Elasticity
Chapter 4

The Basics
Markets
Supply and Demand

Scarcity, Cost – Benefit, Incentive, Comparative Advantage, Increasing Opportunity Costs, Efficiency, Equilibrium
Learning Objectives

1. Define price elasticity of demand and explain what determines whether demand is elastic or inelastic
2. Calculate the price elasticity of demand using information from the demand curve
3. Understand how changes in the price of a good affect total revenue and total expenditure depending on the price elasticity of demand for the good
4. Explain the cross-price elasticity of demand and income elasticity of demand
5. Discuss the price elasticity of supply, explain what determines whether supply is elastic or inelastic, and calculate the price elasticity of supply using information from a supply curve

Drug Enforcement and Local Theft

• Hypothesis
  – Drug users steal to buy drugs
  – Increasing drug enforcement will decrease theft
• Analysis
  – Increased enforcement reduces supply of drugs
    • Price of drugs increases
    • Quantity demanded decreases
  – Theft goes down ONLY IF total expenditure on drugs decreases
    • How responsive is quantity demanded to price?
Price Elasticity of Demand

- **Price elasticity of demand** is defined as the percentage change in quantity demanded from a 1% change in price
  - Measure of responsiveness of quantity demanded to changes in price

- **Example:**
  - Price of beef decreases 1%
  - Quantity of beef demanded increases 2%
  - Price elasticity of demand is $-2$

Calculate Price Elasticity

- Symbol for elasticity is $\varepsilon$
  - Lower case Greek letter epsilon

- For small percentage changes in price
  
  \[
  \varepsilon = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}
  \]

- Price elasticity of demand is always negative
  - Ignore the sign
Elastic Demand

- If price elasticity is greater than 1, demand is **elastic**
  - Percentage change in quantity is greater than percentage change in price
  - Demand is responsive to price

Inelastic Demand

- If price elasticity is less than 1, demand is **inelastic**
  - Percentage change in quantity is less than percentage change in price
  - Quantity demanded is not very responsive to price
Unit Elastic Demand

- If price elasticity is 1, demand is **unit elastic**
  - Price and quantity change by the same percentage

Example: Demand for Pizza

<table>
<thead>
<tr>
<th></th>
<th>Old</th>
<th>New</th>
<th>% Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$1.00</td>
<td>$0.97</td>
<td>3%</td>
</tr>
<tr>
<td>Quantity</td>
<td>400</td>
<td>404</td>
<td>1%</td>
</tr>
</tbody>
</table>

\[
\varepsilon = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}
\]

\[
\varepsilon = \frac{1\%}{3\%} = 0.33 \quad \text{Demand is inelastic}
\]
Determinants of Price Elasticity of Demand

**Substitution Options**
- More options, more elastic
  - Salt
  - Morton’s salt

**Budget Share**
- Large share, more elastic
  - New car
  - Salt

**Time**
- Long time to adjust, more elastic
  - Air conditioner
  - Gasoline

Examples of Elasticities

<table>
<thead>
<tr>
<th>Item</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green peas</td>
<td>2.80</td>
</tr>
<tr>
<td>Restaurant meals</td>
<td>1.63</td>
</tr>
<tr>
<td>Beer</td>
<td>1.19</td>
</tr>
<tr>
<td>Coffee</td>
<td>0.25</td>
</tr>
<tr>
<td>Automobiles</td>
<td>1.35</td>
</tr>
<tr>
<td>Foreign air travel</td>
<td>0.77</td>
</tr>
<tr>
<td>Movies</td>
<td>0.87</td>
</tr>
<tr>
<td>Theater, opera</td>
<td>0.18</td>
</tr>
</tbody>
</table>
Taxes And Teen Smoking

- **Hypothesis:**
  - Teens’ demand for cigarettes is inelastic
    - Demand is driven by peers
    - But, teens also lack income
- **Analysis:**
  - Cigarette taxes increase the price of cigarettes
    - Some teens will smoke less or quit altogether
      - These teens will influence others to quit
    - Higher taxes are likely to reduce teen smoking

Unintended Effects of the Yacht Tax

- **Hypothesis**
  - Luxury tax on yachts over $100,000 will yield $31 million in tax revenue
- **Analysis**
  - Price elasticity of demand is high
  - Actual tax revenue $16.6 million
  - People bought yachts outside US to avoid tax
    - 7,600 jobs in US boating industry lost
- **Outcome:** tax repealed after 2 years
Price Elasticity Notation

\[ \varepsilon = \frac{\Delta Q}{Q} \times \frac{P}{\Delta P} \]

- \( \Delta Q \) is the change in quantity
  - \( \Delta Q / Q \) is percentage change in quantity
- \( \Delta P \) is change in price
  - \( \Delta P / P \) is percentage change in price

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

Price Elasticity: Graphical View

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

\[ \varepsilon = \frac{\Delta Q}{Q} \times \frac{P}{\Delta P} \]

\[ \varepsilon = \frac{P}{Q} \times \frac{1}{\text{slope}} \]
Price Elasticity: Graphical View

- At point A
  \[ P = 8 \]
  \[ Q = 3 \]
  Slope = \( \frac{20}{5} = 4 \)

\[ \varepsilon = \frac{P}{Q} \times \frac{1}{\text{slope}} \]

\[ \varepsilon = \frac{8}{3} \times \frac{1}{4} = 0.67 \]

Price Elasticity and Slope

- When two demand curves cross
  - \( P / Q \) is same for both curves
  - \( (1 / \text{slope}) \) is smaller for the steeper curve
  - At the common point demand is less price elastic for the steeper curve
Price Elasticity on a Straight-Line Demand Curve

- Price elasticity is different at each point

\[ \varepsilon = \frac{P}{Q} \times \frac{1}{\text{slope}} \]

- Slope is the same for the demand curve
- \( P/Q \) decreases as price goes down and quantity goes up

Price Elasticity Pattern

- Price elasticity changes systematically as price goes down
- At high \( P \) and low \( Q \), \( P/Q \) is large
  - Demand is elastic
- At the midpoint, demand is unit elastic
- At low \( P \) and high \( Q \), \( P/Q \) is small
  - Demand is inelastic
Two Special Cases

**Perfectly Elastic Demand**
- Infinite price elasticity of demand

**Perfectly Inelastic Demand**
- Zero price elasticity of demand

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**Elasticity and Total Expenditure**

- When price increases, total expenditure can increase, decrease or remain the same
  - The change in expenditure depends on elasticity
- Terminology: total expenditure = total revenue
  - Calculate as $P \times Q$
- Graphing idea: total expenditure is the area of a rectangle with height $P$ and width $Q$
  - Example: $P = 2$ and $Q = 4$
Price Elasticity and Total Expenditure

• Movie ticket price increases from $2 to $4
  – A and B are both below the midpoint of the curve
    • Inelastic portion of the demand curve
  – Total revenue increases when price increases

![Graph showing price elasticity and total expenditure with quantities and prices for two different price points.]

Price Elasticity and Total Expenditure

• Movie ticket price increases from $8 to $10
  – Prices are both above the midpoint of the curve
    • Elastic portion of the demand curve
  – Total revenue decreases

![Graph showing price elasticity and total expenditure with quantities and prices for two different price points.]

The Effect of a Price Change on Total Expenditure

<table>
<thead>
<tr>
<th>Price ($/ticket)</th>
<th>0</th>
<th>10</th>
<th>8</th>
<th>6</th>
<th>4</th>
<th>2</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity (00s of tickets/day)</td>
<td>0</td>
<td>1,000</td>
<td>2,000</td>
<td>3,000</td>
<td>4,000</td>
<td>5,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Expenditure ($)</td>
<td>0</td>
<td>1,000</td>
<td>1,600</td>
<td>1,800</td>
<td>1,600</td>
<td>1,000</td>
<td>0</td>
</tr>
</tbody>
</table>

Elasticity, Price Change, and Expenditure

If demands is... A price increase will... A price reduction will...

- elastic (\( \epsilon > 1 \)) reduce total expenditure increase total expenditure
- inelastic (\( \epsilon < 1 \)) increase total expenditure reduce total expenditure

Basic Marketing – Chapter 6
Handout 6-13
Cross-Price Elasticity of Demand

- Substitutes and complements affect demand
- **Cross-price elasticity of demand** is defined as the percentage change in quantity demanded of good A from a 1 percent change in the price of good B
- Sign of cross-price elasticity shows relationship between the goods
  - Complements have negative cross-price elasticity
  - Substitutes have positive cross-price elasticity

Income Elasticity of Demand

- **Income elasticity of demand** is defined as the percentage change in quantity demanded from a 1 percent change in income
- Income elasticity of demand can be positive or negative
  - Positive income elasticity is a normal good
  - Negative income elasticity is an inferior good
Price Elasticity of Supply

• Price elasticity of supply
  – Percentage change in quantity supplied from a 1 percent change in price

\[
\text{Price elasticity of supply} = \frac{\Delta Q}{Q} \times \frac{1}{\text{slope}}
\]

• If supply curve has a positive intercept
  • Price elasticity of supply decreases as Q increases
  – Graph shows
    • Slope = 2
    • At A, P = 8 and Q = 2
      – Price elasticity of supply = \frac{8}{2} \times \frac{1}{2} = 2.00
    • At B, P = 10 and Q = 3
      – Price elasticity of supply = \frac{10}{3} \times \frac{1}{2} = 1.67
Price Elasticity of Supply

- If supply curve has a zero intercept
  - Price elasticity of supply is 1.00
    - Graph shows
      - Slope = 1 / 3
      - At A, P = 4 and Q = 12
        - Price elasticity of supply = (4 / 12) (3) = 1.00
      - At B, P = 5 and Q = 15
        - Price elasticity of supply = (5 / 15) (3) = 1.00

Perfectly Inelastic Supply

- Zero price elasticity of supply
  - No response to change in price
- Example: land on Manhattan
  - Supply is completely fixed
- Any one-of-a-kind item has perfectly inelastic supply
  - Work of art (*Mona Lisa*)
  - Hope Diamond
Perfectly Elastic Supply

- Infinite price elasticity of supply
  - Sell all you can at a fixed price

- Inputs purchased at a constant price
  - No volume discounts
  - Constant proportions of production

- Lemonade example
  - Cost of production is 14¢ at all levels of Q
  - Marginal cost $P = 14¢$

Determinants of Price Elasticity of Supply

- Input Flexibility
  - Uses adaptable inputs, more elastic

- Mobility of Inputs
  - Resources move where needed, more elastic

- Produce Substitute Inputs
  - Alternative inputs easy to find, more elastic

- Time
  - Long run, more elastic
### Gas Prices and Car Prices

<table>
<thead>
<tr>
<th><strong>Gasoline Prices</strong></th>
<th><strong>Car Prices</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-run elasticity of demand is smaller</td>
<td>Short-run elasticity of demand is greater</td>
</tr>
<tr>
<td>Difficult to adjust quickly to changes in price</td>
<td>Timing of purchase can be adjusted to price changes</td>
</tr>
<tr>
<td>Supply fluctuates more often and by larger amounts</td>
<td>Supply of cars is relatively stable</td>
</tr>
<tr>
<td>Some oil-producing countries are unstable</td>
<td>Inputs are readily available</td>
</tr>
<tr>
<td>Speculation about instability</td>
<td>Production lines yield predictable, steady output levels</td>
</tr>
</tbody>
</table>

### Supply Bottleneck: Unique Inputs

- Over time, most producers develop alternative production methods and a variety of input choices
  - The more flexible the production process, the more elastic supply
- When production relies on a single input, supply is highly inelastic
  - No alternatives to singular talent
    - Sports stars
    - Actors and musicians
    - Bill Gates, Warren Buffet, George Soros, Carl Icahn
Chapter 4 Appendix

The Midpoint Formula for Demand Elasticity

• Elasticity is different at each point on the demand curve
• Compare 2 points and get 2 answers
  – Depends on which point is the starting point
    • Start at A and elasticity is 2
    • Start at B and elasticity is 1
  – A more stable solution is needed
• Use the midpoint formula

The Midpoint Formula for Elasticity of Demand
The Midpoint Formula for Elasticity of Demand

- Midpoint formula
  - Use average quantity in the numerator
  - Use average price in the denominator

\[
\varepsilon = \frac{\Delta Q / [(Q_A + Q_B)/2]}{\Delta P / [(P_A + P_B)/2]}
\]

\[
\varepsilon = \frac{\Delta Q / (Q_A + Q_B)}{\Delta P / (P_A + P_B)}
\]

- Elasticity using midpoint formula is 1.40