N. GREGORY MANKIW

PRINCIPLES OF

ECONOMICS

Eighth Edition

CHAPTER

5

Elasticity and Its Application
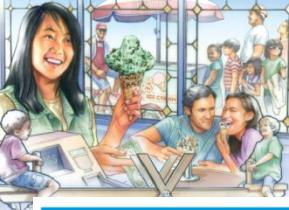
Look for the answers to these questions:

- What is elasticity?

- What kinds of issues can elasticity help us understand?

- What is the price elasticity of demand?
  How is it related to the demand curve?
  How is it related to revenue & expenditure?

- What is the price elasticity of supply?
  How is it related to the supply curve?

- What are the income and cross-price elasticities of demand?

A scenario:

- You design websites for local businesses.
  - You charge $200 per website, and currently sell 12 websites per month.
- Your costs are rising (including the opportunity cost of your time)
  - You consider raising the price to $250.
- The law of demand: you won't sell as many websites if you raise your price.
  - How many fewer websites?
  - How much will your revenue fall, or might it increase?
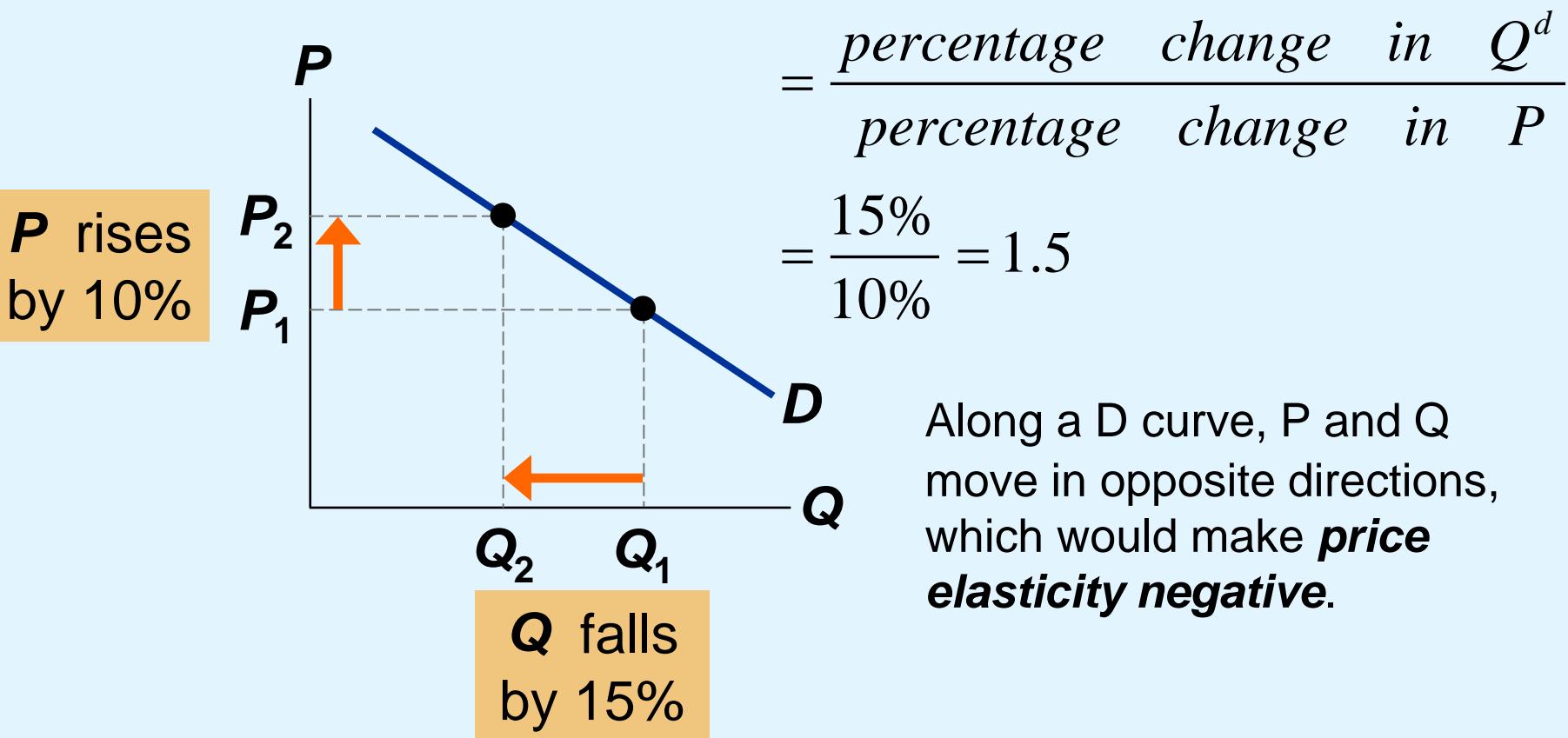
The Elasticity of Demand

- Elasticity
  - Measure of the responsiveness of Q^d or Q^s
   - To a change in one of its determinants
- Price elasticity of demand
  - How much the quantity demanded of a good responds to a change in the price of that good
    - Loosely speaking, it measures the price-sensitivity of buyers' demand

# Price Elasticity of Demand

Price elasticity of demand =

$$= \frac{percentage \quad change \quad in \quad Q^d}{percentage \quad change \quad in \quad P}$$

$$= \frac{15\%}{10\%} = 1.5$$

P rises by 10%

Q falls by 15%

P

P_2

P_1

D

Q

Q_2 Q_1

Along a D curve, P and Q move in opposite directions, which would make *price elasticity negative*.
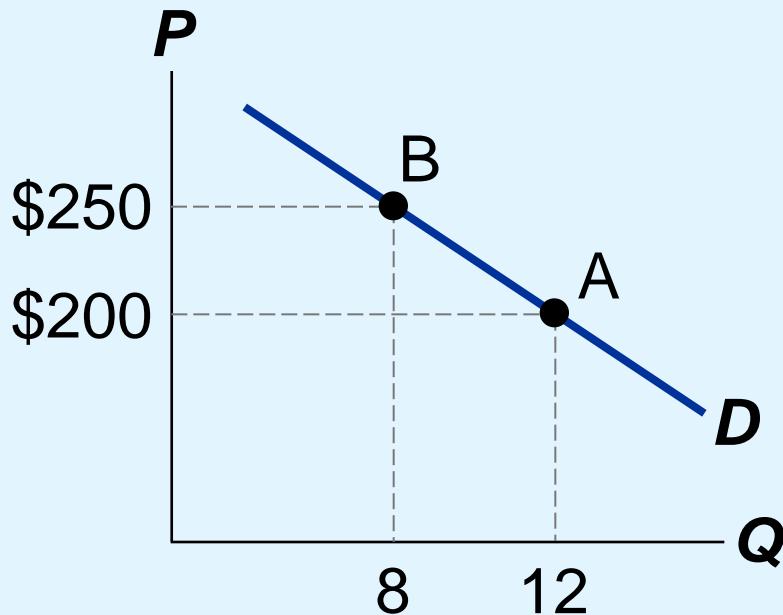
We will drop the minus sign and report all price elasticities as positive numbers.

Calculating Percentage Changes

Demand for your websites

P

$250

$200

B

A

D

Q

8   12

Standard method of computing the percentage (%) change:

$$= \frac{end \quad value - start \quad value}{start \quad value} \times 100\%$$
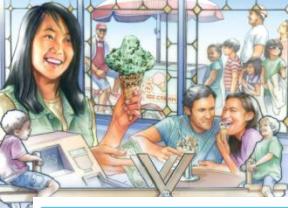
Going from A to B:
- the % change in P = ($250– $200)/$200 = 25%
- the % change in Q = - 33%
- Price elasticity = 33/25 = **1.33**

Going from B to A:
- the % change in P = - 20%
- the % change in Q = 50%
- Price elasticity = 50/20 = **2.5**

We get different values!

The Price Elasticity of Demand

- Determinants of price elasticity of demand
  - We look at a series of examples comparing two common goods

- In each example:
  - Suppose prices of both goods rise by 20%
  - Which good has the highest price elasticity of demand? Why?
  - What lesson we learn about the determinants of price elasticity of demand?
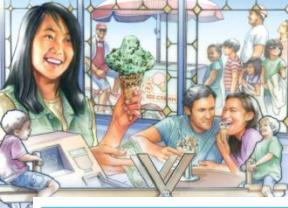
The Price Elasticity of Demand

Example 1: Breakfast cereal vs. Sunscreen

– Prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?

- Breakfast cereal has close substitutes, so buyers can easily switch if the price rises
- Sunscreen has no close substitutes, so a price increase would not affect demand very much

- Price elasticity is higher when close substitutes are available

The Price Elasticity of Demand
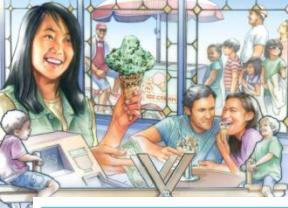
Example 2: Blue Jeans vs. Clothing

– Prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?

- For a narrowly defined good, blue jeans, there are many substitutes
  There are fewer substitutes available for broadly defined goods (clothing)

Price elasticity is higher for narrowly defined goods than for broadly defined ones.
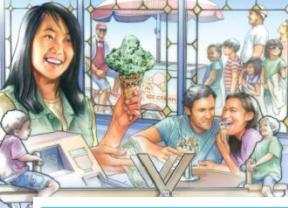
The Price Elasticity of Demand

Example 3: Insulin vs. Yachts

– Prices of both of these goods rise by 20%. For which good does Q^d drop the most? Why?

  • Insulin is a necessity to diabetics. A rise in price would cause little or no decrease in demand

  • A yacht is a luxury. If the price rises, some people will forego it.

• Price elasticity is higher for luxuries than for necessities.
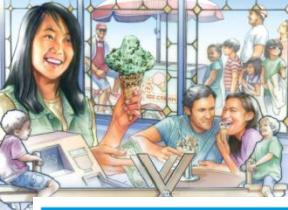
The Price Elasticity of Demand

Example 4: Gasoline in the Short Run vs. Gasoline in the Long Run

- The price of gasoline rises 20%. Does Q^d drop more in the short run or the long run? Why?
  - There's not much people can do in the short run, other than ride the bus or carpool.
  - In the long run, people can buy smaller cars or live closer to work.
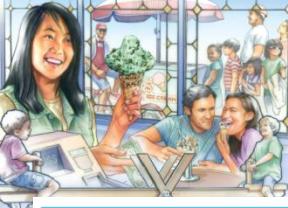
- Price elasticity is higher in the long run

The Price Elasticity of Demand

- Variety of demand curves
  - Demand is elastic
    - Price elasticity of demand > 1
  - Demand is inelastic
    - Price elasticity of demand < 1
  - Demand has unit elasticity
    - Price elasticity of demand = 1
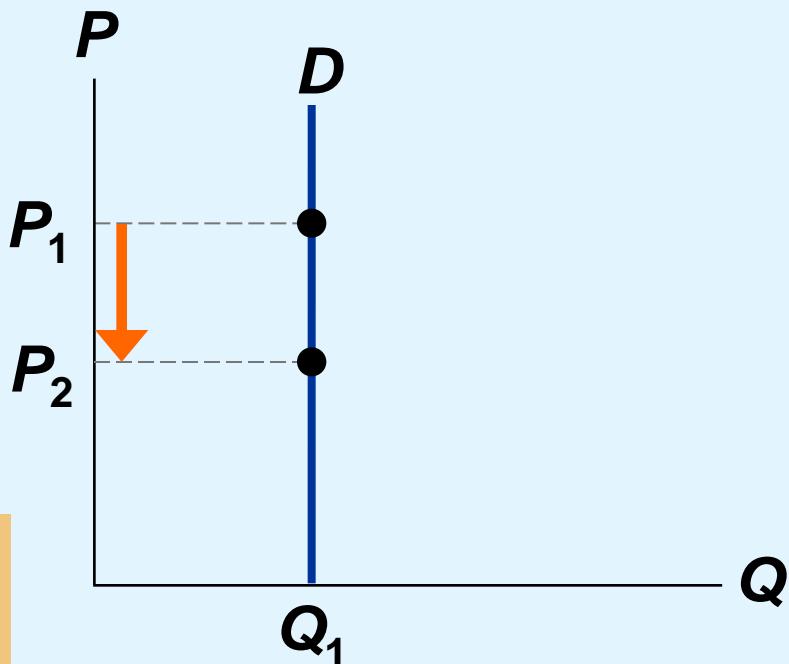
The Price Elasticity of Demand

- Variety of demand curves
  - Demand is perfectly inelastic
    - Price elasticity of demand = 0
    - Demand curve is vertical
  - Demand is perfectly elastic
    - Price elasticity of demand = infinity
    - Demand curve is horizontal
- The flatter the demand curve
  - The greater the price elasticity of demand

Perfectly inelastic demand

Price elasticity of demand $= \dfrac{\text{\% change in } Q}{\text{\% change in } P} = \dfrac{0\%}{10\%} = 0$

P falls by 10%

Q changes by 0%

D curve
Vertical
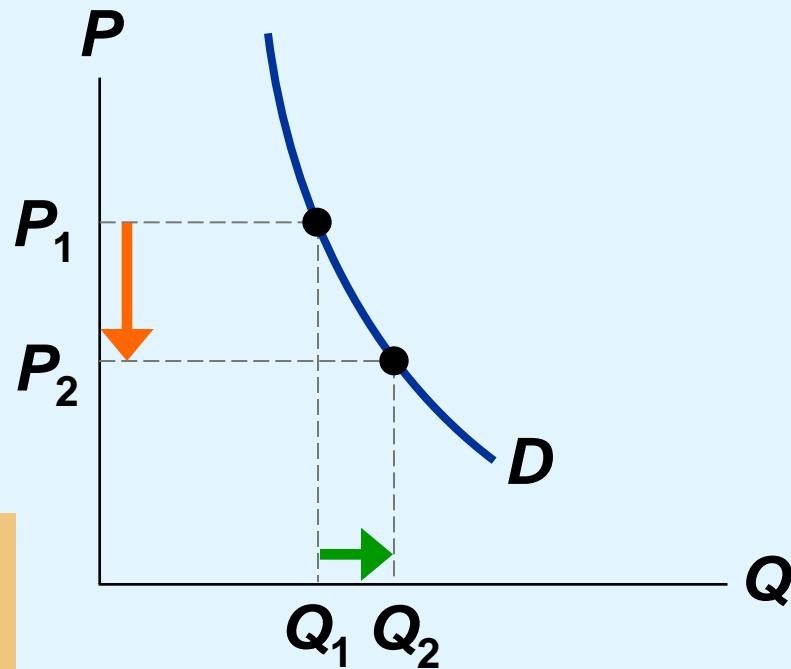
Consumers' price sensitivity:
None

Elasticity:
0

Inelastic demand

$$\text{Price elasticity of demand} = \frac{\%\ \text{change in } Q}{\%\ \text{change in } P} = \frac{<10\%}{10\%} < 1$$

P falls by 10%

Q rises less than 10%
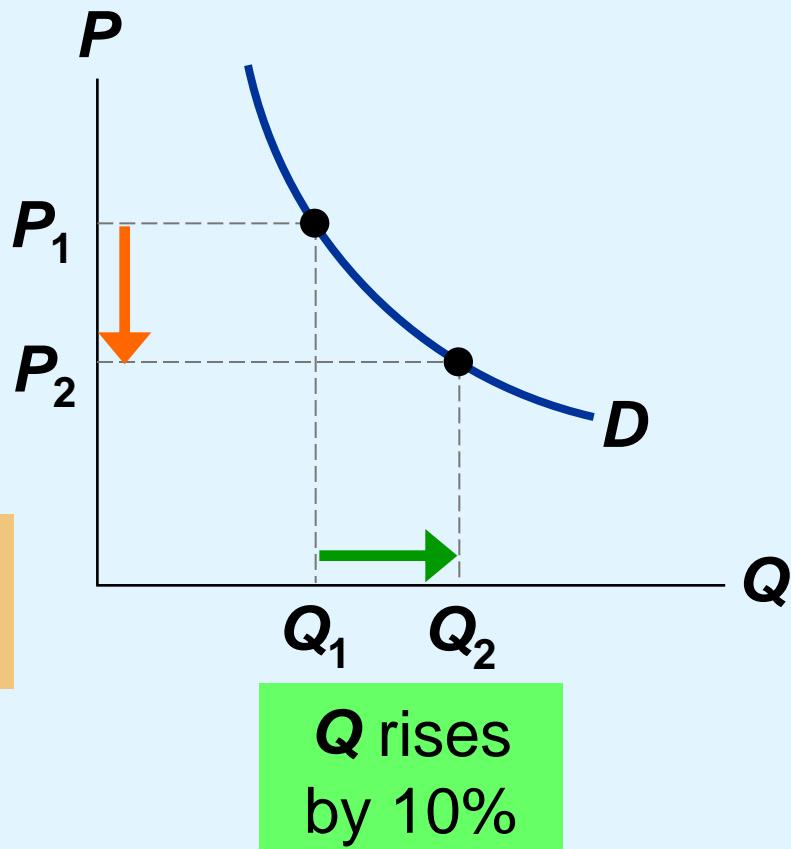
D curve
relatively steep

Consumers' price sensitivity:
relatively low

Elasticity:
<1

Unit elastic demand

Price elasticity of demand $=\dfrac{\text{\% change in } Q}{\text{\% change in } P} = \dfrac{10\%}{10\%} = 1$

P falls by 10%
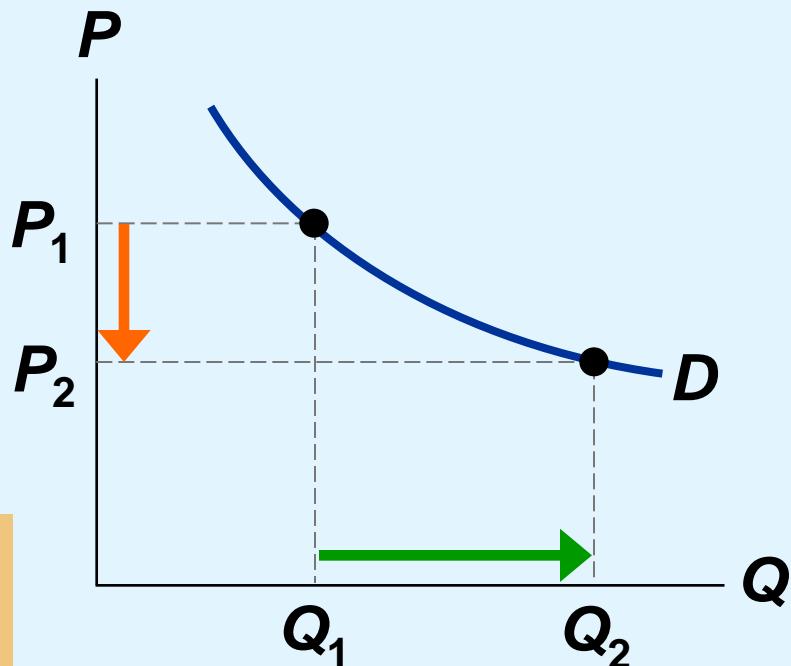
Q rises by 10%

D curve
  intermediate slope

Consumers' price sensitivity:
  intermediate

Elasticity:
  =1

Elastic demand

$$\text{Price elasticity of demand} = \frac{\%\ \text{change in } Q}{\%\ \text{change in } P} = \frac{>10\%}{10\%} > 1$$

P falls by 10%

Q rises more than 10%
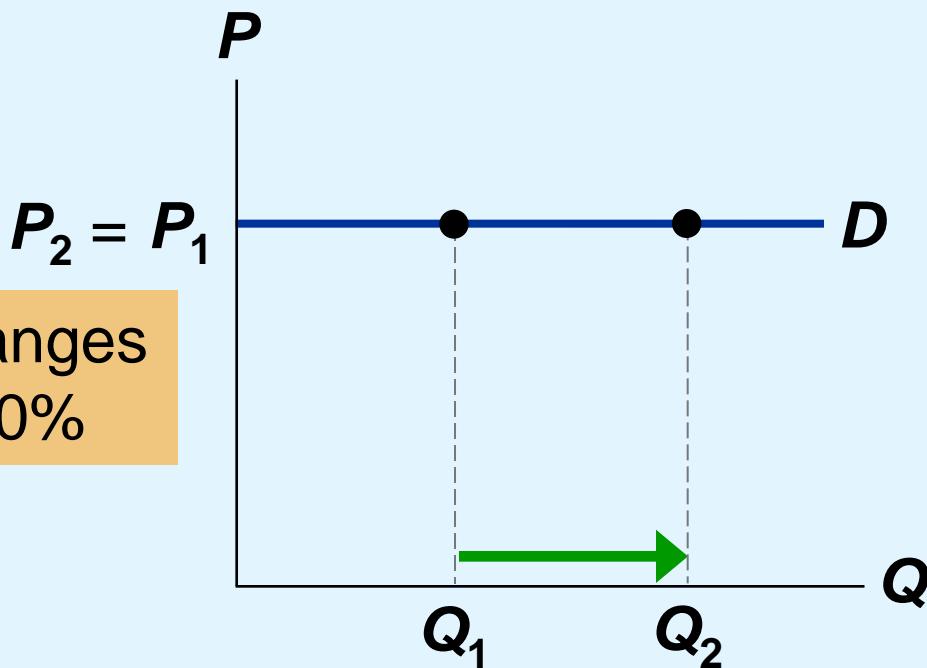
D curve
relatively flat

Consumers' price sensitivity:
relatively high

Elasticity:
>1

Perfectly elastic demand

Price elasticity of demand $= \dfrac{\% \text{ change in } Q}{\% \text{ change in } P} = \dfrac{\text{any \%}}{0\%} = \text{infinity}$

D curve
  horizontal

Consumers' price sensitivity:
  extreme

Elasticity:
  infinity

$P_2 = P_1$

P changes by 0%

Q_1 Q_2

Q changes by any %

A Few Elasticities from the Real World

Eggs	0.1
Healthcare	0.2
Cigarettes	0.4
Rice	0.5
Housing	0.7
Beef	1.6
Peanut Butter	1.7
Restaurant Meals	2.3
Mountain Dew	4.4

Price Elasticity and Total Revenue

Continuing our scenario, if you raise your price from $200 to $250, would your revenue rise or fall?

Total Revenue (TR) = P x Q

- A price increase has two effects on revenue:
  - Higher revenue: because of the higher P
  - Lower revenue: you sell fewer units (lower Q)
- Which of these two effects is bigger?
 - It depends on the price elasticity of demand
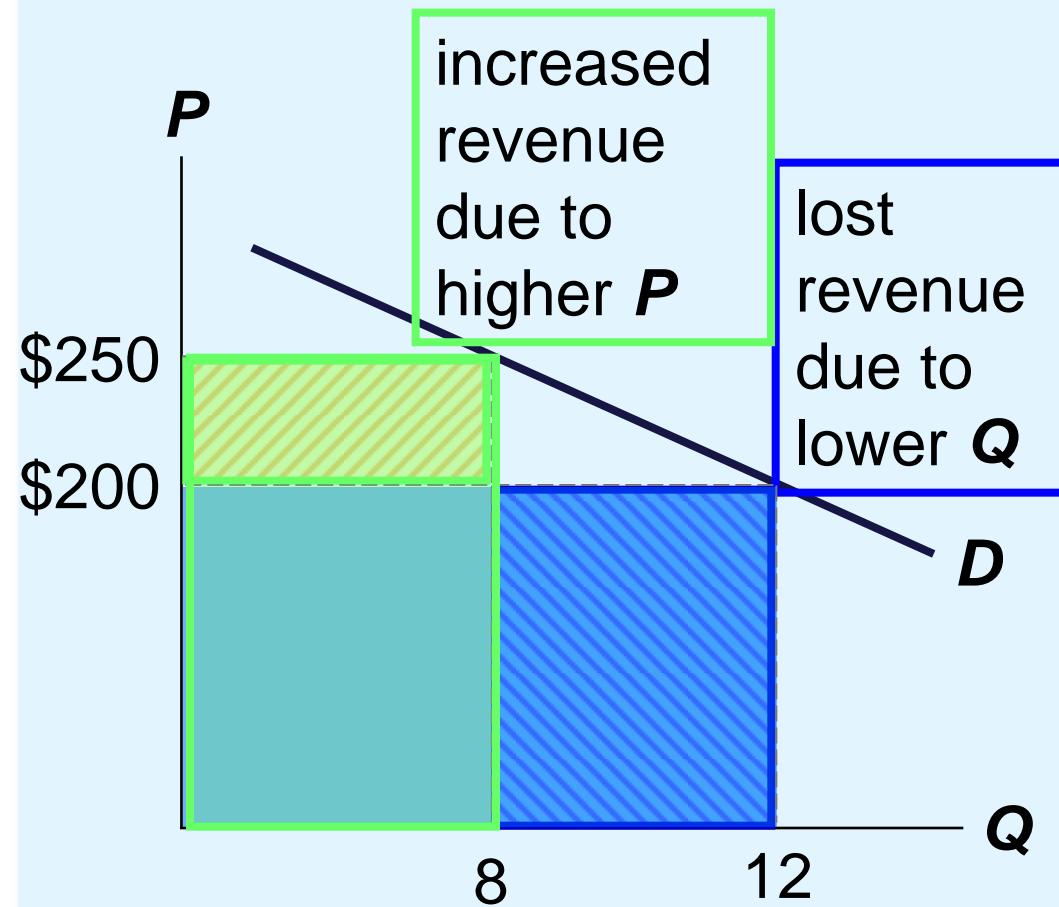
Price Elasticity and Total Revenue

- For a price increase, if demand is elastic
  - E > 1: % change in Q > % change in P
  - TR decreases: the fall in revenue from lower Q > the increase in revenue from higher P

- For a price increase, if demand is inelastic
  - E < 1: % change in Q < % change in P
  - TR increases: the fall in revenue from lower Q < the increase in revenue from higher P

Price Elasticity and Total Revenue

Demand for your websites

increased revenue due to higher **P**

lost revenue due to lower **Q**

Elastic demand (elasticity = 1.333)
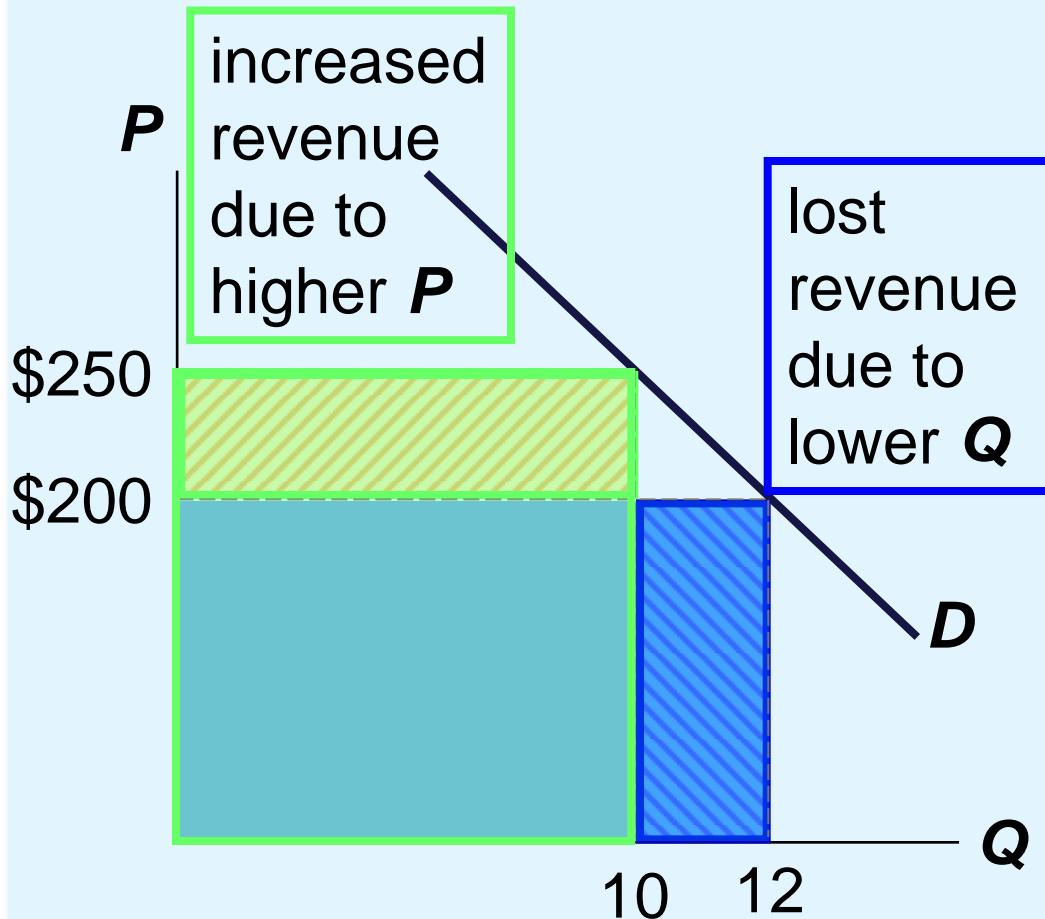
If **P** = $200, **Q** = 12, and revenue = $2400

If **P** = $250, **Q** = 8, and revenue = $2000

When **D** is elastic, a price increase causes revenue to fall.

Price Elasticity and Total Revenue

Demand for your websites

increased revenue due to higher **P**

lost revenue due to lower **Q**

P

$250

$200

D

10   12

Q

Inelastic demand (elasticity = 0.667)

If **P** = $200, **Q** = 12, and revenue = $2400

If **P** = $250, **Q** = 10, and revenue = $2500

When **D** is inelastic, a price increase causes revenue to rise.

Elasticity and revenue

A. Pharmacies raise the price of insulin by 10%.

– Does total expenditure on insulin rise or fall?

B. As a result of a fare war, the price of a luxury cruise falls 20%.

– Does luxury cruise companies' total revenue rise or fall?

Answers

A. Pharmacies raise the price of insulin by 10%.

- Does total expenditure on insulin rise or fall?

- Expenditure = P x Q
- Since demand is inelastic, Q will fall less than 10%, so expenditure rises.

Answers

B. As a result of a fare war, the price of a luxury cruise falls 20%.

– Does luxury cruise companies' total revenue rise or fall?

- Revenue = P x Q

- The fall in P reduces revenue, but Q increases, which increases revenue. Which effect is bigger?

- Since demand is elastic, Q will increase more than 20%, so revenue rises.
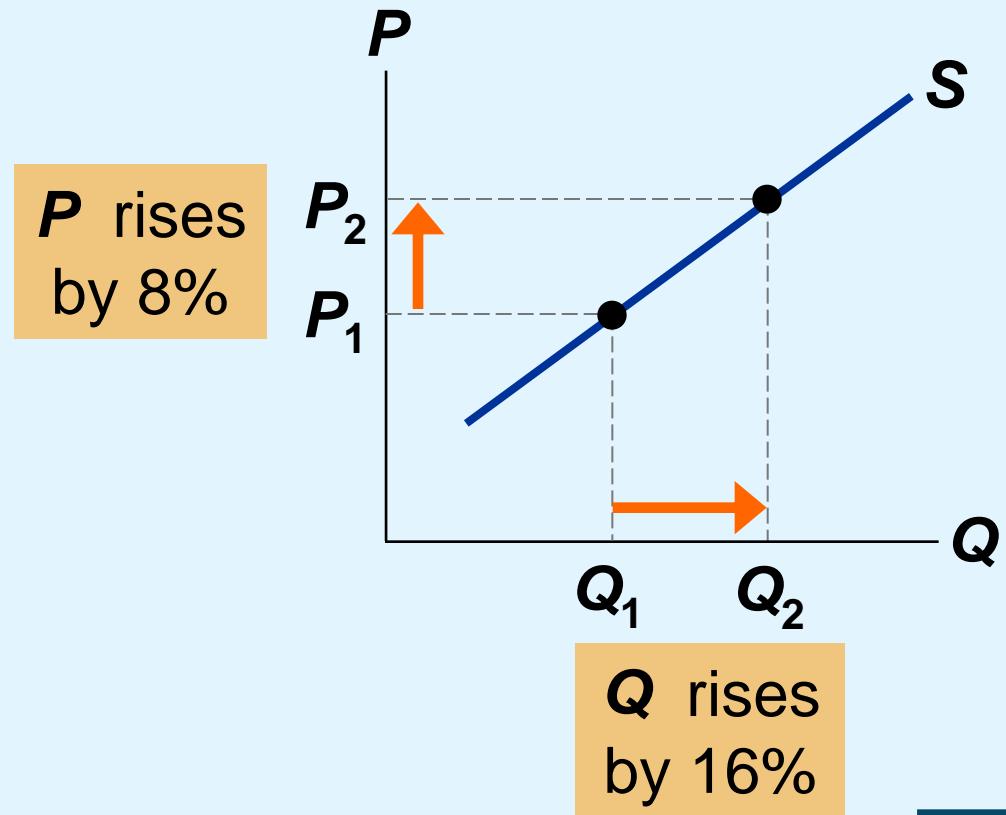
The Price Elasticity of Supply
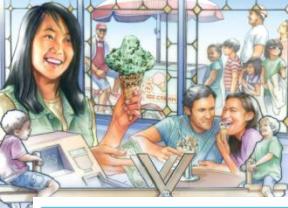
- Price elasticity of supply
  - How much the quantity supplied of a good responds to a change in the price of that good
  - Percentage change in quantity supplied
    - Divided by the percentage change in price
  - Loosely speaking, it measures sellers' price-sensitivity

Price Elasticity of Supply

Price elasticity of supply $= \dfrac{\text{percentage change in Q}^s}{\text{percentage change in P}} = \dfrac{16\%}{8\%} = 2$

Again, we use the midpoint method to compute the percentage changes.

P rises by 8%

Q rises by 16%

The Price Elasticity of Supply

- Variety of supply curves
  - Supply is unit elastic
    - Price elasticity of supply = 1
  - Supply is elastic
    - Price elasticity of supply > 1
  - Supply is inelastic
    - Price elasticity of supply < 1

The Price Elasticity of Supply

- Variety of supply curves
  - Supply is perfectly inelastic
    - Price elasticity of supply = 0
    - Supply curve is vertical
  - Supply is perfectly elastic
    - Price elasticity of supply = infinity
    - Supply curve is horizontal
- The flatter the supply curve
 - The greater the price elasticity of supply

Perfectly inelastic supply

Price elasticity of supply $= \dfrac{\% \text{ change in } Q}{\% \text{ change in } P} = \dfrac{0\%}{10\%} = 0$

S curve:
  vertical
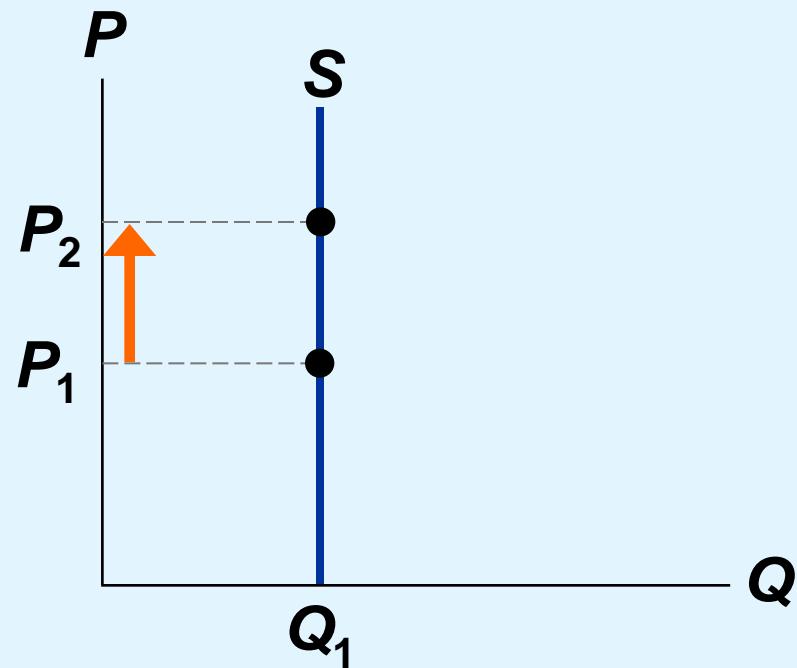
Sellers' price sensitivity:
 none

Elasticity:
  0

P rises by 10%

Q changes by 0%

Inelastic supply

Price elasticity of supply $= \dfrac{\%\ \text{change in } Q}{\%\ \text{change in } P} = \dfrac{< 10\%}{10\%} < 1$

S curve:
  relatively steep
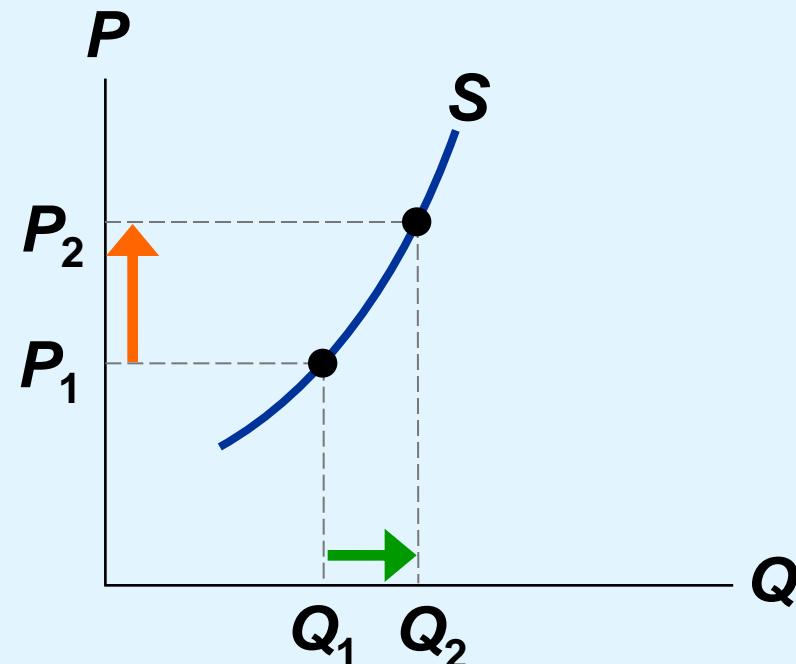
Sellers' price sensitivity:
  relatively low

Elasticity:
  < 1

P rises by 10%

Q rises less than 10%

Unit elastic supply

$$\text{Price elasticity of supply} = \frac{\% \text{ change in } Q}{\% \text{ change in } P} = \frac{10\%}{10\%} = 1$$
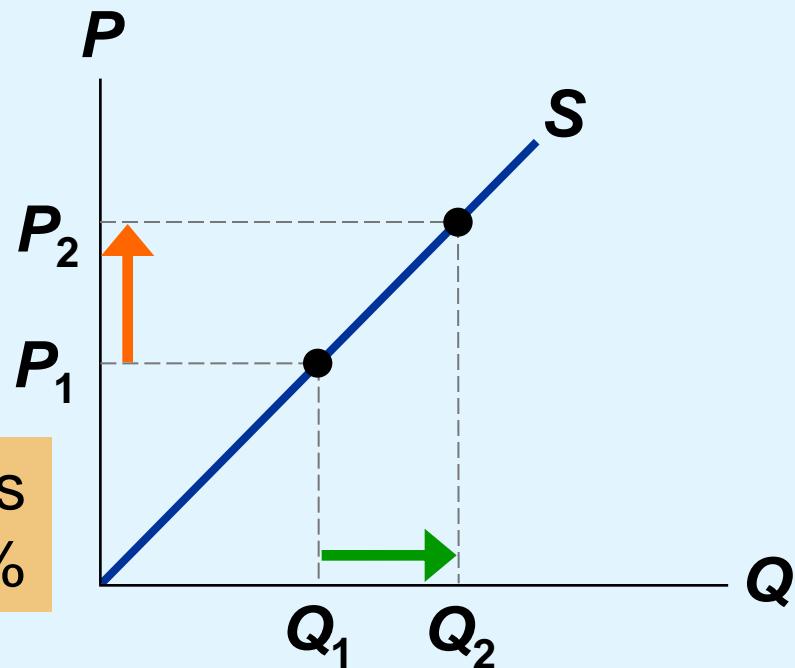
S curve:
    intermediate slope

Sellers' price sensitivity:
    intermediate

Elasticity:
    = 1


P rises by 10%

Q rises by 10%

Elastic supply

$$\text{Price elasticity of supply} = \frac{\% \text{ change in } Q}{\% \text{ change in } P} = \frac{> 10\%}{10\%} > 1$$
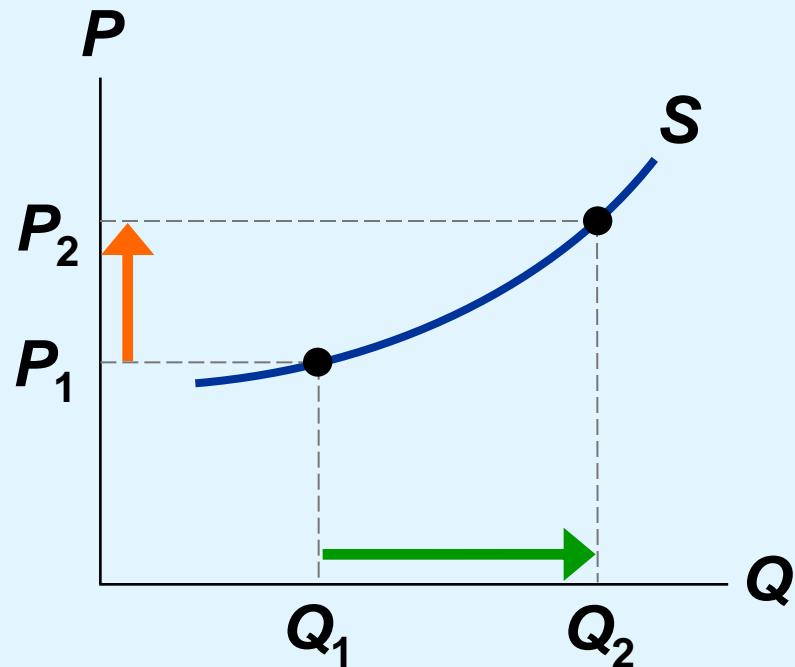
S curve:
  relatively flat

Sellers' price sensitivity:
  relatively high

Elasticity:
  > 1

P rises by 10%

Q rises more than 10%

Perfectly elastic supply

$$\text{Price elasticity of supply} = \frac{\% \text{ change in } Q}{\% \text{ change in } P} = \frac{\text{any } \%}{0\%} = \text{infinity}$$
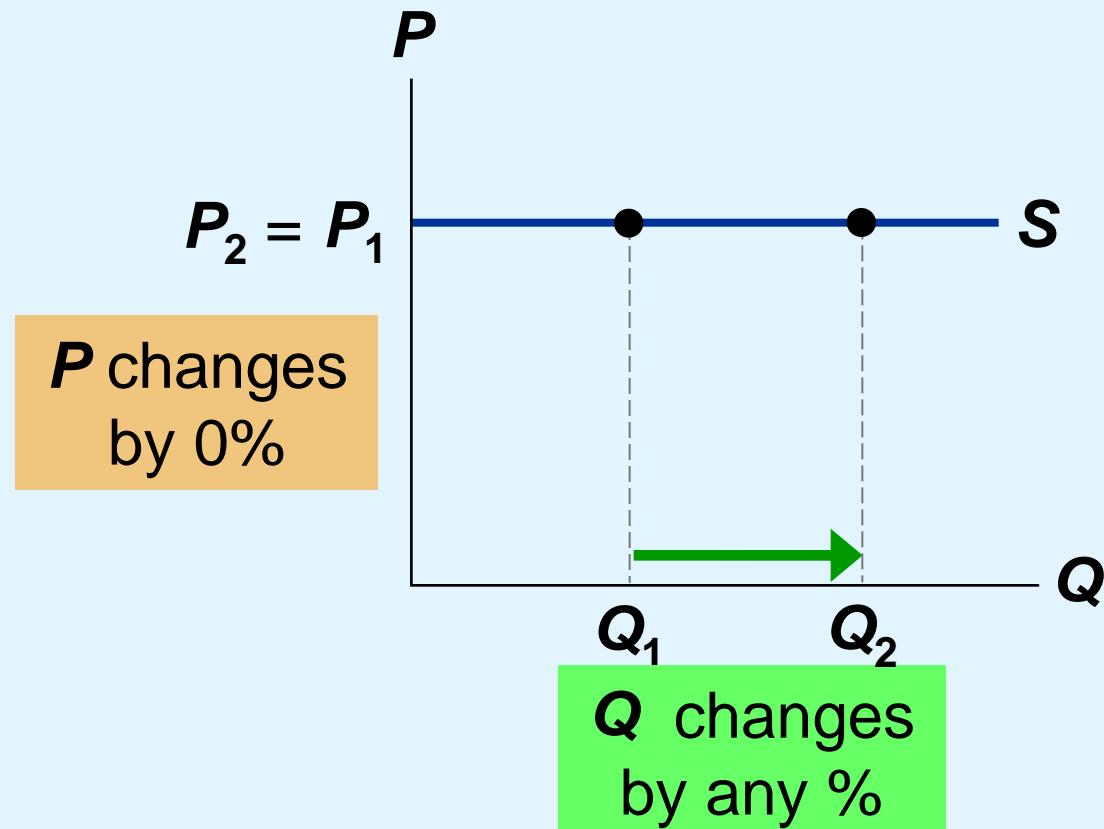
S curve:
   horizontal

Sellers' price sensitivity:
   extreme

Elasticity:
   infinity

P changes by 0%

Q changes by any %

$P_2 = P_1$

S

Q_1 Q_2

P

Q
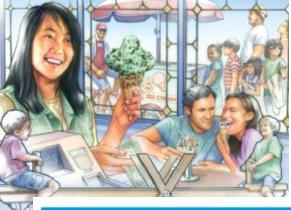
The Determinants of Supply Elasticity

- Greater price elasticity of supply
  - The more easily sellers can change the quantity they produce
    - Supply of beachfront property - harder to vary and thus less elastic than supply of new cars
- Price elasticity of supply is greater in the long run than in the short run
  - In the long run: firms can build new factories, or new firms may be able to enter the market

Other Elasticities of Demand

- Income elasticity of demand
  - How much the quantity demanded of a good responds to a change in consumers' income
  - Percentage change in quantity demanded
    - Divided by the percentage change in income
  - Normal goods: income elasticity > 0
  - Inferior goods: income elasticity < 0

Other Elasticities of Demand

- Cross-price elasticity of demand
  - How much the Q^d of one good responds to a change in the price of another good
  - Percentage change in Q^d of the first good
    - Divided by the percentage change in price of the second good
  - Substitutes: cross-price elasticity > 0
  - Complements: cross-price elasticity < 0

Summary

- Elasticity measures the responsiveness of Q^d or Q^s to one of its determinants.

- Price elasticity of demand equals percentage change in Q^d divided by percentage change in P.
  When it's less than one, demand is "inelastic." When greater than one, demand is "elastic."

- When demand is inelastic, total revenue rises when price rises. When demand is elastic, total revenue falls when price rises.

Summary

- Demand is less elastic in the short run, for necessities, for broadly defined goods, and for goods with few close substitutes.

- Price elasticity of supply equals percentage change in Q^s divided by percentage change in P.
When it's less than one, supply is "inelastic." When greater than one, supply is "elastic."

- Price elasticity of supply is greater in the long run than in the short run.

Summary

- The income elasticity of demand measures how much quantity demanded responds to changes in buyers' incomes.

- The cross-price elasticity of demand measures how much demand for one good responds to changes in the price of another good.

- The tools of supply and demand can be applied in many different kinds of markets. This chapter uses them to analyze the market for wheat, the market for oil, and the market for illegal drugs.