CHAPTER

4

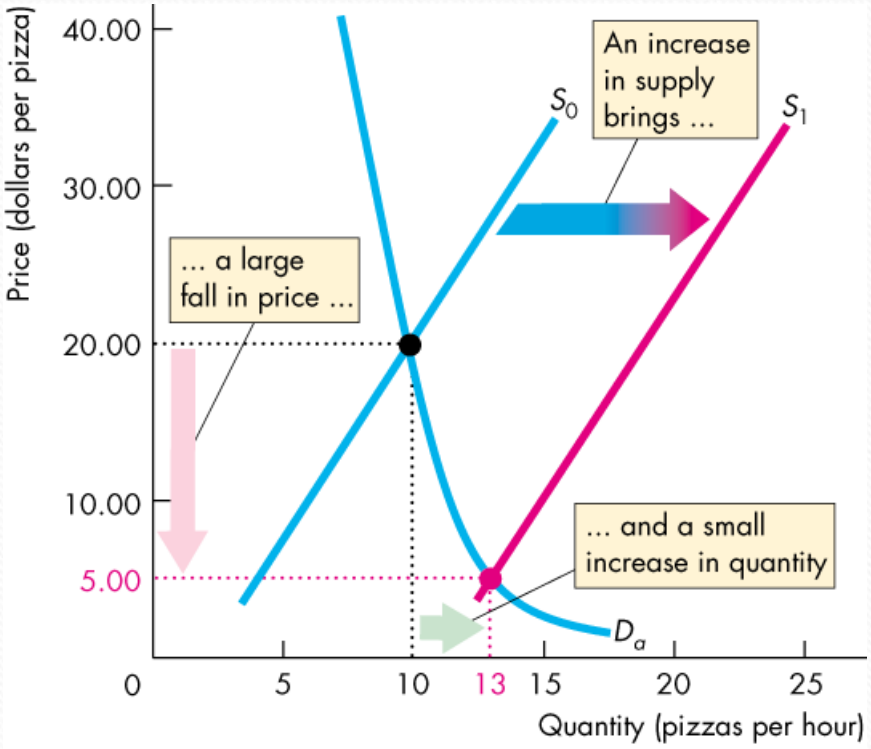
Elasticity

After studying this chapter you will be able to

- Define, calculate, and explain the factors that influence the price elasticity of demand
- Define, calculate, and explain the factors that influence the cross elasticity of demand and the income elasticity of demand
- Define, calculate, and explain the factors that influence the elasticity of supply

Price Elasticity of Demand

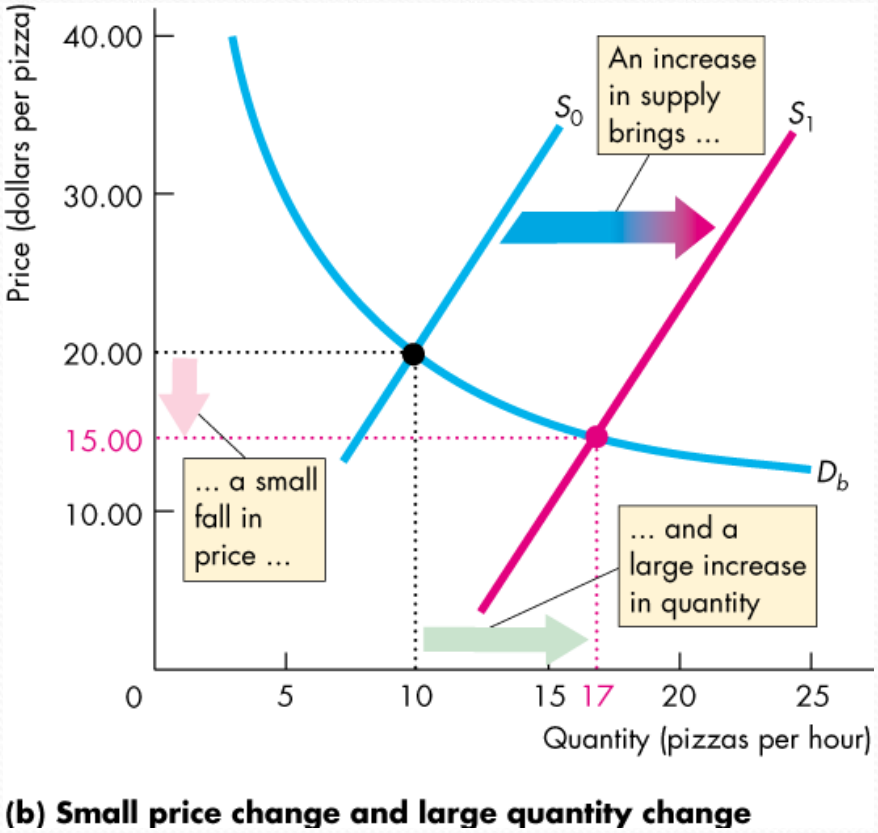
- In Figure 4.1(a), an increase in supply brings
  - A large fall in price
  - A small increase in the quantity demanded



(a) Large price change and small quantity change

Price Elasticity of Demand

- In Figure 4.1(b), an increase in supply brings
  - A small fall in price
  - A large increase in the quantity demanded



(b) Small price change and large quantity change

Price Elasticity of Demand

- The contrast between the two outcomes in Figure 4.1 highlights the need for
- A measure of the responsiveness of the quantity demanded to a price change.
- The **price elasticity of demand** is a units-free measure of the responsiveness of the quantity demanded of a good to a change in its price when all other influences on buying plans remain the same.

Price Elasticity of Demand

- Calculating Price Elasticity of Demand
  - The price elasticity of demand is calculated by using the formula:

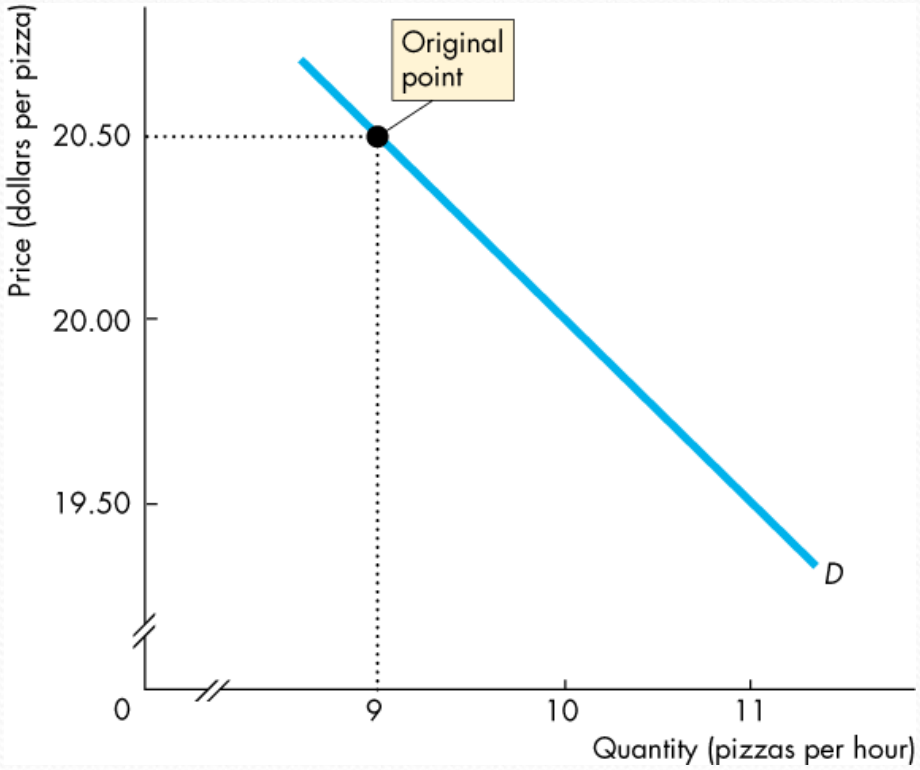
$$\frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Price Elasticity of Demand

- To calculate the price elasticity of demand:
- We express the change in price as a percentage of the *average price*—the average of the initial and new price,
- and we express the change in the quantity demanded as a percentage of the *average quantity* demanded—the average of the initial and new quantity.

Price Elasticity of Demand

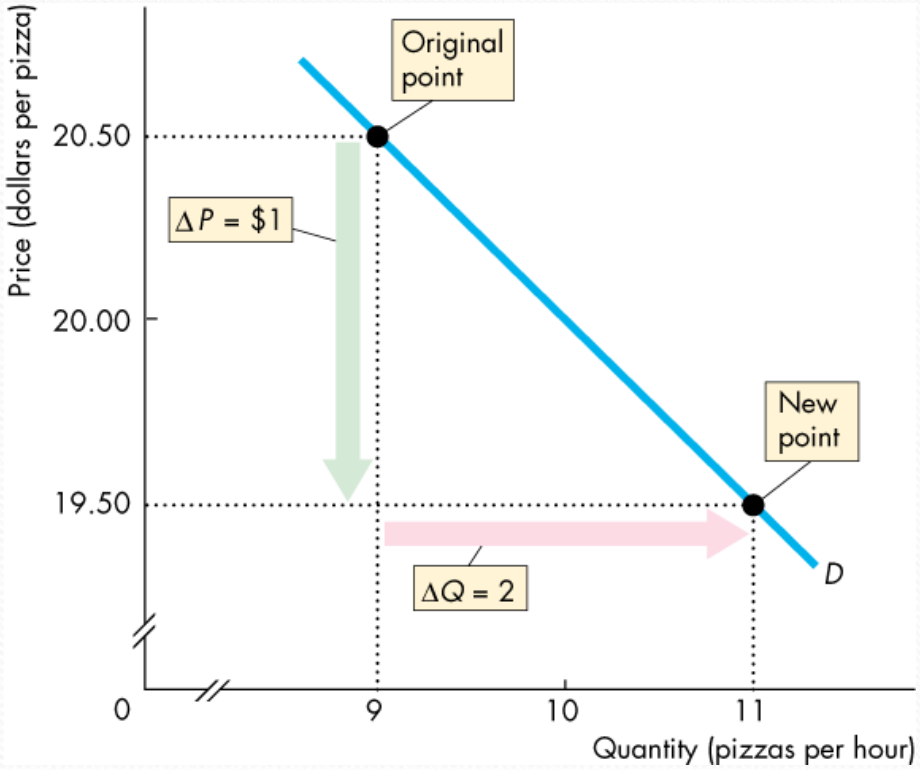
- Figure 4.2 calculates the price elasticity of demand for pizza.
- The price initially is $20.50 and the quantity demanded is 9 pizzas an hour.



Price Elasticity of Demand

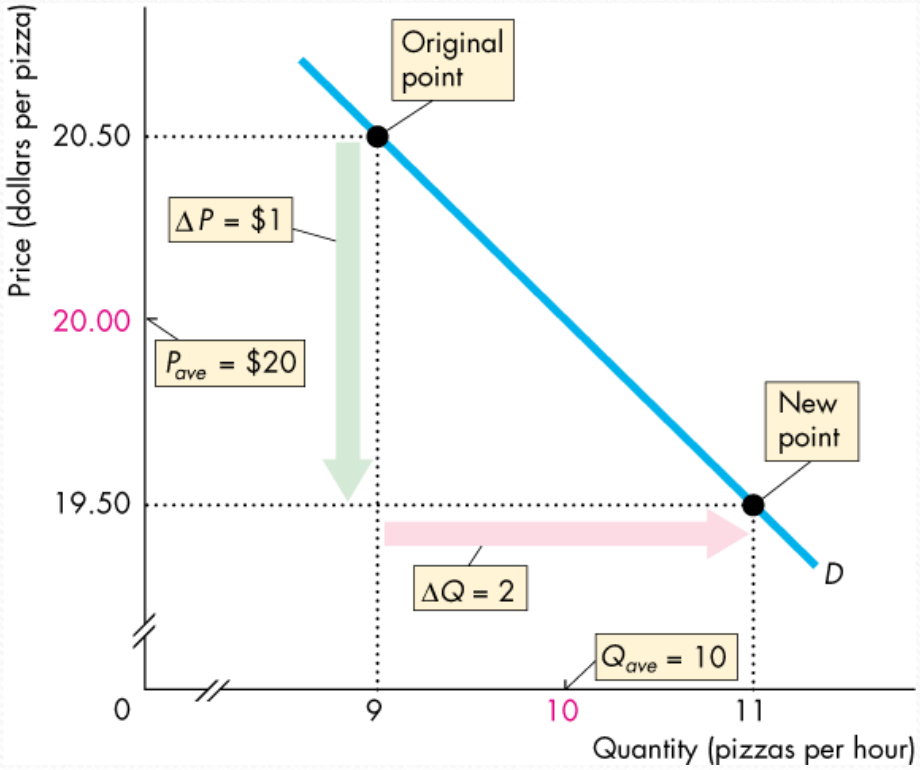
- The price falls to $19.50 and the quantity demanded increases to 11 pizzas an hour.

The price falls by $1 and the quantity demanded increases by 2 pizzas an hour.



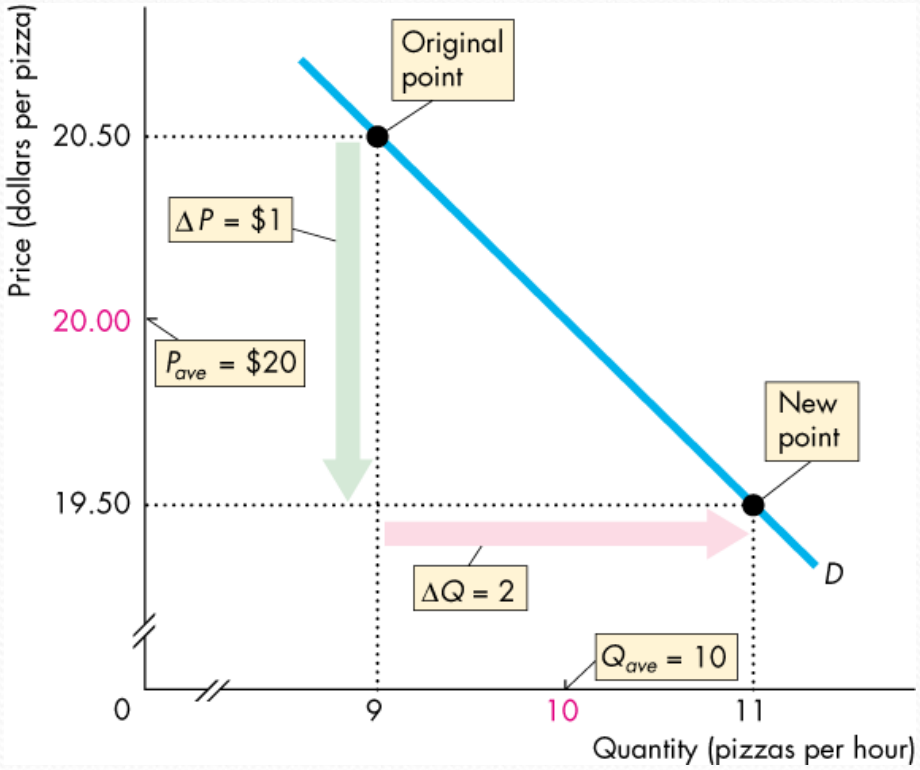
Price Elasticity of Demand

- The average price is $20 and the average quantity demanded is 10 pizzas an hour.



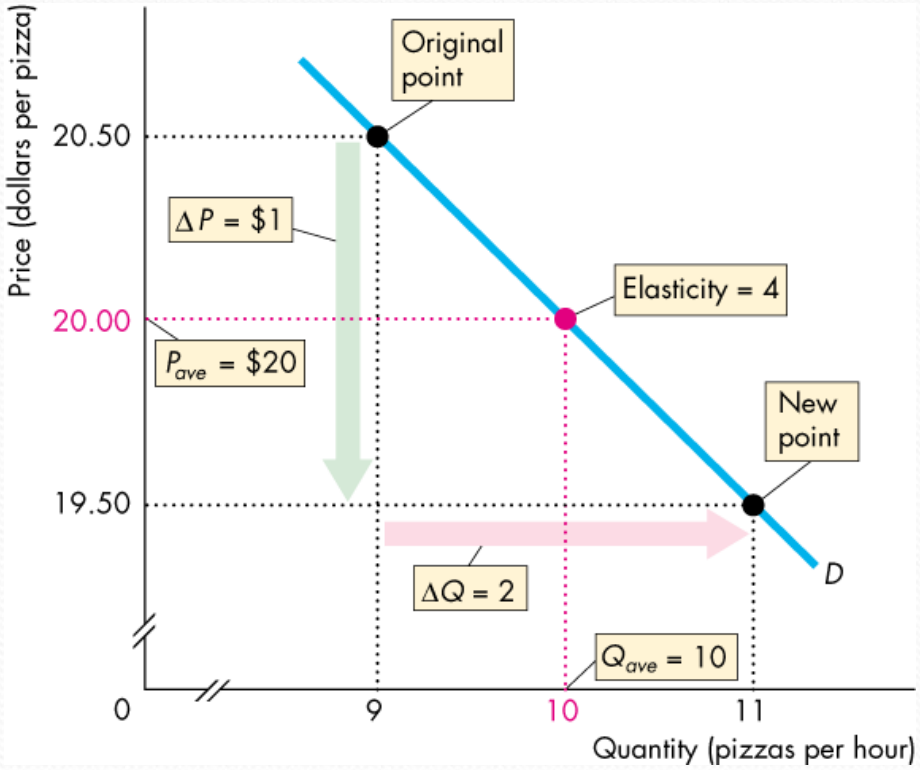
Price Elasticity of Demand

- The percentage change in quantity demanded, $\%\Delta Q$, is calculated as $\Delta Q/Q_{ave}$ x 100, which is
- (2/10) x 100 = 20%.
- The percentage change in price, $\%\Delta P$, is calculated as $\Delta P/P_{ave}$ x 100, which is
- ($1/$20) x 100 = 5%.



Price Elasticity of Demand

- The price elasticity of demand is
- $\%\Delta Q / \%\Delta P = 20\% / 5\%$
- $= 4$.



Price Elasticity of Demand

- **Average Price and Quantity**
- By using the *average price* and *average quantity*, we get the same elasticity value regardless of whether the price rises or falls.
- **Percentages and Proportions**
- The ratio of two proportionate changes is the same as the ratio of two percentage changes.
  - $\%\Delta Q / \%\Delta P = (\Delta Q/Qav) / (\Delta P/Pav)$

Price Elasticity of Demand

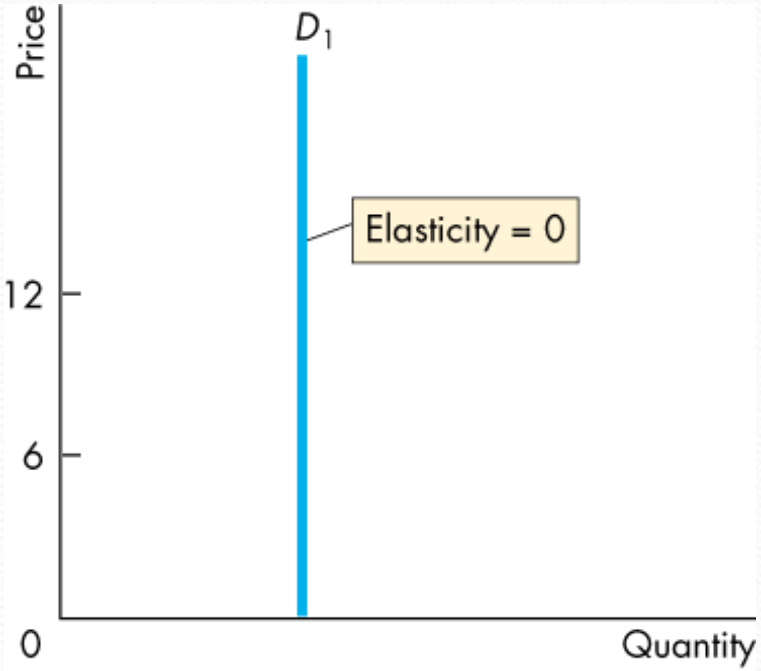
- **A Units-Free Measure**
- Elasticity is a ratio of percentages, so a change the units of measurement of price or quantity leaves the elasticity value the same.
- **Minus Sign and Elasticity**
- The formula yields a negative value, because price and quantity move in opposite directions.
- But it is the *magnitude*, or absolute value, that reveals how responsive the quantity change has been to a price change.

Price Elasticity of Demand

- Inelastic and Elastic Demand
  - Demand can be inelastic, unit elastic, or elastic, and can range from zero to infinity.
  - If the quantity demanded doesn't change when the price changes, the price elasticity of demand is zero and the good has a **perfectly inelastic demand**.

Price Elasticity of Demand

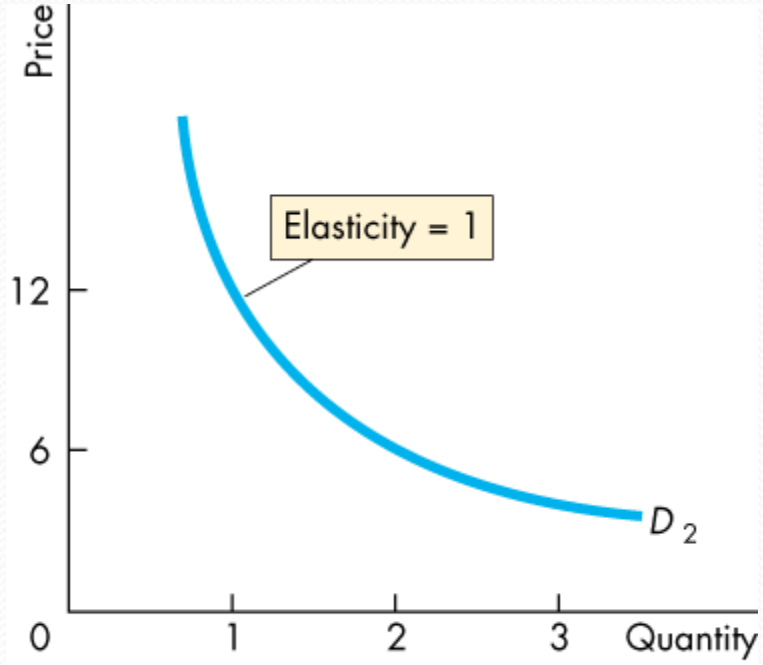
- Figure 4.3(a) illustrates the case of a good that has a perfectly inelastic demand.
- The demand curve is vertical.



(a) Perfectly inelastic demand

Price Elasticity of Demand

- If the percentage change in the quantity demanded equals the percentage change in price, the price elasticity of demand equals 1 and the good has **unit elastic demand.**
- Figure 4.3(b) illustrates this case.



(b) Unit elastic demand

Price Elasticity of Demand

- If the percentage change in the quantity demanded is *smaller* than the percentage change in price,

the price elasticity of demand is *less* than 1 and the good has **inelastic demand**.

- If the percentage change in the quantity demanded is *greater* than the percentage change in price,

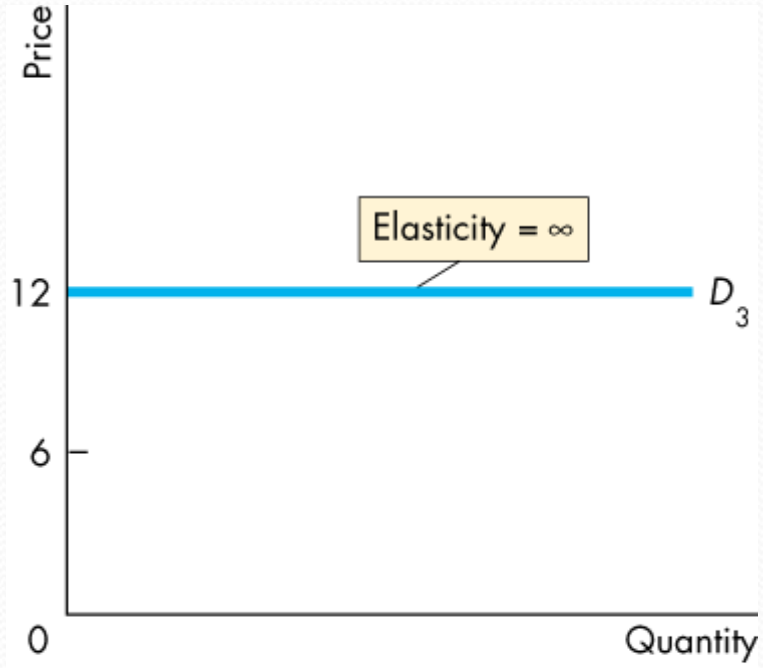
the price elasticity of demand is *greater* than 1 and the good has **elastic demand**.

Price Elasticity of Demand

- If the percentage change in the quantity demanded is infinitely large when the price barely changes, …

the price elasticity of demand is infinite and the good has a **perfectly elastic demand**.

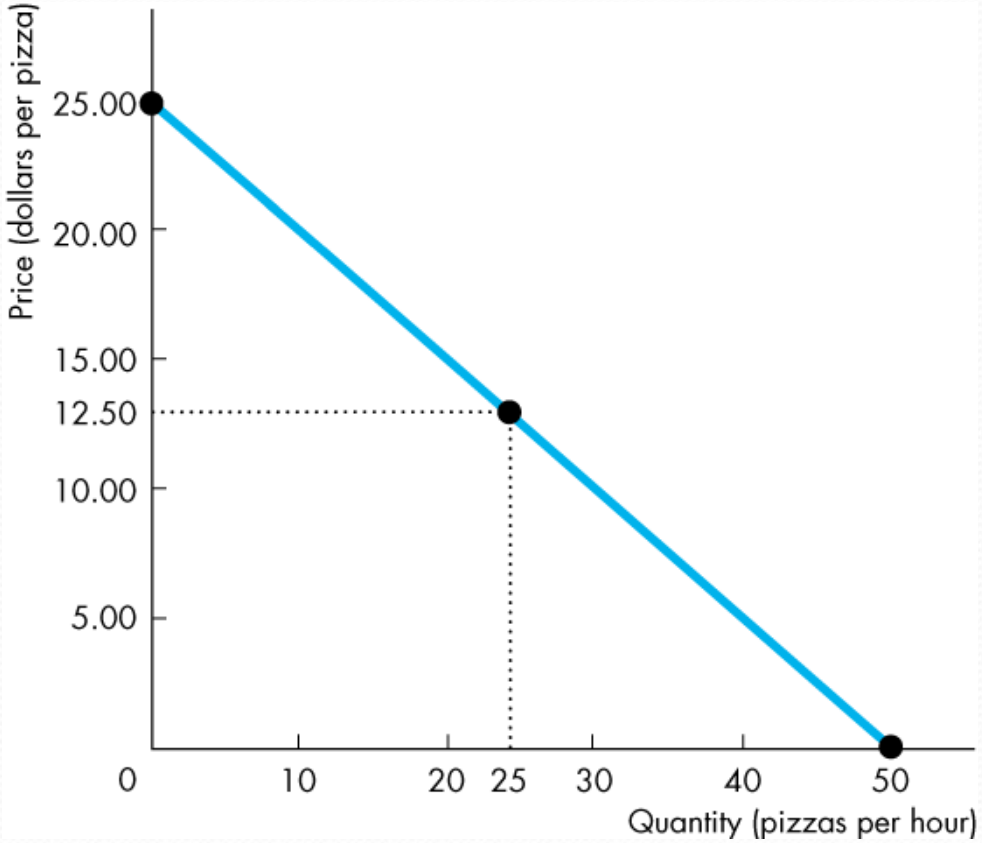
- Figure 4.3(c) illustrates the case of perfectly elastic demand—a horizontal demand curve.



(c) Perfectly elastic demand

Price Elasticity of Demand

- Elasticity Along a Linear Demand Curve
  - Figure 4.4 shows how the elasticity of demand changes along a linear demand curve.
  - At the mid-point of the demand curve, demand is unit elastic.

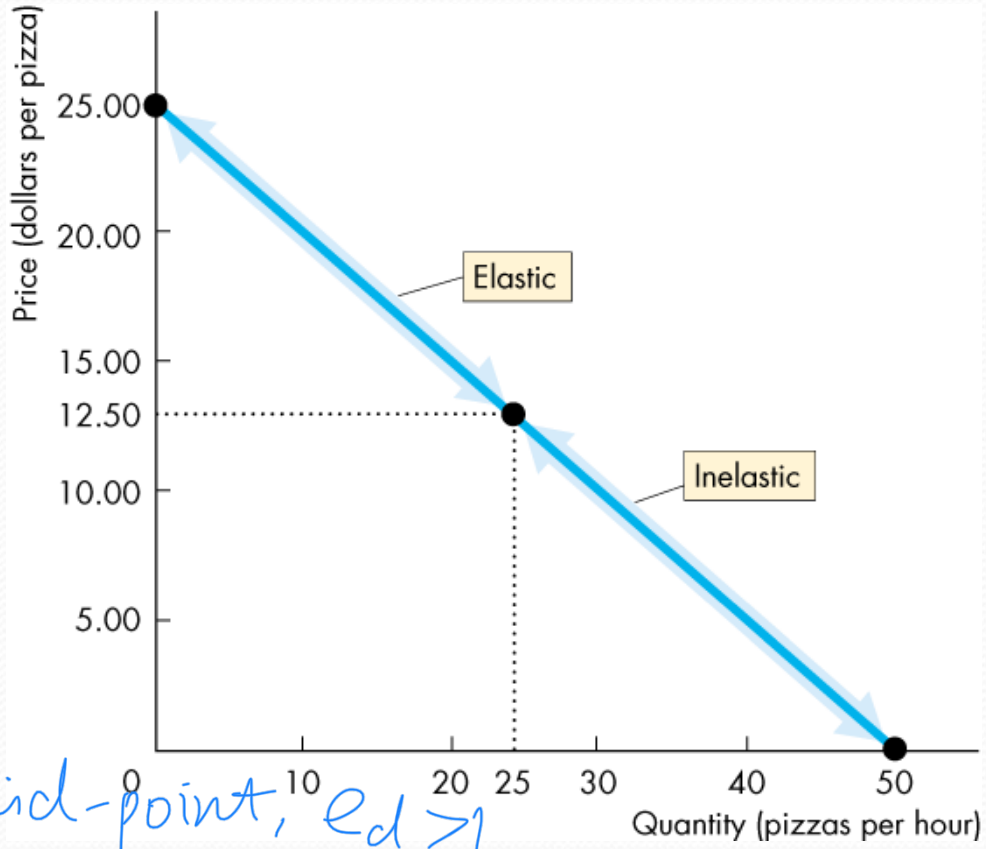


Price Elasticity of Demand

As we move down the demand curve by reducing price, ed falls

- At prices above the mid-point of the demand curve, demand is elastic.

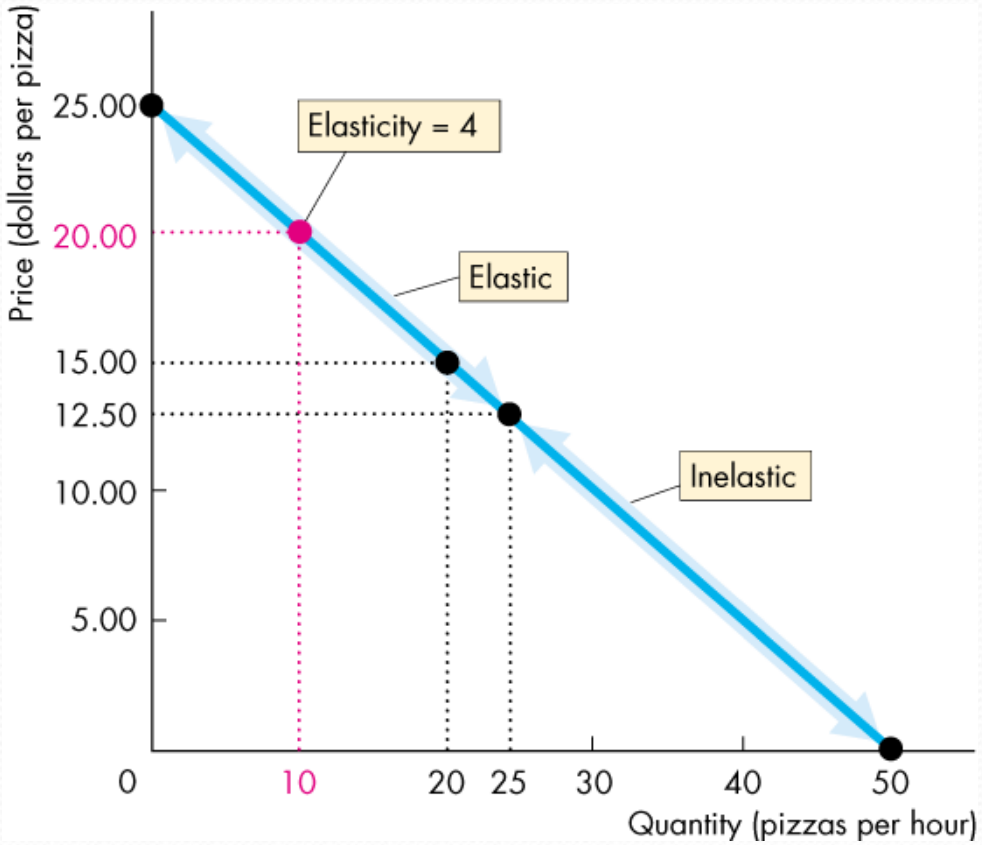
At prices below the mid-point of the demand curve, demand is inelastic.



For any point above the mid-point, $ed > 1$

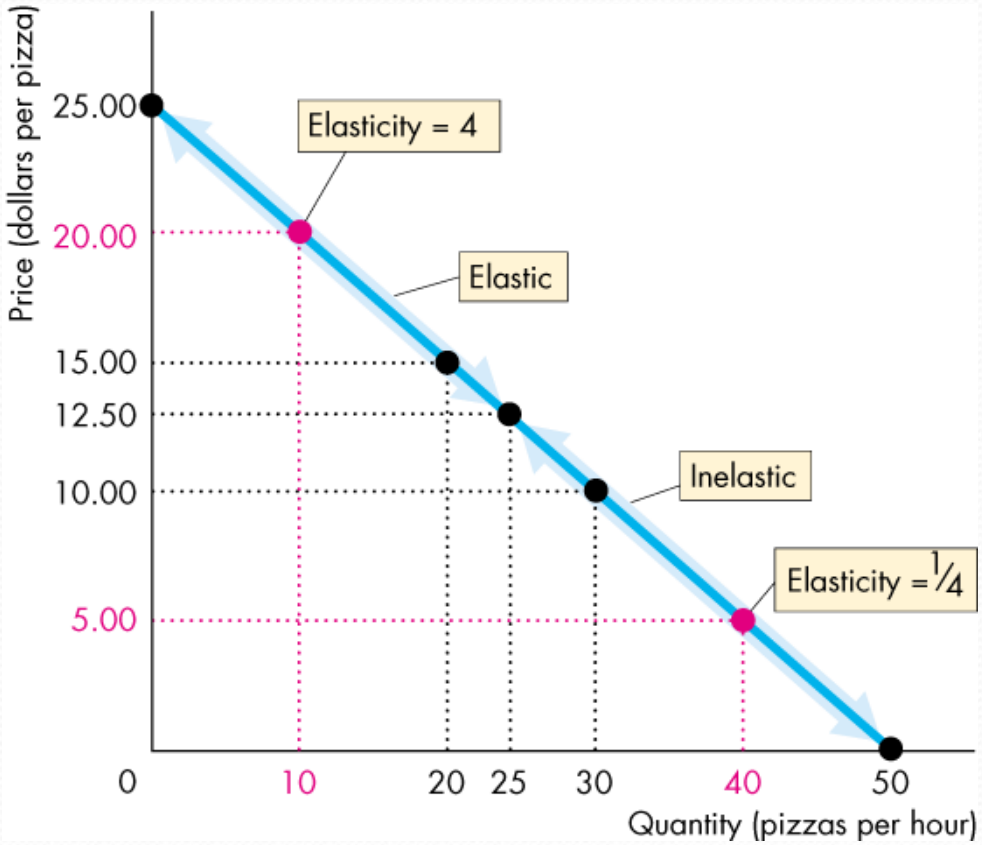
Price Elasticity of Demand

- For example, if the price falls from $25 to $15, the quantity demanded increases from 0 to 20 pizzas an hour.
- The average price is $20 and the average quantity is 10 pizzas.
- The price elasticity of demand is (20/10)/(10/20), which equals 4.



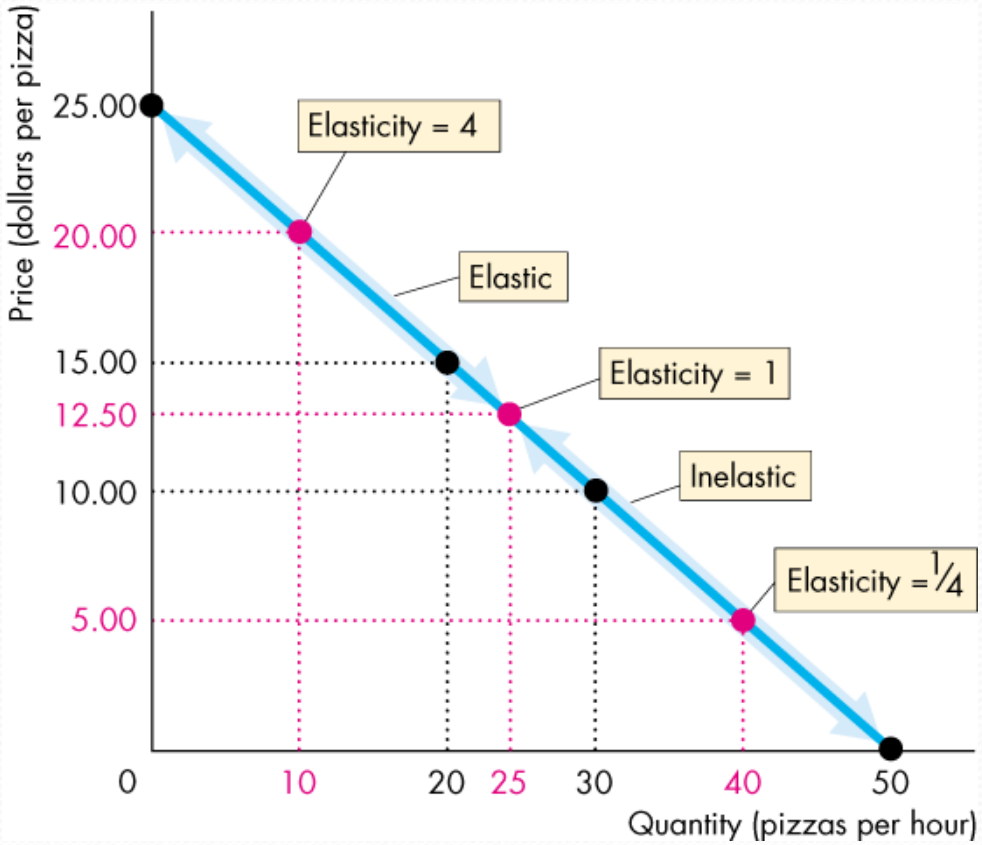
Price Elasticity of Demand

- If the price falls from $10 to $0, the quantity demanded increases from 30 to 50 pizzas an hour.
- The average price is $5 and the average quantity is 40 pizzas.
- The price elasticity is (20/40)/(10/5), which equals 1/4.



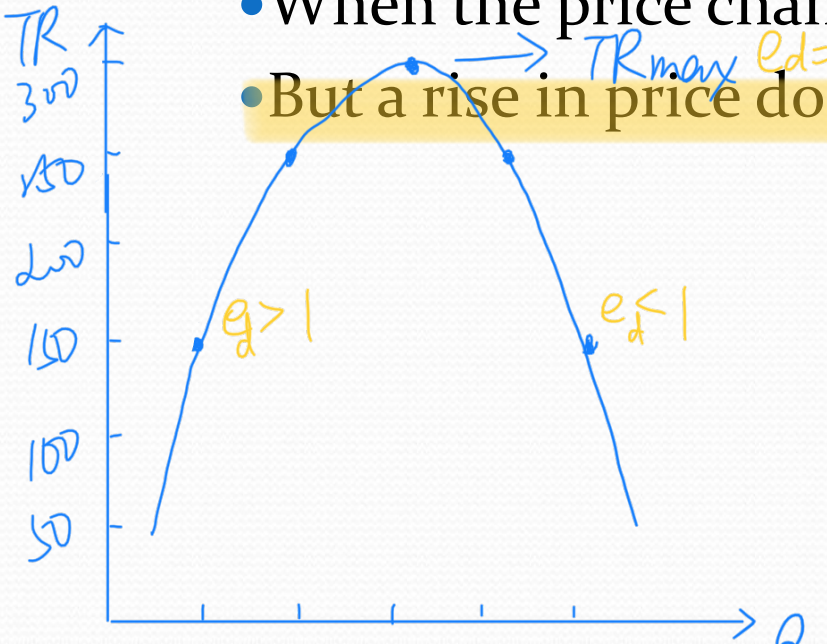
Price Elasticity of Demand

- If the price falls from $15 to $10, the quantity demanded increases from 20 to 30 pizzas an hour.
- The average price is $12.50 and the average quantity is 25 pizzas.
- The price elasticity is (10/25)/(5/12.5), which equals 1.



Price Elasticity of Demand

- Total Revenue and Elasticity
  - The **total revenue** from the sale of good or service equals the price of the good multiplied by the quantity sold. $TR = PQ$ (say $P = 2.5 \Rightarrow Q = 0 \Rightarrow TR = 0$)
  - When the price changes, total revenue also changes.
  - But a rise in price doesn't always increase total revenue.



$e > 1$, $P \downarrow$ $Q_d \uparrow$ but $TR \uparrow$

$e = 1$, $P \downarrow$ $Q_d \uparrow$ but TR = at max

$e < 1$, $P \downarrow$ $Q_d \uparrow$ but $TR \downarrow$

Price Elasticity of Demand

- The change in total revenue due to a change in price depends on the elasticity of demand:

- If demand is *elastic*, a 1 percent price cut increases the quantity sold by more than 1 percent, and total revenue increases.
- If demand is *inelastic*, a 1 percent price cut increases the quantity sold by less than 1 percent, and total revenues decreases.
- If demand is *unit elastic*, a 1 percent price cut increases the quantity sold by 1 percent, and total revenue remains unchanged.

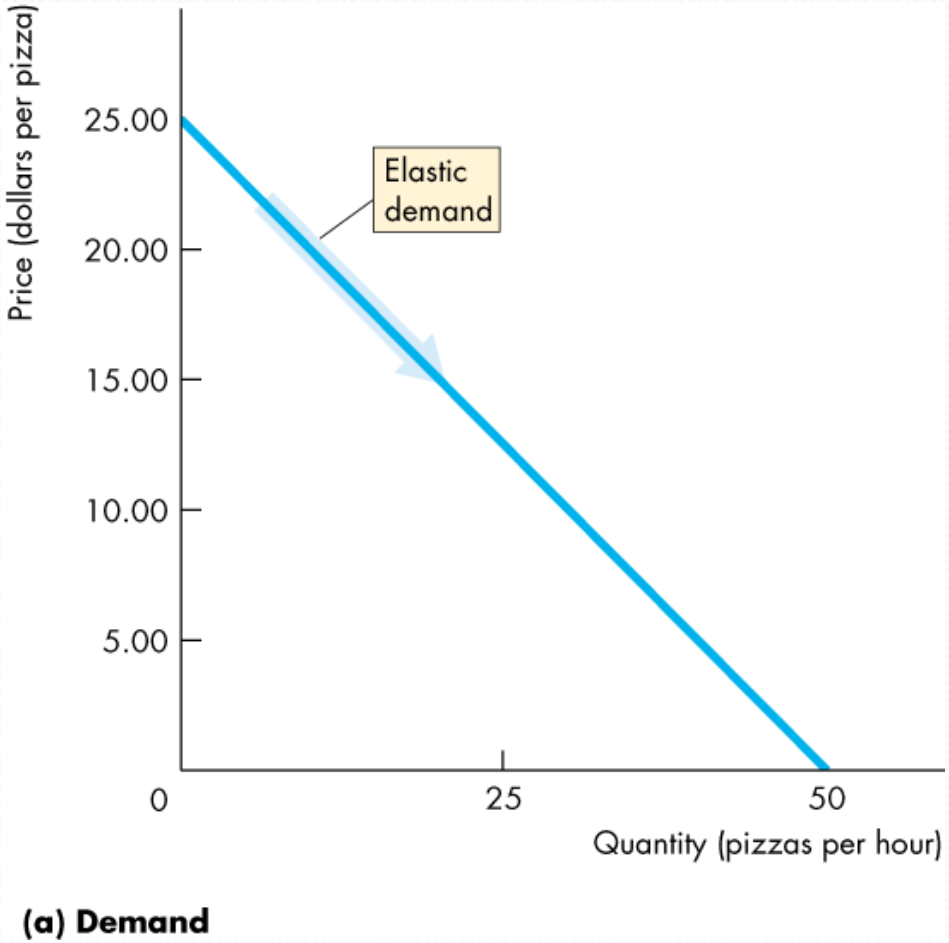
Price Elasticity of Demand

- The **total revenue test** is a method of estimating the price elasticity of demand by observing the change in total revenue that results from a price change (when all other influences on the quantity sold remain the same).

- If a price cut increases total revenue, demand is elastic.
- If a price cut decreases total revenue, demand is inelastic.
- If a price cut leaves total revenue unchanged, demand is unit elastic.

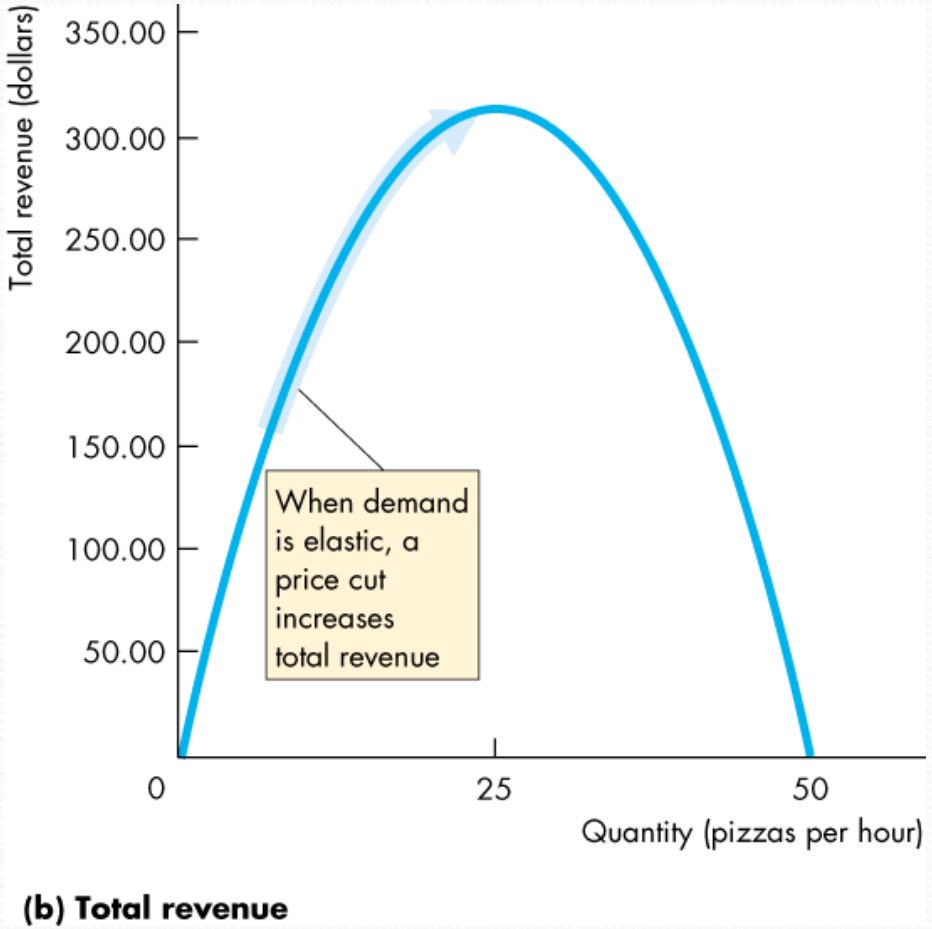
Price Elasticity of Demand

- Figure 4.5 shows the relationship between elasticity of demand and the total revenue.
- As the price falls from $25 to $12.50, the quantity demanded increases from 0 to 25 pizzas.
- Demand is elastic, and total revenue increases.



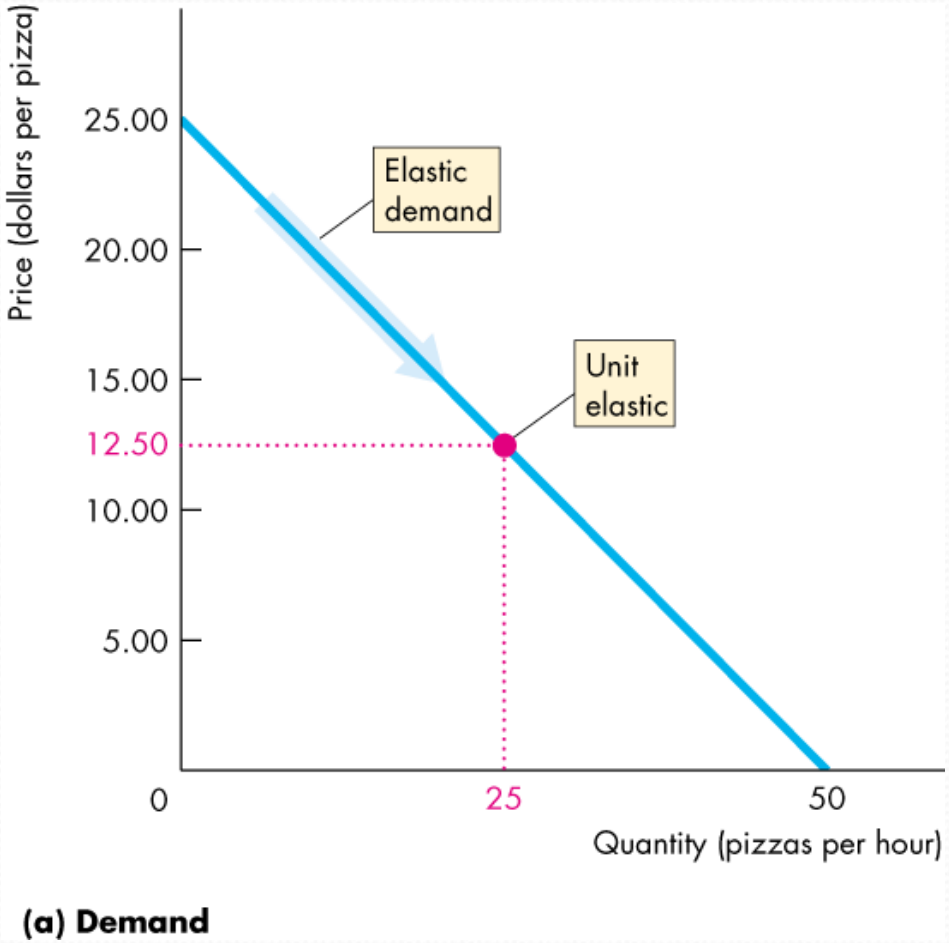
Price Elasticity of Demand

- In part (b), as the quantity increases from 0 to 25 pizzas, demand is elastic, and total revenue increases.



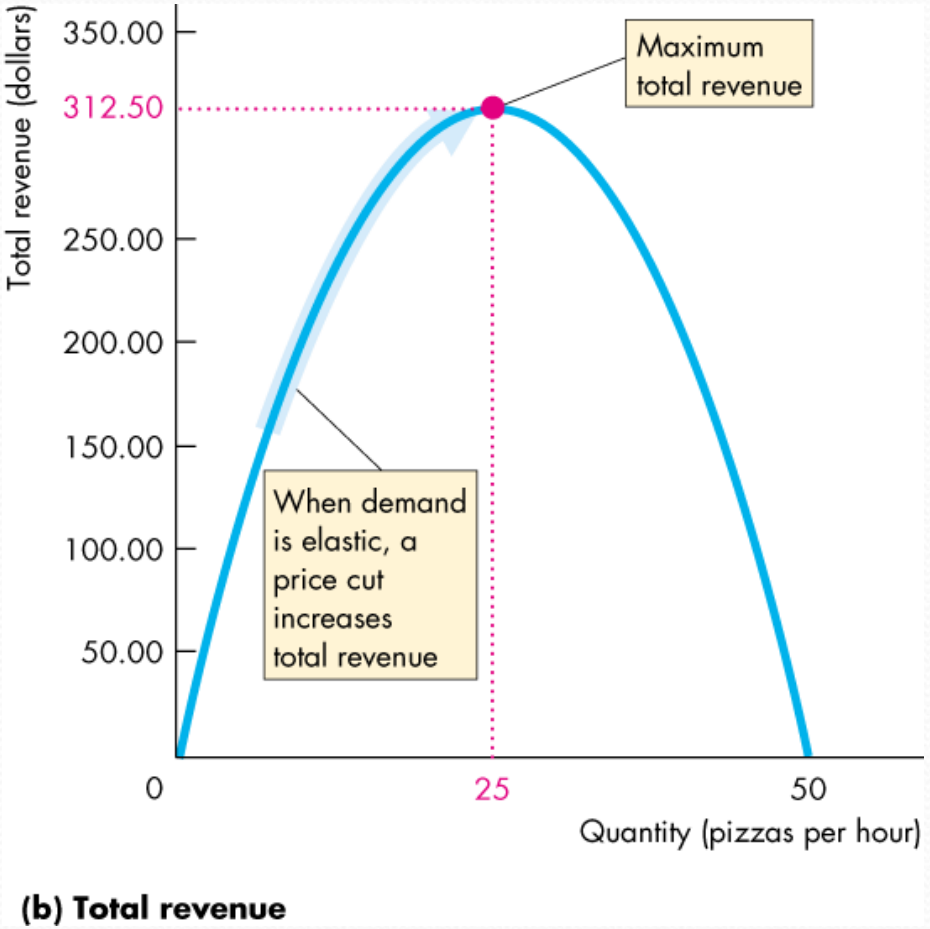
Price Elasticity of Demand

- At $12.50, demand is unit elastic and total revenue stops increasing.



Price Elasticity of Demand

- At 25, demand is unit elastic, and total revenue is at its maximum.

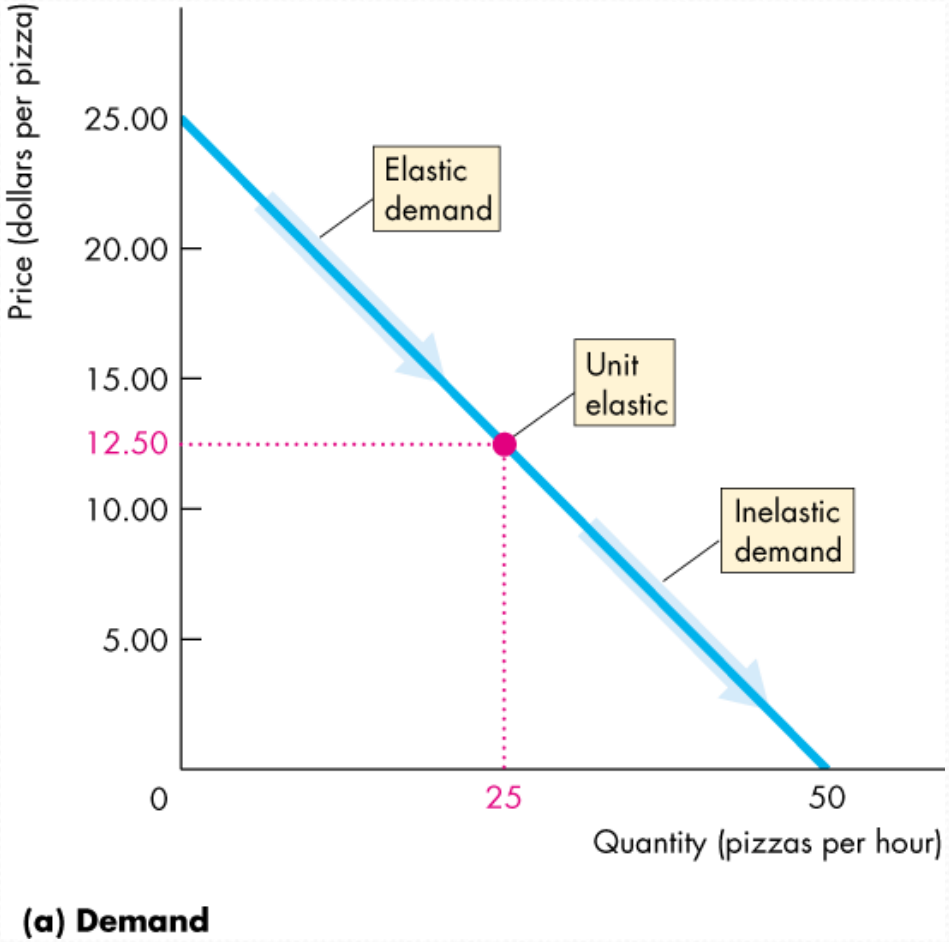


(b) Total revenue

Price Elasticity of Demand

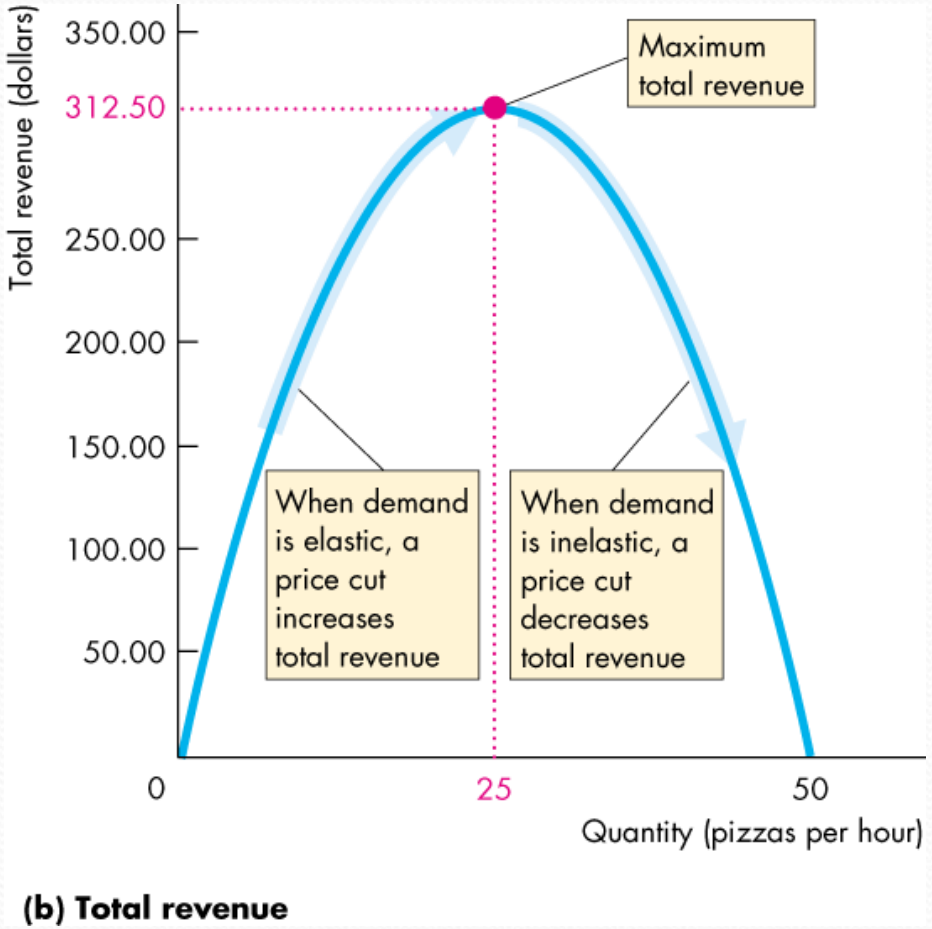
As the price falls from $12.50 to zero, the quantity demanded increases from 25 to 50 pizzas.

Demand is inelastic, and total revenue decreases.



Price Elasticity of Demand

As the quantity increases from 25 to 50 pizzas, demand is inelastic, and total revenue decreases.



(b) Total revenue

Price Elasticity of Demand

- Your Expenditure and Your Elasticity
  - If your demand is elastic, a 1 percent price cut increases the quantity you buy by more than 1 percent and your expenditure on the item *increases*.
  - If your demand is inelastic, a 1 percent price cut increases the quantity you buy by less than 1 percent and your expenditure on the item *decreases*.
  - If your demand is unit elastic, a 1 percent price cut increases the quantity you buy by 1 percent and your expenditure on the item *does not change*.

Price Elasticity of Demand

- The Factors That Influence the Elasticity of Demand
  - The elasticity of demand for a good depends on:
    - The closeness of substitutes
    - The proportion of income spent on the good
    - The time elapsed since a price change

Price Elasticity of Demand

- **Closeness of Substitutes**
- The closer the substitutes for a good or service, the more elastic are the demand for the good or service.
- Necessities, such as food or housing, generally have inelastic demand.
- Luxuries, such as exotic vacations, generally have elastic demand.

Price Elasticity of Demand

- **Proportion of Income Spent on the Good**
- The greater the proportion of income consumers spend on a good, the larger is the elasticity of demand for that good.
- **Time Elapsed Since Price Change**
- The more time consumers have to adjust to a price change, or the longer that a good can be stored without losing its value, the more elastic is the demand for that good.

More Elasticities of Demand

- Cross Elasticity of Demand
  - The **cross elasticity of demand** is a measure of the responsiveness of demand for a good to a change in the price of a *substitute* or a *complement*, other things remaining the same.
  - The formula for calculating the cross elasticity is:

$$\frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price of substitute or complement}}$$

More Elasticities of Demand

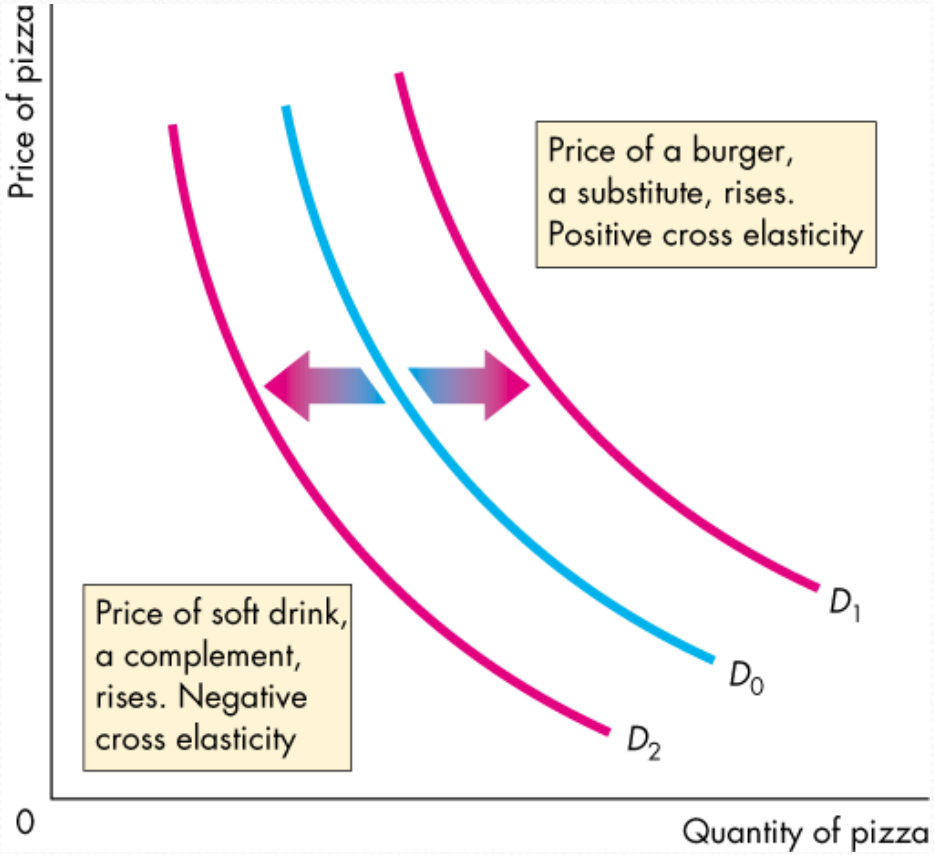
- The cross elasticity of demand for
- a *substitute* is positive.
- a *complement* is negative.

$\frac{Q_d}{P_{substitute/alternative}}$ is positive. | $\frac{\% \Delta Q_d}{\% \Delta P_{complement}}$ is negative.

More Elasticities of Demand

- Figure 4.6 shows the increase in the quantity of pizza demanded when the price of burger (a substitute for pizza) rises.

The figure also shows the decrease in the quantity of pizza demanded when the price of a soft drink (a complement of pizza) rises.



More Elasticities of Demand

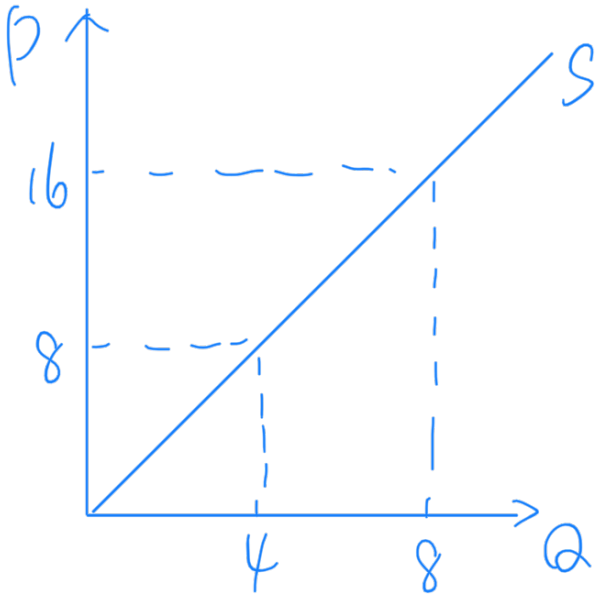
- Income Elasticity of Demand
  - The **income elasticity of demand** measures how the quantity demanded of a good responds to a change in income, other things remaining the same.
  - The formula for calculating the income elasticity of demand is:

$$\frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

More Elasticities of Demand

- If the income elasticity of demand is greater than 1, demand is *income elastic* and the good is a *normal good*.
- If the income elasticity of demand is greater than zero but less than 1, demand is *income inelastic* and the good is a *normal good*.
- If the income elasticity of demand is less than zero (negative) the good is an *inferior good*.

Neither elastic / inelastic
bcs if your income increases your demand will fall
eg.: if you can afford a car, you're less likely to take a subway



$P_1 = 8 \Rightarrow Q_1 = 4$

$P_2 = 16 \Rightarrow Q_2 = 8$

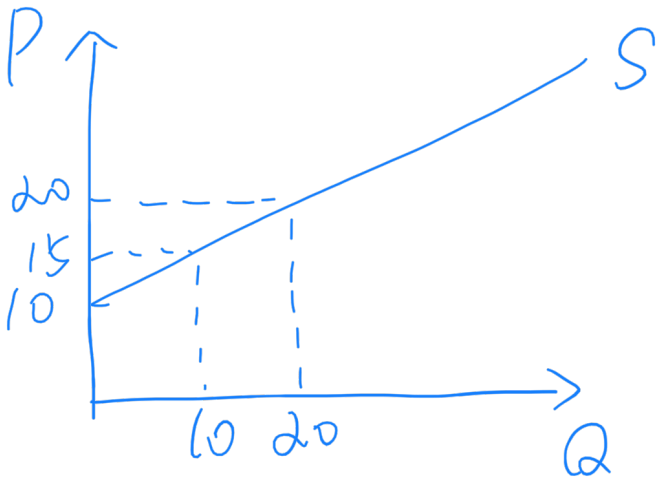
$$e_s = \frac{\%\,\Delta Q_s}{\%\,\Delta P} = \frac{\frac{\Delta Q_s}{Q_{av}} \times 100\%}{\frac{\Delta P}{P_{av}} \times 100} = \frac{\frac{8-4}{(8+4)/2}}{\frac{16-8}{(16+8)/2}} = \frac{4}{6} \times \frac{12}{8} = 1$$

perfectly inelastic supply:

situational $e_s = 0$

perfectly elastic supply

$e_s = \infty$



$P_1 = 15$, $Q_1 = 10$

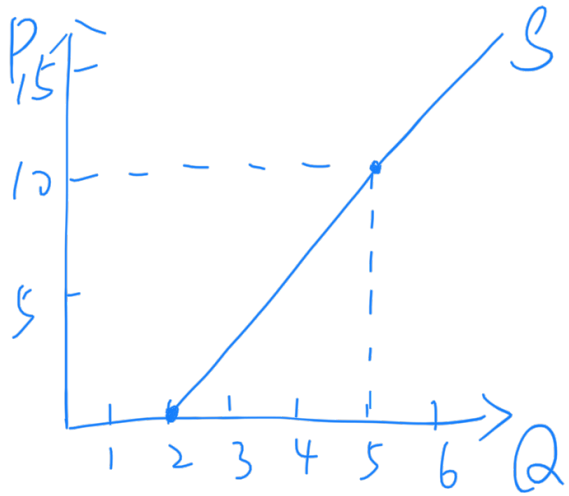
$P_2 = 20$, $Q_2 = 20$

$\Delta P = 20 - 15 = 5$, $P_{av} = 17.5$

$\Delta Q = 20 - 10 = 10$, $Q_{av} = 15$

$$e_s = \frac{\frac{10}{15}}{\frac{5}{17.5}} = \frac{10}{15} \times \frac{17.5}{5} = \frac{35}{15} = \frac{7}{3} > 1$$

it is elastic



$P_1 = 10 \Rightarrow Q_1 = 5$

$P_2 = 15 \Rightarrow Q_2 = 6$

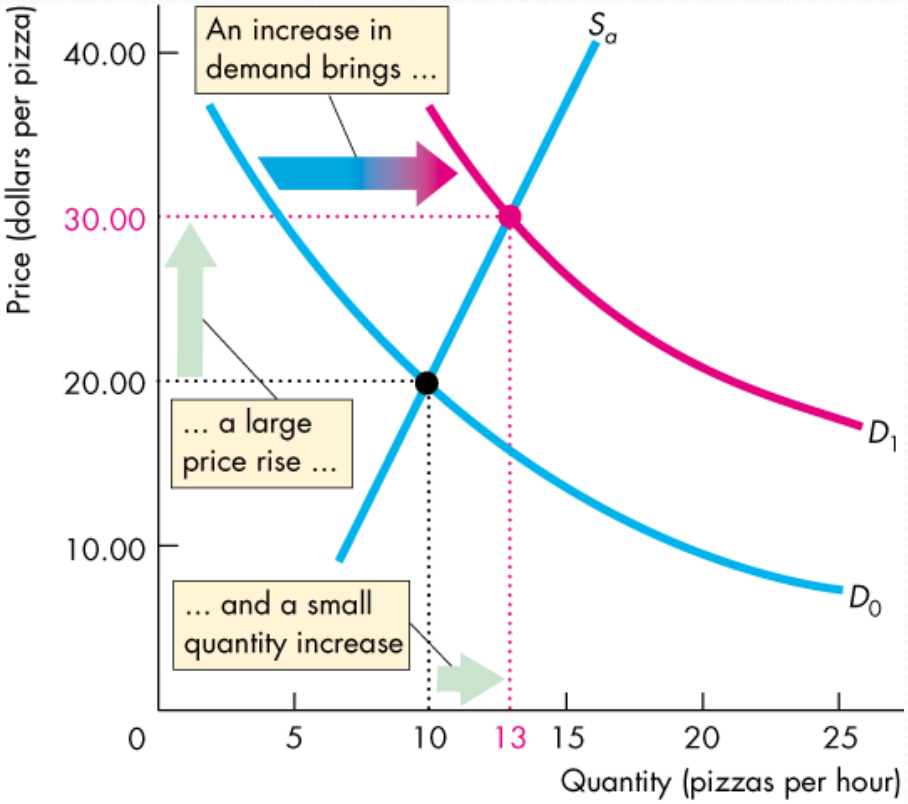
$$e_s = \frac{\frac{6-5}{(6+5)/2}}{\frac{15-10}{(15+10)/2}} = \frac{\frac{1}{5.5}}{\frac{5}{12.5}} = \frac{12.5}{27.5} < 1$$

It is inelastic

⚠ Demand is unit elastic when a change in price does not change total revenue

Elasticity of Supply

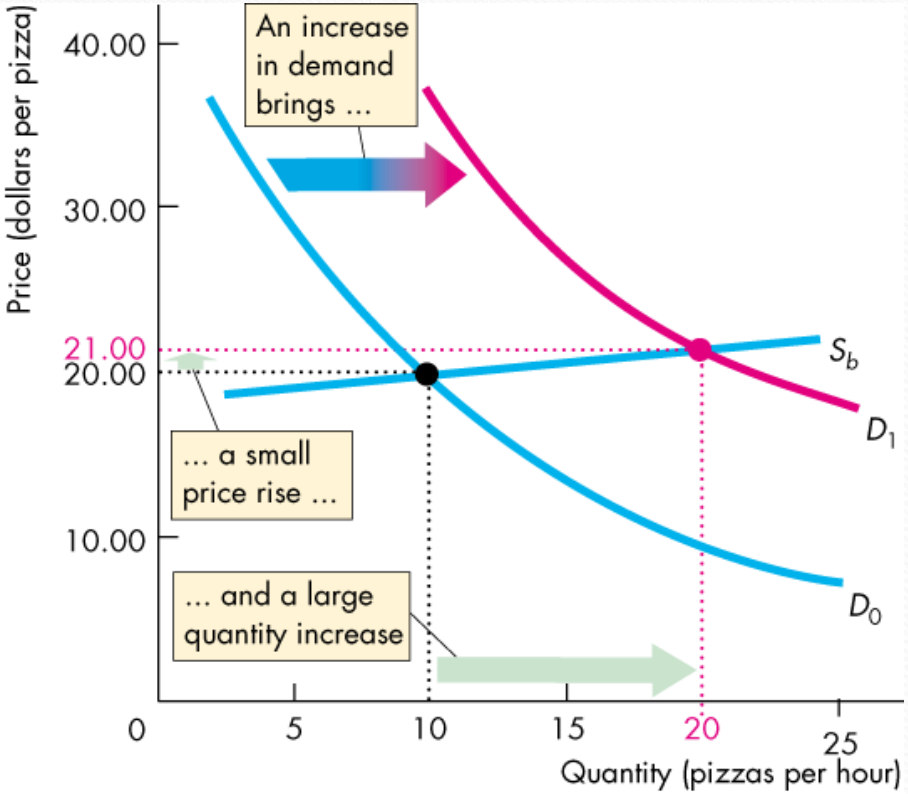
- When demand increases, is the change in the quantity supplied small or large?
- In Figure 4.7(a), an increase in demand brings
  - A large rise in price
  - A small increase in the quantity supplied



(a) Large price change and small quantity change

Elasticity of Supply

- In Figure 4.7(b), an increase in demand brings
  - A small rise in price
  - A large increase in the quantity supplied



(b) Small price change and large quantity change

Elasticity of Supply

- The contrast between the two outcomes in Figure 4.7 highlights the need for
  - A measure of the responsiveness of the quantity supplied to a price change.
- The **elasticity of supply** measures the responsiveness of the quantity supplied to a change in the price of a good when all other influences on selling plans remain the same.

Elasticity of Supply

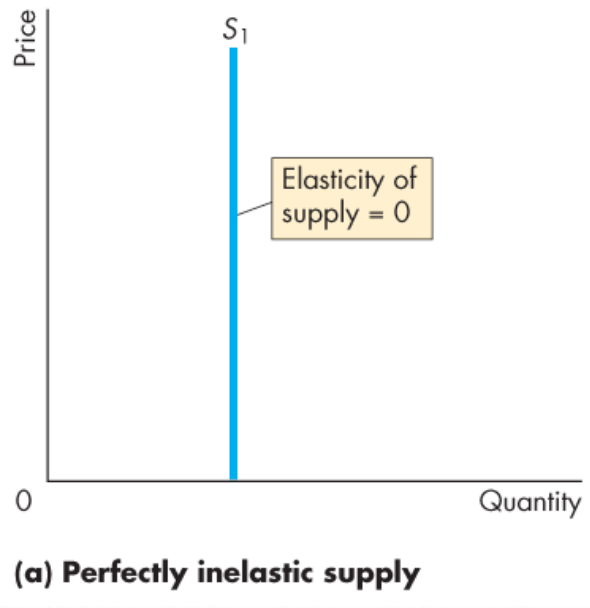
- **Calculating the Elasticity of Supply**
- The elasticity of supply is calculated by using the formula:

$$\frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

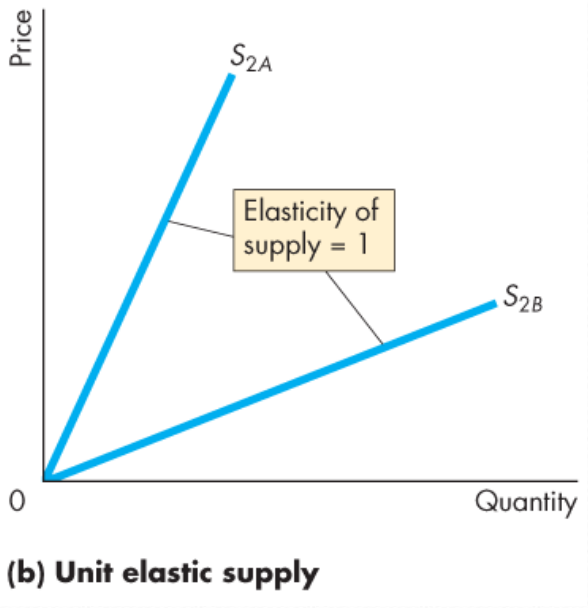
Elasticity of Supply

- Figure 4.8 on the next slide shows three cases of the elasticity of supply.
- Supply is *perfectly inelastic* if the supply curve is vertical and the elasticity of supply is 0.
- Supply is *unit elastic* if the supply curve is linear and passes through the origin. (Note that slope is irrelevant.)
- Supply is *perfectly elastic* if the supply curve is horizontal and the elasticity of supply is infinite.

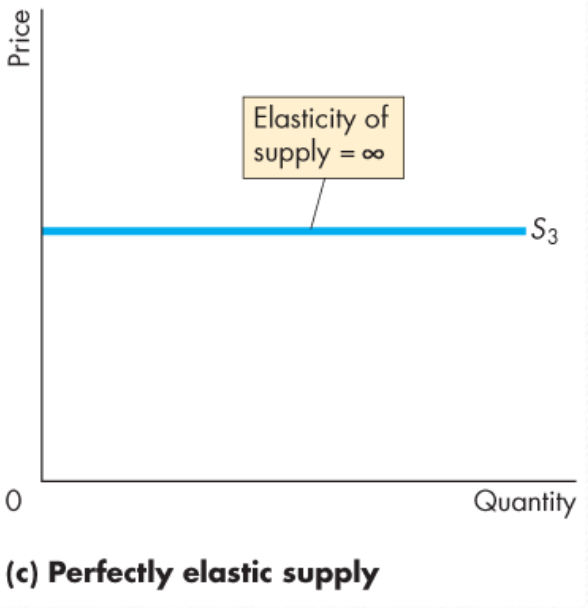
Elasticity of Supply



(a) Perfectly inelastic supply



(b) Unit elastic supply



(c) Perfectly elastic supply

Elasticity of Supply

- The Factors That Influence the Elasticity of Supply
  - The elasticity of supply depends on
    - Resource substitution possibilities
    - Time frame for supply decision
  - **Resource Substitution Possibilities**
  - The easier it is to substitute among the resources used to produce a good or service, the greater is its elasticity of supply.

Elasticity of Supply

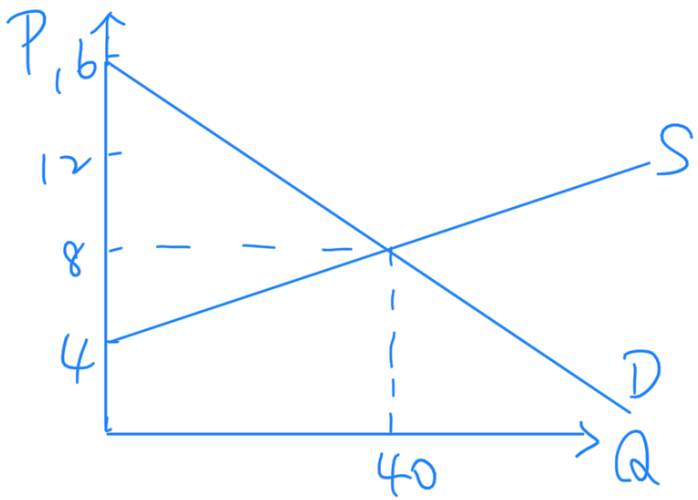
- **Time Frame for Supply Decision**
- The more time that passes after a price change, the greater is the elasticity of supply.
- *Momentary supply* is perfectly inelastic. The quantity supplied immediately following a price change is constant.

Say $D: P = 16 - 0.2Q \Rightarrow Q = 80 - 5P$

$S: P = 4 + 0.1Q \Rightarrow Q = 10P - 40$

At equelibrium, $e_d = ?$, $e_s = ?$

eqm : $16 - 0.2Q = 4 + 0.1Q \Rightarrow Q = 40 \Rightarrow P = 8$



the equilibrium is not neeessary to be at the midpoint

At $P = 8$, $e_d = ?$

At $P = 8$, e_d means e_d when $P_{av} = 8$

Any two prices can be taken here a.l.a. $P_{av} = 8$

$P_1^d = 12 \Rightarrow Q_1^d = 20$

$P_2^d = 4 \Rightarrow Q_1^d = 60$

$$e_d = \frac{\frac{\Delta Q^d}{Q_{av}^d}}{\frac{\Delta P^d}{P_{av}^d}} = \frac{\frac{60-20}{(60+20)/2}}{\frac{12-4}{(12+4)/2}} = \frac{40}{40} \times \frac{8}{8} = 1$$

At $P=8$, $e_s = ?$

$P_1 = 6, \Rightarrow Q_1^s = 20$

$P_2 = 10 \Rightarrow Q_2^s = 60$

$\Delta P = 10 - 6 = 4, \quad P_{av} = \frac{10+6}{2} = 8$

$\Delta Q = 60 - 20 = 40, \quad Q_{av} = \frac{20+60}{2} = 40$

$$e_s = \frac{\frac{40}{40}}{\frac{4}{8}} = 2$$

$e_s > e_d$

So At equilibrium, supply is more elastic.

At which point, total revenue would be maximum?

At $p=8$ (midpoint)