Economics 1
Principles of Economics

Elasticity and Its Applications (Chapter 5)

Dr. Randall R. Rojas

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?

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), so you consider raising the price to $250.
- The law of demand says that you won't sell as many websites if you raise your price.
- Q: How many fewer websites? How much will your revenue fall, or might it increase?

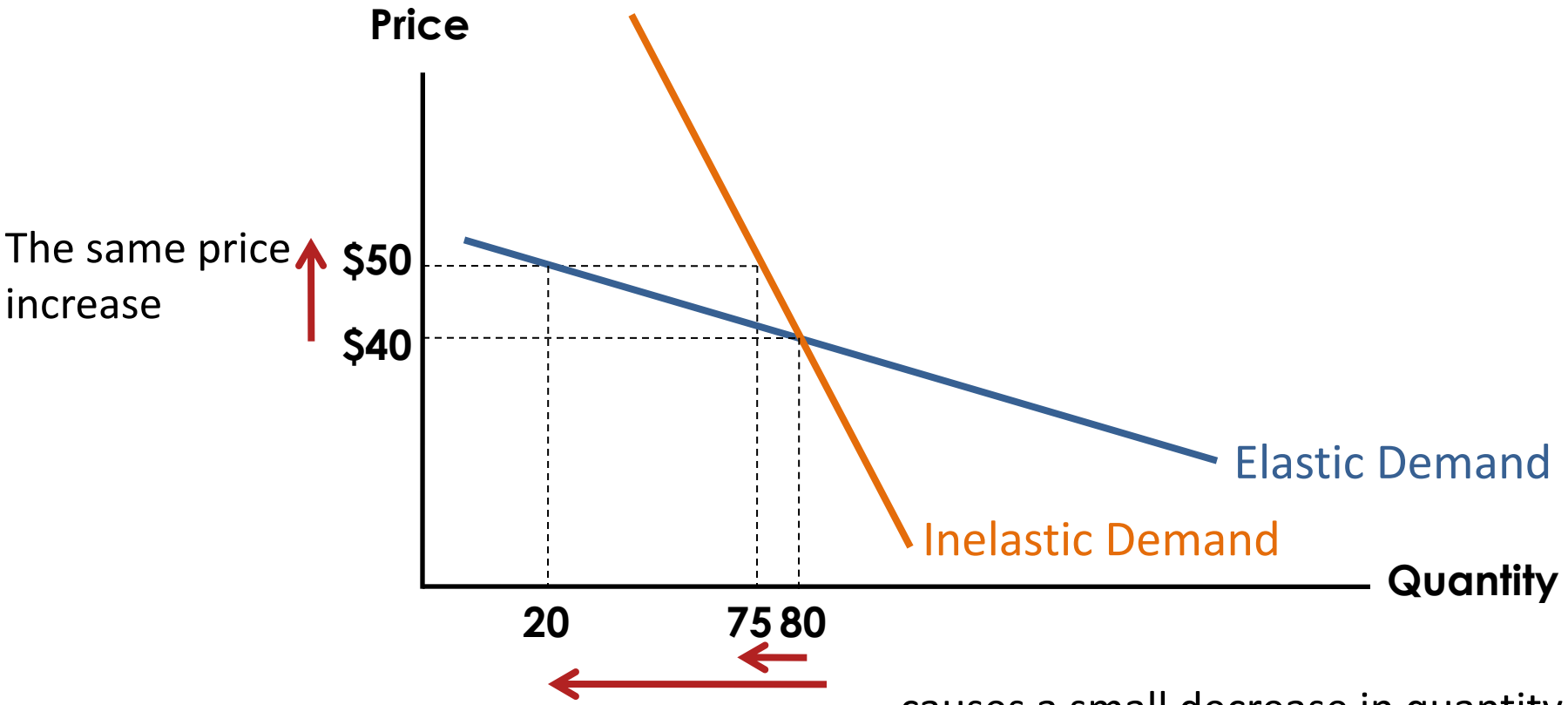
I. Elasticity

- Elasticity measures how much one variable responds to changes in another variable.
  - Example: One type of elasticity measures how much demand for your websites will fall if you raise your price.
- Def: Elasticity = A numerical measure of the responsiveness of Q_D or Q_S to one of its determinants.

II. Elasticity of Demand 1 of 2

- We know there is an inverse relationship between price and quantity demanded.
- But how much does quantity demanded change when price changes?
- Def: Elastic = A demand curve is elastic when an increase in price reduces the quantity demanded a lot (and vice versa).
- Def: Inelastic = A demand curve is inelastic when the same increase in price reduces quantity demanded just a little.

II. Elasticity of Demand 2 of 2



The More Responsive Quantity Demanded is to a Change in Price, the More Elastic is the Demand Curve

III. Elasticity Rule

Elasticity ≠ Slope, but:

If two linear demand (or supply) curves run through a common point, then at any given quantity the curve that is Flatter is More Elastic.

IV. Determinants of the Elasticity of Demand

1. Availability of Substitutes
2. Time Horizon
3. Category of product (specific or broad)
4. Necessities vs. Luxuries
5. Purchase Size

IV. Determinants of the Elasticity of Demand

1. Availability of Substitutes

The availability of substitute is very important!

- fewer substitutes makes it harder for consumers to adjust Q when P changes… so demand is inelastic.

- many substitutes? Switching brands when prices change is easy, so demand is elastic.

IV. Determinants of the Elasticity of Demand 3 of 11

Example 1: When the patent expires on a brand-name drug and 5 generic drugs come on the market, what happens to elasticity of demand?

a) It rises

b) It falls

IV. Determinants of the Elasticity of Demand 4 of 11

Example 2: Breakfast Cereal vs. Sunscreen

- The prices of both of these goods rise by 20%.
  For which good does Q_D drop the most? Why?
  - Breakfast cereal has close substitutes (e.g., pancakes, Eggo waffles, leftover pizza), so buyers can easily switch if the price rises.
  - Sunscreen has no close substitutes, so consumers would probably not buy much less if its price rises.
- Lesson: Price elasticity is higher when close substitutes are available.

IV. Determinants of the Elasticity of Demand

2. Time Horizon

The time horizon matters.

- Less time to adjust means lower elasticity

- Over time consumers can adjust their behavior by finding substitutes (making demand more elastic).

IV. Determinants of the Elasticity of Demand 6 of 11

Example 3: 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 where they work.
- Lesson: Price elasticity is higher in the long run than the short run.

IV. Determinants of the Elasticity of Demand 7 of 11

3. Category of product (Narrow vs. Broad)

The classification of the good matters.

- The less specific the classification, the fewer substitutes there are (making demand inelastic).
- And vice versa…
- E.g. the elasticity of demand is higher for "lettuce (very specific)" than for "food (broad)."

IV. Determinants of the Elasticity of Demand 8 of 11

Example 4: Blue Jeans vs. Clothing

- The prices of both goods rise by 20%.
  For which good does Q_D drop the most? Why?
  - For a narrowly defined good such as blue jeans, there are many substitutes (khakis, shorts, etc.).
  - There are fewer substitutes available for broadly defined goods.
    (There aren't too many substitutes for clothing)
- Lesson: Price elasticity is higher for narrowly defined goods than for broadly defined ones.

IV. Determinants of the Elasticity of Demand

4. Necessities vs. Luxuries

The nature of the good to the consumer can also affect the elasticity of demand.

- For necessities, we do not change Q much when P changes.
  →tend to have inelastic demands

- For luxuries, we are more sensitive to P changes.
  →tend to have elastic demands

IV. Determinants of the Elasticity of Demand 10 of 11

Example 5: Insulin vs. Caribbean Cruises

- The prices of both goods rise by 20%.
  For which good does Q_D drop the most? Why?
  - To millions of diabetics, insulin is a necessity. A rise in its price would cause little or no decrease in demand.
  - A cruise is a luxury. If the price rises, some people will forego it.
- Lesson: Price elasticity is higher for luxuries than for necessities

IV. Determinants of the Elasticity of Demand 11 of 11

5. Purchase Size

The size of the purchase (relative to our budget) matters.

- We are less sensitive to price changes when the good feels cheap.

- We are more sensitive to price changes when the good feels expensive.

Summary of Determinants of Elasticity of Demand

Less Elastic	More Elastic
Fewer Substitutes	More Substitutes
Short Run (less time)	Long Run (more time)
Necessities	Luxuries
Small Part of Budget	Large Part of Budget

V. Price Elasticity of Demand

- Def: Price Elasticity of Demand (E_D)= Measures how much Q_D responds to a change in price (P).
  - Loosely speaking, it measures the price-sensitivity of buyers' demand.

$$E_D = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

V. Price Elasticity of Demand

Example: If the price of oil increases by 10% and over a period of several years, the quantity demanded falls by 5%, then the long run elasticity of demand for oil is:

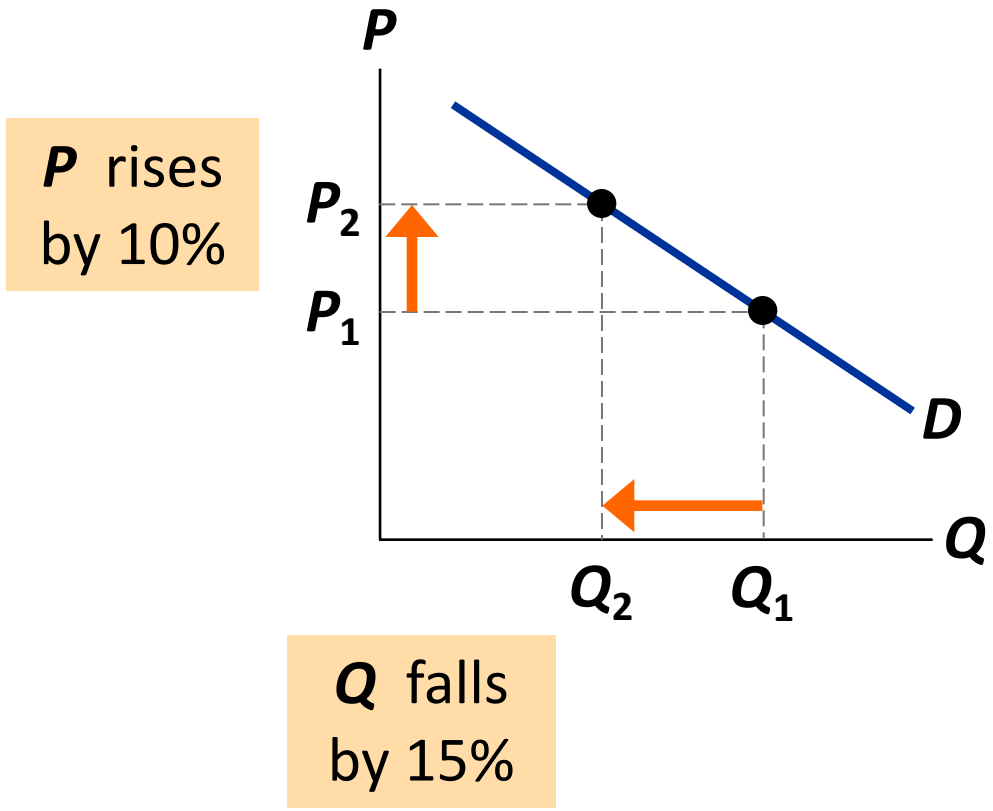
$$E_D = \frac{-5\%}{10\%} = -0.5$$

V. Price Elasticity of Demand

Example:

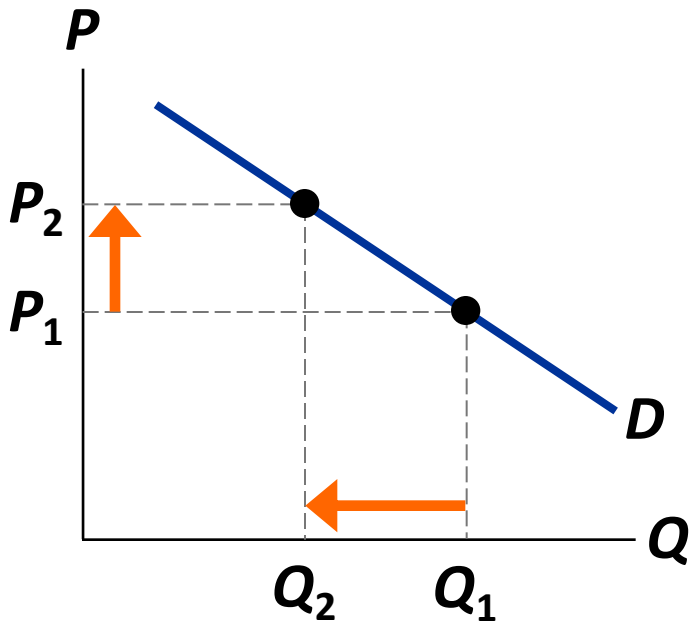
Price elasticity of demand equals:

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



V. Price Elasticity of Demand

Along a ***D*** curve, ***P*** and ***Q*** move in opposite directions, which would make price elasticity negative.



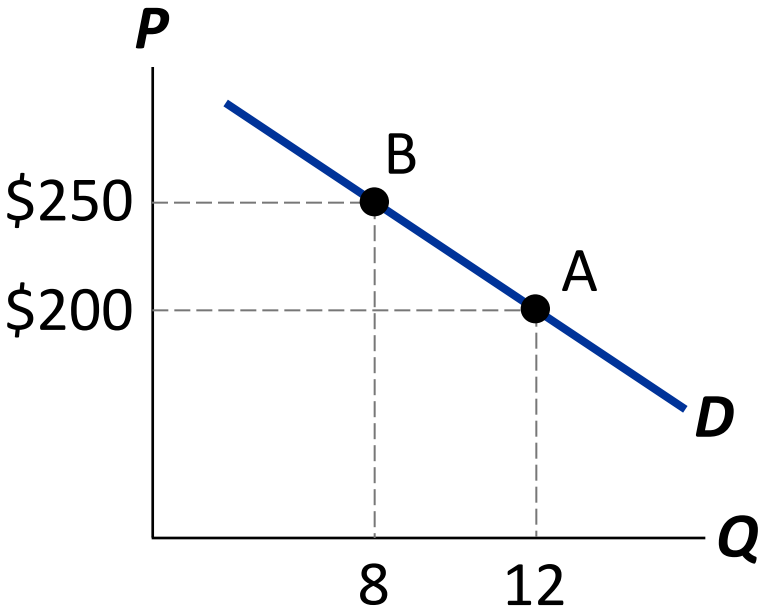
V. Price Elasticity of Demand

Elasticity of demand is always negative, so we typically drop the negative sign and use absolute value instead.

- If the $|E_D| < 1$, the demand curve is inelastic.
- If the $|E_D| > 1$, the demand curve is elastic.
- If the $|E_D| = 1$, the demand curve is unit elastic.

*Calculating Percentage Changes

Demand for your websites



Problem:

The standard method gives different answers depending on where you start.

From A to B,

P rises 25%, ***Q*** falls 33%,

elasticity = 33/25 = 1.33

From B to A,

P falls 20%, ***Q*** rises 50%,

elasticity = 50/20 = 2.50

*Calculating Percentage Changes

- So, we instead use the Midpoint Method:

$$\frac{\text{end value} - \text{start value}}{\text{midpoint}} \times 100\%$$

- The midpoint is the number halfway between the start and end values, the average of those values.
- It doesn't matter which value you use as the start and which as the end—you get the same answer either way!

*Calculating Percentage Changes

- Using the midpoint method, the % change in ***P*** equals

$$\frac{\$250 - \$200}{\$225} \times 100\% = \boxed{22.2\%}$$

- The % change in ***Q*** equals

$$\frac{12 - 8}{10} \times 100\% = \boxed{40.0\%}$$

- The price elasticity of demand equals

$$40/22.2 = \boxed{1.8}$$

VI. Variety of Demand Curves

- The price elasticity of demand is closely related to the slope of the demand curve.
- Rule of thumb:
  - The flatter the curve, the bigger the elasticity.
  - The steeper the curve, the smaller the elasticity.
- Five different classifications of *D* curves....

Perfectly Inelastic Demand (one extreme case)

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

D curve:

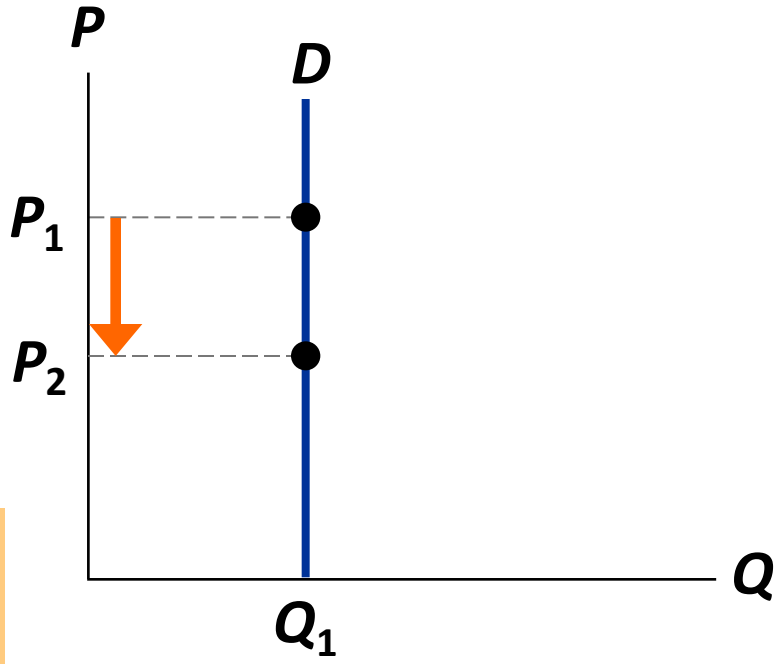
vertical

Consumers' price sensitivity:

none

Elasticity:

0



P falls by 10%

Q changes by 0%

Inelastic Demand

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

D curve:

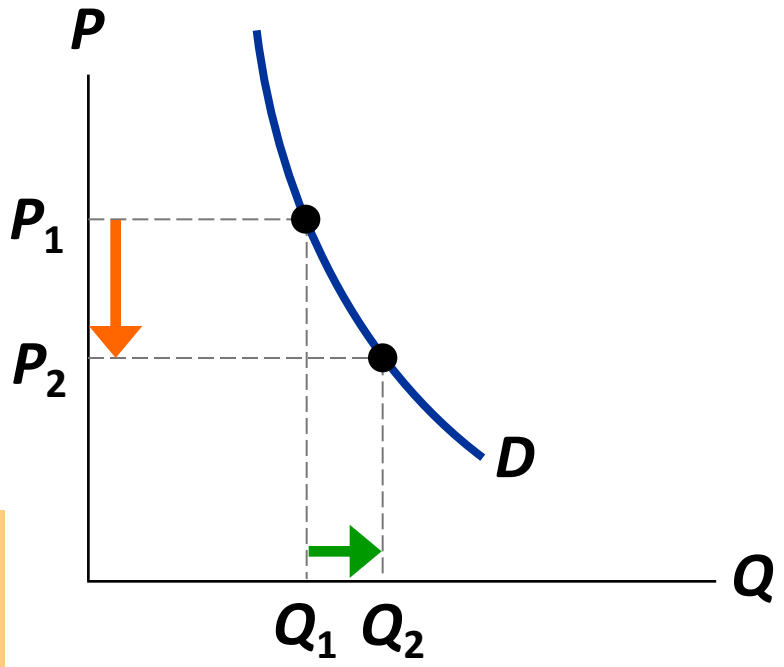
relatively steep

Consumers' price sensitivity:

relatively low

Elasticity:

< 1



P falls by 10%

Q rises less than 10%

Unit Elastic Demand

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

D curve:

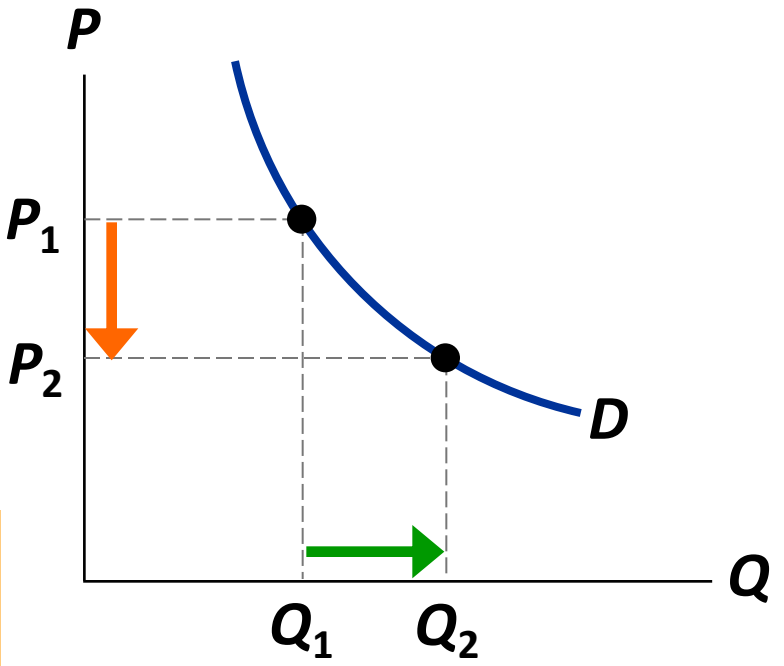
intermediate slope

Consumers' price sensitivity:

intermediate

Elasticity:

1



P falls by 10%

Q rises by 10%

Elastic Demand

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

D curve:

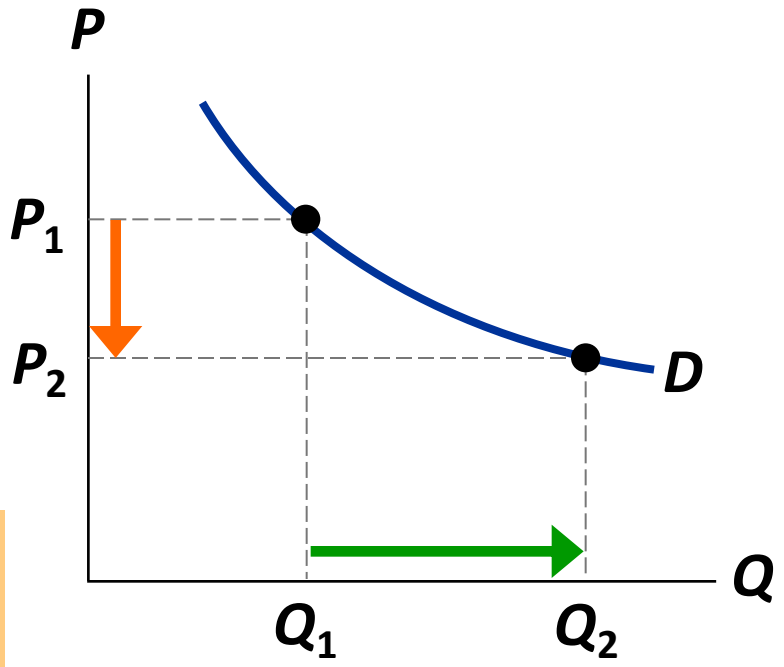
relatively flat

Consumers' price sensitivity:

relatively high

Elasticity:

> 1



P falls by 10%

Q rises more than 10%

Perfectly Elastic Demand (the other extreme)

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

D curve:

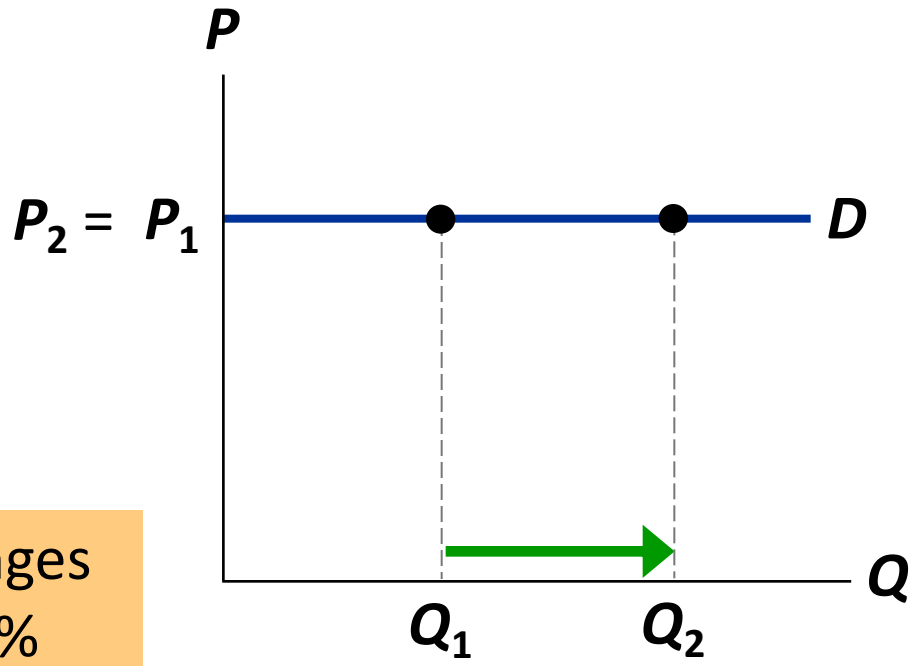
horizontal

Consumers' price sensitivity:

extreme

Elasticity:

infinity



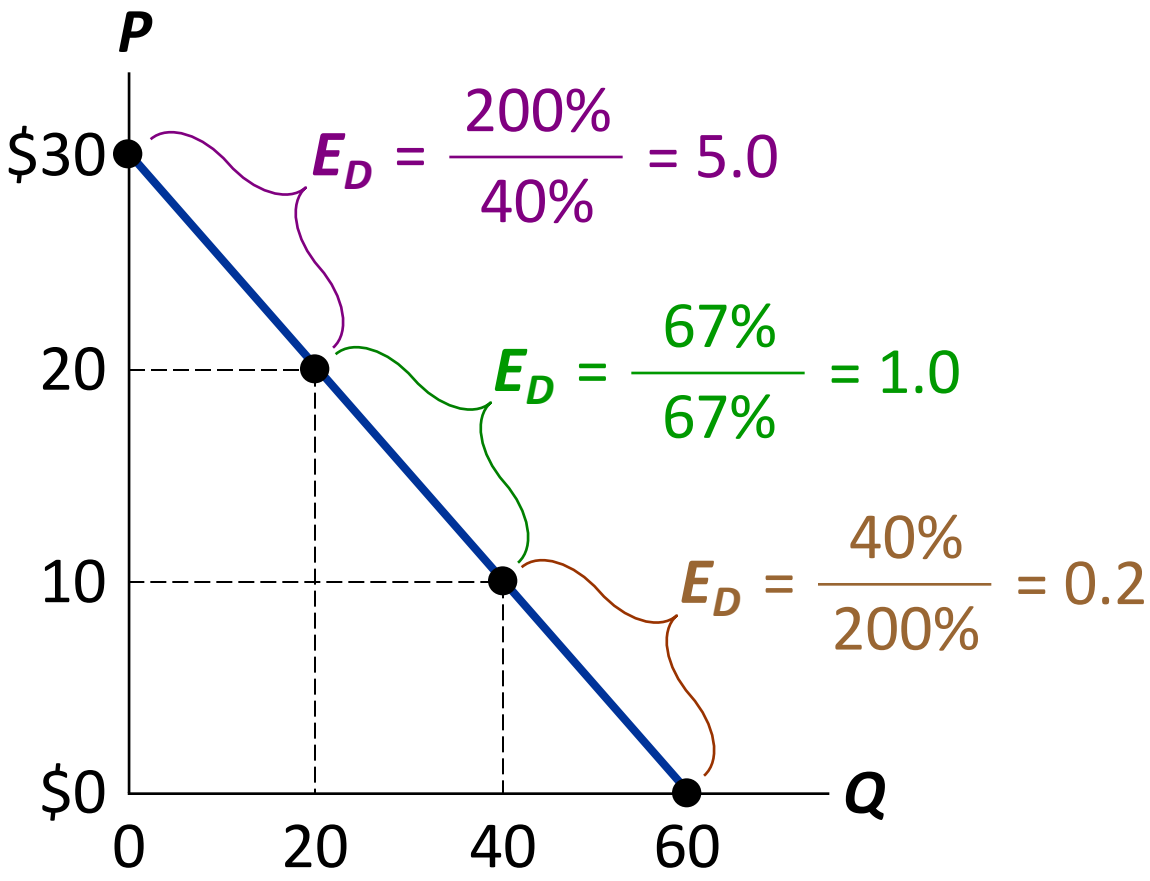
P changes by 0%

Q changes by any %

Examples of Price Elasticities

Product	Price Elasticity
Eggs	0.1
Healthcare	0.2
Rice	0.5
Housing	0.7
Beef	1.6
Restaurant Meals	2.3
Mountain Dew	4.4

VII. Elasticity of a Linear Demand Curve



The slope of a linear demand curve is constant, but its elasticity is not.

VIII. Price Elasticity of Demand using the Midpoint Formula 1 of 2

- To erase the natural bias associated with choice of base point, we calculate the elasticity of demand using the Midpoint Formula given by:

$$E_D = \frac{(Q_{After} - Q_{before})/[(Q_{after} + Q_{before})/2]}{(P_{After} - P_{before})/[(P_{after} + P_{before})/2]} = \frac{\%\Delta Q_D}{\%\Delta P_D}$$

VIII. Price Elasticity of Demand using the Midpoint Formula 2 of 2

Example: At the initial price of $10, the quantity demanded is 100. When the price rises to $20, the quantity demanded is 90.

Percentage Change in Q_D: $\frac{90-100}{(90+100)/2} \times 100\% = -10.5\%$

Percentage Change in P: $\frac{20-10}{(20+10)/2} \times 100\% = 66.6\%$

$$E_D = \frac{-10.5\%}{66.6\%} = 0.16$$

IX. Elasticity of Demand and Total Revenue 1 of 2

- A firm's revenues are equal to price per unit times quantity sold.
  - Revenue (*R*) = Price (*P*) x Quantity (*Q*)
- The elasticity of demand directly influences revenues when the price of the good changes.

IX. Elasticity of Demand and Total Revenue 1 of 2

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

  Revenue = *P* x *Q*

- A price increase has two effects on revenue:
  - Higher *P* means more revenue on each unit you sell.
  - But you sell fewer units (lower *Q*), due to law of demand.
- Which of these two effects is bigger?
  It depends on the price elasticity of demand.

IX. Elasticity of Demand and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q}{\text{Percentage change in } P}$$

$$\text{Revenue} = P \times Q$$

- If demand is elastic, then

  price elasticity of demand > 1

  % change in ***Q*** > % change in ***P***

- The fall in revenue from lower ***Q*** is greater than the increase in revenue from higher ***P***, so revenue falls.

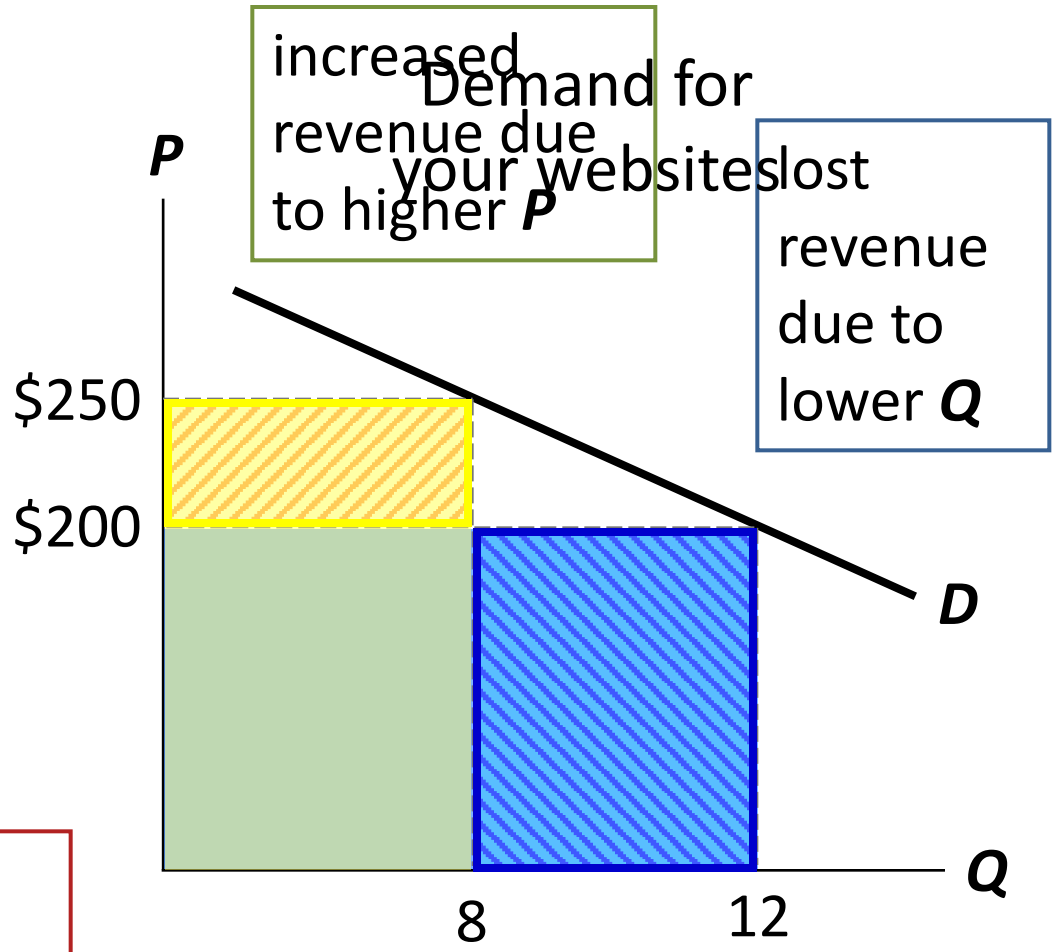
IX. Elasticity of Demand and Total Revenue

Elastic demand
(elasticity = 1.8)

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.



IX. Elasticity of Demand and Total Revenue

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in } Q}{\text{Percentage change in } P}$$

Revenue = P x Q

- If demand is inelastic, then

  price elasticity of demand $<$ 1

  % change in ***Q*** $<$ % change in ***P***

- The fall in revenue from lower ***Q*** is smaller than the increase in revenue from higher ***P***, so revenue rises.
- In our example, suppose that ***Q*** only falls to 10 (instead of 8) when you raise your price to $250.

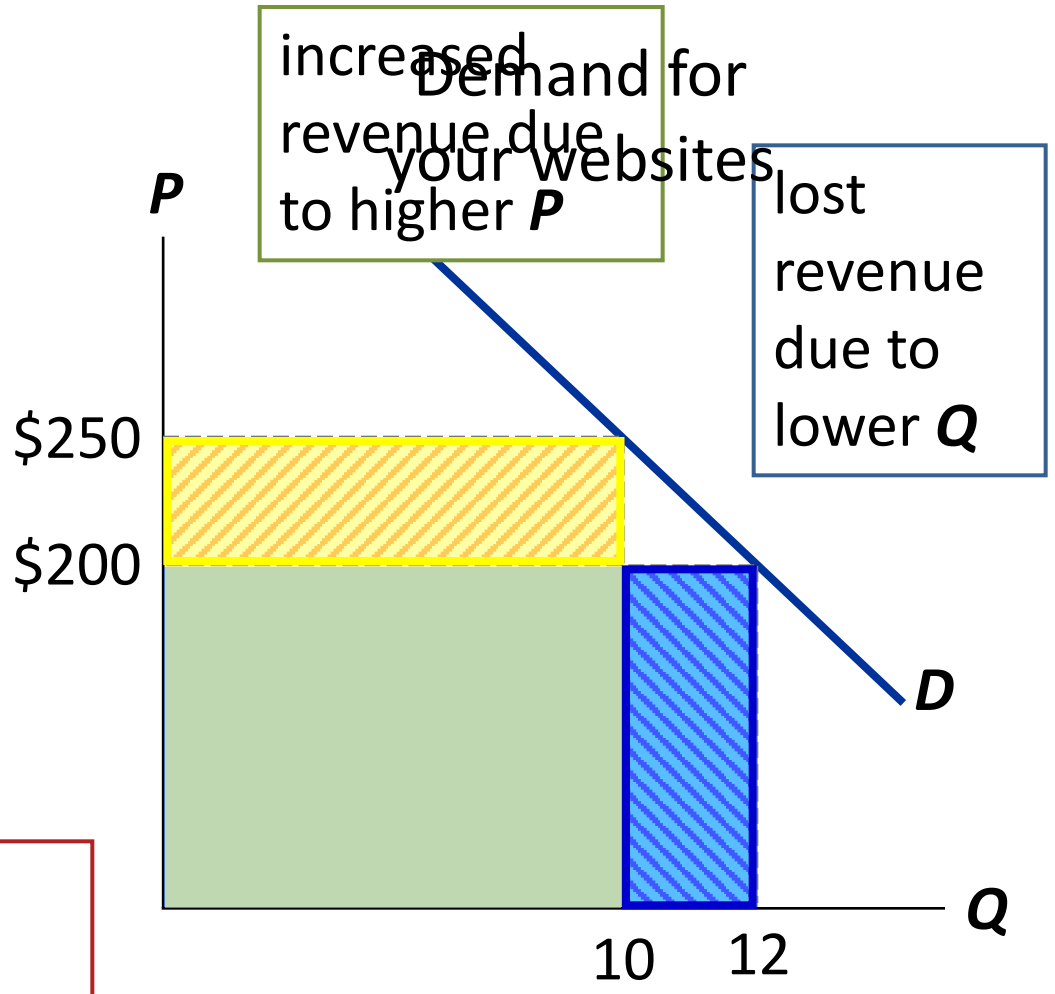
IX. Elasticity of Demand and Total Revenue

Now, demand is inelastic:
(elasticity = 0.82)

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.



Case Study: Does Drug Interdiction Increase or Decrease Drug-Related Crime?

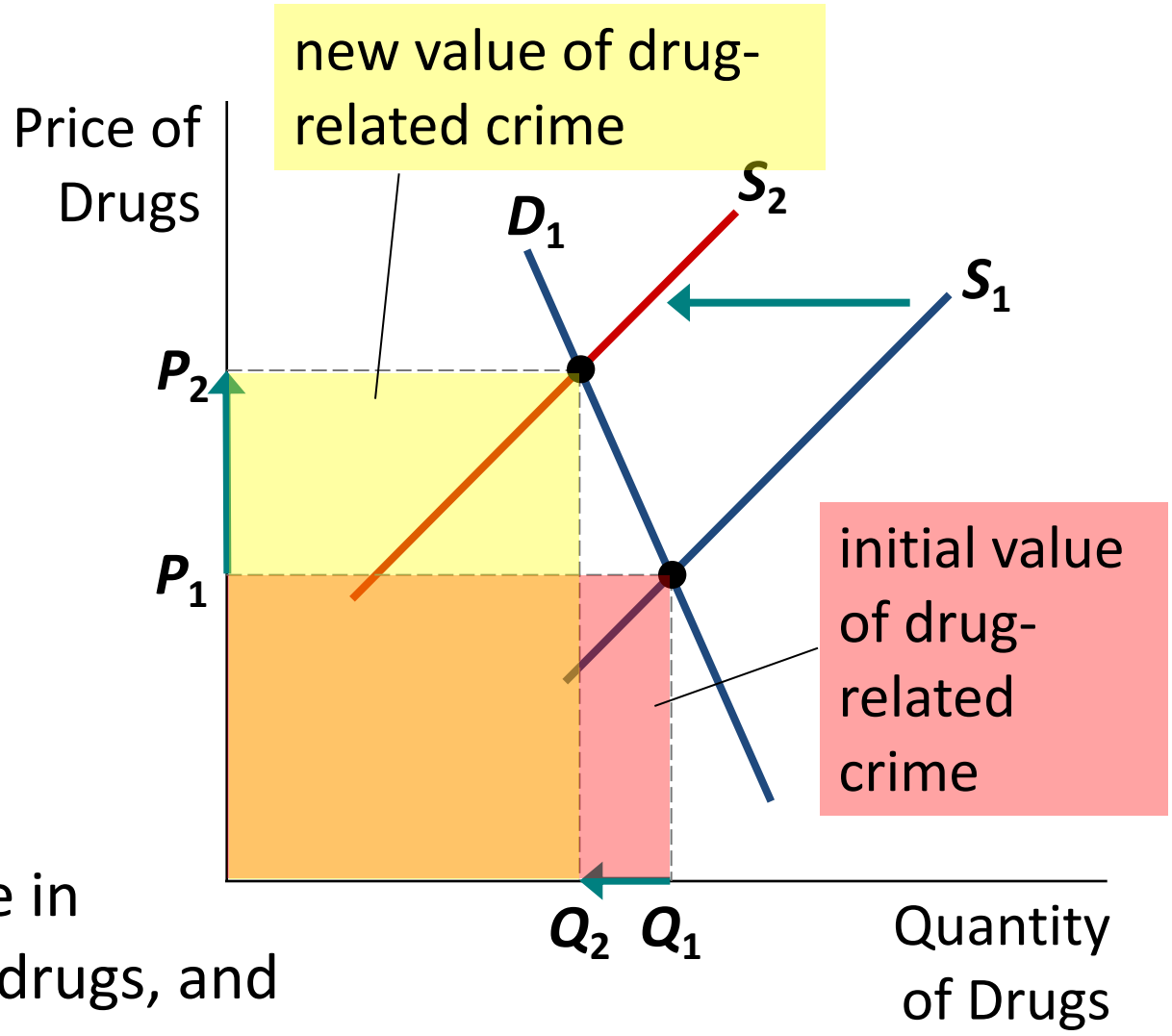
- One side effect of illegal drug use is crime: Users often turn to crime to finance their habit.
- We examine two policies designed to reduce illegal drug use and see what effects they have on drug-related crime.
- For simplicity, we assume the total dollar value of drug-related crime equals total expenditure on drugs.
- Demand for illegal drugs is inelastic, due to addiction issues.

Policy 1: Interdiction

Interdiction reduces the supply of drugs.

Since demand for drugs is inelastic, ***P*** rises proportionally more than ***Q*** falls.

Result: an increase in total spending on drugs, and in drug-related crime

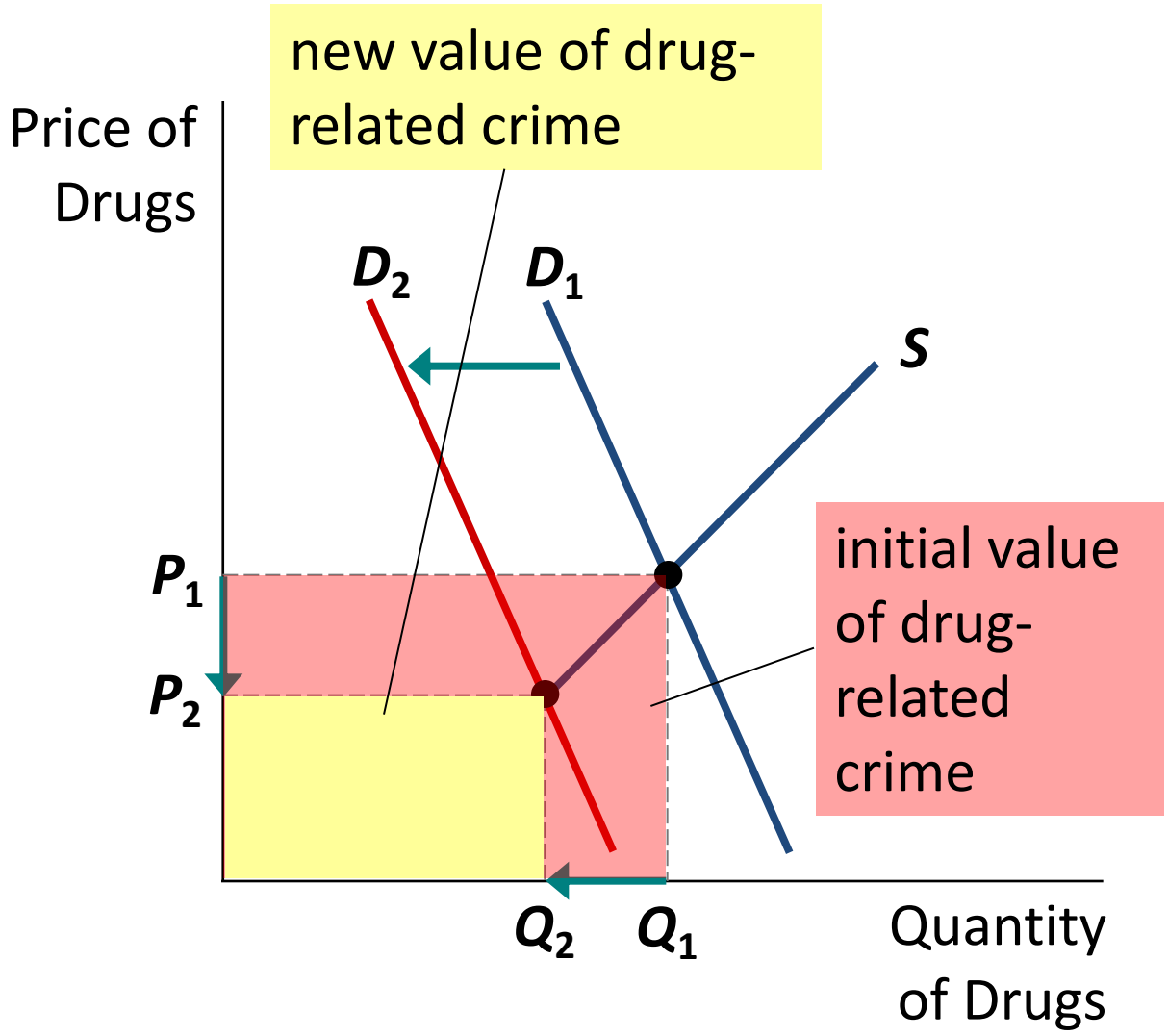


Policy 2: Education

Education reduces the demand for drugs.

P and ***Q*** fall.

Result:
A decrease in total spending on drugs, and in drug-related crime.



Summary of Determinants of Elasticity of Demand

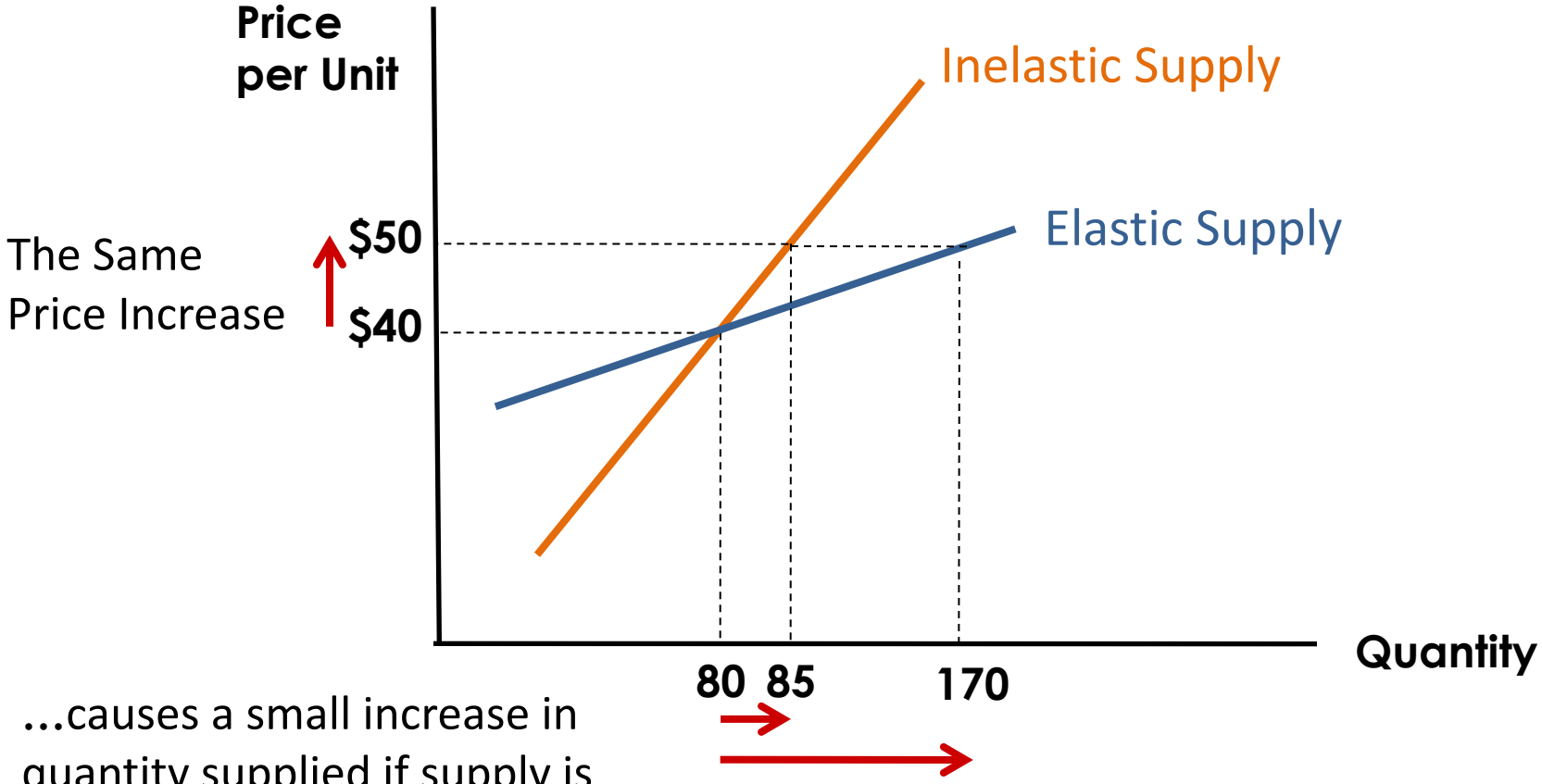
Absolute Value of Elasticity	Name	Price and Revenue
$\lvert E_D \rvert < 1$	Inelastic	P and R Move Together
$\lvert E_D \rvert > 1$	Elastic	P and R Move Opposite
$\lvert E_D \rvert = 1$	Unit Elastic	P Moves but R Stays the Same

X. Elasticity of Supply 1 of 2

- The law of supply indicates a direct relationship between price and quantity supplied.
- But how strong is that relationship?
- Def: Elastic = A supply curve is elastic when an increase in price increases the quantity supplied a lot (and vice versa).
- Def: Inelastic = A supply curve is inelastic when the same increase in price increases quantity supplied just a little.

X. Elasticity of Supply 2 of 2

Elasticity of Supply Captures the Sensitivity of Quantity Supplied to Changes in Price



XI. Determinants of the Elasticity of Supply 1 of 6

1. Change in Per-Unit Costs with Increased Production
2. Time Horizon
3. Share of Market for Inputs
4. Geographic Scope

XI. Determinants of the Elasticity of Supply 2 of 6

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

XI. Determinants of the Elasticity of Supply 3 of 6

1. How quickly do *per-unit costs* increase when more is produced?
   - If increased production is very expensive, then the supply curve will be inelastic.
   - If production can increase with little extra cost, then the supply curve will be elastic.

XI. Determinants of the Elasticity of Supply 4 of 6

2. The time horizon matters.
   - Immediately following a price increase, producers can expand output only using their current capacity (making supply inelastic).
   - Over time, however, producers can expand their capacity (making supply elastic).

XI. Determinants of the Elasticity of Supply 5 of 6

3. The share of the market for the inputs used in production matters.
   - Supply is elastic when the industry can be expanded without causing a big increase in the demand (and price) for the industry's inputs.
   - Supply is inelastic when industry expansion causes a significant increase in the demand/price for inputs.

XI. Determinants of the Elasticity of Supply 5 of 6

4. The geographic scope of the market matters.
   - The wider the scope of the market of a good, the less elastic its supply.
   - The narrower the scope of the market of a good, the more elastic its supply.

Summary of Determinants of Elasticity of Supply

Less Elastic	More Elastic
Difficult to Increase Production at Constant Unit Cost	Easy to Increase Production at Constant Unit Cost
Raw Materials	Manufactured Goods
Short Run	Long Run
Large Share of Market for Inputs	Small Share of Market for Inputs
Global Supply	Local Supply

XII. Price Elasticity of Supply using the Midpoint Formula 1 of 2

- To erase the natural bias associated with choice of base point, we calculate the elasticity of supply using the Midpoint Formula given by:

$$E_S = \frac{(Q_{After} - Q_{before})/[(Q_{after} + Q_{before})/2]}{(P_{After} - P_{before})/[(P_{after} + P_{before})/2]} = \frac{\%\Delta Q_S}{\%\Delta P_S}$$

XIII. Variety of Supply Curves

- The slope of the supply curve is closely related to price elasticity of supply.
- Rule of thumb:
  - The flatter the curve, the bigger the elasticity.
  - The steeper the curve, the smaller the elasticity.
- Five different classifications of *S* curves....

Perfectly inelastic (one extreme)

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

S curve:

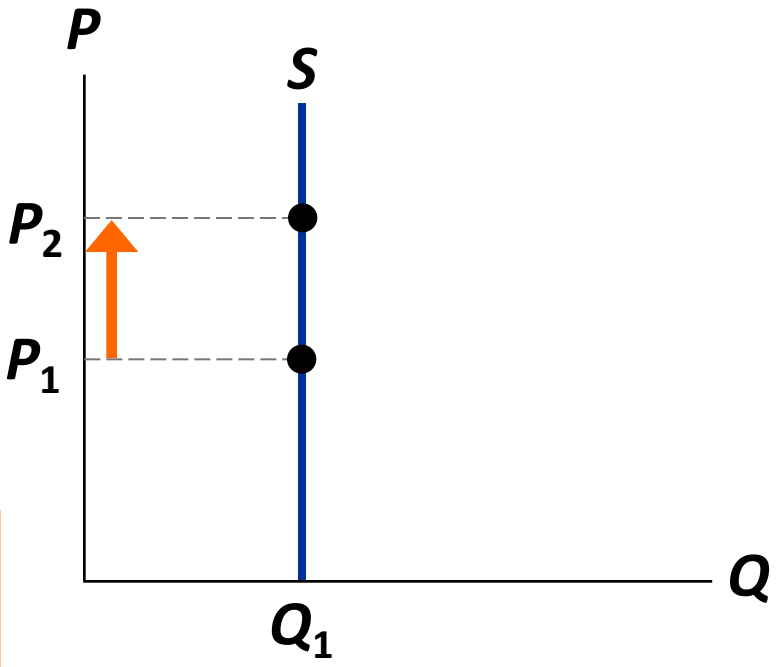
vertical

Sellers' price sensitivity:

none

Elasticity:

0



P rises by 10%

Q changes by 0%

Inelastic

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

S curve:

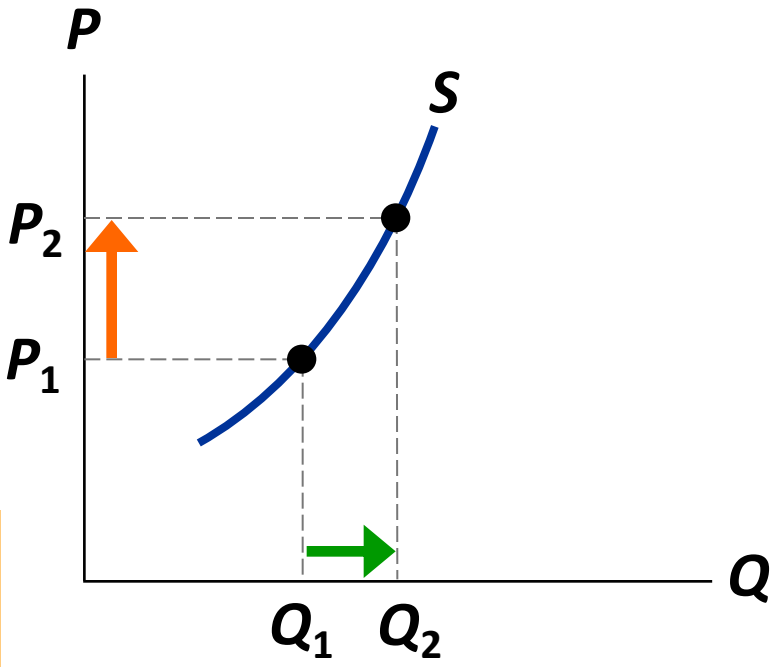
relatively steep

Sellers' price sensitivity:

relatively low

Elasticity:

< 1



P rises by 10%

Q rises less than 10%

Unit Elastic

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

S curve:

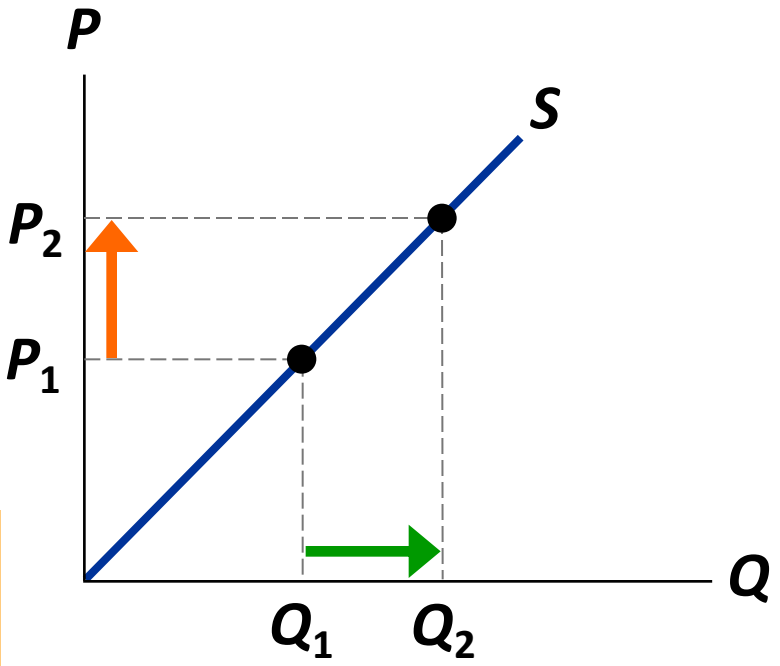
intermediate slope

Sellers' price sensitivity:

intermediate

Elasticity:

= 1



P rises by 10%

Q rises by 10%

Elastic

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

S curve:

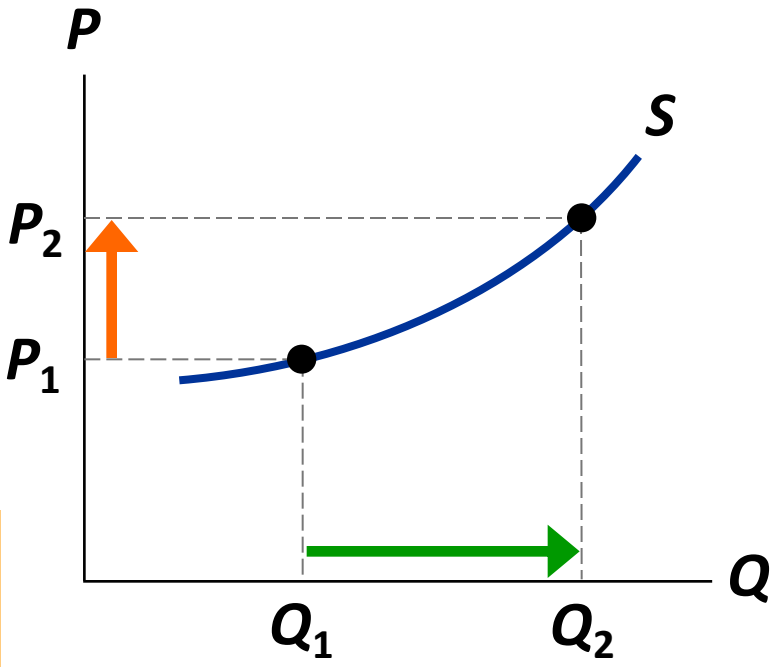
relatively flat

Sellers' price sensitivity:

relatively high

Elasticity:

> 1



P rises by 10%

Q rises more than 10%

Perfectly Elastic (the other extreme)

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

S curve:

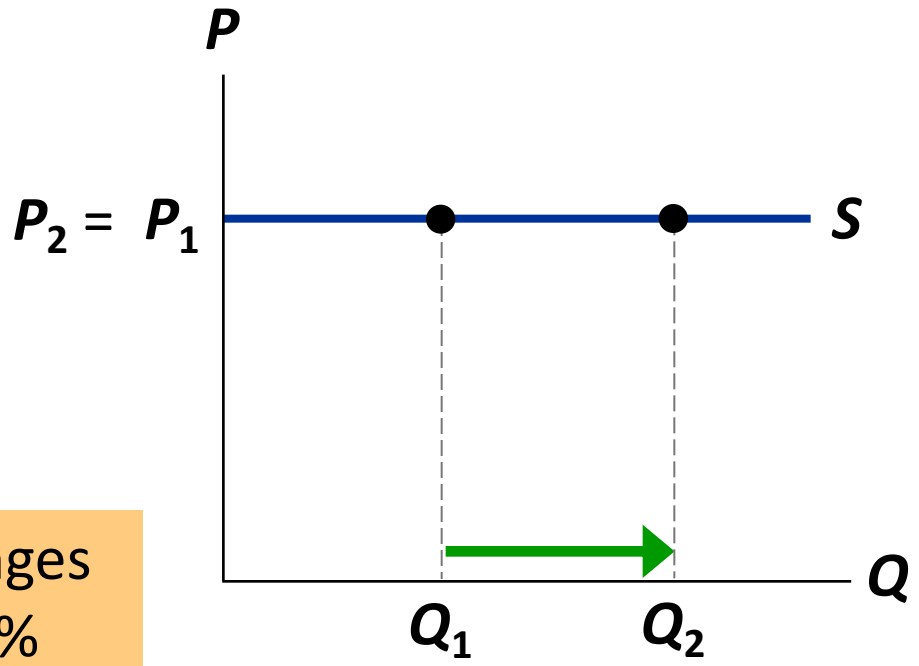
horizontal

Sellers' price sensitivity:

extreme

Elasticity:

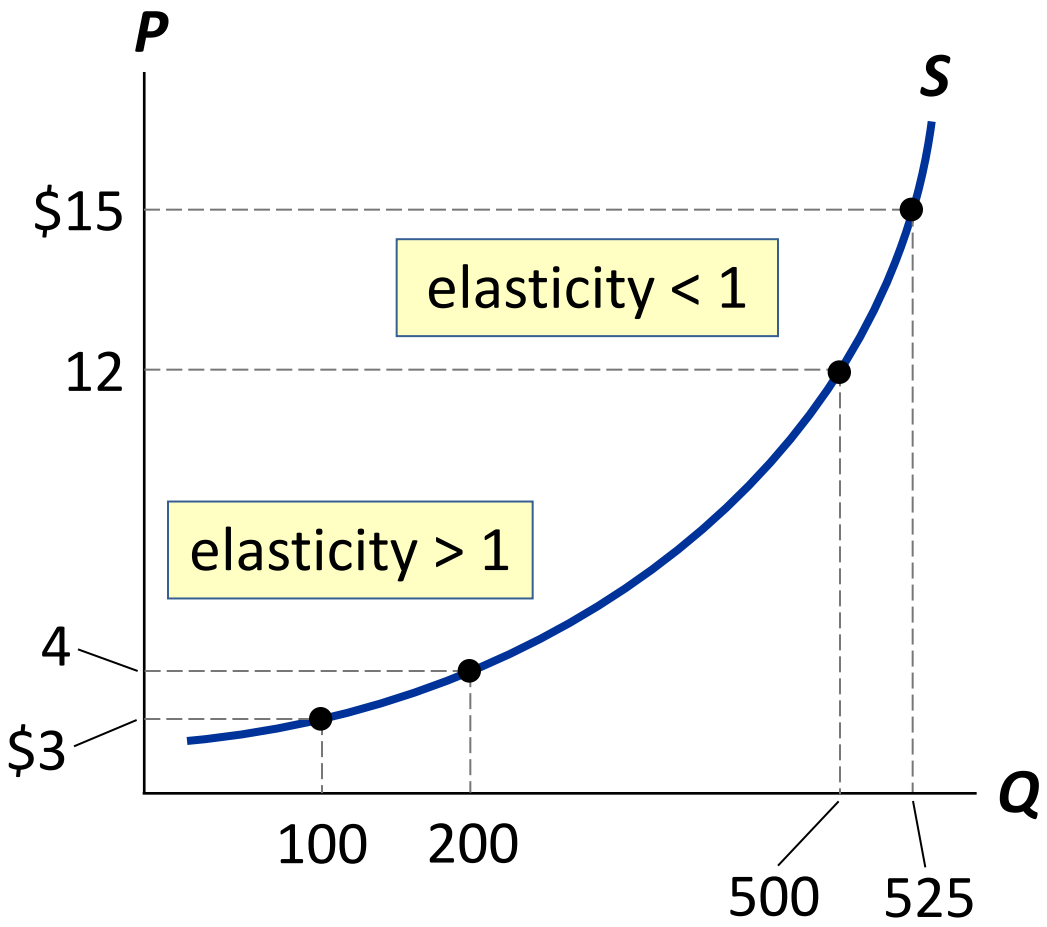
infinity



P changes by 0%

Q changes by any %

XIV. How the Price Elasticity of Supply Can Vary



Supply often becomes less elastic as ***Q*** rises, due to capacity limits.

Summary of Determinants of Elasticity of Supply

Absolute Value of Elasticity	Name
$\lvert E_S \rvert < 1$	Inelastic
$\lvert E_S \rvert > 1$	Elastic
$\lvert E_S \rvert = 1$	Unit Elastic

XV. Other Elasticities

- Def: Income Elasticity of Demand = Measures the response of Q_D to a change in consumer income.

$$\text{Income elasticity of demand} = \frac{\text{Percent change in } Q_D}{\text{Percent change in income}}$$

- Recall from Chapter 4: An increase in income causes an increase in demand for a *normal* good.
- Hence, for normal goods, income elasticity > 0.
- For inferior goods, income elasticity < 0.

Income Elasticity of Demand

The income elasticity of demand can be used to distinguish normal from inferior goods.

- For normal goods, Income Elasticity is positive.
- For luxury goods, Income Elasticity is greater than one.
- For inferior goods, Income Elasticity is negative.

XV. Other Elasticities

- Def: Cross-Price Elasticity of Demand = measures the response of demand for one good to changes in the price of another good.

$$\text{Cross-price elasticity of demand} = \frac{\%\ \text{change in } Q_D \text{ for good 1}}{\%\ \text{change in price of good 2}}$$

- For substitutes, cross-price elasticity > 0
  (e.g., an increase in price of beef causes an increase in demand for chicken).
- For complements, cross-price elasticity < 0
  (e.g., an increase in price of computers causes decrease in demand for software).

Cross-Price Elasticity of Demand

For substitutes, Cross-Price Elasticity of Demand is positive.

An increase in the price of one brand of milk will increase the demand for other brands.

For complements, Cross-Price Elasticity of Demand is negative.

An increase in the price of milk causes a decrease in demand for Oreos.

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.