CHAPTER 2

Market Forces: Demand and Supply
Chapter Outline

• Demand
  – Factors that change quantity demanded and factors that change demand
  – The demand function
  – Consumer surplus

• Supply
  – Factors that change quantity supplied and factors that change supply
  – The supply function
  – Producer surplus

• Market equilibrium

• Price restrictions and market equilibrium
  – Price ceilings
  – Price floors

• Comparative statics
  – Changes in demand
  – Changes in supply
  – Simultaneous shifts in supply and demand
Demand

• Market demand curve
  – Illustrates the relationship between the total quantity and price per unit of a good all consumers are willing and able to purchase, holding other variables constant.

• Law of demand
  – The quantity of a good consumers are willing and able to purchase increases (decreases) as the price falls (rises).
Market Demand Curve

Price ($)

$40

$30

$20

$10

Quantity (thousands per year)

0 20 40 60 80

Demand

$40 0 20 40 60 80

$30 20

$20

$10

(2,4)
Changes in Quantity Demanded

• Changing only price leads to changes in quantity demanded.
  – This type of change is graphically represented by a movement along a given demand curve, holding other factors that impact demand constant.

• Changing factors other than price lead to changes in demand.
  – These types of changes are graphically represented by a shift of the entire demand curve.
Changes in Demand

- Increase in demand
  - D^0 to D^1

- Decrease in demand
  - D^2 to D^0

Price

Quantity
Demand Shifters

• Income
  – Normal good
  – Inferior good

• Prices of related goods
  – Substitute goods
  – Complement goods

• Advertising and consumer tastes
  – Informative advertising
  – Persuasive advertising

• Population

• Consumer expectations

• Other factors
Advertising and the Demand for Clothing

- **Price of high-style clothing**
- **Quantity of high-style clothing**

Due to an increase in advertising.
The Demand Function

• The demand function for good X is a mathematical representation describing how many units will be purchased at different prices for good X, different prices of a related good Y, different levels of income, and other factors that affect the demand for good X.
The Linear Demand Function

• One simple, but useful, representation of a demand function is the linear demand function:

\[ Q_X^d = \alpha_0 + \alpha_X P_X + \alpha_Y P_Y + \alpha_M M + \alpha_H H \]

, where:

– \( Q_X^d \) is the number of units of good X demanded;
– \( P_X \) is the price of good X;
– \( P_Y \) is the price of a related good Y;
– \( M \) is income;
– \( H \) is the value of any other variable affecting demand.
Understanding the Linear Demand Function

• The signs and magnitude of the $\alpha$ coefficients determine the impact of each variable on the number of units of X demanded.

$$Q_X^d = \alpha_0 + \alpha_X P_X + \alpha_Y P_Y + \alpha_M M$$

• For example:
  
  – $\alpha_X < 0$ by the law of demand;
  
  – $\alpha_Y > 0$ if good Y is a substitute for good X;
  
  – $\alpha_M < 0$ if good X is an inferior good.
The Linear Demand Function in Action

• Suppose that an economic consultant for X Corp. recently provided the firm’s marketing manager with this estimate of the demand function for the firm’s product:

\[ Q_X^d = 12,000 - 3P_X + 4P_Y - 1M + 2A_X \]

Question: How many of good X will consumers purchase when \( P_X = $200 \) per unit, \( P_Y = $15 \) per unit, \( M = $10,000 \) and \( A_X = 2,000 \)? Are goods X and Y substitutes or complements? Is good X a normal or an inferior good?

Answer:

\[ Q_X^d = 12,000 - 3(200) + 4(15) - 1(10,000) + 2(2000) = 5,460 \] units. Goods X and Y are substitutes. Good X is an inferior good.
Inverse Demand Function

• By setting $P_Y = $15 and $M = $10,000 and $A = 2,000$ the demand function is

$$Q_X^d = 12,000 - 3P_X + 4(15) - 1(10,000) + 2(2,000)$$

the linear demand function simplifies to

$$Q_X^d = 6,060 - 3P_X$$

Solving this for $P_X$ in terms of $Q_X^d$ results in

$$P_X = 2,020 - \frac{1}{3}Q_X^d$$

which is called the *inverse demand function*. This function is used to construct a *market demand curve*.
Graphing the Inverse Demand Function in Action

\[ P_X = 2,020 - \frac{1}{3} Q_X^d \]
Consumer Surplus

• Marketing strategies – like value pricing and price discrimination – rely on understanding consumer value for products.

  – *Total consumer value* is the sum of the maximum amount a consumer is willing to pay at different quantities.

  – *Total expenditure* is the per-unit market price times the number of units consumed.

  – *Consumer surplus* is the extra value that consumers derive from a good but do not pay for.
Market Demand and Consumer Surplus in Action

### Consumer Surplus

- **Price per liter**
  - $5
  - $4
  - $3
  - $2
  - $1

- **Quantity in liters**
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5

**Consumer Surplus:**

\[
0.5(\$5 - \$3)(2-0) = \$2
\]

**Total Consumer Value:**

\[
0.5(\$5 - \$3) \times 2 + (3-0)(2-0) = \$8
\]

**Expenditures:**

\[
(3-0)(2-0) = \$6
\]

**Consumer Surplus**

\[
0.5(\$5 - \$3)(2-0) = \$2
\]
Supply

• Market supply curve
  – Summarizes the relationship between the total quantity all producers are willing and able to produce at alternative prices, holding other factors affecting supply constant.

• Law of supply
  – As the price of a good rises (falls), the quantity supplied of the good rises (falls), holding other factors affecting supply constant.
Changes in Quantity Supplied

• Changing only price leads to changes in quantity supplied.
  – This type of change is graphically represented by a movement along a given supply curve, holding other factors that impact supply constant.

• Changing factors other than price lead to changes in supply.
  – These types of changes are graphically represented by a shift of the entire supply curve.
Change in Supply in Action

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0</td>
<td>S1</td>
</tr>
</tbody>
</table>

- Decrease in supply
- Increase in supply

Diagram with supply curves S0, S1, and S2.
Supply Shifters

• Input prices
• Technology or government regulation
• Number of firms
  – Entry
  – Exit
• Substitutes in production
• Taxes
  – Excise tax
  – Ad valorem tax
• Producer expectations
Change in Supply in Action

Price of gasoline per week

Price of gasoline

Excise tax

$1.20

$t$

$1.00

$t = 20¢$

$t = \text{per unit tax of } 20¢$

Quantity of gasoline per week

$S^0$

$S^0 + t$

$20¢$ per unit tax
Change in Supply in Action

Supply

Price of backpacks

Ad valorem tax

$24

$20

$12

$10

0

1,100

2,450

Quantity of backpacks per week

$24

$10

$12

$20

S^1 = 1.20 \times S^0

S^0

S^1 = 1.20 \times S^0

S^0
The Supply Function

• The supply function for good X is a mathematical representation describing how many units will be produced at different prices for X, different prices of inputs W, prices of technologically related goods, and other factors that affect the supply for good X.
The Linear Supply Function

• One simple, but useful, representation of a supply function is the linear supply function:

\[ Q_X^s = \beta_0 + \beta_X P_X + \beta_W W + \beta_r P_r + \beta_H H \]

, where:

– \( Q_X^s \) is the number of units of good X produced;
– \( P_X \) is the price of good X;
– \( W \) is the price of an input;
– \( P_r \) is price of technologically related goods;
– \( H \) is the value of any other variable affecting supply.
Understanding the Linear Supply Function

• The signs and magnitude of the $\beta$ coefficients determine the impact of each variable on the number of units of X produced.

$$Q_X^s = \beta_0 + \beta_X P_X + \beta_W W + \beta_r P_r$$

• For example:
  - $\beta_X > 0$ by the law of supply.
  - $\beta_W < 0$ increasing input price.
  - $\beta_r > 0$ technology lowers the cost of producing good X.
The Linear Supply Function in Action

• Your research department estimates that the supply function for televisions sets is given by:

\[ Q_X^s = 2000 + 3P_X - 4P_R - 1P_W \]

Question: How many televisions are produced when \( P_X = \$400 \), \( P_R = \$100 \) per unit, and \( P_W = \$2,000 \)?

Answer:

\[ Q_X^s = 2000 + 3(400) - 4(100) - 1(2,000) = 800 \] television sets.
Inverse Supply Function

• By setting $P_W = $2,000 and $P_r = $100 in $Q_X^s = 2,000 + 3P_X - 4(100) - 1(2,000)$ the linear supply function simplifies to $Q_X^s = 3P_X - 400$

Solving this for $P_X$ in terms of $Q_X^s$ results in $P_X = \frac{400}{3} + \frac{1}{3}Q_X^s$

, which is called the *inverse supply function*. This function is used to construct a *market supply curve*. 
Producer Surplus

• The amount producers receive in excess of the amount necessary to induce them to produce the good.
Producer Surplus in Action

\[ P_x = \frac{400}{3} + \frac{1}{3} Q_x^S \]

Price

$400

\[ \frac{400}{3} \]

Quantity

0

800

Producer surplus

Supply
Market Equilibrium

• Competitive market equilibrium
  – Price of a good is determined by the interactions of the market demand and market supply for the good.
  – A price and quantity such that there is no shortage or surplus in the market.
  – Forces that drive market demand and market supply are balanced, and there is no pressure on prices or quantities to change.
Market Equilibrium I

![Graph showing market equilibrium with supply and demand curves, indicating surplus and shortage points at different price levels.](Image)

- **Quantity (Q)**: The horizontal axis represents the quantity of goods demanded and supplied.
- **Price (P)**: The vertical axis represents the price level.
- **Supply Curve (S)**: The upward-sloping line indicates the relationship where higher prices lead to increased supply.
- **Demand Curve (D)**: The downward-sloping line indicates the relationship where higher prices lead to decreased demand.
- **Market Equilibrium (Q_e)**: The point where supply equals demand, indicated by the intersection of the supply and demand curves.
- **Surplus**: Occurs when the quantity supplied exceeds the quantity demanded at a given price level (P_H). The excess quantity (Q_1 - Q_e) is the surplus.
- **Shortage**: Occurs when the quantity demanded exceeds the quantity supplied at a given price level (P_L). The shortage is the difference (Q_e - Q_0).

The graph illustrates how changes in price affect the balance between supply and demand, resulting in market equilibrium or surplus/shortage conditions.
Market Equilibrium II

- Consider a market with demand and supply functions, respectively, as
  \[ Q^d = 10 - 2P \] and \[ Q^s = 2 + 2P \]
- A competitive market equilibrium exists at a price, \( P^e \), such that \( Q^d(P^e) = Q^s(P^e) \). That is,
  
  \[
  \begin{align*}
  10 - 2P &= 2 + 2P \\
  8 &= 4P \\
  P^e &= $2
  \end{align*}
  \]
  
  \[
  Q^e = 10 - 2($2) = 6 \text{ and } Q^e = 2 + 2($2) = 6
  \]
  
  \[ Q^e = 6 \text{ units} \]
Price Restrictions

• In a competitive market equilibrium, price and quantity freely adjust to the forces of demand and supply.

• Sometimes the government restricts how much prices are permitted to rise or fall.
  – Price ceiling
  – Price floor
Price Ceiling in Action I

Price Restrictions and Market Equilibrium

Price Ceiling in Action I

- Nonpecuniary price
- Price
- Supply
- Demand
- Lost social welfare
- Shortage
- Priceceiling
- $p^F$
- $p^e$
- $p^c$
- $0$
- $Q^s$
- $Q^e$
- $Q^d$
Consider a market with demand and supply functions, respectively, as

\[ Q^d = 10 - 2P \quad \text{and} \quad Q^s = 2 + 2P \]

Suppose a $1.50 price ceiling is imposed on the market.

- \( Q^d = 10 - 2($1.50) = 7 \) units.
- \( Q^s = 2 + 2($1.50) = 5 \) units.
- Since \( Q^d > Q^s \) a shortage of \( 7 - 5 = 2 \) units exists.
- Full economic price of 5th unit is \( 5 = 10 - 2P_{\text{full}} \), or \( P_{\text{full}} = $2.50 \). Of this,
  - $1.50 is the dollar price
  - $1 is the nonpecuniary price
Price Restrictions and Market Equilibrium

Price Floor in Action I

The diagram illustrates the concept of a price floor in action. The price floor ($P_{floor}$) is set above the equilibrium price ($P_e$), resulting in a surplus ($Q^s - Q^d$). The cost of purchasing excess supply is indicated by the shaded area between the supply and demand curves at the price floor.

- **Price** ($P$) is plotted on the vertical axis.
- **Quantity** ($Q$) is plotted on the horizontal axis.
- The demand curve is represented by $Q^d$.
- The supply curve is represented by $Q^s$.
- The equilibrium price is $P_e$.
- The price floor is $P_{floor}$.
- The shaded area represents the excess supply and the cost of purchasing it.

The diagram visually demonstrates how a price floor can lead to a surplus and the associated costs.
Price Floor in Action II

• Consider a market with demand and supply functions, respectively, as
  \[ Q^d = 10 - 2P \] and \[ Q^s = 2 + 2P \]

• Suppose a $4 price floor is imposed on the market.
  - \(Q^d = 10 - 2(\$4) = 2\) units
  - \(Q^s = 2 + 2(\$4) = 10\) units
  - Since \(Q^s > Q^d\) a surplus of \(10 - 2 = 8\) units exists
  - The cost to the government of purchasing the surplus is \(4 \times 8 = 32\).
Comparative Statics

• Comparative static analysis
  – The study of the movement from one equilibrium to another.

• Competitive markets, operating free of price restraints, will be analyzed when:
  – Demand changes;
  – Supply changes;
  – Demand and supply simultaneously change.
Changes in Demand

• Increase in demand only
  – Increase equilibrium price
  – Increase equilibrium quantity

• Decrease in demand only
  – Decrease equilibrium price
  – Decrease equilibrium quantity

• Example of change in demand
  – Suppose that consumer incomes are projected to increase 2.5% and the number of individuals over 25 years of age will reach an all time high by the end of next year. What is the impact on the rental car market?
Change in Demand in Action

Demand for Rental Cars

<table>
<thead>
<tr>
<th>Price</th>
<th>Demand for Rental Cars</th>
</tr>
</thead>
<tbody>
<tr>
<td>$45</td>
<td>Demand_0</td>
</tr>
<tr>
<td>$49</td>
<td>Demand_1</td>
</tr>
</tbody>
</table>

Comparative Statics

Quantity (thousands rented per day)
Changes in Supply

• Increase in supply only
  – Decrease equilibrium price
  – Increase equilibrium quantity

• Decrease in supply only
  – Increase equilibrium price
  – Decrease equilibrium quantity

• Example of change in supply
  – Suppose that a bill before Congress would require all employers to provide health care to their workers. What is the impact on retail markets?
Change in Supply in Action

Comparative Statics
Simultaneous Shifts in Supply and Demand

• Suppose that simultaneously the following events occur:
  – an earthquake hit Kobe, Japan and decreased the supply of fermented rice used to make sake wine.
  – the stress caused by the earthquake led many to increase their demand for sake, and other alcoholic beverages.

• What is the combined impact on Japan’s sake market?
Simultaneous Shifts in Supply and Demand in Action

Japan’s Sake Market

Supply$_1$

Supply$_2$

Supply$_0$

Demand$_0$

Demand$_1$
Conclusion

• Demand and supply analysis is useful for
  – Clarifying the “big picture” (the general impact of a current event on equilibrium prices and quantities).
  – Organizing an action plan (needed changes in production, inventories, raw materials, human resources, marketing plans, etc.).
Market Demand Curve

International Oil Market

Price (Dollars per Barrel)

$140

$100

$60

$20

0 80 160 240 280

Quantity (Millions of Barrels)

Demand_{oil}
Changes in Quantity Demanded

International Oil Market

Price (Dollars per Barrel)

$140

$100

$90

Increase in quantity demanded

Demand

Quantity (Millions of Barrels)

0  80  100  280
Change in Demand

International Oil Market

Price (Dollars per Barrel)

$160

$140

$100

$90

0 80 100 120 140 280 Quantity (Millions of Barrels)

Increase in demand

Demand_{oil1}

Demand_{oil2}
Change in Quantity Supplied

International Oil Market

Price (Dollars per Barrel)

$65

$60

$20

0

80

90

Quantity (Millions of Barrels)

Increase in quantity supplied

Supply oil
The Market Supply Curve

International Oil Market

Supply

Price
(Dollars per Barrel)

$140

$100

$60

$20

Quantity
(Millions of Barrels)

0

80

160

240
Change in Supply in Action

International Oil Market

<table>
<thead>
<tr>
<th>Price (Dollars per Barrel)</th>
<th>Quantity (Millions of Barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$140</td>
<td>Supply_{oil1}</td>
</tr>
<tr>
<td>$100</td>
<td>180</td>
</tr>
<tr>
<td>$50</td>
<td>160</td>
</tr>
<tr>
<td>$20</td>
<td>100</td>
</tr>
</tbody>
</table>

Decrease in supply
International Oil Market

Competitive Market Equilibrium

$P^e = $80$

\[ Q^d(P^e) = Q^s(P^e) \]

Forces of demand and supply put downward pressure on price.

Forces of demand and supply put upward pressure on price.

Surplus 160 million barrels

Demand

Supply

Quantitative Market Equilibrium I

Price (Dollars per Barrel): $140, $120, $80, $40, $20

Quantity (Millions of Barrels): 0, 40, 120, 200, 280
Price Ceiling in Action I

International Oil Market

Price (Dollars per Barrel)

Nonpecuniary price

$140
$120
$80
$40
$20

Competitive market equilibrium
\( Q^d(P^e) = Q^s(P^e) \)

Supply\(_{\text{oil}}\)

Lost social welfare

Price\(_{\text{ceiling}}\)

Demand\(_{\text{oil}}\)

Quantity
(Millions of Barrels)

\( Q^e = 120 \)

Shortage
160 million barrels

\( P_f = $120 \)

\( P^e = $80 \)

\( P_c = $40 \)

\( 0 \)

280

Price Restrictions and Market Equilibrium
Changes in Demand

• Increase in demand only
  – Increase equilibrium price
  – Increase equilibrium quantity

• Decrease in demand only
  – Decrease equilibrium price
  – Decrease equilibrium quantity

• Example of change in demand
  – Suppose that worldwide demand for automobiles is projected to decrease by 30% next year. What is the impact on the international crude oil market?
Change in Demand in Action

International Oil Market

Price (Dollars per Barrel)

Supply_{oil}

$140

p_{e1} = $80

p_{e2} = $54

$20

0

Q^{e2} = 68

Q^{e1} = 120

280

Quantity (Millions of Barrels)

Demand_{oil2}

Demand_{oil1}
Changes in Supply

• Increase in supply only
  – Decrease equilibrium price
  – Increase equilibrium quantity

• Decrease in supply only
  – Increase equilibrium price
  – Decrease equilibrium quantity

• Example of change in supply
  – Suppose that war breaks out in a major oil-producing country in the Middle East. What is the impact on the international crude oil market?
### Change in Supply in Action

**International Oil Market**

<table>
<thead>
<tr>
<th>Supply</th>
<th>Price (Dollars per Barrel)</th>
<th>Quantity (Millions of Barrels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>oil1</td>
<td>$140</td>
<td>120</td>
</tr>
<tr>
<td>oil2</td>
<td>$100</td>
<td>80</td>
</tr>
</tbody>
</table>

**Comparative Statics**

- **Supply**:
  - $P_e^2 = 100$
  - $P_e^1 = 80$

- **Demand**:
  - $Q_e^2 = 80$
  - $Q_e^1 = 120$

**Price** (Dollars per Barrel):
- $140$
- $20$

**Quantity (Millions of Barrels)**:
- $280$
Simultaneous Shifts in Supply and Demand

• Suppose that simultaneously the following two events occur:
  – worldwide demand for automobiles is projected to decrease by 30% next year.
  – war breaks out in a major oil-producing country in the Middle East.

• What is the combined impact on the international crude oil market?
Simultaneous Shifts in Supply and Demand in Action

International Oil Market

The equilibrium price increases or decreases depending on the magnitude of the demand and supply changes.

Comparative Statics

Simultaneous Shifts in Supply and Demand in Action