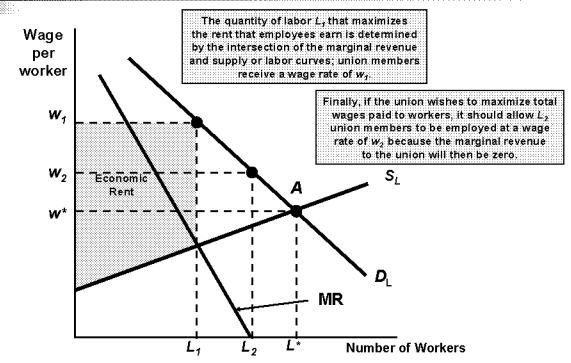
Monopoly Power of Sellers of Labor



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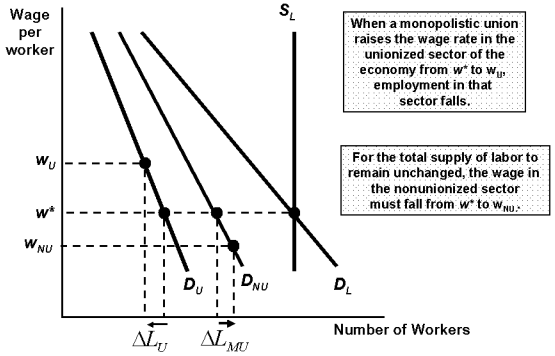
Factor Markets with Monopoly Power

- The primary determinant of controlling wage and economic rent is controlling the supply of labor

Factor Markets with Monopoly Power

- A Two-Sector Model of Labor Employment
  - Union monopoly power impacts the nonunionized part of the economy.

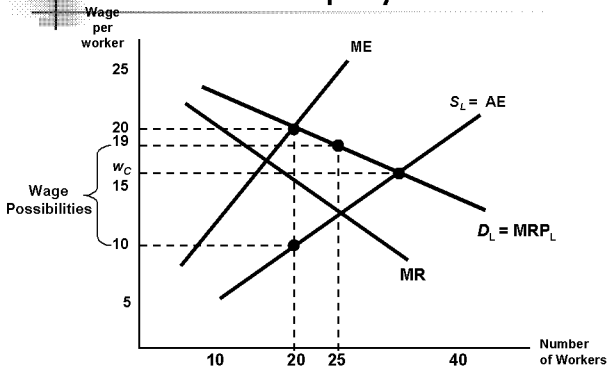
Wage Determination in Unionized and Nonunionized Sectors



Factor Markets with Monopoly Power

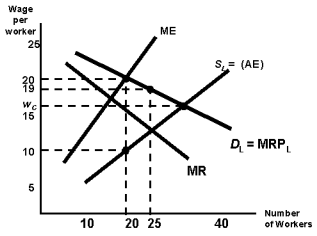
- Bilateral Monopoly
  - Market in which a monopolist sells to a monopsonist.

Bilateral Monopoly



Bilateral Monopoly

- Observations
  - Hiring without union monopoly power
    - *MRP* = *ME* at 20 workers and *w* = \$10/hr
  - Union's objective
    - *MR* = *MC* at 25 workers and *w* = \$19/hr



Bilateral Monopoly

- Who Will Win?
  - The union will if its threat to strike is credible.
  - The firm will if its threat to hire non-union workers is credible.
  - If both make credible threats the wage will be at w_c.

The Decline of Private Sector Unionism

- Observations
  - Union membership and monopoly power has been declining.
  - Initially, during the 1970's, union wages relative to nonunion wages fell.

The Decline of Private Sector Unionism

- Observations
  - In the 1980's union wages stabilized relative to non-union wages.
  - In the 1990's membership has been falling and wage differential has remained stable.

The Decline of Private Sector Unionism

- Explanation
  - The unions have been attempting to maximize the individual wage rate instead of total wages paid.
  - The demand for unionized employees has probably become increasingly elastic as firms find it easier to substitute capital for skilled labor.

Wage Inequality--Have Computers Changed the Labor Market?

- 1950 - 1980
  - Relative wage of college graduates to high-school graduates hardly changed
- 1980-1995
  - The relative wage grew rapidly

Wage Inequality--Have Computers Changed the Labor Market?

- In 1984, 25.1% of all workers used computers
- 1993 -- 46.6%
- 1999 -- nearly 60%

Wage Inequality--Have Computers Changed the Labor Market?

- Percent change in use of computers
  - College degrees
    - 1984 - 1993 -- 42 to 70%
  - Less than high school degree
    - 5 to 10%
  - With high school degree
    - 19 to 35%

Wage Inequality--Have Computers Changed the Labor Market?

- Growth in wages -- 1983 - 1994
  - College graduates using computers - 11%
  - Non-computer users -- less than 4%

Wage Inequality--Have Computers Changed the Labor Market?

- 1993 - 1997
  - High school dropouts out of school less than 10 years earned 29% less than high school graduates
  - 1963 -- The differential was only 19%

Wage Inequality--Have Computers Changed the Labor Market?

- 1993 - 1997
  - Average weekly wage for college graduates (out of school less than 10 years) was 96% higher than high school graduates.
  - College graduation premium has more than doubled.

Summary

- In a competitive input market, the demand for an input is given by the MRP, the product of the firm's marginal revenue, and the marginal product of the input.
- A firm in a competitive labor market will hire workers to the point at which the marginal revenue product of labor is equal to the wage rate.

Summary

- The market demand for an input is the horizontal sum of the industry demands for the input.
- When factor markets are competitive, the buyer of an input assumes that its purchase will have no effect on the price of the input.

Summary

- The market supply of a factor such as labor need not be upward sloping.
- Economic rent is the difference between the payments to factors of production and the minimum payment that would be needed to employ those factors.

Summary

- When a buyer of an input has monopsony power, the marginal expenditure curve lies above the average expenditure curve.
- When the input seller is a monopolist such as a labor union, the seller chooses the point on the marginal revenue product curve that best suits its objective.

Summary

- When a monopolistic union bargains with a monopsonistic employer, the wage rate depends on the nature of the bargaining process.

End of Chapter 14

Markets for Factor Inputs

Chapter 15

Investment, Time, and Capital Markets

Topics to be Discussed

- Stocks Versus Flows
- Present Discounted Value
- The Value of a Bond
- The Net Present Value Criterion for Capital Investment Decisions

Topics to be Discussed

- Adjustments for Risk
- Investment Decisions by Consumers
- Intertemporal Production Decisions---Depletable Resources
- How are Interest Rates Determined?

Introduction

- Capital
  - Choosing an input that will contribute to output over a long period of time
  - Comparing the future value to current expenditures

Stocks Versus Flows

- Stock
  - Capital is a stock measurement.
    - The amount of capital a company owns

Stocks Versus Flows

- Flows
  - Variable inputs and outputs are flow measurements.
    - An amount per time period

Present Discounted Value (PDV)

- Determining the value today of a future flow of income
  - The value of a future payment must be discounted for the time period and interest rate that could be earned.

Present Discounted Value (PDV)

- Future Value (FV)

Future Dollar Value of \$1 invested today $= (1+R)^n$

PDV = Present dollar value of \$1 received in the future $= \frac{1}{(1+R)^n}$; (how much would you have to invest today to have a dollar in the future)

Present Discounted Value (PDV)

- Question
  - What impact does *R* have on the PDV?

PDV of \$1 Paid in the Future

Interest Rate	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years
0.01	\$0.990	\$0.980	\$0.951	\$0.905	\$0.820	\$0.742
0.02	0.980	0.961	0.906	0.820	0.673	0.552
0.03	0.971	0.943	0.863	0.744	0.554	0.412
0.04	0.962	0.925	0.822	0.676	0.456	0.308
0.05	0.952	0.907	0.784	0.614	0.377	0.231
0.06	0.943	0.890	0.747	0.558	0.312	0.174

PDV of \$1 Paid in the Future

Interest Rate	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years
0.07	0.935	0.873	0.713	0.508	0.258	0.131
0.08	0.926	0.857	0.681	0.463	0.215	0.099
0.09	0.917	0.842	0.650	0.422	0.178	0.075
0.10	0.909	0.826	0.621	0.386	0.149	0.057
0.15	0.870	0.756	0.497	0.247	0.061	0.015
0.20	0.833	0.694	0.402	0.162	0.026	0.004

Present Discounted Value (PDV)

- Valuing Payment Streams
  - Choosing a payment stream depends upon the interest rate.

Two Payment Streams

	Today	1 Year	2 Years
Payment Stream *A*:	**\$100**	**\$100**	**0**
Payment Stream *B*:	**\$20**	**\$100**	**\$100**

Two Payment Streams

- PDV of Stream $A = \frac{100}{(1+R)}$

PDV of Stream $B = \frac{100}{(1+R)} + \frac{100}{(1+R)^2}$

PDV of Payment Streams

	R = .05	*R* = .10	*R* = .15	*R* = .20
PDV of Stream *A*:	**\$195.24**	**\$190.90**	**\$186.96**	**\$183.33**
PDV of Stream *B*:	**205.94**	**193.54**	**182.57**	**172.77**

Why does the PDV of *A* relative to *B* increase as *R* increases and vice versa for *B*?

The Value of Lost Earnings

- PDV can be used to determine the value of lost income from a disability or death.

The Value of Lost Earnings

- Scenario
  - Harold Jennings died in an auto accident January 1, 1986 at 53 years of age.
  - Salary: $85,000
  - Retirement Age: 60

The Value of Lost Earnings

- Question
  - What is the PDV of Jennings' lost income to his family?
    - Must adjust salary for predicted increase (g)
      - Assume an 8% average increase in salary for the past 10 years

The Value of Lost Earnings

- Question
  - What is the PDV of Jennings' lost income to his family?
    - Must adjust for the true probability of death (m) from other causes
      - Derived from mortality tables

The Value of Lost Earnings

- Question
  - What is the PDV of Jennings' lost income to his family?
    - Assume $R = 9\%$
      - Rate on government bonds in 1983

The Value of Lost Earnings

- $$\mathrm{PDV} = \mathrm{W}_0 + \frac{\mathrm{W}_0(1+g)(1-m_1)}{(1+R)} + \frac{\mathrm{W}_0(1+g)^2(1-m_2)}{(1+R)^2} + \ldots + \frac{\mathrm{W}_0(1+g)^7(1-m_7)}{(1+R)^7}$$

Calculating Lost Wages

Year	$W_0(1+g)^t$	$(1-m_t)$	$1/(1+R)^t$	$W_0(1+g)^t(1-m_t)/(1+R)^t$
1986	$ 85,000	.991	1.000	$84,235
1987	91,800	.990	.917	83,339
1988	99,144	.989	.842	82,561
1989	107,076	.988	.772	81,671
1990	115,642	.987	.708	80,810
1991	124,893	.986	.650	80,043
1992	134,884	.985	.596	79,185
1993	145,675	.984	.547	78,408

The Value of Lost Earnings

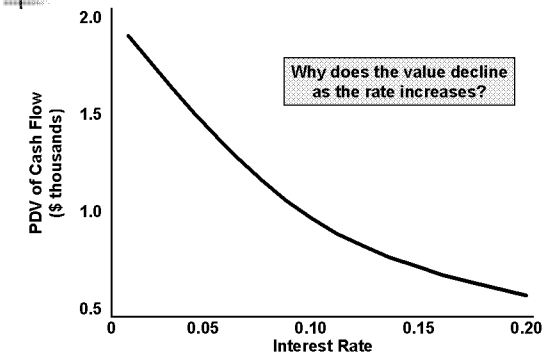
- Finding PDV
  - The summation of column 4 will give the PDV of lost wages ($650,252)
  - Jennings' family could recover this amount as compensation for his death.

The Value of a Bond

- Determining the Price of a Bond
  - Coupon Payments = $100/yr. for 10 yrs.
  - Principal Payment = $1,000 in 10 yrs.

$$\mathrm{PDV} = \frac{\$100}{(1+R)} + \frac{\$100}{(1+R)^2} + \ldots + \frac{\$100}{(1+R)^{10}} + \frac{\$1000}{(1+R)^{10}}$$

Present Value of the Cash Flow from a Bond



The Value of a Bond

- Perpetuities
  - Perpetuities are bonds that pay out a fixed amount of money each year, *forever.*

$$\text{PDV} = \frac{\text{Payment}}{R}$$

Effective Yield on a Bond

- Calculating the Rate of Return From a Bond

$P = \text{PDV}$

$$\text{Perpetuity}: P = \frac{\text{Payment}}{R} = \frac{\$100}{R}$$

$$R = \frac{\$100}{P} \qquad P = \$1{,}000$$

$$R = 10\%$$

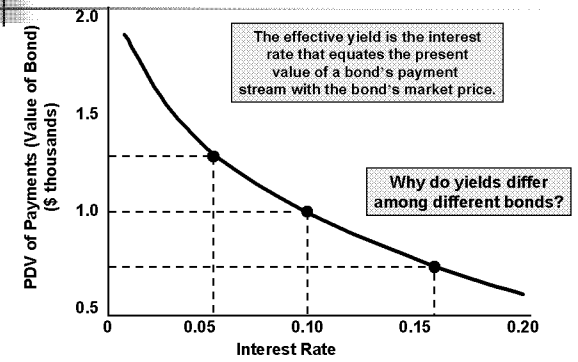
Effective Yield on a Bond

- Calculating the Rate of Return From a Bond

$$\text{Coupon Bond}: \text{PDV} = \frac{\$100}{(1+R)} + \frac{\$100}{(1+R)^2} + \ldots + \frac{\$100}{(1+R)^{10}} + \frac{\$1000}{(1+R)^{10}}$$

Calculate R in terms of P

Effective Yield on a Bond



The Yields on Corporate Bonds

- In order to calculate corporate bond yields, the face value of the bond and the amount of the coupon payment must be known.
- Assume
  - IBM and Polaroid both issue bonds with a face value of $100 and make coupon payments every six months.

The Yields on Corporate Bonds

- Closing prices for each July 23, 1999:

	a	*b*	*c*	*d*	*e*	*f*
IBM	53/8	09	5.8	30	92	-11/2
Polaroid	111/2	06	10.8	80	106	-5/8

a: coupon payments for one year ($5.375)
b: maturity date of bond (2009)
c: annual coupon/closing price ($5.375/92)
d: number traded that day (30)
e: closing price (92)
f: change in price from previous day (-11/2)

The Yields on Corporate Bonds

- The IBM bond yield:
  - Assume annual payments
  - 2009 - 1999 = 10 years

$$92 = \frac{5.375}{(1+R)} + \frac{5.375}{(1+R)^2} + \ldots + \frac{5.375}{(1+R)^{10}} + \frac{100}{(1+R)^{10}}$$

$$R^* = 6.5\%$$

The Yields on Corporate Bonds

- The Polaroid bond yield:

$$106 = \frac{11.5}{(1+R)} + \frac{11.5}{(1+R)^2} + \ldots + \frac{11.5}{(1+R)^7} + \frac{11.50}{(1+R)^7}$$

Why was Polaroid R^* greater?

$$R^* = 10.2\%$$

The Net Present Value Criterion for Capital Investment Decisions

- In order to decide whether a particular capital investment is worthwhile a firm should compare the present value (*PV*) of the cash flows from the investment to the cost of the investment.

The Net Present Value Criterion for Capital Investment Decisions

- NPV Criterion
  - Firms should invest if the *PV* exceeds the cost of the investment.

The Net Present Value Criterion for Capital Investment Decisions

- C = capital cost
- π_n = profits for n years (n = 10)

$$\text{NPV} = -C + \frac{\pi_1}{(1+R)} + \frac{\pi_2}{(1+R)^2} + \frac{\pi_{10}}{(1+R)^{10}}$$

R = discount rate or opportunity cost of capital with a similar risk

Invest if NPV > 0

The Net Present Value Criterion for Capital Investment Decisions

- The Electric Motor Factory (choosing to build a $10 million factory)
  - 8,000 motors/ month for 20 yrs
    - Cost = $42.50 each
    - Price = $52.50
    - Profit = $10/motor or $80,000/month
    - Factory life is 20 years with a scrap value of $1 million
  - Should the company invest?

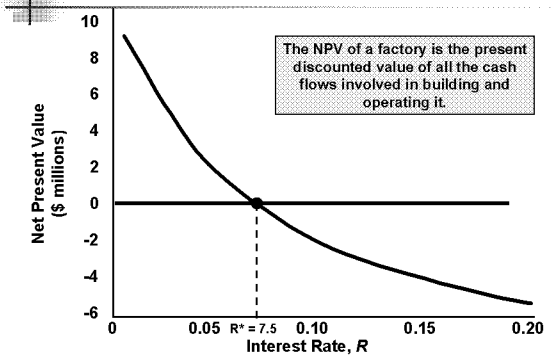
The Net Present Value Criterion for Capital Investment Decisions

- Assume all information is certain (no risk)
  - R = government bond rate

$$\text{NPV} = -10 + \frac{.96}{(1+R)} + \frac{.96}{(1+R)^2} + \ldots + \frac{.96}{(1+R)^{20}} + \frac{1}{(1+R)^{20}}$$

$$R^* = 7.5\%$$

Net Present Value of a Factory



The Net Present Value Criterion for Capital Investment Decisions

- Real versus Nominal Discount Rates
  - Adjusting for the impact of inflation
  - Assume price, cost, and profits are in real terms
    - Inflation = 5%

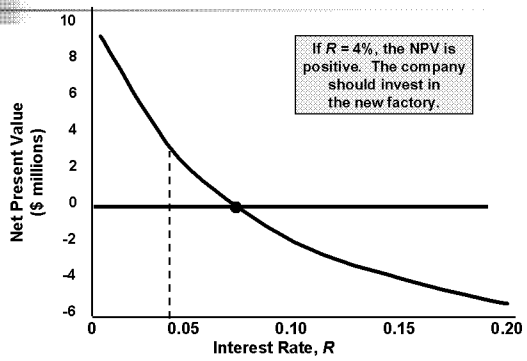
The Net Present Value Criterion for Capital Investment Decisions

- Real versus Nominal Discount Rates
  - Assume price, cost, and profits are in real terms
    - Therefore,
      - P = (1.05)(52.50) = 55.13, Year 2 P = (1.05)(55.13) = 57.88....
      - C = (1.05)(42.50) = 44.63, Year 2 C =....
      - Profit remains $960,000/year

The Net Present Value Criterion for Capital Investment Decisions

- Real versus Nominal Discount Rates
  - Real R = *nominal* R - inflation = 9 - 5 = 4

Net Present Value of a Factory



The Net Present Value Criterion for Capital Investment Decisions

- Negative Future Cash Flows
  - Investment should be adjusted for construction time and losses.

The Net Present Value Criterion for Capital Investment Decisions

- Electric Motor Factory
  - Construction time is 1 year
    - $5 million expenditure today
    - $5 million expenditure next year
  - Expected to lose $1 million the first year and $0.5 million the second year
  - Profit is $0.96 million/yr. until year 20
  - Scrap value is $1 million

The Net Present Value Criterion for Capital Investment Decisions

- $$NPV = -5 - \frac{5}{(1+R)} - \frac{1}{(1+R)^2} - \frac{.5}{(1+R)^3} + \frac{.96}{(1+R)^4} + \frac{.96}{(1+R)^5} + \ldots + \frac{.96}{(1+R)^{20}} + \frac{1}{(1+R)^{20}}$$

Adjustments for Risk

- Determining the discount rate for an uncertain environment:
  - This can be done by increasing the discount rate by adding a *risk-premium* to the risk-free rate.
    - Owners are risk averse, thus risky future cash flows are worth less than those that are certain.

Adjustments for Risk

- Diversifiable Versus Nondiversifiable Risk
  - Diversifiable risk can be eliminated by investing in many projects or by holding the stocks of many companies.
  - Nondiversifiable risk cannot be eliminated and should be entered into the risk premium.

Adjustments for Risk

- Measuring the Nondiversifiable Risk Using the Capital Asset Pricing Model (CAPM)
  - Suppose you invest in the entire stock market (mutual fund)
    - r_m = expected return of the stock market
    - r_f = risk free rate
    - $r_m - r_f$ = risk premium for nondiversifiable risk

Adjustments for Risk

- Measuring the Nondiversifiable Risk Using the Capital Asset Pricing Model (CAPM)
  - Calculating Risk Premium for One Stock

$$r_1 - r_f = \beta(r_m - r_f)$$

r_1 = expected return

β = asset beta = measures the sensitivity of the asset's return to market movements

Adjustments for Risk

- Question
  - What is the relationship between the nondiversifiable risk and the value of the *asset beta*?

Adjustments for Risk

- Given beta, we can determine the correct discount rate to use in computing an asset's net present value:

$$\text{Discount Rate} = r_f + \beta(r_m - r_f)$$

Adjustments for Risk

- Determining beta
  - Stock
    - Estimated statistically for each company

Adjustments for Risk

- Determining beta
  - Factory
    - Weighted average of expected return on the company's stock and the interest on the debt
      - Expected return depends on beta
    - *Caution:* The investment should be typical for the company

Investment Decisions by Consumers

- Consumers face similar investment decisions when they purchase a durable good.
  - Compare *future* benefits with the *current* purchase cost

Investment Decisions by Consumers

- Benefits and Cost of Buying a Car
  - S = value of transportation services in dollars
  - E = total operating cost/yr
  - Price of car is $20,000
  - Resale value of car is $4,000 in 6 years

Investment Decisions by Consumers

- Benefits and Cost

$$\text{NPV} = -20{,}000 + (S-E) + \frac{(S-E)}{(1+R)} + \frac{(S-E)}{(1+R)^2} + \ldots + \frac{(S-E)}{(1+R)^6} + \frac{4000}{(1+R)^6}$$

Choosing an Air Conditioner

- Buying a new air conditioner involves making a trade-off.
  - Air Conditioner *A*
    - Low price and less efficient (high operating cost)

Choosing an Air Conditioner

- Buying a new air conditioner involves making a trade-off.
  - Air Conditioner *B*
    - High price and more efficient
  - Both have the same cooling power
  - Assume an 8 year life

Choosing an Air Conditioner

- $PDV = C_i + OC_i + \frac{OC_i}{(1+R)} + \frac{OC_i}{(1+R)^2} + \ldots \frac{OC_i}{(1+R)^8}$

C_i is the purchase price of i

OC_i is the averge operating cost of i

Choosing an Air Conditioner

- Should you choose *A* or *B*?
  - Depends on the discount rate
    - If you borrow, the discount rate would be high
      - Probably choose a less expensive and inefficient unit
    - If you have plentiful cash, the discount rate would be low.
      - Probably choose the more expensive unit

Intertemporal Production Decisions---Depletable Resources

- Firms' production decisions often have *intertemporal* aspects---production today affects sales or costs in the future.

Intertemporal Production Decisions---Depletable Resources

- Scenario
  - You are given an oil well containing 1000 barrels of oil.
  - *MC* and *AC* = $10/barrel
  - Should you produce the oil or save it?

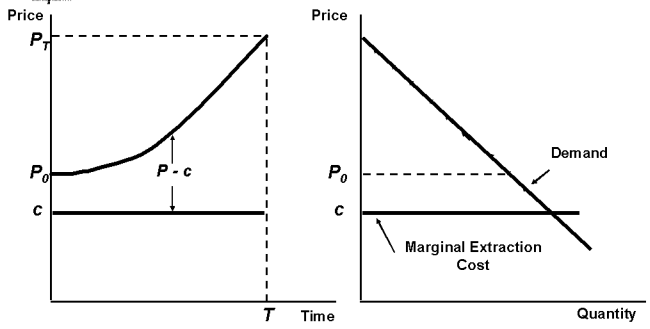
Intertemporal Production Decisions---Depletable Resources

- Scenario
  - P_t = price of oil this year
  - P_{t+1} = price of oil next year
  - C = extraction costs
  - R = interest rate
- If $(P_{t+1} - c) > (1+R)(P_t - c)$: Keep the oil in the ground
  If $(P_{t+1} - c) < (1+R)(P_t - c)$: Sell all the oil now
  If $(P_{t+1} - c) = (1+R)(P_t - c)$: Indifferent

Intertemporal Production Decisions---Depletable Resources

- Do not produce if you expect its price less its extraction cost to rise faster than the rate of interest.
- Extract and sell all of it if you expect price less cost to rise at less than the rate of interest.
- What will happen to the price of oil?

Price of an Exhaustible Resource



Price of an Exhaustible Resource

- In a competitive market, *Price - MC* must rise at exactly the rate of interest.
- Why?
  - How would producers react if:
    - *P - C* increases faster than *R*?
    - *P - C* increases slower than *R*?

Price of an Exhaustible Resource

- Notice
  - *P > MC*
    - Is this a contradiction to the competitive rule that *P = MC?*
      - *Hint:* What happens to the opportunity cost of producing an exhaustible resource?

Price of an Exhaustible Resource

- *P = MC*
  - *MC* = extraction cost + user cost
  - User cost = *P* - marginal extraction cost

Price of an Exhaustible Resource

- How would a monopolist choose their rate of production?
  - They will produce so that marginal revenue revenue less marginal cost rises at exactly the rate of interest, or
  - $(MR_{t+1} - c) = (1 + R)(MR_t - c)$

Price of an Exhaustible Resource

Resource Production by a Monopolist

- The monopolist is *more conservationist* than a competitive industry.
  - They start out charging a higher price and deplete the resources more slowly.

How Depletable Are Depletable Resources?

Resource	User Cost/Competitive Price
Crude oil	.4 to .5
Natural gas	.4 to .5
Uranium	.1 to .2
Copper	.2 to .3
Bauxite	.05 to .2
Nickel	.1 to .2
Iron Ore	.1 to .2
Gold	.05 to .1

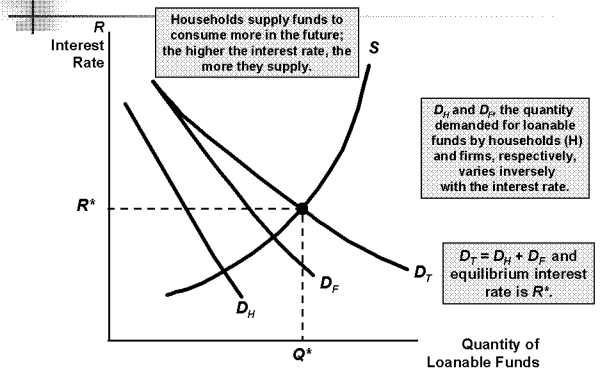
How Depletable Are Depletable Resources?

- The market structure and changes in market demand have had a very dramatic impact on resource prices over the past few decades.
- Question
  - Why would oil and natural gas have such a high user cost ratio compared to the other resources?

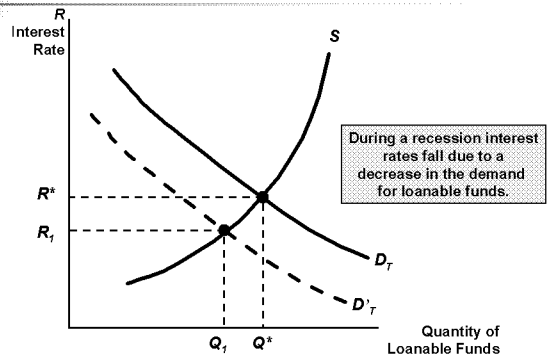
How Are Interest Rates Determined?

- The interest rate is the price that borrowers pay lenders to use their funds.
  - Determined by supply and demand for loanable funds.

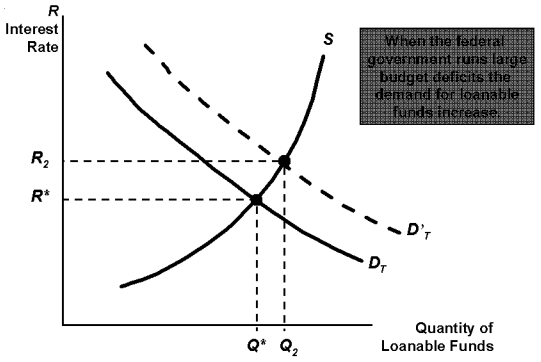
Supply and Demand for Loanable Funds



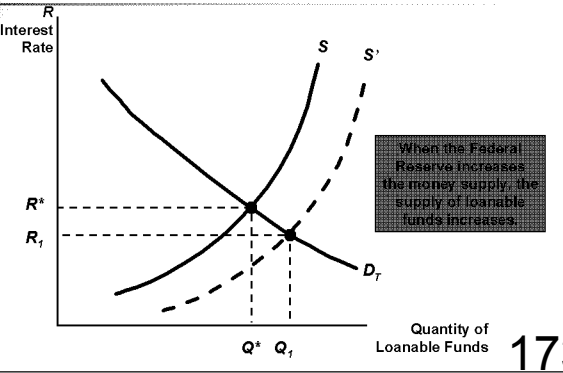
Changes In The Equilibrium



Changes In The Equilibrium



Changes In The Equilibrium



How Are Interest Rates Determined?

- A Variety of Interest Rates
  1) Treasury Bill Rate
  2) Treasury Bond Rate
  3) Discount Rate

How Are Interest Rates Determined?

- A Variety of Interest Rates
  4) Commercial Paper Rate
  5) Prime Rate
  6) Corporate Bond Rate

Summary

- A firm's holding of capital is measured as a stock, but inputs of labor and raw materials are flows.
- When a firm makes a capital investment, it spends money now, so that it can earn profits in the future.

Summary

- The present discounted value (PDV) of \$1 paid n years from now is $\$1/(1 + R)^n$.
- A bond is a contract in which a lender agrees to pay the bondholder a stream of money.

Summary

- Firms can decide whether to undertake a capital investment by applying the NPV criterion.
- The discount rate that a firm uses to calculate the NPV for an investment should be the opportunity cost of capital.

Summary

- An adjustment for risk can be made by adding a risk premium to the discount rate.
- Consumers are also faced with investment decisions that require the same kind of analysis as those of firms.

Summary

- An exhaustible resource in the ground is like money in the bank and must earn a comparable return.
- Market interest rates are determined by the demand and supply of loanable funds.

End of Chapter 15

Investment, Time, and Capital Markets

Chapter 16

General Equilibrium and Economic Efficiency

Topics to be Discussed

- General Equilibrium Analysis
- Efficiency in Exchange
- Equity and Efficiency
- Efficiency in Production

Topics to be Discussed

- The Gains from Free Trade
- On Overview--The Efficiency of Competitive Markets
- Why Markets Fail

General Equilibrium Analysis

- Partial equilibrium analysis presumes that activity in one market is independent of other markets.

General Equilibrium Analysis

- General equilibrium analysis determines the prices and quantity in all markets simultaneously and takes the *feedback effect* into account.

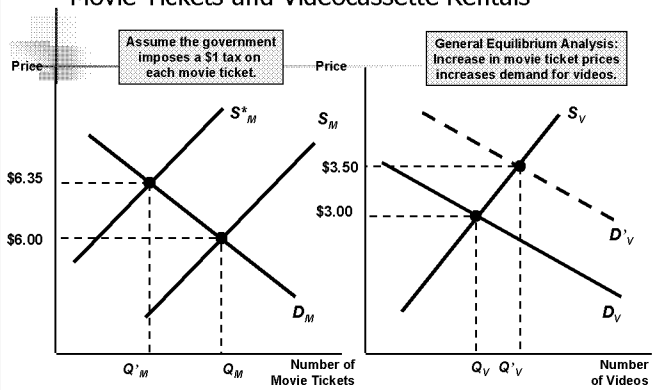
General Equilibrium Analysis

- A feedback effect is a price or quantity adjustment in one market caused by price and quantity adjustments in related markets.

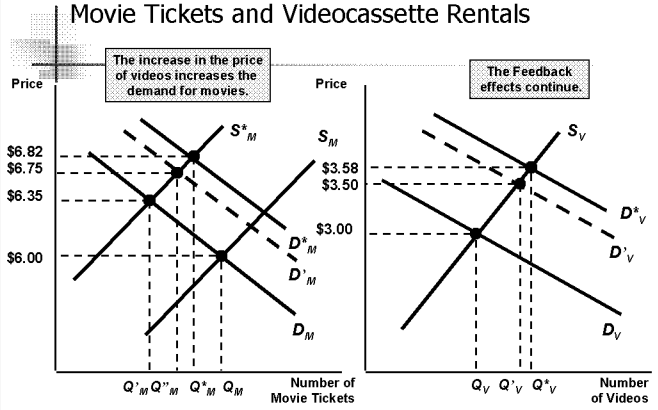
General Equilibrium Analysis

- Two Interdependent Markets--Moving to General Equilibrium
  - Scenario
    - The competitive markets of:
      - Videocassette rentals
      - Movie theater tickets

Two Interdependent Markets: Movie Tickets and Videocassette Rentals



Two Interdependent Markets: Movie Tickets and Videocassette Rentals



Two Interdependent Markets: Movie Tickets and Videocassette Rentals

- Observation
  - Without considering the feedback effect with general equilibrium, the impact of the tax would have been underestimated
  - This is an important consideration for policy makers.

Two Interdependent Markets: Movie Tickets and Videocassette Rentals

- Questions
  - What would be the feedback effect of a tax increase on one of two complementary goods?
  - What are the policy implications of using a partial equilibrium analysis compared to a general equilibrium in this scenario?

The Interdependence of International Markets

- Brazil and the United States export soybeans and are, therefore, interdependent.
- Brazil limited exports in the late 1960's and early 1970's.
- Eventually the export controls were to be removed, and Brazilian exports were expected to increase.

The Interdependence of International Markets

- Partial Analysis
  - Brazilian domestic soybean price will fall and domestic demand for soybean products would increase.

The Interdependence of International Markets

- General Analysis
  - In the U.S. the price of soybeans and output would increase; U.S. exports would increase and Brazilian exports would fall (even after regulations ended).

Efficiency in Exchange

- Exchange increases efficiency until no one can be made better off without making someone else worse off (Pareto efficiency).
- The Advantages of Trade
  - Trade between two parties is mutually beneficial.

Efficiency in Exchange

- Assumptions
  - Two consumers (countries)
  - Two goods
  - Both people know each others preferences
  - Exchanging goods involves zero transaction costs
  - James & Karen have a total of 10 units of food and 6 units of clothing.

The Advantage of Trade

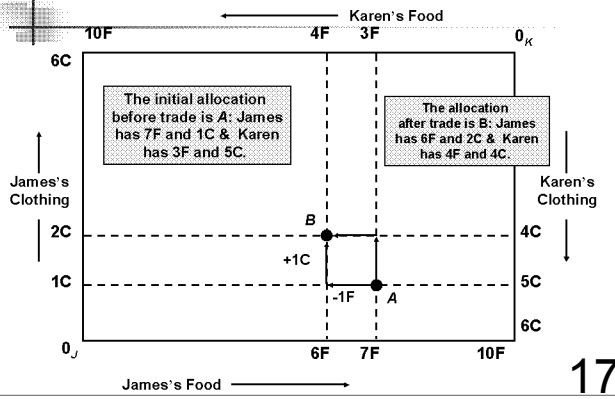
Individual	Initial Allocation	Trade	Final Allocation
James	7F, 1C	-1F, +1C	6F, 2C
Karen	3F, 5C	+1F, -1C	4F, 4C

Karen's MRS of food for clothing is 3. James's MRS of food for clothing is 1/2. Karen and James are willing to trade: Karen trades 1C for 1F. When the MRS is not equal, there is gain from trade. The economically efficient allocation occurs when the MRS is equal.

Efficiency in Exchange

- The Edgeworth Box Diagram
  - Which trades can occur and which allocation will be efficient can be illustrated using a diagram called an Edgeworth Box.

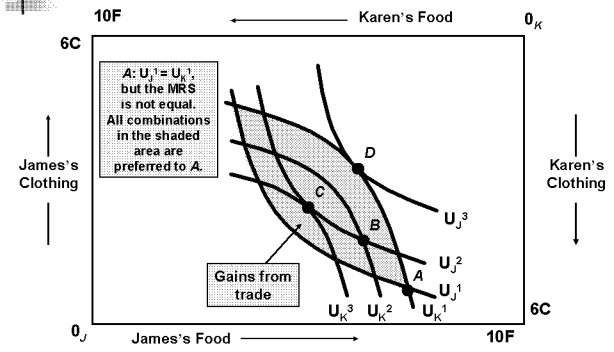
Exchange in an Edgeworth Box



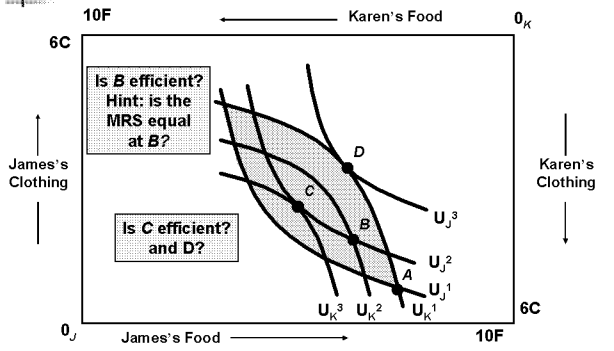
Efficiency in Exchange

- Efficient Allocations
  - If James's and Karen's MRS are the same at *B* the allocation is efficient.
    - This depends on the shape of their indifference curves.

Efficiency in Exchange

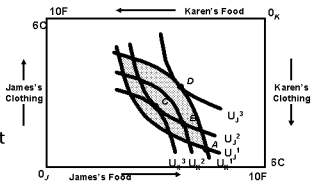


Efficiency in Exchange



Efficiency in Exchange

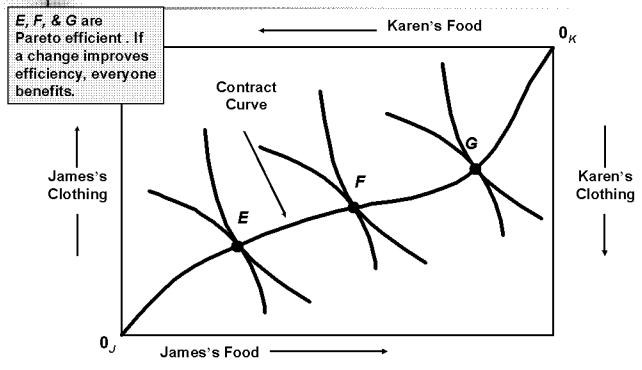
- Efficient Allocations
  - Any move outside the shaded area will make one person worse off (closer to their origin).
  - *B* is a mutually beneficial trade--higher indifference curve for each person.
  - Trade may be beneficial but not efficient.
  - MRS is equal when indifference curves are tangent and the allocation is efficient.



Efficiency in Exchange

- The Contract Curve
  - To find *all possible efficient allocations of food and clothing* between Karen and James, we would look for all points of tangency between each of their indifference curves.

The Contract Curve



Efficiency in Exchange

- Observations
  1) All points of tangency between the indifference curves are efficient.
  2) The contract curve shows all allocations that are *Pareto efficient.*
     - *Pareto efficient* allocation occurs when trade will make someone worse off.

Efficiency in Exchange

- Application: The policy implication of Pareto efficiency when removing import quotas:
  1) Remove quotas
     - Consumers gain
     - Some workers lose
  2) Subsidies to the workers that cost less than the gain to consumers

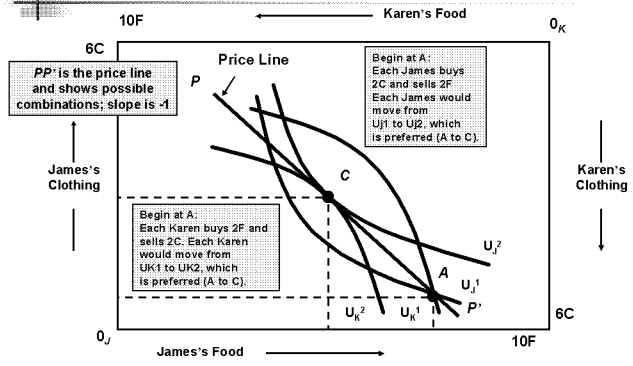
Efficiency in Exchange

- Consumer Equilibrium in a Competitive Market
  - Competitive markets have many actual or potential buyers and sellers, so if people do not like the terms of an exchange, they can look for another seller who offers better terms.

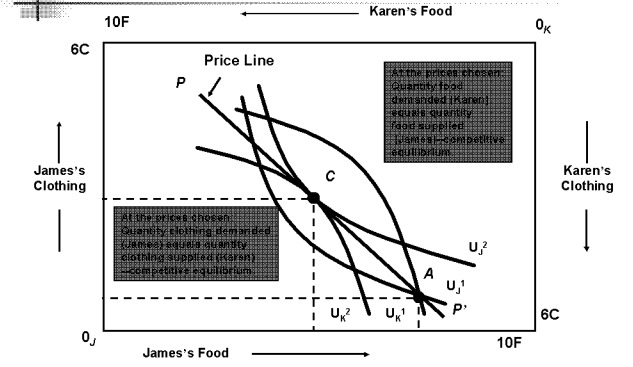
Efficiency in Exchange

- Consumer Equilibrium in a Competitive Market
  - There are many Jameses and Karens.
  - They are price takers
  - Price of food and clothing = 1 (relative prices will determine trade)

Competitive Equilibrium



Competitive Equilibrium



Efficiency in Exchange

- Scenario
  - P_F and $P_C = 3$
  - James's MRS of clothing for food is 1/2.
  - Karen's MRS of clothing for food is 3.
  - James will not trade.
  - Karen will want to trade.
  - The market is in disequilibrium.
    - Surplus of clothing
    - Shortage of food

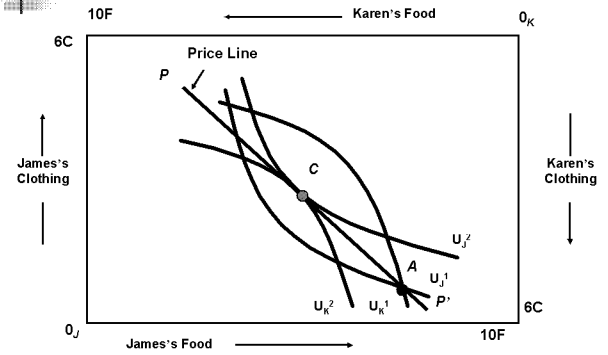
Efficiency in Exchange

- Questions
  - How would the market reach equilibrium?
  - How does the outcome from the exchange with many people differ from the exchange between two people?

Efficiency in Exchange

- The Economic Efficiency of Competitive Markets
  - It can be seen at point *C* (as shown on the next slide) that *the allocation in a competitive equilibrium is economically efficient.*

Competitive Equilibrium



Efficiency in Exchange

- Observations concerning *C:*
  1) Since the two indifference curves are tangent, the competitive equilibrium allocation is efficient.
  2) The MRS_{CF} is equal to the ratio of the prices, or $MRS^J_{FC} = P_C/P_F = MRS^K_{FC}$.

Efficiency in Exchange

- Observations concerning *C:*
  3) If the indifference curves were not tangent, trade would occur.
  4) The competitive equilibrium is achieved without intervention.

1603 of 1807

Efficiency in Exchange

- Observations concerning *C:*

5) In a competitive marketplace, all mutually beneficial trades will be completed and the resulting equilibrium allocation of resources will be economically efficient (the *first theorem of welfare economics*)

1604 of 1807

Efficiency in Exchange

- Policy Issues
  - What is the role of government?

1605 of 1807

Equity and Efficiency

- Is an efficient allocation also an equitable allocation?
  - Economists and others disagree about how to define and quantify equity.

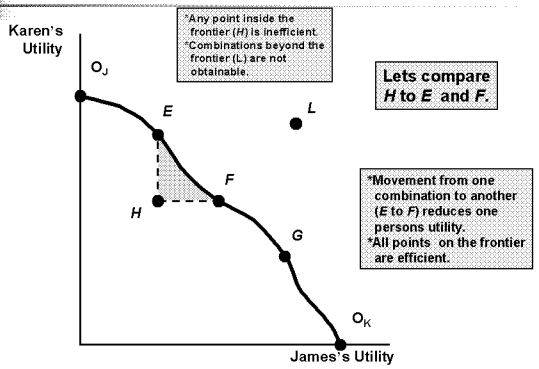
1606 of 1807

Equity and Efficiency

- The Utility Possibilities Frontier
  - Indicates
    - the level of satisfaction that each of two people achieve when they have traded to an efficient outcome on the contract curve.
    - all allocations that are efficient.

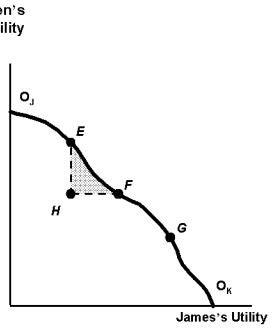
1607 of 1807

Utility Possibilities Frontier



1608 of 1807

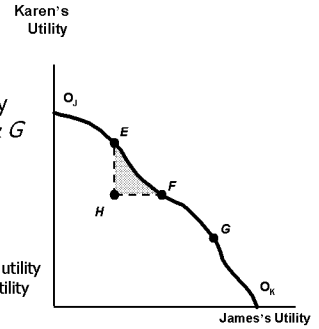
Equity and Efficiency



- *E & F* are efficient.
- Compared to *H, E & F* make one person better off without making the other worse off.

1609 of 1807

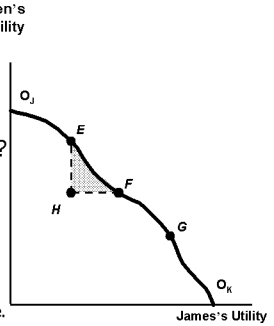
Equity and Efficiency



- Is *H* equitable?
  - Assume the only choices are *H & G*
  - Is *G* more equitable? It depends on perspective.
    - At *G* James total utility > Karen's total utility

1610 of 1807

Equity and Efficiency



- Is *H* equitable?
  - Assume the only choices are *H & G*
  - Is *G* more equitable? It depends on perspective.
    - *H* may be more equitable because the distribution is more equal, therefore, an inefficient allocation may be more equitable.

1611 of 1807

Equity and Efficiency

- Social Welfare Functions
  - Used to describe the particular weights that are applied to each individual's utility in determining what is socially desirable

1612 of 1807

Four Views of Equity

- Egalitarian
  - All members of society receive equal amounts of goods
- Rawlsian
  - Maximize the utility of the least-well-off person

1613 of 1807

Four Views of Equity

- Utilitarian
  - Maximize the total utility of all members of society
- Market-oriented
  - The market outcome is the most equitable

1614 of 1807

Equity and Efficiency

- The Social Welfare Function and Equity
  - Equity is dependent on a normative priority ranging from Egalitarian to Market-orientation.

1615 of 1807

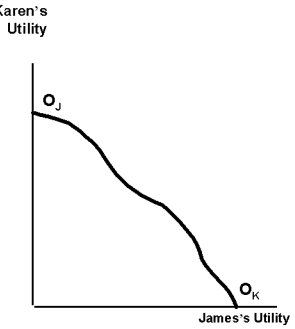
Equity and Efficiency

- Equity and Perfect Competition
  - A competitive equilibrium leads to a Pareto efficient outcome that may or may not be equitable.

1616 of 1807

Equity and Efficiency

- Points on the frontier are Pareto efficient.
  - O_J & O_K are perfect unequal distributions and Pareto efficient.
  - To achieve equity (more equal distribution) must the allocation be efficient?



1617 of 1807

Equity and Efficiency

- Second Theorem of Welfare Economics
  - If individual preferences are convex, then every efficient allocation is a competitive equilibrium from some initial allocation of goods.

1618 of 1807

Equity and Efficiency

- Second Theorem of Welfare Economics
  - Consider the cost of programs to redistribute income and the trade off between equity and efficiency.

1619 of 1807

Efficiency in Production

- Assume
  - Fixed total supplies of two inputs; labor and capital
  - Produce two products; food and clothing
  - Many people own and sell inputs for income
  - Income is distributed between food and clothing

1620 of 1807

Efficiency in Production

- Observations
  - Linkage between supply and demand (income and expenditures)
  - Changes in the price of one input triggers changes in income and demand which establishes a feedback effect.
  - Use general equilibrium analysis with feedback effects

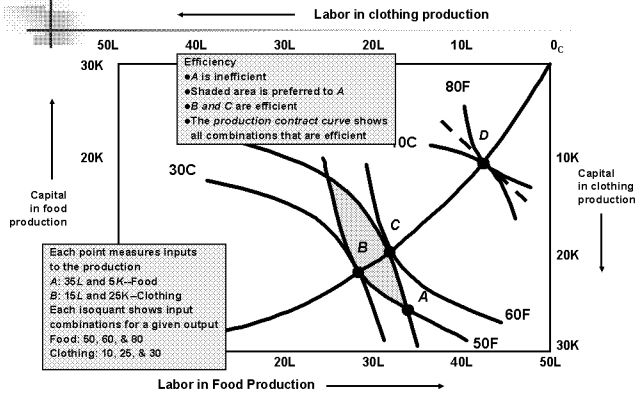
Efficiency in Production

- Production in the Edgeworth Box
  - The Edgeworth box can be used to measure inputs to the production process.

Efficiency in Production

- Production in the Edgeworth Box
  - Each axis measures the quantity of an input
    - Horizontal: Labor, 50 hours
    - Vertical: Capital, 30 hours
  - Origins measure output
    - O_F = Food
    - O_C = Clothing

Efficiency in Production



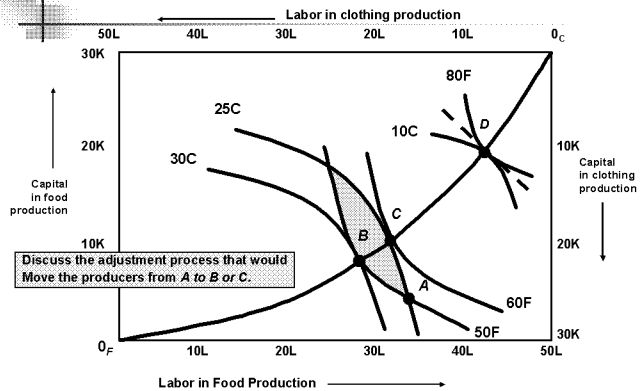
Efficiency in Production

- Producer Equilibrium in a Competitive Input Market
  - Competitive markets create a point of efficient production.

Efficiency in Production

- Competitive Market Observations
  - The wage rate (w) and the price of capital (r) will be the same for all industries.
  - Minimize production cost
    - $MP_L/MP_K = w/r$
    - $w/r = MRTS_{LK}$
  - MRTS = slope of the isoquant
  - Competitive equilibrium is on the production contract curve.
  - Competitive equilibrium is efficient.

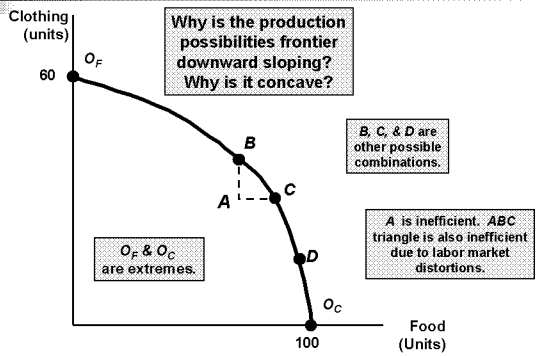
Efficiency in Production



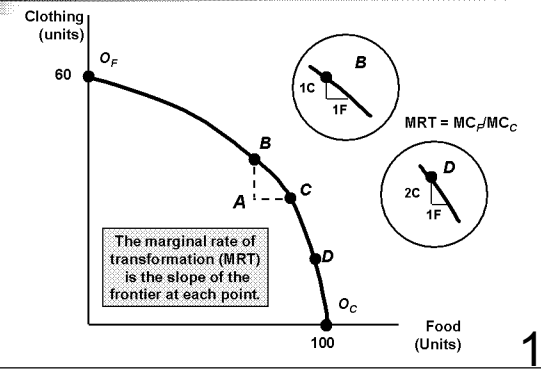
Efficiency in Production

- The Production Possibilities Frontier
  - Shows the various combinations of food and clothing that can be produced with fixed inputs of labor and capital.
  - Derived from the contract curve

Production Possibilities Frontier



Production Possibilities Frontier



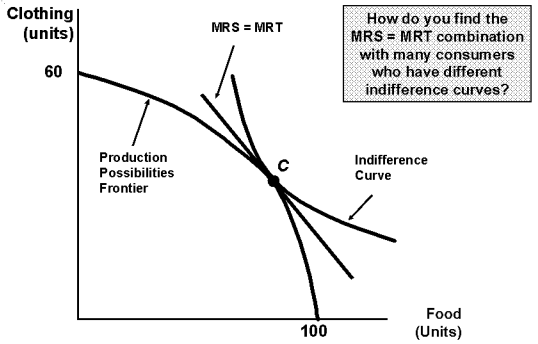
Efficiency in Production

- Output Efficiency
  - Goods must be produced at minimum cost *and must be produced in combinations that match people's willingness to pay for them.*
    - Efficient output and Pareto efficient allocation
    - Occurs where MRS = MRT

Efficiency in Production

- Assume
  - MRT = 1 and MRT = 2
  - Consumers will give up 2 clothes for 1 food
  - Cost of 1 food is 1 clothing
  - Too little food is being produced
  - Increase food production (MRS falls and MRT increases)

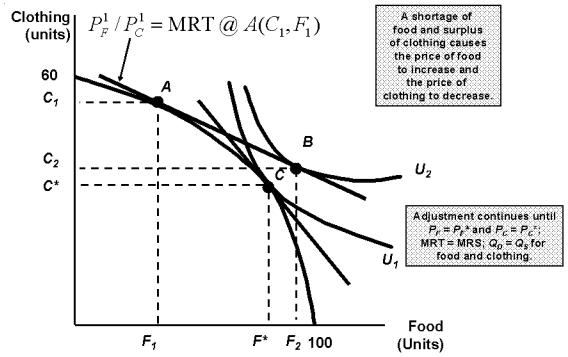
Output Efficiency



Efficiency in Production

- Efficiency in Output Markets
  - Consumer's Budget Allocation
    $\mathrm{MRS} = \mathrm{P_F}/\mathrm{P_C}$
  - Profit Maximizing Firm
    $\mathrm{P_F} = \mathrm{MC_F}$ and $\mathrm{P_C} = \mathrm{MC_C}$
  - $\mathrm{MRT} = \dfrac{\mathrm{MC_F}}{\mathrm{MC_C}} = \dfrac{P_F}{P_C} = \mathrm{MRS}$

Competition and Output Efficiency



The Gains from Free Trade

- Comparative Advantage
  - *Country 1 has a comparative advantage over country 2 in producing a good if the cost of producing that good, relative to the cost of producing other goods, in 1, is lower that the cost of producing the good in 2, relative to the cost of producing other goods in 2.*

The Gains from Free Trade

- Comparative Advantage
  - Comparative advantage is a relative measurement, not absolute.
  - A country with an *absolute advantage* in the production of all goods will not have a comparative advantage in the production of all goods.
    - Example: Holland and Italy produce cheese and wine

Hours of Labor Required to Produce

	Cheese (1 lb.)	Wine (1 gal.)
Holland	1	2
Italy	6	3

Holland has an absolute advantage in both products.

Hours of Labor Required to Produce

	Cheese (1 lb.)	Wine (1 gal.)
Holland	1	2
Italy	6	3

Holland's comparative advantage over Italy is in cheese: the cost of cheese is 1/2 the cost of wine and Italy's cost of cheese is twice the cost of wine.

Hours of Labor Required to Produce

	Cheese (1 lb.)	Wine (1 gal.)
Holland	1	2
Italy	6	3

Italy's comparative advantage is wine, which is half the cost of cheese.

Hours of Labor Required to Produce

	Cheese (1 lb.)	Wine (1 gal.)
Holland	1	2
Italy	6	3

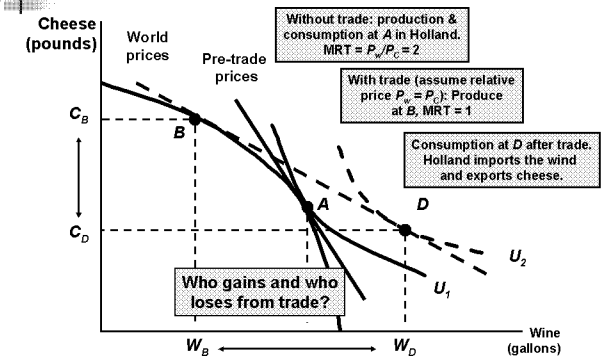
Without Trade: Assume PW = PC in Holland & Italy. Holland has 24 hrs. of labor--max. wine = 12 gals & max. cheese = 24 lbs. or a combination

Hours of Labor Required to Produce

	Cheese (1 lb.)	Wine (1 gal.)
Holland	1	2
Italy	6	3

With Trade: Italy produces 8 gal. and trades 6; consumes 6 lbs. and 2 gals. Without Trade: 3 lbs. and 2 gals.

The Gains from Trade



The Effects of Automobile Import Quotas

- A Changing Automobile Market
  - Imports (as a percentage of domestic sales)
    - 1965 -- 6.1%
    - 1980 -- 28.8%
  - In 1981 a voluntary export restraint (VER) was negotiated.
    - In 1980 Japan exported 2.5 million cars to the U.S.
    - In 1981 with the VER exports fell to 1.68 million cars.

The Effects of Automobile Import Quotas

- Measuring the Impact of the VER
  1) Japanese car prices rose nearly $1,000/car in 1981-1982, and revenue increase by $2 billion.
  2) Demand for U.S. cars increased U.S. profits by $10 billion

The Effects of Automobile Import Quotas

- Measuring the Impact of the VER
  3) U.S. car prices were $350 to $400/auto higher than they would have been without VER, or consumers were worse off by $3 billion .
  4) U.S. sales rose by 500,000 units creating about 26,000 jobs.

The Effects of Automobile Import Quotas

- Measuring the Impact of the VER
  5) Cost/Job = $4.3 billion (consumer cost)/26,000 jobs)
     = $160,000

Quantifying the Costs of Protection

Industry	*Producer Gains ($ millions)*	*Consumer Losses ($millions)*	*Efficiency Losses ($millions)*
Book manufacturing	305	500	29
Orange juice	390	525	130
Textiles an apparel	22,000	27,000	4,850
Carbon steel	3,800	6,800	330
Color televisions	190	420	7
Sugar	550	930	130
Dairy products	5,000	5,500	1,370
Meat	1,600	1,800	145

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in Exchange***

$$MRS_{FC}^{J} = MRS_{FC}^{K}$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in Exchange (for a competitive market)***

$$MRS_{FC}^{J} = P_F / P_C = MRS_{FC}^{K}$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in the Use of Inputs in Production***

$$\mathrm{MRTS}_{LK}^{F} = \mathrm{MRTS}_{\mathrm{LK}}^{\mathrm{C}}$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in the Use of Inputs in Production (for a competitive market)***

$$\mathrm{MRTS}_{LK}^{F} = w/r = \mathrm{MRTS}_{\mathrm{LK}}^{\mathrm{C}}$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in the Output Market***

$$MRT_{FC} = MRS_{FC} \text{ (for all consumers)}$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***Efficiency in the Output Market (in a competitive market)***

$$P_F = \mathrm{MC}_F, P_C = \mathrm{MC}_{\mathrm{C}}$$

$$\mathrm{MRT}_{\mathrm{FC}} = \mathrm{MC}_F / \mathrm{MC}_C = P_F / P_C$$

An Overview---The Efficiency of Competitive Markets

- Conditions Required for Economic Efficiency
  - ***However, consumers maximize their satisfaction in competitive markets only if***

$$P_F / P_C = \mathrm{MRS}_{FC} \text{ (for all consumers)}$$

$$\text{Therefore, } \mathrm{MRS}_{FC} = \mathrm{MRT}_{FC}$$

Why Markets Fail

- Market Power
  - In a monopoly in a product market, MR < *P*
    - MC = MR
    - Lower output than a competitive market
    - Resources allocated to another market
    - Inefficient allocation

Why Markets Fail

- Market Power
  - Monopsony in the labor market
    - Restricted supply of labor in food
    - w_f would rise, w_L would fall
    - Clothing input:

$$\mathrm{MRTS}_{LK}^{C} = w_c / r$$

    - Food input:

$$\mathrm{MRTS}_{LK}^{F} = w_F / r > w_c / r = \mathrm{MRTS}_{LK}^{C}$$

Why Markets Fail

- Incomplete Information
  - Lack of information creates a barrier to resource mobility.
- Externalities
  - When consumption or production creates cost and benefits to third parties which changes the cost and benefits of decisions and create inefficiencies.

Why Markets Fail

- Public Good
  - Markets undersupply public goods because of difficulty associated with measuring consumption.

Summary

- Partial equilibrium analyses of markets assume that related markets are unaffected, while general equilibrium analyses examine all markets simultaneously.
- An allocation is efficient when no consumer can be made better off by trade without making someone else worse off.

Summary

- A competitive equilibrium describes a set of prices and quantities, so that when each consumer chooses his or her most preferred allocation, the quantity demanded is equal to the quantity supplied in every market.
- The utility possibilities frontier measures all efficient allocations in terms of the levels of utility that each person achieves.

Summary

- Because a competitive equilibrium need not be equitable, the government may wish to help redistribute wealth from rich to poor.
- An allocation of production inputs is technically efficient if the output of one good cannot be increased without increasing the output of some other good.

Summary

- The production possibilities frontier measures all efficient allocations in terms of the levels of output that can be produced with a given combination of inputs.
- Efficiency in the allocation of goods to consumers is achieved only when the MRS of one good for another in consumption is equal to the MRT of one good for another in production.

Summary

- Free international trade expands a country's production possibilities frontier.
- Competitive markets may be inefficient for one or more of four reasons.

End of Chapter 16

General Equilibrium and Economic Efficiency

Chapter 17

Markets with Asymmetric Information

Topics to be Discussed

- Quality Uncertainty and the Market for Lemons
- Market Signaling
- Moral Hazard
- The Principal-Agent Problem

Topics to be Discussed

- Managerial Incentives in an Integrated Firm
- Asymmetric Information in Labor Markets: Efficiency Wage Theory

Introduction

- We will study how imperfect information influences resource allocation and the price system.

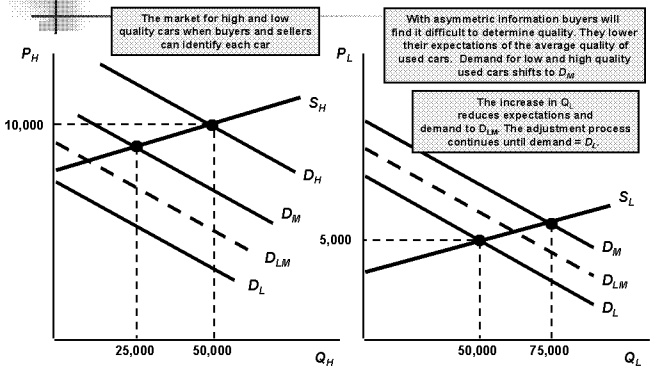
Quality Uncertainty and the Market for Lemons

- The lack of complete information when purchasing a used car increases the risk of the purchase and lowers the value of the car.

Quality Uncertainty and the Market for Lemons

- The Market for Used Cars
  - Assume
    - Buyers and sellers can distinguish between high and low quality cars
    - There will be two markets

The Lemons Problem



Quality Uncertainty and the Market for Lemons

- The Market for Used Cars
  - With asymmetric information:
    - Low quality goods drive high quality goods out of the market.
    - The market has failed to produce mutually beneficial trade.
    - Too many low and too few high quality cars are on the market.
    - Adverse selection occurs; the only cars on the market will be low quality cars.

Implications of Asymmetric Information

The Market for Insurance

- Medical Insurance
  - Question
    - Is it possible for insurance companies to separate high and low risk policy holders?
  - If not, only high risk people will purchase insurance.
  - Adverse selection would make medical insurance unprofitable.

Implications of Asymmetric Information

The Market for Insurance

- Automobile Insurance
  - Questions
    - What impact does asymmetric information and adverse selection have on insurance rates and the delivery of automobile accident insurance?
    - How can the government reduce the impact of adverse selection in the insurance industry?

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Implications of Asymmetric Information

- The Market for Credit
  - Asymmetric information creates the potential that only high risk borrowers will seek loans.
  - Question
    - How can credit histories help make this market more efficient and reduce the cost of credit?

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Implications of Asymmetric Information

- The Importance of Reputation and Standardization
  - Asymmetric Information and Daily Market Decisions
    - Retail sales
    - Antiques, art, rare coins
    - Home repairs
    - Restaurants

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Implications of Asymmetric Information

- Question
  - How can these producers provide high-quality goods when asymmetric information will drive out high-quality goods through adverse selection.
  - Answer
    - Reputation

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Implications of Asymmetric Information

- Question
  - Why do you look forward to a Big Mac when traveling even though you would never consider buying one at home.
- Holiday Inn once advertised "No Surprises" to address the issue of adverse selection.

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Lemons in Major League Baseball

- Asymmetric information and the market for free agents
  - If a lemons market exists, free agents should be less reliable (disabled) than renewed contracts.

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Player Disability

	Days Spent on Disabled List per Season		
	Precontract	Postcontract	Percentage Change
All Players	**4.73**	**12.55**	**165.4**
Renewed players	**4.76**	**9.68**	**103.4**
Free agents	**4.67**	**17.23**	**268.9**

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Lemons in Major League Baseball

- Findings
  - Days on the disabled list increase for both free agents and renewed players.
  - Free agents have a significantly higher disability rate than renewed players.
  - This indicates a lemons market.

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Lemons in Major League Baseball

- Question
  - If you are a team owner, what steps would you take to reduce the asymmetric information for free agents?

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Market Signaling

- The process of sellers using *signals* to convey information to buyers about the product's quality helps buyers and sellers deal with asymmetric information.

Market Signaling

- Strong Signal
  - To be effective, a signal must be easier for high quality sellers to give than low quality sellers.
  - Example
    - Highly productive workers signal with educational attainment level.

Market Signaling

- A Simple Model of Job Market Signaling
  - Assume
    - Two groups of workers
      - Group I: Low productivity--*AP* & *MP* = 1
      - Group II: High productivity--*AP* & *MP* = 2
      - The workers are equally divided between Group I and Group II--*AP* for all workers = 1.5

Market Signaling

- A Simple Model of Job Market Signaling
  - Assume
    - Competitive Product Market
      - P = \$10,000
      - Employees average 10 years of employment
      - Group I Revenue = \$100,000 (10,000/yr. x 10)
      - Group II Revenue = \$200,000 (20,000/yr. X 10)

Market Signaling

- With Complete Information
  - w = MRP
  - Group I wage = \$10,000/yr.
  - Group II wage = \$20,000/yr.
- With Asymmetric Information
  - w = average productivity
  - Group I & II wage = \$15,000

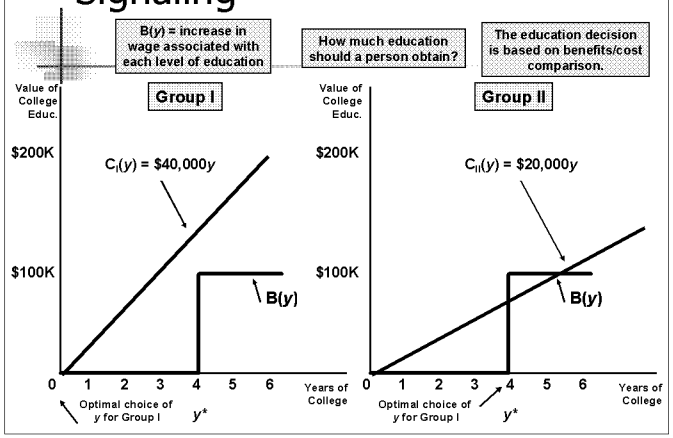
Market Signaling

- Signaling With Education to Reduce Asymmetric Information
  - y = education index (years of higher education)
  - C = cost of attaining educational level y
  - Group I--$C_I(y)$ = \$40,000y
  - Group II--$C_{II}(y)$ = \$20,000y

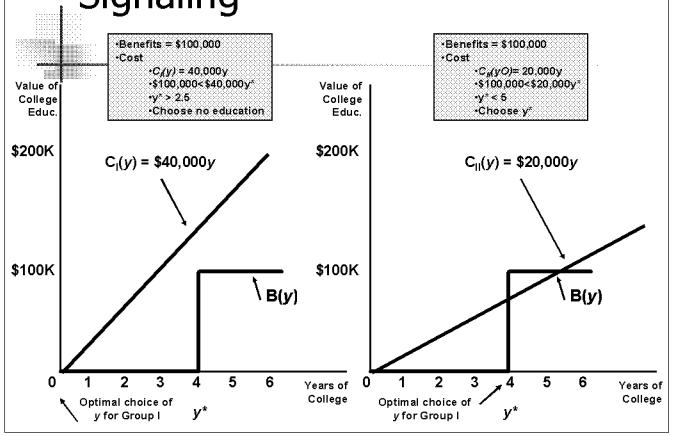
Market Signaling

- Signaling With Education to Reduce Asymmetric Information
  - Assume education does not increase productivity
  - Decision Rule:
    - y^* signals G_{II} and wage = \$20,000
    - Below y^* signals G_I and wage = \$10,000

Signaling



Signaling



Signaling

- Cost/Benefit Comparison
  - Decision rule works if y^* is between 2.5 and 5
  - If $y^* = 4$
    - Group I would choose no school
    - Group II would choose y^*
    - Rule discriminates correctly

Signaling

- Education does increase productivity and provides a useful signal about individual work habits.

Working into the Night

- Question
  - How can you signal to your employer you are more productive?

Market Signaling

- Guarantees and Warranties
  - Signaling to identify high quality and dependability
  - Effective decision tool because the cost of warranties to low-quality producers is too high

Moral Hazard

- *Moral hazard occurs when the insured party whose actions are unobserved can affect the probability or magnitude of a payment associated with an event.*

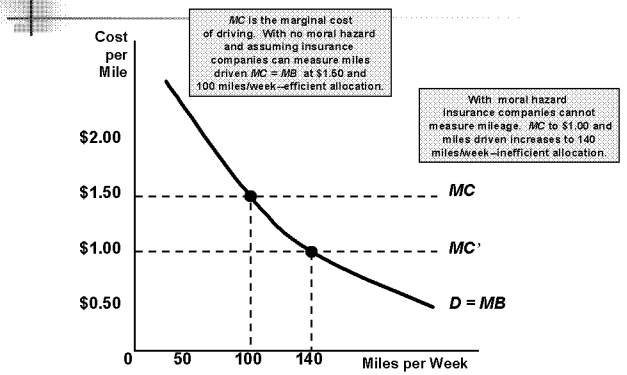
Moral Hazard

- Determining the Premium for Fire Insurance
  - Warehouse worth $100,000
  - Probability of a fire:
    - .005 with a $50 fire prevention program
    - .01 without the program

Moral Hazard

- Determining the Premium for Fire Insurance
  - With the program the premium is:
    - .005 x $100,000 = $500
  - Once insured owners purchase the insurance, the owners no longer have an incentive to run the program, therefore the probability of loss is .01
  - $500 premium will lead to a loss because the expected loss is not $1,000 (.01 x $100,000)

The Effects of Moral Hazard



Reducing Moral Hazard --Warranties of Animal Health

- Scenario
  - Livestock buyers want disease free animals.
  - Asymmetric information exists
  - Many states require warranties
  - Buyers and sellers no longer have an incentive to reduce disease (moral hazard).
- Question
  - How can this moral hazard be reduced?

Crisis in the Savings and Loan Industry

- Question
  - How many people know the financial strength of their bank?
  - Why not?
  - Deposit insurance, moral hazard, and failures in the S&L industry

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Crisis in the Savings and Loan Industry

- Cost of the S&L Bailout
  - 1,000+ failed institutions
  - $200 billion (1990)
  - Texas alone--$42 billion (1990)
  - Agency expenditures--$100 million (1990)
- Question
  - How can this moral hazard be reduced?

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The Principal--Agent Problem

- Agency Relationship
  - One person's welfare depends on what another person does
- Agent
  - Person who acts
- Principal
  - Person whom the action effects

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The Principal--Agent Problem

- Company owners are principals.
- Workers and managers are agents.
- Owners do not have complete knowledge.
- Employees may pursue their own goals and reduce profits.

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The Principal--Agent Problem

- The Principal--Agent Problem in Private Enterprises
  - Only 16 of 100 largest corporations have individual family or financial institution ownership exceeding 10%.
  - Most large firms are controlled by management.
  - Monitoring management is costly (asymmetric information).

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The Principal--Agent Problem

- The Principal--Agent Problem in Private Enterprises
  - Managers may pursue their own objectives.
    - Growth
    - Utility from job

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The Principal--Agent Problem

- The Principal--Agent Problem in Private Enterprises
  - Limitations to managers' ability to deviate from objective of owners
    - Stockholders can oust managers
    - Takeover attempts
    - Market for managers who maximize profits

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The Principal--Agent Problem

- The Principal--Agent Problem in Public Enterprises
  - Observations
    - Managers' goals may deviate from the agencies goal (size)
    - Oversight is difficult (asymmetric information)
    - Market forces are lacking

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The Principal--Agent Problem

- The Principal--Agent Problem in Public Enterprises
  - Limitations to Management Power
    - Managers choose a public service position
    - Managerial job market
    - Legislative and agency oversight (GAO & OMB)
    - Competition among agencies

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The Managers of Nonprofit Hospitals as Agents

- Are non profit organizations more or less efficient that for-profit firms?
  - 725 hospitals from 14 hospital chains
  - Return on investment (ROI) and average cost (AC) measured

The Managers of Nonprofit Hospitals as Agents

	Return On Investment 1977	1981
For-Profit	11.6%	12.7%
Nonprofit	8.8%	7.4%

The Managers of Nonprofit Hospitals as Agents

- After adjusting for differences in services:
  - AC/patient day in nonprofits is 8% greater than profits
  - Conclusion
    - Profit incentive impacts performance
  - Cost and benefits of subsidizing nonprofits must be considered.

The Managers of Nonprofit Hospitals as Agents

- Incentives in the Principal-Agent Framework
  - Designing a reward system to align the principal and agent's goals--an example
    - Watch manufacturer
    - Uses labor and machinery
    - Owners goal is to maximize profit
    - Machine repairperson can influence reliability of machines and profits

The Principal--Agent Problem

- Incentives in the Principal-Agent Framework
  - Designing a reward system to align the principal and agent's goals--an example
    - Revenue also depends, in part, on the quality of parts and the reliability of labor.
    - High monitoring cost makes it difficult to assess the repair-person's work

The Revenue from Making Watches

	Poor Luck	Good Luck
Low effort (a = 0)	$10,000	$20,000
High effort (a = 1)	$20,000	$40,000

The Principal--Agent Problem

- Incentives in the Principal-Agent Framework
  - Designing a reward system to align the principal and agent's goals--an example
    - Repairperson can work with either high or low effort
    - Revenues depend on effort relative to the other events (poor or good luck)
    - Owners cannot determine a high or low effort when revenue = $20,000

The Principal--Agent Problem

- Incentives in the Principal-Agent Framework
  - Designing a reward system to align the principal and agent's goals--an example
    - Repairperson's goal is to maximize wage net of cost
    - Cost = 0 for low effort
    - Cost = $10,000 for high effort
    - $w(R)$ = repairperson wage based only on output

The Principal--Agent Problem

- Incentives in the Principal-Agent Framework
  - Choosing a Wage
    - $w = 0$; $a = 0$; $R =$ $15,000
    - $R =$ $10,000 or $20,000, $w = 0$
    - $R =$ $40,000; $w =$ $24,000
      - $R =$ $30,000; Profit = $18,000
      - Net wage = $2,000

The Principal--Agent Problem

- Incentives in the Principal-Agent Framework
  - Choosing a Wage
    - $w = R$ - $18,000
      - Net wage = $2,000
      - High effort

The Principal--Agent Problem

- Conclusion
  - Incentive structure that rewards the outcome of high levels of effort can induce agents to aim for the goals set by the principals.

The Principal--Agent Problem

- Asymmetric Information and Incentive Design in the Integrated Firm
  - In integrated firms, division managers have better (asymmetric) information about production than central management

The Principal--Agent Problem

- Asymmetric Information and Incentive Design in the Integrated Firm
  - Two Issues
    - How can central management illicit accurate information
    - How can central management achieve efficient divisional production

The Principal--Agent Problem

- Possible Incentive Plans
  - Bonus based on output or profit
    - Will this plan provide an incentive for accurate information?

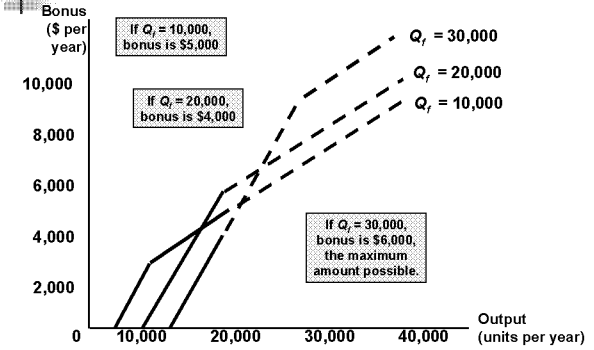
The Principal--Agent Problem

- Possible Incentive Plans
  - Bonus based on how close the managers get to their forecasts of output and profits
    - Q_f = estimate of feasible production level
    - B = bonus in dollars
    - Q = actual output
    - $B = 10{,}000 - .5(Q_f - Q)$
  - Incentive to underestimate Q_f

The Principal--Agent Problem

- Possible Incentive Plans
  - Bonus still tied to accuracy of forecast
    - If $Q > Q_f$; $B = .3Q_f + .2(Q - Q_f)$
    - If $Q \leq Q_f$; $B = .3Q_f - .5(Q_f - Q)$

Incentive Design in an Integrated Firm



Asymmetric Information in Labor Markets: Efficiency Wage Theory

- In a competitive labor market, all who wish to work will find jobs for a wage equal to their marginal product.
  - However, most countries' economies experience unemployment.

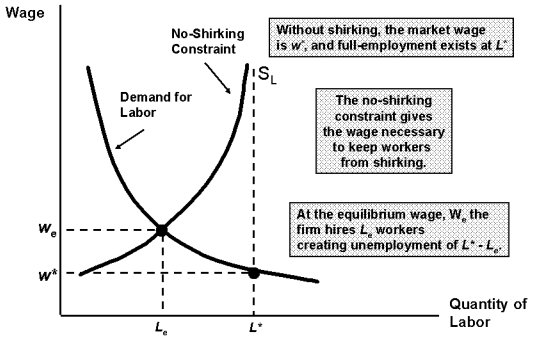
Asymmetric Information in Labor Markets: Efficiency Wage Theory

- The *efficiency wage theory* can explain the presence of unemployment and wage discrimination.
  - In developing countries, productivity depends on the wage rate for nutritional reasons.

Asymmetric Information in Labor Markets: Efficiency Wage Theory

- The *shirking model* can be better used to explain unemployment and wage discrimination in the United States.
  - Assumes perfectly competitive markets
  - However, workers can work or *shirk.*
  - Since performance information is limited, workers may not get fired.

Unemployment in a Shirking Model



Efficiency Wages at Ford Motor Company

- Labor turnover at Ford
  - 1913: 380%
  - 1914: 1000%
    - Average pay = $2 - $3
    - Ford increased pay to $5

Efficiency Wages at Ford Motor Company

- Results
  - Productivity increased 51%
  - Absenteeism had been halved
  - Profitability rose from $30 million in 1914 to $60 million in 1916.

Summary

- Asymmetric information creates a market failure in which bad products tend to drive good products out of the market.
- Insurance markets frequently involve asymmetric information because the insuring party has better information about the risk involved than the insurance company.

Summary

- Asymmetric information may make it costly for the owners of firms to monitor accurately the behavior of the firm's manager.
- Asymmetric information can explain why labor markets have substantial unemployment when some workers are actively seeking work.

End of Chapter 17

Markets with Asymmetric Information

Chapter 18

Externalities and Public Goods

Topics to be Discussed

- Externalities
- Ways of Correcting Market Failure
- Externalities and Property Rights
- Common Property Resources

Topics to be Discussed

- Public Goods
- Private Preferences for Public Goods

Externalities

- Negative
  - Action by one party imposes a cost on another party
- Positive
  - Action by one party benefits another party

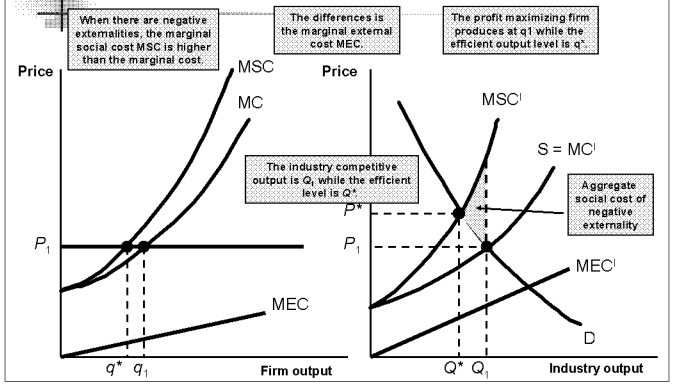
External Cost

- Scenario
  - Steel plant dumping waste in a river
  - The entire steel market effluent can be reduced by lowering output (fixed proportions production function)

External Cost

- Scenario
  - Marginal External Cost (MEC) is the cost imposed on fishermen downstream for each level of production.
  - Marginal Social Cost (MSC) is MC plus MEC.

External Costs



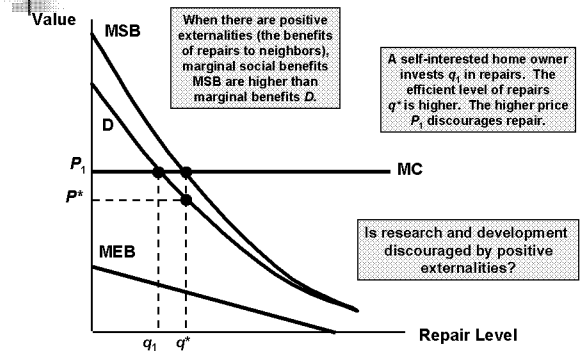
External Cost

- Negative Externalities encourage inefficient firms to remain in the industry and create excessive production in the long run.

Externalities

- Positive Externalities and Inefficiency
  - Externalities can also result in too little production, as can be shown in an example of home repair and landscaping.

External Benefits



Ways of Correcting Market Failure

- Assumption: The market failure is pollution
  - Fixed-proportion production technology
    - Must reduce output to reduce emissions
    - Use an output tax to reduce output
  - Input substitution possible by altering technology

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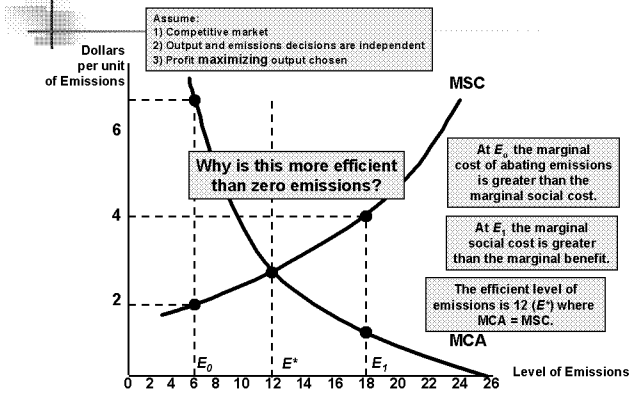
The Efficient Level of Emissions



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Ways of Correcting Market Failure

- Options for Reducing Emissions to E^*
  - Emission Standard
    - Set a legal limit on emissions at E^* (12)
    - Enforced by monetary and criminal penalties
    - Increases the cost of production and the threshold price to enter the industry

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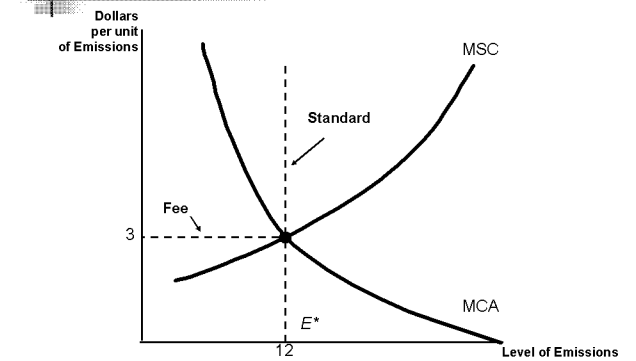
Standards and Fees



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Ways of Correcting Market Failure

- Options for Reducing Emissions to E^*
  - Emissions Fee
    - Charge levied on each unit of emission

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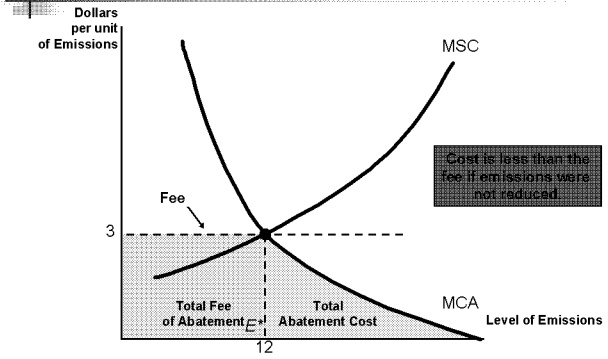
Standards and Fees



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Ways of Correcting Market Failure

- Standards Versus Fees
  - Assumptions
    - Policymakers have asymmetric information
    - Administrative costs require the same fee or standard for all firms

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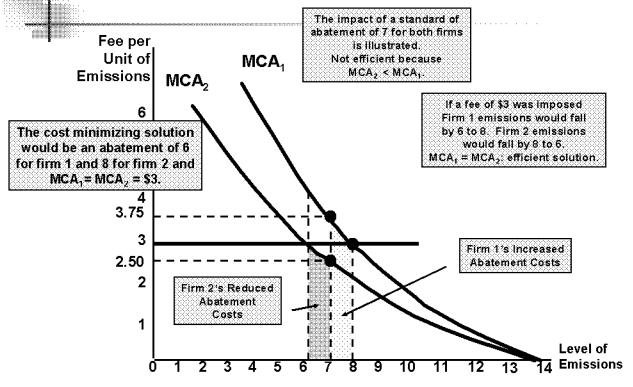
The Case for Fees



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Ways of Correcting Market Failure

- Advantages of Fees
  - When equal standards must be used, fees achieve the same emission abatement at lower cost.
  - Fees create an incentive to install equipment that would reduce emissions further.

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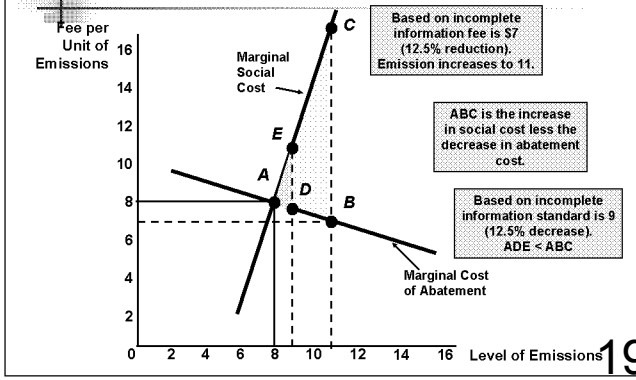
The Case for Standards



Ways of Correcting Market Failure

- Summary: Fees vs. Standards
  - Standards are preferred when MSC is steep and MCA is flat.
  - Standards (incomplete information) yield more certainty on emission levels and less certainty on the cost of abatement.

Ways of Correcting Market Failure

- Summary: Fees vs. Standards
  - Fees have certainty on cost and uncertainty on emissions.
  - Preferred policy depends on the nature of uncertainty and the slopes of the cost curves.

Ways of Correcting Market Failure

- Transferable Emissions Permits
  - Permits help develop a competitive market for externalities.
    - Agency determines the level of emissions and number of permits
    - Permits are marketable
    - High cost firm will purchase permits from low cost firms

Ways of Correcting Market Failure

- Question
  - What factors could limit the efficiency of this approach?

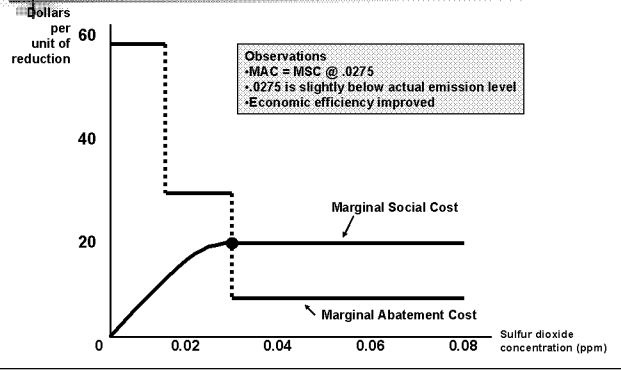
The Costs and Benefits of Reduced Sulfur Dioxide Emissions

- Cost of Reducing Emissions
  - Conversion to natural gas from coal and oil
  - Emission control equipment

The Costs and Benefits of Reduced Sulfur Dioxide Emissions

- Benefits of Reducing Emissions
  - Health
  - Reduction in corrosion
  - Aesthetic

Sulfur Dioxide Emissions Reductions



Emissions Trading and Clean Air

- Bubbles
  - Firm can adjust pollution controls for individual sources of pollutants as long as a *total pollutant limit* is not exceeded.
- Offsets
  - New emissions must be offset by reducing existing emissions
    - 2000 offsets since 1979

Emissions Trading and Clean Air

- Cost of achieving an 85% reduction in hydrocarbon emissions for DuPont
  - Three Options
    - 85% reduction at each source plant (total cost = $105.7 million)
    - 85% reduction at each plant with internal trading (total cost = $42.6 million)
    - 85% reduction at all plants with internal and external trading (total cost = $14.6 million)

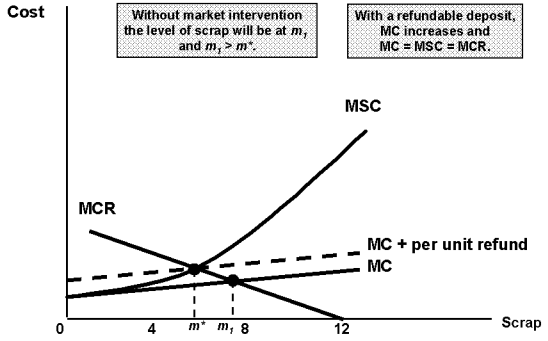
Emissions Trading and Clean Air

- 1990 Clean Air Act
  - Since 1990, the cost of the permits has fallen from an expected $300 to below $100.
- Causes of the drop in permit prices
  - More efficient abatement techniques
  - Price of low sulfur coal has fallen

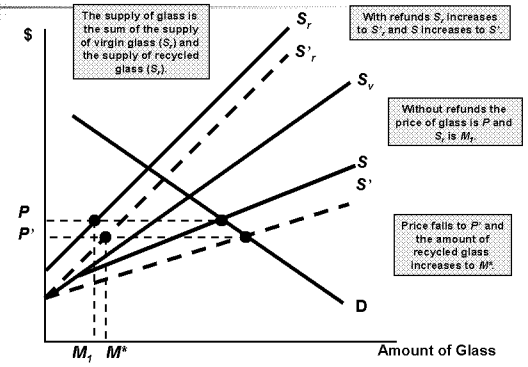
Ways of Correcting Market Failure

- Recycling
  - Households can dispose of glass and other garbage at very low cost.
  - The low cost of disposal creates a divergence between the private and the social cost of disposal.

The Efficient Amount of Recycling



Refundable Deposits



Externalities and Property Rights

- Property Rights
  - Legal rules describing what people or firms may do with their property
  - For example
    - If residents downstream owned the river (clean water) they control upstream emissions.

Externalities and Property Rights

- Bargaining and Economic Efficiency
  - Economic efficiency can be achieved without government intervention when the externality affects relatively few parties and when property rights are well specified.

Profits Under Alternative Emissions Choices (Daily)

	Factory's Profit	Fishermen's Profit	Total Profit
No filter, not treatment plant	**600**	**500**	**100**
Filter, no treatment plant	**300**	**500**	**800**
No filter, treatment plant	**500**	**200**	**700**
Filter, treatment plant	**300**	**300**	**600**

Externalities and Property Rights

- Assumptions
  - Factory pays for the filter
  - Fishermen pay for the treatment plant
- Efficient Solution
  - Buy the filter and do not build the plant

Bargaining with Alternative Property Rights

	Right to Dump	Right to Clean Water
No Cooperation		
Profit of factory	$500	$300
Profit of fishermen	$200	$500
Cooperation		
Profit of factory	$550	$300
Profit of fishermen	$250	$500

Externalities and Property Rights

- Conclusion: Coase Theorem
  - *When parties can bargain without cost and to their mutual advantage, the resulting outcome will be efficient, regardless of how the property rights are specified.*

Externalities and Property Rights

- Costly Bargaining --- The Role of Strategic Behavior
  - Bargaining requires clearly defined rules and property rights.

Externalities and Property Rights

- A Legal Solution --- Suing for Damages
  - Fishermen have the right to clean water
  - Factory has two options
    - No filter, pay damages
      - Profit = $100 ($500 - $400)
    - Filter, no damages
      - Profit = $300 ($500 - $200)

Externalities and Property Rights

- A Legal Solution --- Suing for Damages
  - Factory has the right to emit effluent
  - Fishermen have three options
    - Put in treatment plant
      - Profit = $200
    - Filter and pay damages
      - Profit = $300 ($500 - $200)
    - No plant, no filter
      - Profit = $100

Externalities and Property Rights

- Conclusion
  - A suit for damages results in an efficient outcome.
- Question
  - How would imperfect information impact the outcome?

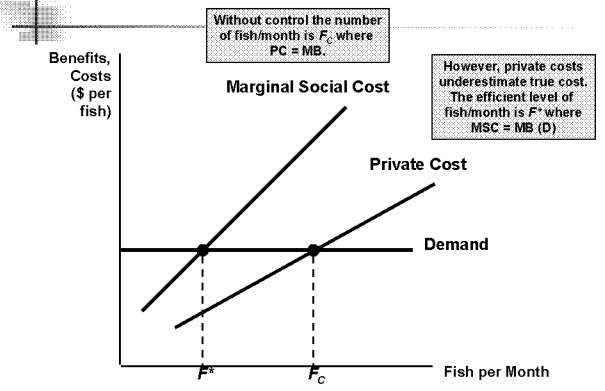
The Coase Theorem at Work

- Negotiating an Efficient Solution
  - 1987 --- New York garbage spill (200 tons) littered the New Jersey beaches
    - The potential cost of litigation resulted in a solution that was mutually beneficial to both parties.

Common Property Resources

- Common Property Resource
  - Everyone has free access.
  - Likely to be overutilized
  - Examples
    - Air and water
    - Fish and animal populations
    - Minerals

Common Property Resources



Common Property Resources

- Solution
  - Private ownership
- Question
  - When would private ownership be impractical?

Crawfish Fishing in Lousiana

- Finding the Efficient Crawfish Catch
  - F = crawfish catch in millions of pounds/yr
  - C = cost in dollars/pound

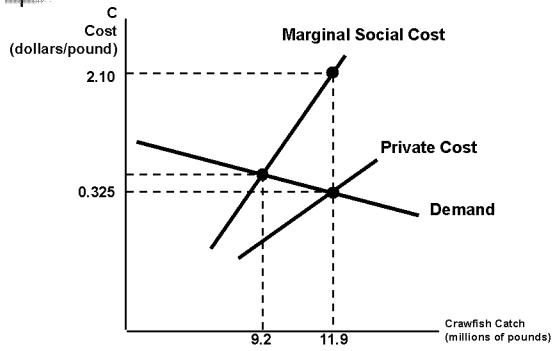
Crawfish Fishing in Lousiana

- Demand
  - $C = 0.401 = 0.0064F$
- *MSC*
  - $C = -5.645 + 0.6509F$
- *PC*
  - $C = -0.357 + 0.0573F$

Crawfish Fishing in Lousiana

- Efficient Catch
  - 9.2 million pounds
  - $D = MSC$

Crawfish as a Common Property Resource



Public Goods

- Question
  - When should government replace firms as the producer of goods and services?

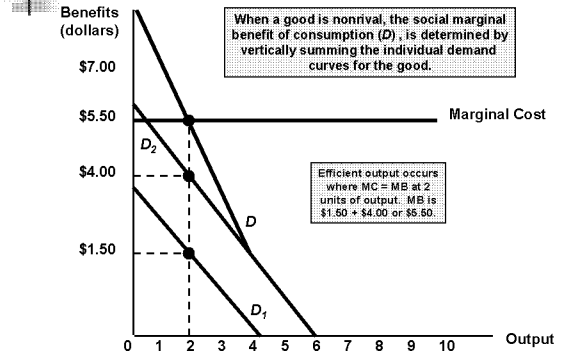
Public Goods

- Public Good Characteristics
  - Nonrival
    - For any given level of production the marginal cost of providing it to an additional consumer is zero.
  - Nonexclusive
    - People cannot be excluded from consuming the good.

Public Goods

- Not all government produced goods are public goods
  - Some are rival and nonexclusive
    - Education
    - Parks

Efficient Public Good Provision



Public Goods

- Public Goods and Market Failure
  - How much national defense did you consume last week?

1792 of 1807

Public Goods

- Free Riders
  - There is no way to provide some goods and services without benefiting everyone.
  - Households do not have the incentive to pay what the item is worth to them.
  - Free riders understate the value of a good or service so that they can enjoy its benefit without paying for it.

1793 of 1807

Public Goods

- Establishing a mosquito abatement company
  - How do you measure output?
  - Who do you charge?
  - A mosquito meter?

1794 of 1807

The Demand for Clean Air

- Clean Air is a public good
  - Nonexclusive and nonrival
- What is the price of clean air?

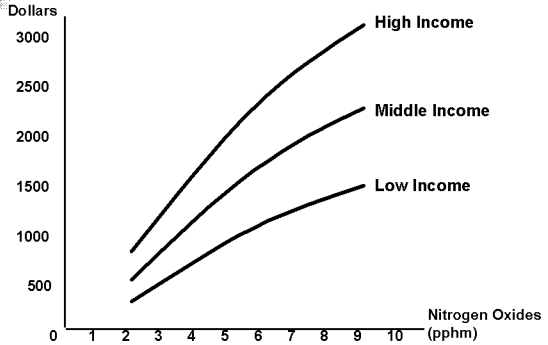
1795 of 1807

The Demand for Clean Air

- Choosing where to live
  - Study in Boston correlates housing prices with the quality of air and other characteristics of the houses and their neighborhoods.

1796 of 1807

The Demand for Clean Air



1797 of 1807

The Demand for Clean Air

- Findings
  - Amount people are willing to pay for clean air increases substantially as pollution increases.
  - Higher income earners are willing to pay more (the gap between the demand curves widen)
  - National Academy of Sciences found that a 10% reduction in auto emissions yielded a benefit of $2 billion---somewhat greater than the cost.

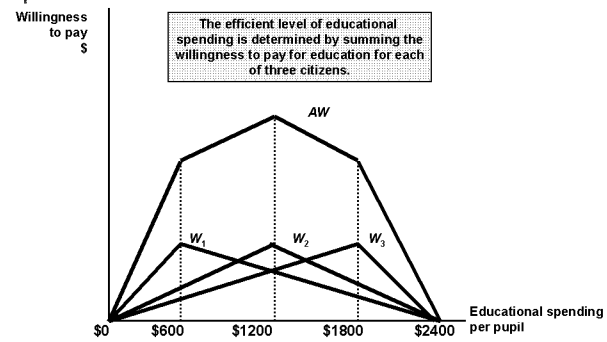
1798 of 1807

Private Preferences for Public Goods

- Government production of a public good is advantageous because the government can assess taxes or fees to pay for it.
- Determining how much of a public good to provide when free riders exist is difficult.

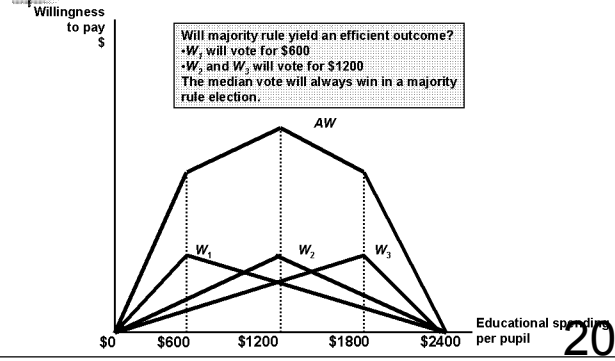
1799 of 1807

Determining the Level of Educational Spending



1800 of 1807

Determining the Level of Educational Spending



Private Preferences for Public Goods

- Question
  - Will the median voter selection always be efficient?
- Answer
  - If two of the three preferred $1200 there would be overinvestment.
  - If two of the three preferred $600 there would be underinvestment.

Private Preferences for Public Goods

- Majority rule is inefficient because it weighs each citizen's preference equally---the efficient outcome weighs each citizen's vote by his or her strength of preference.

Summary

- There is an externality when a producer or a consumer affects the production or consumption activities of others in a manner that is not directly reflected in the market.
- Pollution can be corrected by emission standards, emissions fees, marketable emissions permits, or by encouraging recycling.

Summary

- Inefficiencies due to market failure may be eliminated through private bargaining among the affected parties.
- Common property resources are not controlled by a single person and can be used without a price being paid.

Summary

- Goods that private markets are not likely to produce efficiently are either nonrival or nonexclusive. Public goods are both.
- A public good is provided efficiently when the vertical sum of the individual demands for the public good is equal to the marginal cost of producing it.

Summary

- Under majority rule voting, the level of spending provided will be that preferred by the median voter---this need not be the efficient outcome.

End of Chapter 18

Externalities and Public Goods