ECONOMICS

- Economics is the study of how societies use scarce resources to produce valuable commodities and distribute them among different people.
- Microeconomics deals with:
  - Behavior of individual units
    - When Consuming; How we choose what to buy
    - When Producing; How we choose what to produce
  - Markets: The interaction of consumers and producers
  - Analysis of aggregate issues:
    - Economic growth
    - Inflation
    - Unemployment

Microeconomics vs. Macroeconomics
Microeconomics is the foundation of macroeconomic analysis.

Themes of Microeconomics
- According to Mick Jagger & the Rolling Stones, “You can’t always get what you want”. Why Not?
  - Limited Resources
  - Unlimited Wants
- Allocation of Scarce Resources and Trade-offs
  - In a planned economy
  - In a market economy
- Microeconomics and Optimal Trade-offs
  1. Consumer Theory
  2. Workers
  3. Theory of the Firm
- Microeconomics and Prices
  - The role of prices in a market economy
  - How prices are determined

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
  - Models:
    - A mathematical representation of a theory used to make a prediction.
  - Validating a Theory
    - The validity of a theory is determined by the quality of its prediction, given the assumptions.
  - Evolving the Theory
    - Testing and refining theories is central to the development of the science of economics.

Positive versus Normative Economics
- Positive Economics
  Positive economics deals with the observations or predictions of the facts of economic life. For example:
  What will be the impact of an increase in wages on the price of a product?
Normative Economics
Normative Economics is the value judgments about how economics should operate, based on certain moral principles or preferences? For example:

What wage rate should be paid to the auto workers to make them an active member of the society?

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.
- Markets vs. Industries
  Industries are the supply side of the market.
- Defining the Market
  The market parameters must be set before an analysis of the market can take place.
- Arbitrage
  Buying a product at a low price in one location and selling at a high price in another.
- 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
  - Noncompetitive Markets
    - Markets where individual producers can influence the price.
    - Example: OPEC
- Market Price
  - Competitive markets establish one price.
  - Noncompetitive markets may set many prices for the same product.
- Market Definition - The Extent of a Market
  - Market Definition
    - Which buyers and sellers should be included in a given market?
  - Market Extent
    - Defines the boundaries of the market
      - Geographic
      - Range of products
  - Examples
  - Geographic boundaries
    - Gold: Lahore vs. Karachi
    - Housing: Islamabad vs. Rawalpindi
  - Range of Products
    - Gasoline: regular, super, & diesel
    - Cameras: Polaroid, point & shoot, digital
  - Markets for Prescription Drugs
    - Well-defined markets - therapeutic drugs
    - Ambiguous markets – painkillers
Lesson 2

Economics: Another Perspective
- Economics is the study of the choices made by people who are faced with scarcity.
- Scarcity is a situation in which resources are limited but can be used in different ways; so one good or service must be sacrificed for another.

Society’s Choices
- The decisions of producers, consumers and government determine how an economic system answers three fundamental questions:
  1. What products do we produce?
  2. How do we produce these products?
  3. Who consumes the products?

Factors of Production
Factors of production are the resources that are used to produce goods and services:
  1. Natural resources:
     The things created by acts of nature such as land, water, mineral, oil and gas deposits, renewable and nonrenewable resources.
  2. Labor:
     The human effort, physical and mental, used by workers in the production of goods and services.
  3. Physical capital:
     All the machines, buildings, equipment, roads and other objects made by human beings to produce goods and services.
  4. Human capital:
     The knowledge and skills acquired by a worker through education and experience.
  5. Entrepreneurship:
     The effort to coordinate the production and sale of goods and services. Entrepreneurs take risk and commit time and money to a business without any guarantee of profit.

The Production Possibilities Frontier (PPF)
The PPF curve shows the possible combinations of goods and services available to an economy, given that all productive resources are fully and efficiently employed.
When the economy is at point $i$, resources are not fully employed and/or they are not used efficiently. Point $g$ is desirable because it yields more of both goods, but not attainable given the amount of resources available. Point $d$ is one of the possible combinations of goods produced when resources are fully and efficiently employed.
**Scarcity and the PPF**
To increase the amount of farm goods by 10 tons, we must sacrifice 100 tons of factory goods. The PPF curve is bowed out because resources are not perfectly adaptable to the production of the two goods. As we increase the production of one good, we sacrifice progressively more of the other.

**Shifting the PPF Curve**
To increase the production of one good without decreasing the production of the other, the PPF curve must shift outward. The PPF curve shifts outward as a result of an increase in the economy's resources OR a technological innovation that increases the output obtained from a given amount of resources. From point $d$, an additional 200 tons of factory goods or 20 tons of farm goods are now possible (or any combination in between).
Lesson 3

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

- Calculating Real Prices

\[
\text{Real Price} = \frac{\text{CPI} \text{ base year}}{\text{CPI} \text{ current year}} \times \text{Nominal Price current year}
\]

Calculating the Real Price of Milk

<table>
<thead>
<tr>
<th>Year</th>
<th>Nominal Price of Milk</th>
<th>CPI</th>
<th>Real Price of Milk in 1970 dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>.40</td>
<td>38.8</td>
<td>.40 = \frac{38.8}{38.8} \times .40</td>
</tr>
<tr>
<td>1980</td>
<td>.65</td>
<td>82.4</td>
<td>.31 = \frac{38.8}{82.4} \times .65</td>
</tr>
<tr>
<td>1999</td>
<td>1.05</td>
<td>167.0</td>
<td>.24 = \frac{38.8}{167.0} \times 1.05</td>
</tr>
</tbody>
</table>

Calculating Real Prices: An Example - Eggs & College

\[
\text{Real Price of Eggs} = \frac{38.8_{1970}}{163} \times 1.04
\]

\[
\text{Real Price of College Education} = \frac{38.8}{163.0} \times $19,213 = $4,573
\]

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Consumer Price Index (1983 = 100)</td>
<td>38.3</td>
<td>53.8</td>
<td>82.4</td>
<td>107.6</td>
<td>130.7</td>
<td>163.0</td>
</tr>
</tbody>
</table>

Nominal Prices ($)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade A Large Eggs</td>
<td>0.61</td>
<td>0.77</td>
<td>0.84</td>
<td>0.80</td>
<td>0.98</td>
<td>1.04</td>
</tr>
<tr>
<td>College Education</td>
<td>2530</td>
<td>3403</td>
<td>4912</td>
<td>8156</td>
<td>12800</td>
<td>19213</td>
</tr>
</tbody>
</table>

Real Prices ($1970)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Grade A Large Eggs</td>
<td>0.61</td>
<td>0.56</td>
<td>0.40</td>
<td>0.29</td>
<td>0.30</td>
<td>0.25</td>
</tr>
<tr>
<td>College Education</td>
<td>2530</td>
<td>2454</td>
<td>2313</td>
<td>2941</td>
<td>3800</td>
<td>4573</td>
</tr>
</tbody>
</table>
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.
  - This price-quantity relationship can be shown by the equation:
  $Q_s = Q_s(P)$

- **Non-price Determining Variables of Supply**
  - Costs of Production
    - Labor
    - Capital
    - Raw Materials
  - The cost of raw materials falls
    - At P1, produce Q2
    - At P2, produce Q1
    - Supply curve shifts right to S'
    - More produced at any price on S' than on S

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

- **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:
  $Q_D = Q_D(P)$
Non-price Determining Variables of Demand
- Income
- Consumer Tastes
- Price of Related Goods
  - Substitutes
  - Complements

Income Increases
- At $P1$, produce $Q2$
- At $P2$, produce $Q1$
- Demand Curve shifts right
- More purchased at any price on $D'$ than on $D$

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.

The Market Mechanism
- Characteristics of the equilibrium or market clearing price:
  - $QD = QS$
  - No shortage
  - No excess supply
  - No pressure on the price to change

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 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.

• Market Mechanism Summary
  1) Supply and demand interacts 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.
Lesson 4

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.

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

- Raw material prices Rise
  - $S$ shifts to $S'$
  - Shortage @ $P_1$ of $Q_1, Q_2$
  - Equilibrium @ $P_3, Q_3$

- Income Increases
  - Demand shifts to $D'$
  - Shortage @ $P_1$ of $Q_1, Q_2$
  - Equilibrium @ $P_3, Q_3$
Income Decreases
- Demand shifts to $D’$
- Surplus @ $P1$ of $Q1$, $Q2$
- Equilibrium @ $P3$, $Q3$

Income Increases & raw material prices fall
- The increase in $D$ is greater than the increase in $S$
- Equilibrium price and quantity increase to $P2$, $Q2$

* Income Increases & raw material prices fall
- The increase in $D$ is less than the increase in $S$
- Equilibrium price decrease to $P2$ and quantity increase to $Q2$

* Income Decreases & raw material prices Fall
- The decrease in $D$ is greater than the increase in $S$
- Equilibrium price and quantity decrease to $P2$, $Q2$
• Income decreases & raw material prices fall
  - The decrease in \( D \) is less than the increase in \( S \)
  - Equilibrium price decrease to \( P_2 \) and quantity increase to \( Q_2 \)

**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 curves

**The Prices of Eggs & 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**

**Price of 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 College Education

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

- **Conclusion**
  - Decreases in the costs of production have increased the supply by more than enough to offset the increase in demand.
### Factors Shifting Demand Curve

<table>
<thead>
<tr>
<th>Factors Changing Demand</th>
<th>Effect on Demand</th>
<th>Direction of Shift in Demand Curve</th>
<th>Effect on Equilibrium Price</th>
<th>Effect on Equilibrium Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in income (normal good)</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Decrease in income (normal good)</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Increase in income (inferior good)</td>
<td>Decrease</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Decrease in income (inferior good)</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Increase in price of Substitute</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Decrease in price of substitute</td>
<td>Decrease</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Increase in price of complement</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Decrease in price of complement</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Increase in taste and preference for good</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Decrease in taste and preference for good</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
<tr>
<td>Increase in number of consumers</td>
<td>Increase</td>
<td>Rightward</td>
<td>Increase</td>
<td>Increase</td>
</tr>
<tr>
<td>Decrease in number of consumers</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Decrease</td>
<td>Decrease</td>
</tr>
</tbody>
</table>

### Factors Shifting Supply Curve

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in resource price</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Decrease in resource price</td>
<td>Increase</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>Improved technology</td>
<td>Increase</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>Decline in technology</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Expect a price increase</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Expect a price decrease</td>
<td>Increase</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>Increase in number of suppliers</td>
<td>Increase</td>
<td>Rightward</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
<tr>
<td>Decrease in number of suppliers</td>
<td>Decrease</td>
<td>Leftward</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
</tbody>
</table>
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.
- 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 services that results from a one percent change in the price of that good or service.
- The price elasticity of demand is:
  
  \[ E_P = \frac{\% \Delta Q}{\% \Delta P} \]

  - The percentage change in a variable is the absolute change in the variable divided by the original level of the variable.
  - So the price elasticity of demand is also:

  \[ E_P = \frac{\Delta Q/Q}{\Delta P/P} = \frac{P}{Q} \frac{\Delta Q}{\Delta P} \]

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

\[ Q = 8 - 2P \]

The lower portion of a downward sloping demand curve is less elastic than the upper portion.

\[ Q = a - bP \]

Linear Demand Curve
Price

Completely Inelastic Demand

\[ EP = 0 \]

Price

Infinitely Elastic Demand

\[ EP = 0 \]

Price

Q

Q

0 2 3 6 10

0 2 3 6 10

Completely Inelastic Demand

Infinitely Elastic Demand

\[ EP = -3 \]

\[ EP = -1 \]

\[ EP = -0.4 \]
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.
  - The income elasticity of demand is:
    \[
    E_i = \frac{\Delta Q/Q}{\Delta I/I} = \frac{I \Delta Q}{Q \Delta I}
    \]

- Income Elasticity of Demand for:
  - Normal goods
  - Superior goods
  - Inferior goods

- 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.
  - The cross elasticity of demand is:
    \[
    E_{Q_bP_m} = \frac{\Delta Q_b/Q_b}{\Delta P_m/P_m} = \frac{P_m \Delta Q_b}{Q_b \Delta P_m}
    \]
    - Cross elasticity for substitutes is positive
    - Cross elasticity for complements is negative

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

<table>
<thead>
<tr>
<th>Price ($)</th>
<th>Quantity Demanded</th>
<th>Quantity Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>60</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td>80</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>100</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>120</td>
<td>16</td>
<td>20</td>
</tr>
</tbody>
</table>
Recall

\[ E_p = \frac{\Delta Q/Q}{\Delta P/P} = \frac{P}{Q} \frac{\Delta Q}{\Delta P} \]

- Elasticity of demand when price is $80 is
  \[ E_p = \frac{80}{20} \times \frac{-2}{20} = -0.40 \]
- Elasticity of demand when price is $100 is
  \[ E_p = \frac{100}{18} \times \frac{-2}{20} = -0.56 \]
- Elasticity of supply when price is $80 is
  \[ E_p = \frac{80}{16} \times \frac{2}{20} = 0.50 \]
- Elasticity of supply when price is $100 is
  \[ E_p = \frac{100}{18} \times \frac{2}{20} = 0.56 \]

The Market for Wheat

- 1981 Supply Curve for Wheat
  \[ QS = 1,800 + 240P \]
- 1981 Demand Curve for Wheat
  \[ QD = 3,550 - 266P \]
- Equilibrium: \( QS = QD \)
  \[
  1,800 + 240P = 3,550 - 266P \\
  506P = 1,750 \\
  P = $3.46 \text{ / bushel} \\
  Q = 1,800 + (240)(3.46) = 2,630 \text{ million bushels}
  \]

  \[ E_p = \frac{P}{Q} \frac{\Delta Q_p}{\Delta P} = \frac{3.46}{2,630} (-2.66) = -0.035 \text{ Inelastic} \]

  \[ E_p = \frac{P}{Q} \frac{\Delta Q_s}{\Delta P} = \frac{3.46}{2,630} (2.40) = 0.032 \text{ Inelastic} \]

- Assume the price of wheat is $4.00/bushel
  \[
  Q_D = 3,550 - (266)(4.00) = 2,486 \\
  Q_P = \frac{4.00}{2,486} (-266) = -0.43
  \]

<table>
<thead>
<tr>
<th>Supply (Qs)</th>
<th>Demand (Qd)</th>
<th>Equilibrium Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>1800 + 240P</td>
<td>3550 – 266P</td>
</tr>
<tr>
<td></td>
<td>1800 + 240P</td>
<td>3550 – 266P</td>
</tr>
<tr>
<td></td>
<td>506P = 1750</td>
<td>( P_{1981} = $3.46 \text{ / bushel} )</td>
</tr>
<tr>
<td>1998</td>
<td>1944 + 207P</td>
<td>3244 – 283P</td>
</tr>
<tr>
<td></td>
<td>1944 + 207P</td>
<td>3244 – 283P</td>
</tr>
<tr>
<td></td>
<td>506P = 1750</td>
<td>( P_{1998} = $2.65 \text{ / bushel} )</td>
</tr>
</tbody>
</table>

Short-Run Versus Long-Run Elasticities

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

- Income elasticity also varies with the amount of time consumers have to respond to an income change.
- 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.
- 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.
- Gasoline and Automobiles are complementary goods.
- 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.
The Demand for Gasoline

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>-0.11</td>
<td>-0.22</td>
<td>-0.32</td>
<td>-0.49</td>
<td>-0.82</td>
<td>-1.17</td>
</tr>
<tr>
<td>Income</td>
<td>0.07</td>
<td>0.13</td>
<td>0.20</td>
<td>0.32</td>
<td>0.54</td>
<td>0.78</td>
</tr>
</tbody>
</table>

The Demand for Automobiles

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>-1.20</td>
<td>-0.93</td>
<td>-0.75</td>
<td>-0.55</td>
<td>-0.42</td>
<td>-0.40</td>
</tr>
<tr>
<td>Income</td>
<td>3.00</td>
<td>2.33</td>
<td>1.88</td>
<td>1.38</td>
<td>1.02</td>
<td>1.00</td>
</tr>
</tbody>
</table>

- **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.

![Primary Copper: Short-Run and Long-Run Supply Curves](image1)

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

![Secondary Copper: Short-Run and Long-Run Supply Curves](image2)

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

<table>
<thead>
<tr>
<th>Price Elasticity of:</th>
<th>Short Run</th>
<th>Long run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Supply</td>
<td>0.20</td>
<td>1.60</td>
</tr>
<tr>
<td>Secondary Supply</td>
<td>0.43</td>
<td>0.31</td>
</tr>
<tr>
<td>Total Supply</td>
<td>0.25</td>
<td>1.50</td>
</tr>
</tbody>
</table>

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.

![Graph showing the price of coffee from 1965 to 2000](image)

![Diagram showing the supply and demand of coffee](image)
**Intermediate-Run**
1) Supply and demand are more elastic
2) Price falls back to $P_2$
3) Quantity falls to $Q_2$

**Long-Run**
1) Supply is extremely elastic.
2) Price falls back to $P_0$
3) Quantity increase to $Q_0$
Consumer Behavior
- The explanation of how consumers allocate their resources (income) to the purchase of different goods and services to maximize their well being.
- 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.
  2) Then we will turn to budget constraints.
     - People have limited incomes.
  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?

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

<table>
<thead>
<tr>
<th>Market Basket</th>
<th>Units of Food</th>
<th>Units of Clothing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>D</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>E</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>G</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>H</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>

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

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.

Combination $B, A, \& D$ yield the same satisfaction
- $E$ is preferred to $U_1$
- $U_1$ is preferred to $H \& G$
• Indifference Curves
  – Finally, indifference curves cannot cross.
    • This would violate the assumption that more is preferred to less.

![Indifference Curves Cannot Cross](image)

The consumer should be indifferent between A, B and D. However, B contains more of both goods than D.

• 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.

![Observation: MRS](image)

Observation: The amount of clothing given up for a unit of food decreases from 6 to 1

\[ MRS = \frac{-\Delta C}{\Delta F} \]
• 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.
• 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
    – Perfect Substitutes and Perfect Complements
      • Two goods are perfect substitutes when the marginal rate of substitution
        of one good for the other is constant.

![Diagram of Perfect Substitutes]

![Diagram of Perfect Complements]

• Two goods are complements when the indifference curves for the goods
  are shaped as right angles.

• BADS
  – Things for which less is preferred to more
• Example
  – Air pollution
• Designing New Automobiles
  – Automobile executives must regularly decide when to introduce new models
    and how much money to invest in restyling.
  – An analysis of consumer preferences would help to determine when and if car
    companies should change the styling of their cars.
Designing New Automobiles
- What Do You Think?
  - How can we determine the consumers preference?

Designing New Automobiles
- A recent study of automobile demand in the USA shows that over the past two decades most consumers have preferred styling over performance.

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
LESSON 7

CONSUMER PREFERENCES

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

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

<table>
<thead>
<tr>
<th>Market Baskets:</th>
<th>F units</th>
<th>C units</th>
<th>U (F, C) = F + 2C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8</td>
<td>3</td>
<td>8 + 2(3) = 14</td>
</tr>
<tr>
<td>B</td>
<td>6</td>
<td>4</td>
<td>6 + 2(4) = 14</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>4</td>
<td>4 + 2(4) = 12</td>
</tr>
</tbody>
</table>

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

- 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.

- 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.

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

---
The Budget Line
- Let F equal the amount of food purchased, and C is the amount of clothing.
- Price of food = Pf and price of clothing = Pc
- Then Pf F is the amount of money spent on food, and Pc C is the amount of money spent on clothing.
- The budget line then can be written:

\[ P_F F + P_C C = I \]

<table>
<thead>
<tr>
<th>Market Basket</th>
<th>Food (F)</th>
<th>Clothing (C)</th>
<th>Total Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>40</td>
<td>$80</td>
</tr>
<tr>
<td>B</td>
<td>20</td>
<td>30</td>
<td>$80</td>
</tr>
<tr>
<td>D</td>
<td>40</td>
<td>20</td>
<td>$80</td>
</tr>
<tr>
<td>E</td>
<td>60</td>
<td>10</td>
<td>$80</td>
</tr>
<tr>
<td>G</td>
<td>80</td>
<td>0</td>
<td>$80</td>
</tr>
</tbody>
</table>

- 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.
  - The slope indicates the rate at which the two goods can be substituted without changing the amount of money spent.
  - The vertical intercept (I/PC), illustrates the maximum amount of C that can be purchased with income I.
  - The horizontal intercept (I/PF), illustrates the maximum amount of F that can be purchased with income I.

- 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).
    - A decrease in income causes the budget line to shift inward, parallel to the original line (holding prices constant).
Price Changes

- If the price of one good increases, the budget line shifts inward, pivoting from the other good’s intercept.
- If the price of one good decreases, the budget line shifts outward, pivoting from the other good’s intercept.

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.
  - However, the budget line will shift inward to a point parallel to the original budget line.
  - If the two goods decrease in price, but the ratio of the two prices is unchanged, the slope will not change.
  - However, the budget line will shift outward to a point parallel to the original budget line.

Consumer Choice

- Consumers choose a combination of goods that will maximize the satisfaction they can achieve, given the limited budget available to them.
- The maximizing market basket must satisfy two conditions:
  1) It must be located on the budget line.
Recall, the slope of an indifference curve is:

\[ MRS = - \frac{\Delta C}{\Delta F} \]

Further, the slope of the budget line is:

\[ Slope = - \frac{P_F}{P_C} \]

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

\[ MRS = \frac{P_F}{P_C} \]

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).
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.
- 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.

At market basket A, the budget line and the indifference curve are tangent and no higher level of satisfaction can be attained.

At A:
\[ \text{MRS} = \frac{P_f}{P_c} = 0.5 \]

These consumers are willing to trade off a considerable amount of styling for some additional performance.

These consumers are willing to trade off a considerable amount of performance for some additional styling.
Decision making & Public Policy
- Choosing between a non-matching and matching grant to fund police expenditures

**Non-matching Grant**

**Before Grant**
- Budget line: $PQ$
- $A$: Preference maximizing market basket
- Expenditure
  - OR: Private
  - OS: Police

**After Grant**
- Budget line: $TV$
- $B$: Preference maximizing market basket
- Expenditure
  - OU: Private
  - OZ: Police

**Matching Grant**

**Before Grant**
- Budget line: $PQ$
- $A$: Preference maximizing market basket

**After Grant**
- Budget line: $PQ$
- $C$: Preference maximizing market basket
- Expenditure
  - OW: Private
  - OX: Police
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 PA/PB

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!
- When a corner solution arises, the consumer’s MRS does not necessarily equal the price ratio.
- In this instance it can be said that:

\[ MRS \geq \frac{P_{\text{Ice Cream}}}{P_{\text{Frozen Yogurt}}} \]
– 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.

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

![A College Trust Fund Diagram]

A College Trust Fund

A: Consumption before the trust fund
B: Requirement that the trust fund must be spent on education
C: If the trust could be spent on other goods
Note it is repeated

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

Budget Constraints
- The Budget Line
  - The budget line indicates all combinations of two commodities for which total money spent equals total income.
  - 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 $P_fF$ is the amount of money spent on food, and $P_cC$ is the amount of money spent on clothing.
- The budget line then can be written:
  $P_fF + P_cC = I$

\[
\text{Slope} = \frac{\Delta C}{\Delta F} = -\frac{1}{2} = -\frac{P_f}{P_c}
\]
Consumer Choice
- Consumers choose a combination of goods that will maximize the satisfaction they can achieve, given the limited budget available to them.
- 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.

Recall, the slope of an indifference curve is:
\[
MRS = -\frac{\Delta C}{\Delta F}
\]

Further, the slope of the budget line is:
\[
Slope = -\frac{P_F}{P_C}
\]

Therefore, it can be said that satisfaction is maximized where:
\[
MRS = \frac{P_F}{P_C}
\]

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.
- 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.
These consumers are willing to trade off a considerable amount of styling for some additional performance.

These consumers are willing to trade off a considerable amount of performance for some additional styling.

**Consumer Choice**
- Decision making & Public Policy
  - Choosing between a non-matching and matching grant to fund police expenditures

**Non-matching Grant**
- Budget line: $PQ$
- $A$: Preference maximizing market basket
- Expenditure
  - OR: Private
  - OS: Police
Matching Grant

Non-matching Grant

Before Grant
- Budget line: PQ
- A: Preference maximizing market basket

After Grant
- C: Preference maximizing market basket

Expenditures
- OU: Private
- OZ: Police

Matching Grant

Non-matching Grant
- Point B
- OU: Private expenditure
- OZ: Police expenditure

Matching Grant

Non-matching Grant
- Point C
- OW: Private expenditure
- OX: Police expenditure

Private Expenditures ($)

Police Expenditures ($)

Before Grant
- Budget line: PQ
- A: Preference maximizing market basket

After Grant
- C: Preference maximizing market basket

Expenditures
- OW: Private
- OX: Police

Matching Grant

Non-matching Grant
- Point B
- OU: Private expenditure
- OZ: Police expenditure

Matching Grant

Non-matching Grant
- Point C
- OW: Private expenditure
- OX: Police expenditure
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.

Revealed Preferences--Two Budget Lines

\[ I_1: \text{Chose } A \text{ over } B \]
\[ A \text{ is revealed preferred to } B \]
\[ I_2: \text{Choose } B \text{ over } D \]
\[ B \text{ is revealed preferred to } D \]

Revealed Preferences--Four Budget Lines

All market baskets in the blue shaded area are preferred to \( A \).

B is preferred to all market baskets in the pink area.
All market baskets in the blue area preferred to A

A: preferred to all market baskets in the pink area

 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?
Lesson 9

MARGINAL UTILITY AND CONSUMER CHOICE

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

Relationship of Total and Marginal Utility
- Diminishing Marginal Utility: An Example

<table>
<thead>
<tr>
<th>Quantity of good consumed</th>
<th>Total utility</th>
<th>Marginal utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>

Total utility of consuming a certain amount is equal to the sum of the marginal utilities up to the point.

Total utility increases at a decreasing rate.
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 of one good, food (F), must balance the loss of utility from the decrease in the consumption in the other good, clothing (C).

- Formally:
  
  \[ 0 = \text{MU}_F (\Delta F) + \text{MU}_C (\Delta C) \]

- Rearranging:
  
  \[-(\Delta C / \Delta F) = \frac{\text{MU}_F}{\text{MU}_C}\]

  Because:
  
  \[-(\Delta C / \Delta F) = \frac{\text{MRS}}{\text{of F for C}}\]
  
  \[\text{MRS} = \frac{\text{MU}_F}{\text{MU}_C}\]

- When consumers maximize satisfaction the:
  
  \[\text{MRS} = \frac{P_F}{P_C}\]

- Since the MRS is also equal to the ratio of the marginal utilities of consuming F and C, it follows that:
  
  \[\frac{\text{MU}_F}{\text{MU}_C} = \frac{P_F}{P_C}\]

- Which gives the equation for utility maximization?
  
  \[\frac{\text{MU}_F}{P_F} = \frac{\text{MU}_C}{P_C}\]

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

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

<table>
<thead>
<tr>
<th>Price of books</th>
<th>$20/book</th>
<th>$100/book</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of books</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>Price of food</td>
<td>$2.00/lb</td>
<td>$2.20/lb</td>
</tr>
<tr>
<td>Pounds of food</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Expenditure</td>
<td>$500</td>
<td>$1,260</td>
</tr>
</tbody>
</table>
  - Sarah’ Expenditure
    - $500=100 lbs of food x $2.00/lb +15 books x $20/book
  - Raheela’ Expenditure for Equal Utility
    - $1,260=300 lbs of food x $2.20/lb +6 books x $100/book
• The ideal cost-of-living adjustment for Raheela 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.

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.

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.

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.

Calculating Raheela’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)

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.
What Do You Think?

— Does the Laspeyres index always overstate the true cost-of-living index?

* Yes!

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

* 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.

* Comparing the Two Indexes

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

* 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

— 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 \( C_t \).

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

\[
LI = \frac{P_{Ft} F_b + P_{Ct} C_b}{P_{Fb} F_t + P_{Cb} C_t}
\]

\[
PI = \frac{P_{Ft} F_t + P_{Ct} C_t}{P_{Fb} F_t + P_{Cb} C_t}
\]

— Sarah (1990)

• Cost of base-year bundle at current prices equals
  $1,720 (100 lbs \times $2.20/lb + 15 books \times $100/book)

• Cost of same bundle at base year prices is
  $500 (100 lbs \times $2.00/lb + 15 books \times $20/book)

— Sarah (1990)

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

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

\[ PI = \frac{1,260}{720} = 1.75 \]

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.
Lesson 10

Review of Consumer Equilibrium
- Consumer Preferences
- Budget Constraint
- Consumer Choices

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

Assume:
- $I = $20
- $P_C = $2

Three separate indifference curves are tangent to each budget line.

The price-consumption curve traces out the utility maximizing market basket for the various prices for food.
Effect of a Price Change

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.
  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

When the price falls: \( P_f / P_c \) & \( MRS \) also fall

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.
Effects of Income Changes

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

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.
  - 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**.

**An Inferior Good**

Both Tea and Coffee behave as a normal good, between A and B...

...but Tea becomes an inferior good when the income consumption curve bends backward between B and C.

**Engel Curves**

- 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.

Engel curves slope upward for normal goods.

Engel curves slope backward bending for inferior goods.
### Consumer Expenditures in US

**Income Group (1997 $)**

<table>
<thead>
<tr>
<th>Expenditure ($) on</th>
<th>Less than 1,000- $10,000</th>
<th>1,000- 19,000</th>
<th>20,000- 29,000</th>
<th>30,000- 39,000</th>
<th>40,000- 49,000</th>
<th>50,000- 69,000</th>
<th>70,000- and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment</td>
<td>700</td>
<td>947</td>
<td>1274</td>
<td>1514</td>
<td>2054</td>
<td>2654</td>
<td>4300</td>
</tr>
<tr>
<td>Owned Res.</td>
<td>1116</td>
<td>1725</td>
<td>253</td>
<td>3243</td>
<td>4454</td>
<td>5793</td>
<td>9898</td>
</tr>
<tr>
<td>Rented Res.</td>
<td>1957</td>
<td>2170</td>
<td>2371</td>
<td>2536</td>
<td>2137</td>
<td>1540</td>
<td>1266</td>
</tr>
<tr>
<td>Health Care</td>
<td>1031</td>
<td>1697</td>
<td>1918</td>
<td>820</td>
<td>2052</td>
<td>2214</td>
<td>2642</td>
</tr>
<tr>
<td>Food</td>
<td>656</td>
<td>3385</td>
<td>4109</td>
<td>4888</td>
<td>5429</td>
<td>6220</td>
<td>8279</td>
</tr>
<tr>
<td>Clothing</td>
<td>859</td>
<td>978</td>
<td>1363</td>
<td>1772</td>
<td>1778</td>
<td>2614</td>
<td>3442</td>
</tr>
</tbody>
</table>

### 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

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

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

- 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!
Lesson 11

Income & 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 Effect
      - Consumers experience an increase in real purchasing power when the price of one good falls.
  - 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.
  - 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.
    - Even with inferior goods, the income effect is rarely large enough to outweigh the substitution effect.

Income & Substitution Effects: Normal Good

[Diagram showing the effects of price changes on consumption of goods, with labels for substitution effect, income effect, and total effect.]
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.

Effect of a Gasoline Tax with a Rebate

*Assume*

- \( P_e^d = -0.5 \)
- Income = $9,000
- Price of gasoline = $1

Since food is an inferior good, the income effect is negative. However, the substitution effect is larger than the income effect.
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.

Determining the Market Demand Curve

<table>
<thead>
<tr>
<th>Price ($)</th>
<th>Individual A (units)</th>
<th>Individual B (units)</th>
<th>Individual C (units)</th>
<th>Market (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>10</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>8</td>
<td>13</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

Summing to Obtain a Market Demand Curve

[Graphs showing demand curves D_A and D_B]
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.

Elasticity of Demand

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

$$E_P = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{Q} \div \frac{\Delta P}{P}$$
Price Elasticity and Consumer Expenditure

<table>
<thead>
<tr>
<th>Demand</th>
<th>If Price Increases,</th>
<th>If Price Decreases,</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expenditures:</td>
<td>Expenditures:</td>
</tr>
<tr>
<td>Inelastic ($E_p &lt; 1$)</td>
<td>Increase</td>
<td>Decrease</td>
</tr>
<tr>
<td>Unit Elastic ($E_p = 1$)</td>
<td>Are unchanged</td>
<td>Are unchanged</td>
</tr>
<tr>
<td>Elastic ($E_p &gt; 1$)</td>
<td>Decrease</td>
<td>Increase</td>
</tr>
</tbody>
</table>

• 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.
  — Point elasticity measures elasticity at a point on the demand curve.
  — Its formula is:

\[ E_p = \frac{(P/Q)(1/\text{slope})}{\text{ }} \]

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.
• 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%

Elasticity equals:
-33.33/.25 = -1.33 or -.50/.20 = -2.54

—Which one is correct?
• Arc Elasticity of Demand
  — Arc elasticity calculates elasticity over a range of prices
  — Its formula is:

\[ E_p = (\Delta Q/\Delta P) \left( \frac{\bar{P}}{\bar{Q}} \right) \]

\[ \bar{P} = \text{the average price} \]
\[ \bar{Q} = \text{the average quantity} \]
• Arc Elasticity of Demand: An Example

\[ E_P = \left( \frac{\Delta Q}{\Delta P} \right) \left( \frac{\bar{P}}{\bar{Q}} \right) \]

\[ P_1 = 8, \quad P_2 = 10, \quad Q_1 = 6, \quad Q_2 = 4 \]

\[ \bar{P} = \frac{18}{2} = 9 \quad \text{and} \quad \bar{Q} = \frac{10}{2} = 5 \]

\[ E_p = \left( \frac{-2}{2} \right) \left( \frac{9}{5} \right) = -1.8 \]
Lesson 12

The Aggregate Demand For Wheat

- The demand for U.S. wheat is comprised of domestic demand and export demand.
- The domestic demand for wheat is given by the equation:
  \[ Q_{DD} = 1700 - 107P \]
- The export demand for wheat is given by the equation:
  \[ Q_{DE} = 1544 - 176P \]
- Domestic demand is relatively price inelastic (-0.2), while export demand is more price elastic (-0.4).

Consumer Surplus

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

The consumer surplus of purchasing 6 concert tickets is the sum of the surplus derived from each one individually.
The stepladder demand curve can be converted into a straight-line demand curve by making the units of the good smaller.

- 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.
- Question: Are the benefits of cleaning up the air worth the costs?
- People pay more to buy houses where the air is clean.
- Data for house prices among neighborhoods of Lahore and Rawalpindi were compared with the various air pollutants.
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.
• If this is the case, a network externality exists.
• Network externalities can be positive or negative.
• 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.

• 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).

Positive Network Externality: Bandwagon Effect
The Snob Effect

- If the network externality is negative, a \textbf{snob effect} exists.
- The \textbf{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.
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
Lesson 13

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).

- Interpreting Probability
  - The likelihood that a given outcome will occur
  - Objective Interpretation
    - Based on the observed frequency of past events
  - 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

- 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
  - An Example
    - Investment in drilling exploration:
      - Two outcomes are possible
        - Success -- the stock price increase from $30 to $40/share
        - Failure -- the stock price falls from $30 to $20/share
      - Objective Probability
        - 100 explorations, 25 successes and 75 failures
        - Probability (Pr) of success = 1/4 and the probability of failure = 3/4
        - Expected value ($EV$) = $Pr(\text{success})$($40/\text{share}$) + $Pr(\text{failure})$($20/\text{share}$)
        - $EV = 1/4 (40/\text{share}) + 3/4 (20/\text{share})$
        - $EV = 25/\text{share}$

- Given:
  - Two possible outcomes having payoffs $X_1$ and $X_2$
  - Probabilities of each outcome is given by $Pr_1$ & $Pr_2$
  - Generally, expected value is written as:
    
    \[
    E(X) = Pr_1X_1 + Pr_2X_2 + ... + Pr_nX_n
    \]
Variability

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

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.
- 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).

<table>
<thead>
<tr>
<th>Income from Sales Jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Outcome 1</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Probability</td>
</tr>
<tr>
<td>Job 1: Commission</td>
</tr>
<tr>
<td>Job 2: Fixed salary</td>
</tr>
</tbody>
</table>

E(X₁) = .5($2000) + .5($1000) = $1500

Job 2 Expected Income

E(X₂) = .99($1510) + .01($510) = $1500

- 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

<table>
<thead>
<tr>
<th>Deviations from Expected Income ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome 1</td>
</tr>
<tr>
<td>Job 1</td>
</tr>
<tr>
<td>Job 2</td>
</tr>
</tbody>
</table>

- 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.

- The standard deviation is written:

$$\sigma = \sqrt{\Pr(X_1-E(X))^2} + \Pr(X_2-E(X))^2}$$
Calculating Variance ($)

<table>
<thead>
<tr>
<th>Outcome 1</th>
<th>Deviation Squared</th>
<th>Outcome 2</th>
<th>Deviation Squared</th>
<th>Deviation Squared</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job 1</td>
<td>$2,000</td>
<td>$250,000</td>
<td>$1,000</td>
<td>$250,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>Job 2</td>
<td>1,510</td>
<td>100</td>
<td>510</td>
<td>980,100</td>
<td>9,900</td>
</tr>
</tbody>
</table>

* The standard deviations of the two jobs are:

\[ \sigma_1 = \sqrt{.5(250,000)^2 + .5(250,000)^2} = 500 \text{ (Greater Risk)} \]

\[ \sigma_2 = \sqrt{.99(100)^2 + .01(980,100)^2} = 99.50 \]

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

* An Example

- Job 1 is a job in which the income ranges from $1000 to $2000 in increments of $100 that are all equally likely.
- Job 2 is a job in which the income ranges from $1300 to $1700 in increments of $100 that, also, are all equally likely.

![Probability](image)

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

- 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

<table>
<thead>
<tr>
<th>Job 1</th>
<th>Outcome 1</th>
<th>Deviation Squared</th>
<th>Outcome 2</th>
<th>Deviation Squared</th>
<th>Deviation Squared</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$2,100</td>
<td>$250,000</td>
<td>$1,100</td>
<td>$250,000</td>
<td>$1,600</td>
<td>$500</td>
</tr>
<tr>
<td>Job 2</td>
<td>1510</td>
<td>100</td>
<td>510</td>
<td>980,100</td>
<td>1,500</td>
<td>99.50</td>
</tr>
</tbody>
</table>

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

- 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?
- Example
  — Suppose a city wants to deter people from wrong parking.
  — The alternatives ……
Assumptions:

1) Wrong 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.

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

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.

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
  - Example
    - A person is earning $15,000 and receiving 13 units of utility from the job.
    - She is considering a new, but risky job.
  - 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.
  - 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.
  - The expected utility can be written:
    - \[ E(u) = (\frac{1}{2})u(10,000) + (\frac{1}{2})u(30,000) \]
    - \[ = 0.5(10) + 0.5(18) \]
    - \[ = 14 \]
    - \[ E(u) \] of new job is 14 which is greater than the current utility of 13 and therefore preferred.

* Different Preferences Toward Risk
  - People can be
    - Risk averse
    - Risk neutral or
    - Risk loving
  - 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.
  - 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.
  - Expected Income = \[ (0.5)(30,000) + (0.5)(10,000) = 20,000 \]
  - Expected income from both jobs is the same -- risk averse may choose current job
  - The expected utility from the new job is found:
    - \[ E(u) = (\frac{1}{2})u(10,000) + (\frac{1}{2})u(30,000) \]
    - \[ E(u) = (0.5)(10) + (0.5)(18) = 14 \]
    - \[ E(u) \] of Job 1 is 16 which is greater than the \[ E(u) \] of Job 2 which is 14.
• 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.

Risk Averse

The consumer is risk averse because she would prefer a certain income of $20,000 to a gamble with a .5 probability of $10,000 and a .5 probability of $30,000.

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.

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
Risk Premium
- The **risk premium** is the amount of money that a risk-averse person would pay to avoid taking a 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:
  - $E(u) = .5(18) + .5(10) = 14$

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

Risk Aversion and Income
- Variability in potential payoffs increases 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).
- The expected income is still $20,000, but the expected utility falls to 10.
- Expected utility = .5u($) + .5u($40,000)

\[= 0 + .5(20) = 10\]

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

- **Indifference Curve**
  - Combinations of expected income & standard deviation of income that yield the same utility.

**Risk Aversion and Indifference Curves**

![Risk Aversion and Indifference Curves](image)

- **Highly Risk Averse:** An increase in standard deviation requires a large increase in income to maintain satisfaction.
- **Slightly Risk Averse:** A large increase in standard deviation requires only a small increase in income to maintain satisfaction.
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 averse
    - 20% did not respond
- Those who liked risky situations did so when losses were involved.
- When risks involved gains the same, executives opted for less risky situations.
- The executives made substantial efforts to reduce or eliminate risk by delaying decisions and collecting more information.
Reducing Risk

Three ways consumers attempt to reduce risk are:

1) Diversification
2) Insurance
3) Obtaining more information

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.

<table>
<thead>
<tr>
<th>Income from Sales of Appliances</th>
<th>Hot Weather</th>
<th>Cold Weather</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air conditioner sales</td>
<td>$30,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>Heater sales</td>
<td>12,000</td>
<td>30,000</td>
</tr>
</tbody>
</table>

* 0.5 probability of hot or cold weather

- If the firm 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
- If the firm divides their time evenly between appliances their air conditioning and heating sales would be half their original values.
- 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.
- With diversification, expected income is $21,000 with no risk
- Firms can reduce risk by diversifying among a variety of activities that are not closely related.

Stock Market

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

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

<table>
<thead>
<tr>
<th>Insurance</th>
<th>Burglary (Pr = .1)</th>
<th>No Burglary (Pr = .9)</th>
<th>Expected Wealth</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>$40,000</td>
<td>$50,000</td>
<td>$49,000</td>
<td>$9,055</td>
</tr>
<tr>
<td>Yes</td>
<td>49,000</td>
<td>49,000</td>
<td>49,000</td>
<td>0</td>
</tr>
</tbody>
</table>

- 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.
- The Law of Large Numbers
  - Although single events are random and largely unpredictable, the average outcome of many similar events can be predicted.
- 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
- 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
- Then:
  - $1,000 premium generates a $100,000 fund to cover losses
  - Actuarial Fairness
    - When the insurance premium = expected payout

The Value of Title Insurance When Buying a House

- A Scenario:
  - Price of a house is $200,000
  - 5% chance that the seller does not own the house
- Risk neutral buyer would pay:
  \[
  (.95 \times 200,000) + .05 \times 0 = 190,000
  \]
- 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.
- Value of Complete Information
  - The difference between the expected value of a choice with complete information and the expected value when information is incomplete.
- 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
- 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

<table>
<thead>
<tr>
<th>Sale of 50</th>
<th>Sale of 100</th>
<th>Expected Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Buy 50 suits</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>2. Buy 100 suits</td>
<td>1,500</td>
<td>12,000</td>
</tr>
</tbody>
</table>

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

- 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.
- 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).

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

**Findings**
- Packed milk demand is seasonal with the greatest demand in the summer
- $E_s$ is negative and small
- $E_i$ is positive and large
- Milk advertising increases sales most in the summer.
- Allocating advertising based on this information in Karachi increased sales by Rs. 400,000 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).
- **Capital Gain**
  - An increase in the value of an asset, while a decrease is a capital loss.
- **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
  - **Riskless Asset**
    - Provides a flow of money or services that is known with certainty.
    - Examples
      - Short-term government bonds, short-term certificates of deposit
• 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.
• Asset Returns

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

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

• Expected vs. Actual Returns
  – Expected Return
    • Return that an asset should earn on average
  – Actual Return
    • Return that an asset earns
  – Higher returns are associated with greater risk.
  – The risk-averse investor must balance risk relative to return
• Risk and Budget Line

Expected return, \( R_p \), increases as risk increases.

The slope is the price of risk or the risk-return trade-off.

**Choosing Between Risk and Return**

\( U_2 \) is the optimal choice of those obtainable, since it gives the highest return for a given risk and is tangent to the budget line.
The Choices of Two Different Investors

Given the same budget line, investor A chooses low return-low risk, while investor B chooses high return-high risk.
Lesson 16

Introduction
ɨ Our focus is the supply side.
ɨ The theory of the firm will address:
   – How a firm makes cost-minimizing production decisions
   – How cost varies with output
   – Characteristics of market supply

The Technology of Production
ɨ The Production Process
   – Combining inputs or factors of production to achieve an output
ɨ Categories of Inputs (factors of production)
   – Labor
   – Materials
   – Capital
ɨ 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.
ɨ The production functions for two inputs:

\[
Q = F(K,L)
\]

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

Isoquants
ɨ Assumptions
   – Food producer has two inputs
      • Labor (L) & Capital (K)
ɨ 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.
ɨ Isoquants
   – Curves showing all possible combinations of inputs that yield the same output
### Production Function for Food

#### Labor Input vs. Capital Input

<table>
<thead>
<tr>
<th>Capital Input</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>40</td>
<td>55</td>
<td>65</td>
<td>75</td>
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<tr>
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<td>75</td>
<td>90</td>
<td>105</td>
<td>115</td>
<td>120</td>
</tr>
</tbody>
</table>

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

**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.

**The Short Run vs. 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.
- **Long-run**
  - Amount of time needed to make all production inputs variable.
### Production with One Variable Input (Labor)

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

**Observations:**

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

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

\[
AP = \frac{Output}{Labor Input} = \frac{Q}{L}
\]

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

\[ MP_L = \frac{\Delta Output}{\Delta Labor Input} = \frac{\Delta Q}{\Delta L} \]
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.

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

**The Effect of Technological Improvement**

Labor productivity can increase if there are improvements in technology, even though any given production process exhibits diminishing returns to labor.
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

<table>
<thead>
<tr>
<th>Year</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948-1952</td>
<td>100</td>
</tr>
<tr>
<td>1960</td>
<td>115</td>
</tr>
<tr>
<td>1970</td>
<td>123</td>
</tr>
<tr>
<td>1980</td>
<td>128</td>
</tr>
<tr>
<td>1990</td>
<td>137</td>
</tr>
<tr>
<td>1995</td>
<td>135</td>
</tr>
<tr>
<td>1998</td>
<td>140</td>
</tr>
</tbody>
</table>

- 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.
- Technology has created surpluses and driven the price down.
- Question
  — If food surpluses exist, why is there hunger?
- Answer
  — The cost of distributing food from productive regions to unproductive regions and the low income levels of the non-productive regions.
- Labor Productivity

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

- 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

<table>
<thead>
<tr>
<th>Country</th>
<th>Output per Employed Person (1997)</th>
<th>Annual Rate of Growth of Labor Productivity (%)</th>
</tr>
</thead>
</table>

**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.

**Explanations for Productivity Growth Slowdown**

1) Growth in the stock of capital is the primary determinant of the growth in productivity.
2) Rate of capital accumulation in the U.S. was slower than other developed countries because the others were rebuilding after WWII.
3) Depletion of natural resources
4) Environment regulations
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

**The Shape of Isoquants**

- **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.
    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.
- **Substituting Among Inputs**
  - Managers want to determine what combination of inputs to use.
  - They must deal with the trade-off between inputs.
  - The slope of each isoquant gives the trade-off between two inputs while keeping output constant.
  - The marginal rate of technical substitution equals:

\[
MRTS = -\frac{\Delta K}{\Delta L} \quad \text{(for a fixed level of Q)}
\]
Marginal Rate of Technical Substitution

- 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.

MRTS and Marginal Productivity
- The change in output from a change in labor equals:
  \[(\frac{MP_L}{\Delta L})\]
- The change in output from a change in capital equals:
  \[(\frac{MP_K}{\Delta K})\]
- If output is constant and labor is increased, then:
  \[(\frac{MP_L}{\Delta L}) + (\frac{MP_K}{\Delta K}) = 0\]
  \[(\frac{MP_L}{\Delta L})\frac{MP_K}{\Delta L} = - (\frac{\Delta K}{\Delta L}) = MRTS\]

Isoquants When Inputs are perfectly substitutable
Perfect Substitute

Observations when inputs are perfectly substitutable:

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

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**

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).

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.
Observations:

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

2) Operating at B
   - Increase L to 760 and decrease K to 90 the MRTS < 1:
     \[ MRTS = \frac{-\Delta K}{\Delta L} = -\frac{10}{260} = 0.04 \]

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.).

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

![Increasing Returns Diagram](image1)

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

![Constant Returns Diagram](image2)

3. **Decreasing returns to scale**: output less than doubles when all inputs are doubled
   - Isoquants move further apart

![Decreasing Returns Diagram](image3)
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

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

#### The U.S. Carpet Industry
**Carpet Shipments, 1996**
(Millions of Dollars per Year)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Company</th>
<th>Shipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Shaw Industries</td>
<td>$3,202</td>
</tr>
<tr>
<td>2.</td>
<td>Mohawk Industries</td>
<td>1,795</td>
</tr>
<tr>
<td>3.</td>
<td>Beaulieu of America</td>
<td>1,006</td>
</tr>
<tr>
<td>4.</td>
<td>Interface Flooring</td>
<td>820</td>
</tr>
<tr>
<td>5.</td>
<td>Queen Carpet</td>
<td>775</td>
</tr>
<tr>
<td>6.</td>
<td>World Carpets</td>
<td>$475</td>
</tr>
<tr>
<td>7.</td>
<td>Burlington Industries</td>
<td>450</td>
</tr>
<tr>
<td>8.</td>
<td>Collins &amp; Aikman</td>
<td>418</td>
</tr>
<tr>
<td>9.</td>
<td>Masland Industries</td>
<td>380</td>
</tr>
<tr>
<td>10.</td>
<td>Dixied Yarns</td>
<td>280</td>
</tr>
</tbody>
</table>

- Are there economies of scale?
  - Costs (percent of cost)
    - Capital -- 77%
    - Labor -- 23%
- Large Manufacturers
  - Increased in machinery & labor
  - Doubling inputs has more than doubled output
  - Economies of scale exist for large producers
- 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
Lesson 18

Introduction

The production technology measures the relationship between input and output.

Given the production technology, managers must choose how to produce.

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.

Measuring Cost: Which Costs Matter?

Accounting Cost vs. Economic 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

Opportunity cost.

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

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?

Sunk Cost

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

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?

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...

\[
TC = FC + VC
\]

- Fixed Cost
  - Does not vary with the level of output

- Variable Cost
  - Cost that varies as output varies

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

Personal Computers: most costs are variable

- Components, labor

Software: most costs are sunk

- Cost of developing the software
Pizza

- Largest cost component is fixed

### A Firm’s Short-Run Costs ($)

<table>
<thead>
<tr>
<th>Rate of output</th>
<th>Fixed cost FC</th>
<th>Variable cost VC</th>
<th>Total cost TC</th>
<th>Marginal cost MC</th>
<th>Average fixed cost AFC</th>
<th>Average variable cost AVC</th>
<th>Average total cost ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>85</td>
<td>4.5</td>
<td>35</td>
<td>39.5</td>
</tr>
</tbody>
</table>

**Cost in the Short Run**

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

\[
MC = \frac{\Delta VC}{\Delta Q} = \frac{\Delta TC}{\Delta Q}
\]

- 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:

\[
ATC = \frac{TFC}{Q} + \frac{TVC}{Q}
\]

- 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:

\[
ATC = AFC + AVC \quad \text{or} \quad \frac{TC}{Q}
\]

- 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.
  - 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.

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

\[
MC = \frac{\Delta VC}{\Delta Q}
\]
\[ VC = wL \]
\[ MC = \frac{w\Delta L}{\Delta Q} \]
\[ \Delta MP_l = \frac{\Delta Q}{\Delta L} \]

\[ \Delta L \text{ for a 1 unit } \Delta Q = \frac{\Delta L}{\Delta Q} = \frac{1}{\Delta MP_l} \]

\*In conclusion:

\[ MC = \frac{w}{MP_l} \]
### Lesson 19

#### A Firm’s Short-Run Costs ($)

<table>
<thead>
<tr>
<th>Rate of output</th>
<th>Fixed cost FC</th>
<th>Variable cost VC</th>
<th>Total cost TC</th>
<th>Marginal cost MC</th>
<th>Average fixed cost AFC</th>
<th>Average variable cost AVC</th>
<th>Average total cost ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50</td>
<td>0</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>78</td>
<td>128</td>
<td>28</td>
<td>25</td>
<td>39</td>
<td>64</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>98</td>
<td>148</td>
<td>20</td>
<td>16.5</td>
<td>32.7</td>
<td>49.3</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>112</td>
<td>162</td>
<td>14</td>
<td>12.5</td>
<td>28</td>
<td>40.5</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>130</td>
<td>180</td>
<td>18</td>
<td>10</td>
<td>26</td>
<td>36</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>150</td>
<td>200</td>
<td>20</td>
<td>8.3</td>
<td>25</td>
<td>33.3</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td>175</td>
<td>225</td>
<td>25</td>
<td>7.1</td>
<td>25</td>
<td>32.1</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
<td>204</td>
<td>254</td>
<td>29</td>
<td>6.3</td>
<td>25.5</td>
<td>31.8</td>
</tr>
<tr>
<td>9</td>
<td>50</td>
<td>242</td>
<td>292</td>
<td>38</td>
<td>5.6</td>
<td>26.9</td>
<td>32.4</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>300</td>
<td>350</td>
<td>58</td>
<td>5</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>11</td>
<td>50</td>
<td>385</td>
<td>435</td>
<td>85</td>
<td>4.5</td>
<td>35</td>
<td>39.5</td>
</tr>
</tbody>
</table>

- 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

![Graph showing relationship between output and cost](image-url)
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)

Unit Costs

- AFC falls continuously
- When MC < AVC or MC < ATC, AVC & ATC decrease
- When MC > AVC or MC > ATC, AVC & ATC increase
- MC = AVC and ATC at minimum AVC and ATC
- Minimum AVC occurs at a lower output than minimum ATC due to FC

The User Cost of Capital

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

- Example

  • An Airline 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%
  
  • 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

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

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

The Isocost Line
- $C = wL + rK$
- Isocost: A line showing all combinations of L & K that can be purchased for the same cost
- Rewriting C as linear:
  - $K = C/r - (w/r)L$
  - Slope of the Isocost:
    - $\left(\frac{\Delta K}{\Delta L}\right) = \left(\frac{w}{r}\right)$
    - 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

- Isoquants and Isocosts and the Production Function

\[ \text{MRTS} = \frac{-\Delta K}{\Delta L} = \frac{MP_L}{MP_K} \]

Slope of isocost line \[ \frac{\Delta K}{\Delta L} = -\frac{w}{r} \]

and \[ \frac{MP_L}{MP_K} = \frac{w}{r} \]

- The minimum cost combination can then be written as:

\[ \frac{MP_L}{w} = \frac{MP_K}{r} \]

- 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.

- 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 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.

3) How should the firm respond?

The Cost-Minimizing Response to an Effluent Fee

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 (e.g.: $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

The expansion path illustrates the least-cost combinations of labor and capital that can be used to produce each level of output in the long-run.

Expansion Path

A firm’s Long 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 Average Cost (LAC)**
  - Constant Returns to Scale
    - If input is doubled, output will double and average cost is constant at all levels of output.
  - Increasing Returns to Scale
    - If input is doubled, output will more than double and average cost decreases at all levels of output.
  - Decreasing Returns to Scale
    - If input is doubled, the increase in output is less than twice as large and average cost increases with output.
  - In the long-run:
    - Firms experience increasing and decreasing returns to scale and therefore long-run average cost is "U" shaped.
  - 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**

![Graph showing long-run expansion path and marginal cost relationship](image-url)
• Question
– What is the relationship between long-run average cost and long-run marginal cost when long-run average cost is constant?

• 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.

• Measuring Economies of Scale

\[ E_c = \text{Cost} - \text{output elasticity} \]

\[ = \%\Delta \text{ in cost from a 1\% increase} \]

in output

• 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 economies of scale

• 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**

\[ \text{Cost ($ per unit of output)} \]

With many plant sizes with \( SAC = $10 \)
the \( LAC = LMC \) and is a straight line

• 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?
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.

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?

Measuring Economies of Scale

\[
EC = \frac{\Delta C}{\Delta Q} \cdot \frac{Q}{C} = \frac{MC}{AC}
\]

Therefore, the following is true:
— EC < 1: MC < AC
  • Average cost indicate decreasing economies of scale
— EC = 1: MC = AC
  • Average cost indicate constant economies of scale
— EC > 1: MC > AC
  • Average cost indicate increasing economies of scale

The Relationship Between Short-Run and Long-Run Cost
— We will use short and long-run cost to determine the optimal plant size
Observation
– The optimal plant size will depend on the anticipated output (e.g. Q₁ choose SAC₁, 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?

What is the firm’s 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.

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?
Lesson 21

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.
- Examples:
  - Chicken farm--poultry and eggs
  - Automobile company--cars and trucks
  - University--Teaching and research
- What are the advantages of joint production?
  - Consider an automobile company producing cars and tractors
- Advantages
  1) Both use capital and labor.
  2) The firms share management resources.
  3) Both use the same labor skills and type of machinery.
- Production:
  - Firms must choose how much of each to produce.
  - The alternative quantities can be illustrated using product transformation curves.

Product Transformation Curve

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

- **Interpretation:**
  - If \( SC > 0 \) -- Economies of scope
  - If \( SC < 0 \) -- Diseconomies of scope

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

**Economies of Scope in the Trucking Industry**

- **Questions:**
  - Economies of Scope
    - 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?
  - **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
    - **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.

**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.
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.

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

\[ L = A + BN^β \]

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

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

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

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?

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?
- How would the learning curve influence your decision?

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?
- 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%.
- 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.

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.

**Total Cost Curve for the Automobile Industry**

![Graph showing total cost curve for the automobile industry]

**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 \( \beta \).

- 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:

\[ VC = \beta Q + \gamma Q^2 \]

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

\[ VC = \beta Q + \gamma Q^2 + \delta Q^3 \]

![Graph showing marginal and average cost curves]
Cubic Cost Function

- 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.

- 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

<table>
<thead>
<tr>
<th>Output (million kwh)</th>
<th>43</th>
<th>338</th>
<th>1109</th>
<th>2226</th>
<th>5819</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value of SCI, 1955</td>
<td>.41</td>
<td>.26</td>
<td>.16</td>
<td>.10</td>
<td>.04</td>
</tr>
</tbody>
</table>

Average Cost of Production in the Electric Power Industry

<table>
<thead>
<tr>
<th>Average Cost (dollar/1000 kwh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (billions of kwh)</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>18</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>36</td>
</tr>
</tbody>
</table>

- 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.
- 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 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.
- 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.
- Questions

1) What are the implications of the analysis for expansion and mergers?

2) What are the limitations of using these results?
Lesson 22

Perfectly Competitive Markets

- Characteristics of Perfectly Competitive Markets
  1) Price taking
  2) Product homogeneity
  3) Free entry and exit
- 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.
- Product Homogeneity
  - The products of all firms are perfect substitutes.
  - Examples
    - Agricultural products, oil, copper, iron, lumber
- Free Entry and Exit
  - Buyers can easily switch from one supplier to another.
  - Suppliers can easily enter or exit a market.
- Discussion Questions
  - What are some barriers to entry and exit?
  - Are all markets competitive?
  - When is a market highly competitive?
- Do firms maximize profits?
  - Possibility of other objectives
    - Revenue maximization
    - Dividend maximization
    - Short-run profit maximization
  - Implications of non-profit objective
    - Over the long-run investors would not support the company
    - Without profits, survival unlikely
    - Long-run profit maximization is valid and does not exclude the possibility of altruistic behavior.

Marginal Revenue, Marginal Cost & Profit Maximization

- Determining the profit maximizing level of output
  - Profit ($\pi$) = 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

Marginal Revenue, Marginal Cost & 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.
• Comparing R(q) and C(q)
  — Output levels: 0 - q0:
    • C(q) > R(q)

Negative profit
• FC + VC > R(q)
• MR > MC
  Indicates higher profit at higher output
— Question: Why is profit negative when output is zero?
— Output levels: q0 - q*
  • R(q) > C(q)
  • MR > MC
  Indicates higher profit at higher output while Profit is increasing
— Output level: q*
  • R(q) = C(q)
  • MR = MC
  • Profit is maximized
  • Question
    — Why is profit reduced when producing more or less than q*?
— Output levels beyond q*:
  • R(q) > C(q)
  • MC > MR
  • Profit is decreasing

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

\[ \pi = R - C \quad MR = \frac{\Delta R}{\Delta q} \quad MC = \frac{\Delta C}{\Delta q} \]

Profits are maximized when:

\[ \frac{\Delta \pi}{\Delta q} = \frac{\Delta R}{\Delta q} - \frac{\Delta C}{\Delta q} = 0 \quad or \quad MR - MC = 0 \quad so \quad that \quad MR(q) = MC(q) \]

• 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
Demand & Marginal Revenue Faced by a 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.
  - If the producer tries to lower price he cannot increase sales
    - $P = D = MR = AR$

Profit Maximization
- $MC(q) = MR = P$

Choosing Output in Short Run
- We will combine production and cost analysis with demand to determine output and profitability.

A Competitive Firm Making a Positive Profit
- $AR = MR$
- At $q^* : MR = MC$ and $P > ATC$
- $\pi = (P - AC)x q^*$
- or $ABCD$
Choosing Output in 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.

### The Short-Run Output of an Aluminum Smelting Plant

**Observations**
- Price between $1140 & $1300: \( q = 600 \)
- Price > $1300: \( q = 900 \)
- Price < $1140: \( q = 0 \)

**Question**
- Would this producer continue to produce with a loss?
- Should the firm stay in business when \( P < $1140 \)?
1) Average variable cost should not be used as a substitute for marginal cost.

2) A single item on a firm’s accounting ledger may have two components, only one of which involves marginal cost.

3) All opportunity cost should be included in determining marginal cost.

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 \( q = q_2 \)

- 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.
- 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.

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.
- 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 Short Run

The short-run industry supply curve is the horizontal summation of the supply curves of the firms.

Question: If increasing output raises input costs, what impact would it have on market supply?
Lesson 24

Elasticity of Market Supply

\[ E_s = \left( \frac{\Delta Q}{Q} \right) / \left( \frac{\Delta P}{P} \right) \]

- 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 World Copper Industry (1999)

<table>
<thead>
<tr>
<th>Country</th>
<th>Annual Production (thousand metric tons)</th>
<th>Marginal Cost (dollars/pound)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>600</td>
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</tr>
<tr>
<td>Canada</td>
<td>710</td>
<td>0.75</td>
</tr>
<tr>
<td>Chile</td>
<td>3660</td>
<td>0.50</td>
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<tr>
<td>Indonesia</td>
<td>750</td>
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<tr>
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<td>450</td>
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<tr>
<td>Russia</td>
<td>450</td>
<td>0.50</td>
</tr>
<tr>
<td>United States</td>
<td>1850</td>
<td>0.55</td>
</tr>
</tbody>
</table>

The Short-Run World Supply of Copper

- 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 in the Short-Run**

Producer Surplus: \( \text{PS} = \pi - VC \)

Profit: \( \pi = R - VC - FC \)

**Observation**

- Short-run with positive fixed cost
  \( \text{PS} > \pi \)

**Producer Surplus for a Market**

Market producer surplus is the difference between \( P^* \) and \( S \) from 0 to \( Q^* \).

**Choosing Output in 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.
Accounting Profit & Economic Profit
- Accounting profit ($\pi$) = $R - wL$
- Economic profit ($\pi$) = $R - wL - rK$
  * $wL$ = labor cost
  * $rK$ = opportunity cost of capital

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
- Entry and Exit

In the short run, the firm is faced with fixed inputs. $P = $40 > ATC. Profit is equal to $ABCD.$

In the long run, the plant size will be increased and output increased to $q_3$. Long-run profit, $EFGD >$ short run profit $ABCD$. 

Question: Is the producer making a profit after increased output lowers the price to $30$?
• 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**

1) MC = MR
2) P = LAC
• No incentive to leave or enter
• Profit = 0

3) Equilibrium Market Price

**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?

**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.

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

**Firms Earn Zero Profit in Long-Run Equilibrium**

- A baseball team in a moderate-sized city sells enough tickets so that price is equal to marginal and average cost (profit = 0).
- A team with the same cost in a larger city sells tickets for $10.

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.
- If the opportunity cost of the input (rent) is not taken into consideration it may appear that economic profits exist in the long-run.
The Industry’s Long-Run Supply Curve

1) Constant-cost industry
   - Long-run supply is horizontal
   - Small increase in price will induce an extremely large output increase
   - Long-run supply elasticity is infinitely large
   - Inputs would be readily available

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

- Scenario 2: Rental property
  - Urban location
  - High-rise construction cost
- Questions
  - Is this an increasing or a constant-cost industry?
  - What would you predict about the elasticity of supply?

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

The firm will reduce output to the point at which the marginal cost plus the tax equals the price.

\[ MC_2 = MC_1 + \text{tax} \]

Price ($ per unit of output)

Output

\[ MC \]

\[ AVC \]

\[ AVC \]

Effect of an Output Tax on Industry Output

Tax shifts \( S_1 \) to \( S_2 \) and output falls to \( Q_2 \). Price increases to \( P_2 \).

Price ($ per unit of output)

Output

\[ S_2 = S_1 + t \]

\[ S \]

\[ D \]

Evaluating the Gains & Losses from Government Policies:

Consumer & Producer Surplus

- **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.
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.

### 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.
Observation

- Consumers can experience a net loss in consumer surplus when the demand is sufficiently inelastic.

Effect of Price Controls When Demand Is Inelastic

If demand is sufficiently inelastic, triangle $B$ can be larger than rectangle $A$ and the consumer suffers a net loss from price controls.

Example

Oil price controls and gasoline shortages

The gain to consumers is rectangle $A$ minus triangle $B$, and the loss to producers is rectangle $A$ plus triangle $C$. 

Price Controls and Natural Gas Shortages
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)

  2) Lack of Information
  - Imperfect information prevents consumers from making utility-maximizing decisions.

- Government intervention in these markets can increase efficiency.
- Government intervention without a market failure creates inefficiency or deadweight loss.
Lesson 27

**Welfare loss if price is held below market-clearing level**

When price is regulated to be no higher than \( P_1 \), the deadweight loss given by triangles \( B \) and \( C \) results.

**Welfare loss if price is held above market-clearing level**

When price is regulated to be no lower than \( P_2 \) only \( Q_3 \) will be demanded. The deadweight loss is given by triangles \( B \) and \( C \).

What would the deadweight loss be if \( Q_S = Q_2 \)?

**Quantity**

**Price**
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.

**Diagram:**

- If producers produce $Q_0$, the amount $Q_2 - Q_0$ will go unsold.
- The change in producer surplus will be $A - C - D$. Producers may be worse off.
The Minimum Wage

Firms are not allowed to pay less than $w_{min}$. This results in unemployment.

The deadweight loss is given by triangles $B$ and $C$.

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.

Effect of Airline Regulation by the Civil Aeronautics Board

Prior to deregulation price was at $P_{min}$ and $Q_D = Q_1$ and $Q_s = Q_2$.

Area $D$ is the cost of unsold output.

After deregulation: Prices fell to $P_0$. The change in consumer surplus is $A + B$. 

Area $A$
Lesson 28

Price Supports

To maintain a price $P_s$ the government buys quantity $Q_g$. The change in consumer surplus = $-A - B$, and the change in producer surplus is $A + B + D$.

The cost to the government is the speckled rectangle $P_s(Q_2-Q_1)$.

Total welfare loss $D - (Q_2-Q_1)p_s$.

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.

- What is the impact of controlling entry into the taxicab market?
Supply Restrictions

\[ \Delta \text{PS} = A - C + B + C + D = A + B + D. \]

The change in consumer and producer surplus is the same as with price supports.

\[ \Delta \text{welfare} = -A - B + A + B + D - B - C - D = -B - C. \]

Questions:
- How could the government reduce the cost and still subsidize the farmer?
- Which is more costly: supports or acreage limitations?
The Wheat Market in 1981

\[ P_0 = \$3.70 \]
\[ P_0 = \$3.46 \]

By buying 122 million bushels the government increased the market-clearing price.

Supporting the Price of Wheat

• 1981
  – 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.
  – 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

The Wheat Market in 1985

To increase the price to $3.20, the government bought 466 million bushels and imposed a production quota of 2,425 bushels.
1985

- Government Purchase:
  - Government cost = $3.20 \times 466 = $1,491 million
  - 80 cent subsidy = 0.80 \times 2,425 = $1,940 million
  - Total cost = $3.5 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**

- In a free market, the domestic price equals the world price $P_W$.
- By eliminating imports, the price is increased to $P_0$. The gain is area $A$. The loss to consumers is $A + B + C$, so the deadweight loss is $B + C$.
- How high would a tariff have to be to get the same result?

---

- 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 $A + B + C + D$.
- 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 $B + C + D$.
- Question:
  - Would a country be better off or worse off with a quota instead of a tariff?
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 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

**Sugar Quota in 1997**

The cost of the quotas to consumers was \( A + B + C + D \), or $2.4b. The gain to producers was area \( A \), or $1b.

Rectangle \( D \) was the gain to foreign producers who obtained quota allotments, or $600 million. Triangles \( B \) and \( C \) represent the deadweight loss of $800 million.
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 Specific Tax**

$P_b$ is the price (including the tax) paid by buyers.
$P_s$ is the price sellers receive, net of the tax. The burden of the tax is split evenly.

Buyers lose $A + B$, and sellers lose $D + C$, and the government earns $A + D$ in revenue. The deadweight loss is $B + C$.

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: $Q^S = Q^S(P_s)$
3. $Q^D = Q^S$
4. $P_b - P_s = \text{tax}$

**Impact of Tax Depends on Elasticities of Supply & Demand**

- Burden on Buyer
- Burden on Seller
The Impact of a Tax or Subsidy

- Pass-through fraction
  - \( \frac{E_S}{E_S - E_d} \)
  - 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.
- 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.

With a subsidy (\( s \)), the selling price \( P_b \) is below the subsidized price \( P_S \) so that:
- \( s = P_S - P_b \)
- 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.

**Impact of a $0.50 Gasoline Tax**

The annual revenue from the tax is \( .50 \times 89 \) or $44.5 billion. The buyer pays 22 cents of the tax, and the producer pays 28 cents.
Price ($ per gallon)

$1.50

$1.00

$0.50

$0.72

$0.50

Deadweight loss = $2.75 billion/yr

Lost Consumer

Lost Producer

Deadweight loss = $2.75 billion/yr

Price ($ per gallon)

Quantity (billion gallons per year)

$P_s = 1.22$

$P_0 = 1.00$

$t = 0.50$

$P_s = .72$
Perfect Competition

- Review of Perfect Competition
  - \( P = \text{LMC} = \text{LRAC} \)
  - 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

Monopoly

- Monopoly
  1) One seller - many buyers
  2) One product (no good substitutes)
  3) Barriers to entry
- 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.
- 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

<table>
<thead>
<tr>
<th>Price P</th>
<th>Total Quantity Q</th>
<th>Marginal Revenue MR</th>
<th>Average Revenue AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6</td>
<td>0</td>
<td>$0</td>
<td>---</td>
</tr>
<tr>
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</tr>
<tr>
<td>1</td>
<td>5</td>
<td>5</td>
<td>-3</td>
</tr>
</tbody>
</table>

### 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

### Monopolist’s Output Decision

1) Profits maximized at the output level where MR = MC

2) Cost functions are the same

\[
\pi (Q) = R(Q) - C(Q)
\]

\[
\frac{\Delta \pi}{\Delta Q} = \frac{\Delta R}{\Delta Q} - \frac{\Delta C}{\Delta Q} = 0 = MC - MR
\]

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)

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
Observations

- Slope of $rr'$ = slope $cc'$ and they are parallel at 10 units
- Profits are maximized at 10 units
- $P = $30, $Q = 10, \hspace{1cm} TR = P \times Q = $300
- $AC = $15, $Q = 10, \hspace{1cm} TC = AC \times Q = 150$
  - Profit = $TR - TC$
  - $150 = $300 - $150$

- $AC = $15, $Q = 10, \hspace{1cm} TC = AC \times Q = 150$
- Profit = $TR = TC = $300 - $150 = $150$
  or
- Profit = $(P - AC) \times Q = ($30 - $15)(10) = $150$
Lesson 31

• 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:

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. \[ E_d = \left( \frac{P}{Q} \right) \left( \frac{\Delta Q}{\Delta P} \right) \]
4. \[ \left( \frac{Q}{P} \right) \left( \frac{\Delta P}{\Delta Q} \right) = \frac{1}{E_d} \]
5. \[ MR = P + P \left( \frac{1}{E_d} \right) \]

6. \( \pi \) is maximized \( @ \ MR = MC \)

\[ P + P \left[ \frac{1}{E_D} \right] = - \frac{1}{E_D} \]

\[ P = \frac{MC}{1 + \left( \frac{1}{E_D} \right)} \]

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.

9. \( P = \frac{MC}{1 + \left( \frac{1}{E_d} \right)} \)

Assume

\[ E_d = -4 \quad MC = 9 \]

\[ P = \frac{9}{1 + \left( \frac{1}{-4} \right)} = \frac{9}{.75} = \$12 \]

• Monopoly pricing compared to perfect competition pricing:
  — Monopoly
    \( P > MC \)
  — Perfect Competition
    \( P = MC \)

• 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.

**A Monopolist’s Pricing**

- The Monopolist’s Output Decision
  - Price of Medicine A = $3.50/daily dose
  - Price of Medicine B and Medicine C = $1.50 - $2.25/daily dose
  - MC of Medicine A = 30 - 40 cents/daily dose

- The Monopolist’s Output Decision

  \[
  P = \frac{MC}{1 + \left[ \frac{1}{E_D} \right]} = \frac{0.35}{1 + \left[ \frac{1}{-1.1} \right]} = \frac{0.35}{0.91} \approx 0.389 = \$3.89
  \]

- Price of $3.50 is consistent with “the rule of thumb pricing”

- 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**
Monopoly

- Observations
  - Shifts in demand usually cause a change in both price and quantity.
  - A monopolistic market has no supply curve.
  - Monopolist may supply many different quantities at the same price.
  - Monopolist may supply the same quantity at different prices.

- 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

- Question
  - Suppose: \( E_d = -2 \)
  - How much would the price change?

- Answer

\[
P = \frac{MC}{1 + \left(\frac{1}{E_d}\right)}
\]

If \( E_d = -2 \rightarrow P = 2 \cdot MC \)

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.
- 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.
- Algebraically:

\[ Q_1 & C_1 \Rightarrow \text{Output} & \text{Cost for Plant 1} \]
\[ Q_2 & C_2 \Rightarrow \text{Output} & \text{Cost for Plant 2} \]
\[ \text{Total Output} = Q_T = Q_1 + Q_2 \]

- Algebraically:

\[ \pi = P Q_T - C_1 (Q_1) - C_2 (Q_2) \]
\[ \frac{\Delta \pi}{\Delta Q_1} = \frac{\Delta (P Q_T)}{\Delta Q_1} - \frac{\Delta C_1}{\Delta Q_1} = 0 \]
\[ (MR) \frac{\Delta (P Q_T)}{\Delta Q_1} - (MC) \frac{\Delta C_1}{\Delta Q_1} = 0 \]
\[ MR = MC_1 \]
\[ MR = MC_2 \]

\[ MR = MC_1 = MC_2 \]
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.
- 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
Measuring Monopoly Power

- In perfect competition: $P = MR = MC$
- Monopoly power: $P > MC$

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 does not guarantee profits.

Profit depends on average cost relative to price.

The Rule of Thumb for Pricing

\[ P = \frac{MC}{1 + \left( \frac{1}{E_d} \right)} \]

- 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

- The more elastic is demand, the less the markup.
Markup Pricing: Supermarkets to Designer Jeans

- **Supermarkets**
  - Several firms
  - Similar product
  - \( E_d = -10 \) for individual stores
  - \[ P = \frac{MC}{1 + \left( \frac{1}{-1} \right)} = \frac{MC}{0.9} = 1.11(MC) \]
  - Prices set about 10 – 11% above MC.

- **Convenience Stores**
  - Higher prices than supermarkets
  - Convenience differentiates them
  - \( E_d = -5 \)
  - \[ P = \frac{MC}{1 + \left( \frac{1}{-5} \right)} = \frac{MC}{0.8} = 1.25(MC) \]
  - Prices set about 25% above MC.
  - Convenience stores have more monopoly power.
  - Question:
    - Do convenience stores have higher profits than supermarkets?
  - **Designer jeans**
    - \( E_d = -3 \) to -4
    - Price 33 - 50% > \( MC \)
    - \( MC = $12 - $18/\text{pair} \)
    - Wholesale price = $18 - $27

**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.
- 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**

- Rent Seeking
  - Firms may spend to gain monopoly power
    - Lobbying
    - Advertising
    - Building excess capacity
- 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.

**Price Regulation**
- Recall that in competitive markets, price regulation created a deadweight loss.

**Question:**
- What about a monopoly?
Price Regulation

- 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.

![Graph showing price regulation of a natural monopoly]

- Marginal revenue curve when price is regulated to be no higher than \( P_1 \).
- If price is lowered to \( P_3 \), output decreases and a shortage exists.
- If left alone, a monopolist produces \( Q_m \) and charges \( P_m \).

Regulating the Price of a Natural Monopoly

- Natural monopolies occur because of extensive economies of scale.
Regulation in Practice
- It is very difficult to estimate the firm's cost and demand functions because they change with evolving market conditions.
- 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.
  \[ P = AVC + \frac{(D + T + sK)}{Q} \]
  - \( P \) = price, \( AVC \) = average variable cost
  - \( D \) = depreciation, \( T \) = taxes
  - \( s \) = allowed rate of return, \( K \) = firm's capital stock

Monopsony
- A monopsony is a market in which there is a single buyer.
- 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.
- Competitive Buyer
  - Price taker
  - \( P = \text{Marginal expenditure} = \text{Average expenditure} \)
  - \( D = \text{Marginal value} \)

**Competitive Buyer: Compared to Competitive Seller**
Monopsonist Buyer

The market supply curve is the monopsonist’s average expenditure curve.

Monopsony
- \( ME > P \) & above \( S \)
- Competitive
- \( P = P_C \)
- \( Q = Q_C \)

Monopoly

Note: \( MR = MC;\)
- \( AR > MC;\) \( P > MC \)

Monopoly and Monopsony

Monopsony
Note: \( ME = MV;\)
- \( ME > AE;\) \( MV > P \)
• Monopoly
  - \( MR < P \)
  - \( P > MC \)
  - \( Q_m < Q_C \)
  - \( P_m > P_C \)

• 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.
- 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.

2) Number of buyers
- The fewer the number of buyers, the less elastic the supply and the greater the monopsony power.

3) Interaction Among Buyers
- The less the buyers compete, the greater the monopsony power.

Monopsony Power:
If the Elastic versus Inelastic Supply

Deadweight Loss from Monopsony Power in the
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

The Social Cost 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.
  - 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

Pricing With Market Power

- 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.
- 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

- Between 0 and Q*, consumers will pay more than P*-consumer surplus (A).
- P*C is the price that would exist in a perfectly competitive market.
- If price is raised above P*, the firm will lose sales and reduce profit.
Capturing Consumer Surplus

- \( P^*Q^* \): single \( P \) & \( Q \) @ \( MC=MR \)
- \( A \): consumer surplus with \( P^* \)
- \( B \): \( P>MC \) & consumer would buy at a lower price
- \( P_1 \): less sales and profits
- \( P_2 \): increase sales & and reduce revenue and profits
- \( P_C \): competitive price

Question: How can the firm capture the consumer surplus in \( A \) and sell profitably in \( B \)?

Answer: Price discrimination Two-part tariffs Bundling

- Price discrimination is the charging of different prices to different consumers for similar goods.

Price Discrimination

- First Degree Price Discrimination
  – Charge a separate price to each customer: the maximum or reservation price they are willing to pay.

**Additional Profit From Perfect First-Degree Price Discrimination**

Without price discrimination, output is \( Q^* \) and price is \( P^* \). Variable profit is the area between the MC & MR.

With perfect discrimination, each consumer pays the maximum price they are willing to pay.

Without price discrimination, output is \( Q^* \) and price is \( P^* \). Consumer surplus is the area above \( P^* \) and between 0 and \( Q^* \) output.

Output expands to \( Q^{**} \) and price falls to \( P_C \) where \( MC = MR = AR = D \). Profits increase by the area above \( MC \) between old MR and D to output \( Q^{**} \).
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

First Degree Price Discrimination

- The model does demonstrate the potential profit (incentive) of practicing price discrimination to some degree.
- 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

First-Degree Price Discrimination in Practice

- With perfect discrimination
  - Each customer pays their reservation price
  - Profits increase

- Six prices exist resulting in higher profits. With a single price \( P^* \), there are few consumers and those who pay \( P_5 \) or \( P_6 \) may have a surplus.
Second-Degree Price Discrimination

Economies of scale permit:
* Increase consumer welfare
* Higher profits
• Third Degree Price Discrimination

1) Divides the market into two-groups.

2) Each group has its own demand function.

3) Most common type of price discrimination.
   - Examples: airlines, vegetables, discounts to students and senior citizens.

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)

   - Objectives
     - MR₁ = MR₂
     - MC₁ = MR₁ and MC₂ = MR₂
     - MR₁ = MR₂ = MC

   - P₁: price first group
   - P₂: price second group

   - C(Q₁) = total cost of Q₁ = Q₁ + Q₂
   - Profit (π) = P₁Q₁ + P₂Q₂ - C(Q₁)

   - Set incremental π for sales to group 1=0
     \[
     \frac{\Delta \pi}{\Delta Q_1} = \frac{\Delta (P_1Q_1)}{\Delta Q_1} - \frac{\Delta C}{\Delta Q_1} = 0
     \]

     \[
     \frac{\Delta (P_1Q_1)}{\Delta Q_1} = MR_1 - \frac{\Delta C}{\Delta Q_1} = MC
     \]

   - Second group of customers: MR₂ = MC
   - MR₁ = MR₂ = MC

   - Determining relative prices
     Recall: MR = P (1 + 1/E_d)
     Then: MR₁ = P₁ (1 + 1/E₁) = MR₂ = P₂ (1 + 1/E₂)

   - Determining relative prices
     And: \[
     \frac{P_1}{P_2} = \frac{1}{1 + \frac{1}{E_1}} \quad \frac{1}{1 + \frac{1}{E_2}}
     \]

   - Pricing: Charge higher price to group with a low demand elasticity
     - Example: E₁ = -2 & E₂ = -4
       \[
       \frac{P_1}{P_2} = \frac{1 - 1/4}{1 - 1/2} = \frac{3/4}{1/2} = 1.5
       \]

     - P₁ should be 1.5 times as high as P₂
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.
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

<table>
<thead>
<tr>
<th>Product</th>
<th>Nonusers</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toilet tissue</td>
<td>-0.60</td>
<td>-0.66</td>
</tr>
<tr>
<td>Stuffing/dressing</td>
<td>-0.71</td>
<td>-0.96</td>
</tr>
<tr>
<td>Shampoo</td>
<td>-0.84</td>
<td>-1.04</td>
</tr>
<tr>
<td>Cooking/salad oil</td>
<td>-1.22</td>
<td>-1.32</td>
</tr>
<tr>
<td>Dry mix dinner</td>
<td>-0.88</td>
<td>-1.09</td>
</tr>
<tr>
<td>Cake mix</td>
<td>-0.21</td>
<td>-0.43</td>
</tr>
<tr>
<td>Cat food</td>
<td>-0.49</td>
<td>-1.13</td>
</tr>
<tr>
<td>Frozen entree</td>
<td>-0.60</td>
<td>-0.95</td>
</tr>
<tr>
<td>Gelatin</td>
<td>-0.97</td>
<td>-1.25</td>
</tr>
<tr>
<td>Spaghetti sauce</td>
<td>-1.65</td>
<td>-1.81</td>
</tr>
<tr>
<td>Crème rinse/conditioner</td>
<td>-0.82</td>
<td>-1.12</td>
</tr>
<tr>
<td>Soup</td>
<td>-1.05</td>
<td>-1.22</td>
</tr>
<tr>
<td>Hot dogs</td>
<td>-0.59</td>
<td>-0.77</td>
</tr>
</tbody>
</table>

• Cake Mix
  —Nonusers of coupons: \( P_E = -0.21 \)
  —Users: \( P_E = -0.43 \)

• Cake Mix Brand A
  —\( P_E \): 8 to 10 times cake mix \( P_E \)

• Example
  —\( P_E \) Users: -4
  —\( P_E \) Nonusers: -2

• 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**

<table>
<thead>
<tr>
<th>Elasticity</th>
<th>First-Class</th>
<th>Economy Plus</th>
<th>Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.9</td>
</tr>
<tr>
<td>Income</td>
<td>1.2</td>
<td>1.2</td>
<td>1.8</td>
</tr>
</tbody>
</table>

- 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
  - 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

Consumers are divided into groups over time. Initially, demand is less elastic resulting in a price of $P_1$. Over time, demand becomes more elastic and price is reduced to appeal to the mass market.
**Peak-Load Pricing**

- Demand for some products may peak at particular times.
  - Rush hour traffic
  - Electricity - summer season
  - Restaurants on weekends
- Capacity restraints will also increase MC.
- Increased MR and MC would indicate a higher price.
- MR is not equal for each market because one market does not impact the other market.

**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?

  2) How long do you wait to release the paperback edition? Could the popularity of the book impact your decision?

  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.
- Examples

  1) Amusement Park
     - Pay to enter
     - Pay for rides and food within the park
2) Tennis Club
- Pay to join
- Pay to play

3) Safety Razor
- Pay for razor
- Pay for blades

4) Polaroid Film
- Pay for the camera
- Pay for the film

- 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**

Usage price $P^*$ is set where $MC = D$. Entry price $T^*$ is equal to the entire consumer surplus.

The price, $P^*$, will be greater than $MC$. Set $T^*$ at the surplus value of $D_2$.

$$\pi = 2T^* + (P^* - MC)x(Q_1 + Q_2)$$

$\pi$ more than twice $ABC$.
Two-Part Tariff with Two Consumers
- 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.
  - To find optimum combination, choose several combinations of $P, T$.
  - Choose the combination that maximizes profit.

\[
\pi = \pi_e + \pi_s = \pi(T) + (P - MQQ(n))
\]

- Rule of Thumb
  - Similar demand: Choose $P$ close to MC and high $T$
  - Dissimilar demand: Choose high $P$ and low $T$.
- Two-Part Tariff With A Twist
  - Entry price ($T$) entitles the buyer to a certain number of free units
    - Razors with several blades
    - Amusement parks with some tokens
    - On-line with free time
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
- An example: Leasing Movie X & Movie Y
  - The reservation prices for each theater and movie are:
    |       | Movie X | Movie Y |
    |-------|---------|---------|
    | Theater A | $12,000 | $3,000  |
    | Theater B  | $10,000 | $4,000  |
- Renting the movies separately would result in each theater paying the lowest reservation price for each movie:
  - Maximum price X = $10,000
  - Maximum price Y = $3,000
  - Total Revenue = $26,000
- 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.
- Relative Valuations
  - Negative Correlated: Profitable to Bundle
    - A pays more for X ($12,000) than B ($10,000).
    - B pays more for Y ($4,000) than A ($3,000).
  - 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.
    |       | Movie X | Movie Y |
    |-------|---------|---------|
    | Theater A | $12,000 | $4,000  |
    | Theater B  | $10,000 | $3,000  |
- 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 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
- The effectiveness of bundling depends upon the degree of negative correlation between the two demands.

**Reservation Prices**

If the demands are perfectly positively correlated, the firm will not gain by bundling. It would earn the same profit by selling the goods separately.

**Reservation Prices**

If the demands are perfectly negatively correlated bundling is the ideal strategy--all the consumer surplus can be extracted and a higher profit results.

**Movie Example**

Bundling pays due to negative correlation.
Lesson 38

Bundling

- Mixed Bundling
  - Selling both as a bundle and separately
- Pure Bundling
  - Selling only a package

Mixed Versus Pure Bundling

- Mixed vs. Pure Bundling
  - Scenario
    - Perfect negative correlation
    - Significant marginal cost
  - 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 buy the bundle
<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>PB</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sell separately</td>
<td>$50</td>
<td>$90</td>
<td>----</td>
<td>$150</td>
</tr>
<tr>
<td>Pure bundling</td>
<td>----</td>
<td>----</td>
<td>$100</td>
<td>$200</td>
</tr>
<tr>
<td>Mixed bundling</td>
<td>$89.95</td>
<td>$89.95</td>
<td>$100</td>
<td>$229.90</td>
</tr>
</tbody>
</table>

\[ C_1 = $20 \]

\[ C_2 = $30 \]

- **Sell Separately**
  \[ 3($50 - $20) + 1($90 - $30) = $150 \]
- **Pure Bundling**
  \[ 4($100 - $20 - $30) = $200 \]
- **Mixed Bundling**
  \[ ($89.95 - $20) + ($89.95 - $30) - 2($100 - $20 - $30) = $229.90 \]

\[ C_1 = $20 \quad C_2 = $30 \]

**Question**

- If MC = 0, would mixed bundling still be the most profitable strategy with perfect negative correlation?

---

**Mixed Bundling with Zero Marginal Costs**

In this example, consumers B and C are willing to pay $20 more for the bundle than are consumers A and D. With mixed bundling, the price of the bundle can be increased to $120. A & D can be charged $90 for a single good.

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
<th>PB</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sell separately</td>
<td>$80</td>
<td>$80</td>
<td>----</td>
<td>$320</td>
</tr>
<tr>
<td>Pure bundling</td>
<td>----</td>
<td>----</td>
<td>$100</td>
<td>$400</td>
</tr>
<tr>
<td>Mixed bundling</td>
<td>$90</td>
<td>$90</td>
<td>$120</td>
<td>$420</td>
</tr>
</tbody>
</table>
• Bundling in Practice
  — Automobile option packages
  — Vacation travel
  — Cable television
• Mixed Bundling in Practice
  — Use of market surveys to determine reservation prices
  — Design a pricing strategy from the survey results

![Diagram](image_url)

The dots are estimates of reservation prices for a representative sample of consumers.

The firm can first choose a price for the bundle and then try individual prices $P_1$ and $P_2$ until total profit is roughly maximized.

The Complete Dinner vs. 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
  — 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

AR and MR are average and marginal revenue when the firm doesn’t advertise. If the firm advertises, its average and marginal revenue curves shift to the right -- average costs rise, but marginal cost does not.

\[ \pi = PQ (P, A) - C(Q) - A \]

\[ MR_{Ads} = P \frac{\Delta Q}{\Delta A} = 1 + MC \frac{\Delta Q}{\Delta A} = \text{full MC of adv.} \]

* Choosing Price and Advertising Expenditure
* A Rule of Thumb for Advertising

\( \frac{A}{Q} \) \( \frac{\Delta Q}{\Delta A} = E_A = \text{Adv. elasticity of demand} \)

\( \frac{(P-MC)}{P} = -1 / E_p \)

\[ \frac{A}{PQ} = - \frac{E_A}{E_p} = \text{Rule of Thumb} \]

- 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.
- \( R(Q) = $1 \text{ million/yr} \)
- $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)
* Question
  - Should the firm increase advertising?
YES

- \[ A/PQ = -(2/-4) = 5\% \]
- Increase budget to $50,000

Questions

- When \( E_A \) is large, do you advertise more or less?
- When \( E_P \) is large, do you advertise more or less?

Advertising: In Practice

- Estimate the level of advertising for each of the firms

  - Supermarkets \( E_P = -10; E_A = 0.1 \) to \( 0.3 \)
  - Convenience stores \( E_P = -5; E_A = \) very small
  - Designer jeans \( E_P = -3 \) to \( -4; E_A = 0.3 \) to \( 1 \)
  - Laundry detergents \( E_P = -3 \) to \( -4; E_A = \) very large
Monopolistic Competition

- Characteristics

1) Many firms
2) Free entry and exit
3) Differentiated product
- The amount of monopoly power depends on the degree of differentiation.
- Examples of this very common market structure include:
  - Toothpaste
  - Soap
  - Cold remedies
- Toothpaste
  - Brand J and monopoly power
    - Suppose an MNC is the sole producer of Brand J
    - Consumers can have a preference for Brand J---taste, reputation, decay preventing efficacy
    - The greater the preference (differentiation) the higher the price.
- 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

- 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

★ 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

Monopolistically Competitive vs. Perfectly Competitive Equilibrium

★ 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 shaded triangle.
– With no economic profits in the long run, the firm is still not producing at minimum AC and excess capacity exists.

★ Questions

1) If the market became competitive, what would happen to output and price?

2) Should monopolistic competition be regulated?

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

Colas:  
- Brand X: -2.4
- Brand Y: 5.2 to -5.7

Ground Coffee:  
- Hills Brothers: -7.1
- Maxwell House: -8.9
- Chase and Sanborn: -5.6

Questions

1) Why is the demand for Brand X more price inelastic than for Brand Y?
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
- Examples
  - Automobiles
  - Steel
  - Aluminum
  - Petrochemicals
  - Electrical equipment
  - Computers
- The barriers to entry are:
  - Natural
    - Scale economies
    - Patents
    - Technology
    - Name recognition
  - Strategic action
    - Flooding the market
    - Controlling an essential input
- Management Challenges
  - Strategic actions
  - Rival behavior
- Question
  - What are the possible rival responses to a 10% price cut by an automobile company?
- 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.
  - 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.
- Nash Equilibrium
  - Each firm is doing the best it can given what its competitors are doing.
- 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

If Firm 1 thinks Firm 2 will produce nothing, its demand curve, \( D_1(0) \), is the market demand curve.

If Firm 1 thinks Firm 2 will produce 50 units, its demand curve is shifted to the left by this amount.

If Firm 1 thinks Firm 2 will produce 75 units, its demand curve is shifted to the left by this amount.

What is the output of Firm 1 if Firm 2 produces 100 units?

The Reaction Curve

– A firm’s profit-maximizing output is a decreasing schedule of the expected output of Firm 2.

The linear Demand Curve

– An Example of the Cournot Equilibrium

Duopoly

Market demand is \( P = 30 - Q \)
where \( Q = Q_1 + Q_2 \)
MC1 = MC2 = 0

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?

• The linear Demand Curve

– An Example of the Cournot Equilibrium

In Cournot equilibrium, each firm correctly assumes how much its competitors will produce and thereby maximize its own profits.
Duopoly Example

The demand curve is \( P = 30 - Q \) and both firms have 0 marginal cost.

- **Profit Maximization with Collusion**
  - **Collusion 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

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
- **Firm 1**
  - Must consider the reaction of Firm 2
- **Firm 2**
\[ \text{Takes Firm 1's output as fixed and therefore determines output with the Cournot reaction curve} \]

\* Firm 1

\( - \text{Choose } Q_1 \text{ so that: } MR = MC, MC = 0 \text{ therefore } MR = 0 \)

\[ R_1 = PQ_1 = 30Q_1 - Q_1^2 - Q_2Q_1 \]

\* Conclusion

\( - \text{Firm 1's output is twice as large as firm 2's} \)

\( - \text{Firm 1's profit is twice as large as firm 2's} \)

\section*{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.

\* Bertrand Model

\( - \text{Assumptions} \)

\( - \text{Homogenous good} \)

\( - \text{Market demand is } P = 30 - Q \text{ where } Q = Q_1 + Q_2 \)

\( - MC = $3 \text{ for both firms and } MC_1 = MC_2 = $3 \)

\( - \text{Assumptions} \)

\( - \text{The Cournot equilibrium:} \)

\[ P = $12 \]

\[ \pi = $81 \]

\( - \text{Assume the firms compete with price, not quantity.} \)

\( - \text{How will consumers respond to a price differential?} \)

\( - \text{The Nash equilibrium:} \)

\( - P = MC; P_1 = P_2 = $3 \)

\( - Q = 27; Q_1 & Q_2 = 13.5 \)

\( - \pi = 0 \)

\* Price Competition with Differentiated Products

\( - \text{Market shares are now determined not just by prices, but by differences in the design, performance, and durability of each firm's product.} \)

\* Differentiated Products

\( - \text{Assumptions} \)

\( - \text{Duopoly} \)

\( - \text{FC} = $20 \)

\( - \text{VC} = 0 \)

\( - \text{Firm 1's demand is } Q_1 = 12 - 2P_1 + P_2 \)

\( - \text{Firm 2's demand is } Q_2 = 12 - 2P_1 + P_1 \)

\( - P_1 \text{ and } P_2 \text{ are prices firms 1 and 2 charge respectively} \)
$Q_1$ and $Q_2$ are the resulting quantities they sell

**Nash Equilibrium in Prices**
Lesson 41

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?

Assume:

\[ FC = \$20 \text{ and } VC = \$0 \]

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 : \( P = \$6 \quad \pi = \$16 \)

Possible Pricing Outcomes:

Firm 1: \( P = \$6 \)  
Firm 2: \( P = \$6 \quad \pi = \$16 \)

\[ P = \$6 \quad P = \$4 \]

\[ \pi_2 = P_2Q_2 - 20 \]
\[ = (4)[12 - (2)(4) + 6] - 20 = \$20 \]

\[ \pi_1 = P_1Q_1 - 20 \]
\[ = (6)[12 - (2)(6) + 4] - 20 = \$4 \]

Payoff Matrix for Pricing Game

<table>
<thead>
<tr>
<th>Firm 1</th>
<th>Charge $4</th>
<th>Charge $6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge $4</td>
<td>$12,</td>
<td>$20,</td>
</tr>
<tr>
<td>Firm 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charge $6</td>
<td>$4,</td>
<td>$16,</td>
</tr>
</tbody>
</table>

These two firms are playing a non-co-operative 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?

An example in game theory, called the Prisoners’ Dilemma, illustrates the problem oligopolistic firms face.
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

Payoff Matrix for Pricing Game

<table>
<thead>
<tr>
<th>Firm 1</th>
<th>Firm 2</th>
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<td></td>
</tr>
</tbody>
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Conclusions: Oligopolistic 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

Implications of the Prisoners’ Dilemma for Oligopolistic 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.

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.
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

- Price Leadership
  - Pattern of pricing in which one firm regularly announces price changes that other firms then match

- 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**

The dominant firm's demand curve is the difference between market demand (\(D\)) and the supply of the fringe firms (\(S_F\)).

\[
\begin{align*}
\text{Price Setting by a Dominant Firm} \\
\text{Price} & \quad D \quad S_F \\
P_1 & \quad P^* & \quad P_2 \\
Q_F & \quad Q_o & \quad Q_T \\
\text{MC} & \quad MR \\
\text{Quantity} & & 
\end{align*}
\]

At this price, fringe firms sell \(Q_F\), so that total sales are \(Q_T\).

**CARTELS**

- **Characteristics**
  1) Explicit agreements to set output and price
  2) May not include all firms
  3) Most often international

- **Examples of successful cartels**
  - OPEC
  - International Bauxite Association

- **Examples of unsuccessful cartels**
  - Copper
  - Tin
  - Coffee
  - Tea
  - Cocoa

- **Conditions for success**
  - Competitive alternative sufficiently deters cheating
  - Potential of monopoly power--inelastic demand
The OPEC Oil Cartel

TD is the total world demand curve for oil, and $S_C$ is the Competitive supply. OPEC’s demand is the difference between the two.

OPEC’s profits maximizing quantity is found at the intersection of its MR and MC curves. At this quantity OPEC charges price $P^*$. 

Cartels

- About OPEC
  - Very low MC
  - TD is inelastic
  - Non-OPEC supply is inelastic
  - $DOPEC$ is relatively inelastic

The price without the cartel:

- Competitive price ($P_C$) where $DOPEC = MC_{OPEC}$
The CIPEC Copper Cartel

**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.
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

• 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
  — 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
  — Problem
  • How much labor to hire?
  — Measuring the Value of a Worker’s Output
    • Marginal Revenue Product of Labor (MRPL)
    • MRPL = (MPL)(MR)
  — Assume perfect competition in the product market
    • Then MR = P
  — Question
    • What will happen to the value of MRPL when more workers are hired?

Marginal Revenue Product

Choosing the profit-maximizing amount of labor
• If MRPL > w (the marginal cost of hiring a worker): hire the worker
• If \( MRPL < w \): hire less labor
• If \( MRPL = w \): profit maximizing amount of labor

**Hiring by a Firm in the Labor Market (with Capital Fixed)**

In a competitive labor market, a firm faces a perfectly elastic supply of labor and can hire as many workers as it wants at \( w^* \).

![Diagram](diagram1.png)

The profit maximizing firm will hire \( L^* \) units of labor at the point where the marginal revenue product of labor is equal to the wage rate.

**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**

![Diagram](diagram2.png)
• Comparing Input and Output Markets
  \[ \text{MRP}_L = (\text{MP}_L)(\text{MR}) \]
  and at profit maximizing
  number of workers \[ \text{MRP}_L = w \]
  \[ (\text{MP}_L)(\text{MR}) = w \]
  \[ \text{MR} = w/\text{MP}_L \]
  \[ w/\text{MP}_L = \text{MC of production} \]
  – In both markets, input and output choices occur where \( \text{MR} = \text{MC} \)
    • MR from the sale of the output
    • MC from the purchase of the input
  • 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
    – Question
      • How will the decrease in the wage rate impact the demand for labor?

**Firm’s Demand Curve for Labor (with Variable Capital)**

When two or more inputs are variable, a firm’s demand for one input depends on the marginal revenue product of both inputs.

When the wage rate is $20, A represents one point on the firm’s demand for labor curve.

When the wage rate falls to $15, the MRP curve shifts, generating a new point C on the firm’s demand for labor curve. Thus A and C are on the demand for labor curve, but B is not.
**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.

![Diagram of Industry Demand for Labor](image)

- **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 impacts the airlines and refineries alike
  - The short-run price elasticity of demand for jet-fuel is very inelastic

- **Question**
  - How would the long-run price elasticity of demand compare to the short-run?
The Short- and Long-Run

The Supply of Inputs to a Firm
- Determining how much of an input to purchase
  - Assume a perfectly competitive factor market

A Firm’s Input Supply in a Competitive Factor Market

- 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
- 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
– 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)
– If the income effect exceeds the substitution effect the supply curve is backward bending

**Backward-Bending Supply of Labor**

**Substitution and Income Effects of a Wage Increase**
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

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

Profits maximized

• Using less than efficient level of input

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.
Question

- What would be the economic rent if \( S_L \) is perfectly elastic or perfectly inelastic?

Land: A Perfectly Inelastic Supply

- With land inelastically supplied, its price is determined entirely by demand, at least in the short run.

**Land Rent**

<table>
<thead>
<tr>
<th>Price ($ per acre)</th>
<th>Supply of Land</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( D_1 )</td>
</tr>
<tr>
<td></td>
<td>( D_2 )</td>
</tr>
<tr>
<td>( S_1 )</td>
<td>Economic Rent</td>
</tr>
<tr>
<td>( S_2 )</td>
<td>Economic Rent</td>
</tr>
</tbody>
</table>

Pay in the Public Sector

- The percentage of personnel working in public sector has been declining
- Shortages of skilled personnel has occurred? Why?
  - If there is a shortage, the wage must be below the competitive wage rate

**The Shortage of Skilled Personnel**

The economic rent associated with the employment of labor is the excess of wages paid above the minimum amount needed to hire workers.

Total expenditure (wage) paid is \( 0w^* \times AL^* \)

Economic rent is \( ABW^* \)
• Public sector pay is based on years of service not MRP.
• MRP increases and the private sector pay is greater than public sector pay.
• Many leave the public sector.

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

Monopsony Power in the Market for Baseball Players
• Baseball owners created a monopsonistic cartel
  — Reserve clause prevented competition for players
  — 1969—Average salary was $42,000
  — 1997—Average salary was $1,383,578
  — 1975 salaries were 25% of team expenditures
  — 1980 salaries were 40% of team expenditures
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.

Monopoly Power of Sellers of Labor

The primary determinant of controlling wage and economic rent is controlling the supply of labor

A Two-Sector Model of Labor Employment

- Union monopoly power impacts the nonunionized part of the economy.
Wage Determination in Unionized & Nonunionized Sectors

Bilateral Monopoly
- Market in which a monopolist sells to a monopsonist.

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
- 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