



Presentation to accompany

# **Principles of Microeconomics, Fourth Edition**

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## **Lecture 4**

# Previously...

- Supply and Demand
- Determinants of supply
- Determinants of demand
- Changes in demand and supply
- Equilibrium
  - Price and Quantity

# Today...

- Elasticity
- Applications and exercises

# Today...

- Elasticity
  - allows us to analyze supply and demand with greater precision
  - is a measure of how much buyers and sellers respond to changes in market conditions
  - Quantitative analysis (vs. qualitative)

# Practical Concept

- Why do airlines charge different prices to students and business?
- Why do hotels or car rental companies offer discounts for weekends?
- Why does an increase in taxes on cigarettes decrease smoking of teenagers but not adults?

# Price Elasticity of Demand

**Price elasticity of demand** is a measure of how much the quantity demanded of a good responds to a change in the price of that good

Price elasticity of demand is the percentage change in quantity demanded given a percent change in the price

# Price Elasticity of Demand

Price elasticity – ratio of two changes

Price elasticity of demand =  
percentage change in quantity demanded  
percentage change in price

= 20% change in Q / 10% change in P = 2

# Price Elasticity of Demand

## Price elasticity – range

- Price elasticity of demand is negative number (increase in P leads to decrease in Q)
- Use about absolute value – positive number
- Range **[0, infinity)**



# Price Elasticity of Demand

## Price elasticity – range

Elasticity	
0	Perfectly inelastic
(0,1)	Inelastic
1	Unit elasticity
(1,∞)	Elastic
∞	Perfectly elastic

# Price Elasticity of Demand

- **Inelastic & perfectly inelastic demand**
  - Small or no response of Q to change in P
  - Elasticity –  $[0, 1)$
  - Necessities = necessary goods  
(food, clothing, ...)
- **Unit elasticity – one to one change**
  - Quantity demanded changes by the same percentage as the price

# Price Elasticity of Demand

- **Elastic demand**
  - Larger responsiveness to changes in P
  - Elasticity (**1, infinity**)
  - **Luxuries** = goods with higher price elasticity, not necessary for existence
- **Perfectly elastic demand**
  - Elasticity = infinity
  - Infinite change in Q in response to any change in P

# Elasticity - Determinants

- **Availability of close substitutes**
  - Elasticity is higher if there are close substitutes  
(Butter/margarine, Coca-cola/Pepsi-cola, Coat/Jacket)
  - Elasticity is smaller if there are no close substitutes
- **Degree of necessity of the good**

# Elasticity - Determinants

- **Definition of the market**

- Elasticity is higher with narrowly defined markets  
Coat/jacket vs. winter clothing vs. clothing  
Chocolate bar with nuts vs. chocolate vs. desserts vs. food

- **Time horizon**

- Elasticity is higher with longer time horizon  
Gasoline prices – today/tomorrow vs. next year vs. decade

# Elasticity - Mathematics

$$E = \frac{\Delta Q / Q}{\Delta P / P} = \frac{(Q_2 - Q_1) / Q_1}{(P_2 - P_1) / P_1}$$

Problem: elasticity between A & B

$$\text{A: } P = 4 \quad Q = 120$$

$$\text{B: } P = 6 \quad Q = 80$$

Going from A->B & going from B->A - direction of change

$$E(\text{A}) = 2/3 \neq E(\text{B}) = 1.5$$

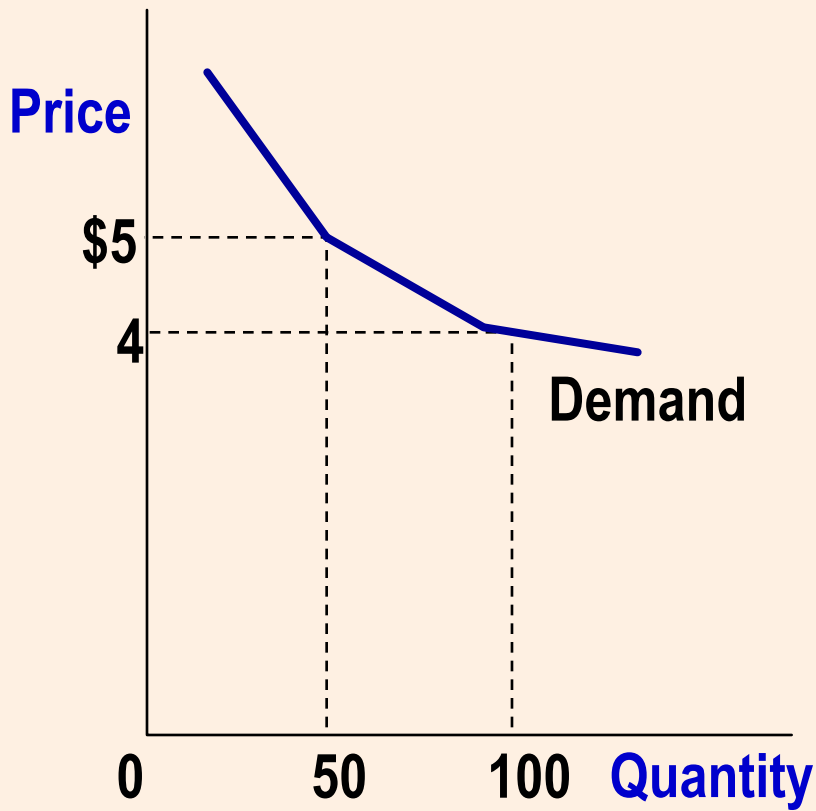
# Elasticity - Mathematics

Avoiding the problem  $E(A) \neq E(B)$

Compute the elasticity in the midpoint between A & B, where:  $P = 5$ ,  $Q = 100$

$$\begin{aligned} E &= \frac{\Delta Q / Q}{\Delta P / P} = \frac{(Q_2 - Q_1) / (Q_1 + Q_2) / 2}{(P_2 - P_1) / (P_1 + P_2) / 2} = \\ &= \frac{(Q_2 - Q_1) / (Q_1 + Q_2)}{(P_2 - P_1) / (P_1 + P_2)} \end{aligned}$$

# Elasticity - Mathematics



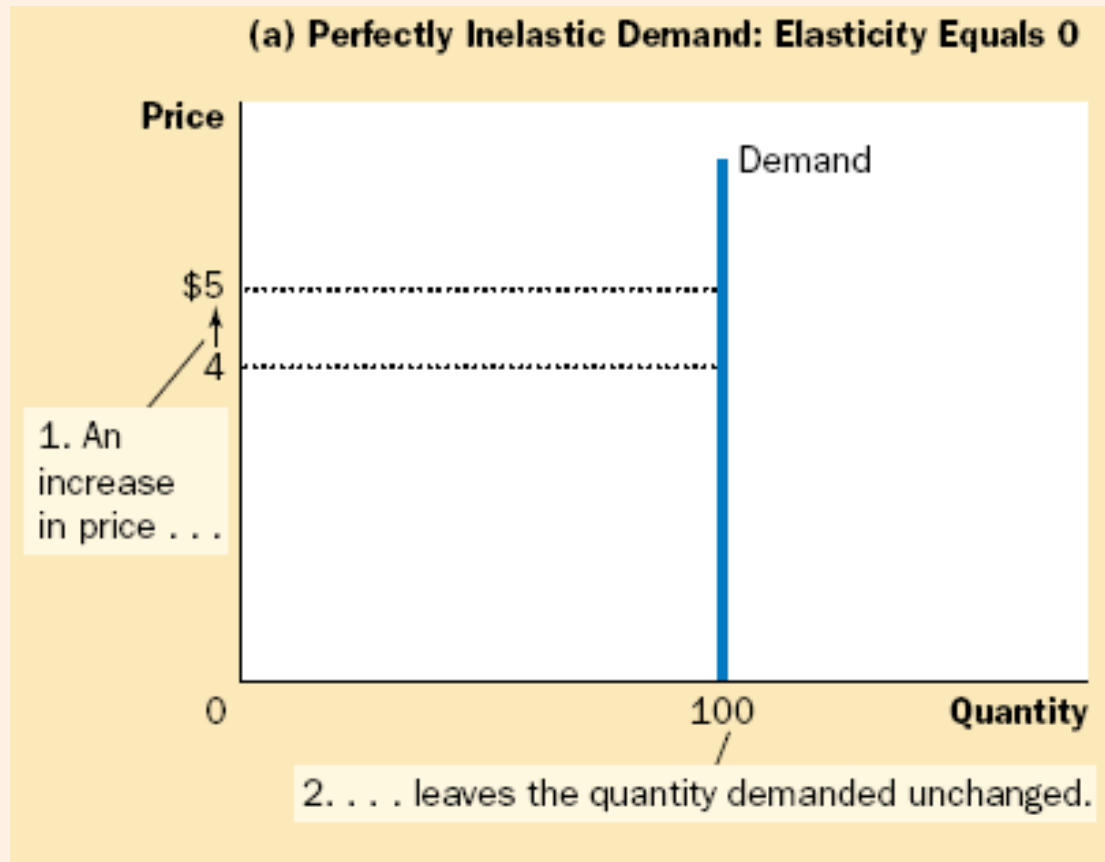
$$E_D = \frac{(100 - 50) / (100 + 50) / 2}{(4.00 - 5.00) / (4.00 + 5.00) / 2} = \frac{67 \text{ percent}}{-22 \text{ percent}} = -3$$



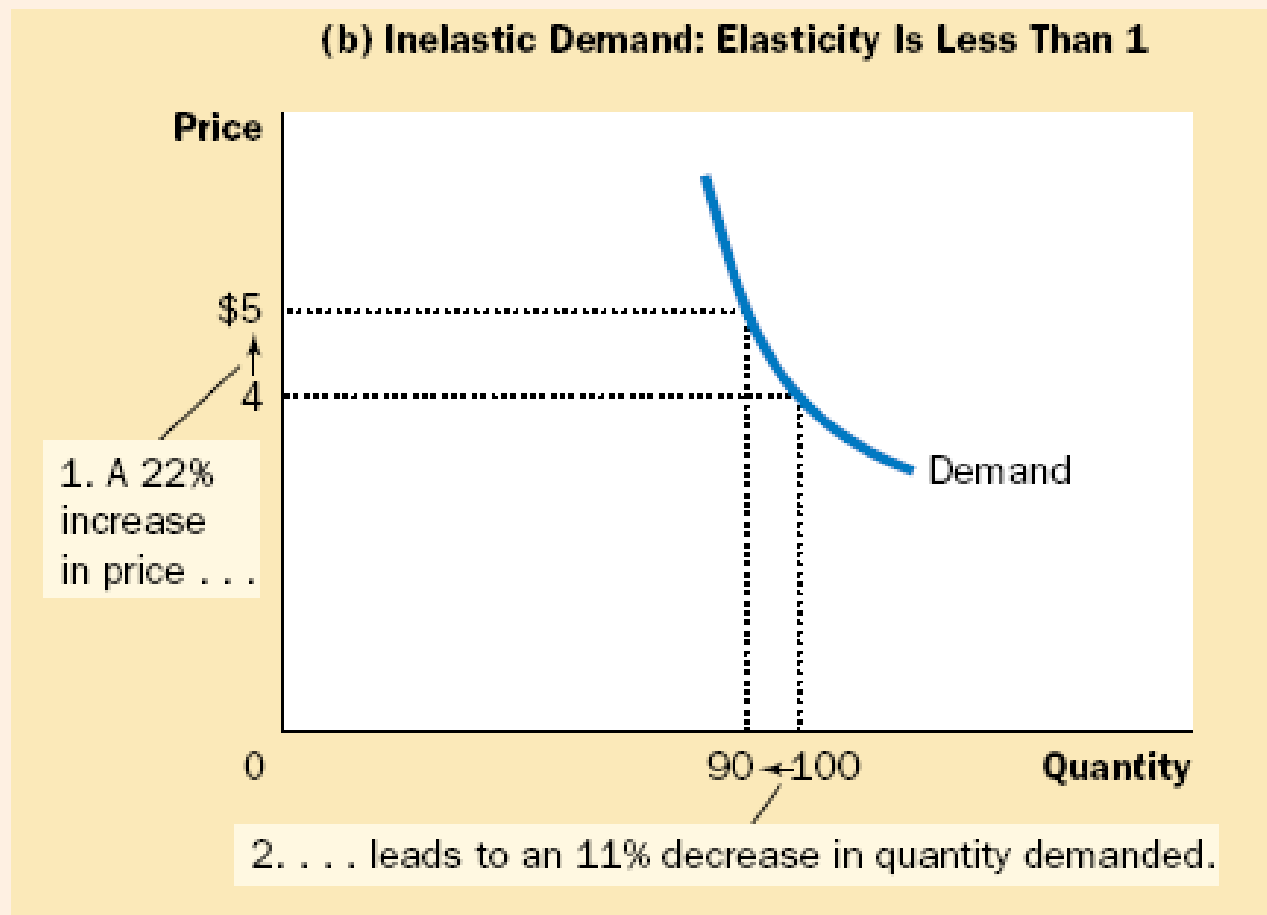
# Demand Elasticity

- Because the price elasticity of demand measures how much quantity demanded responds to the price, it is closely related to the slope of the demand curve

# (a) Perfectly inelastic demand; $E=0$

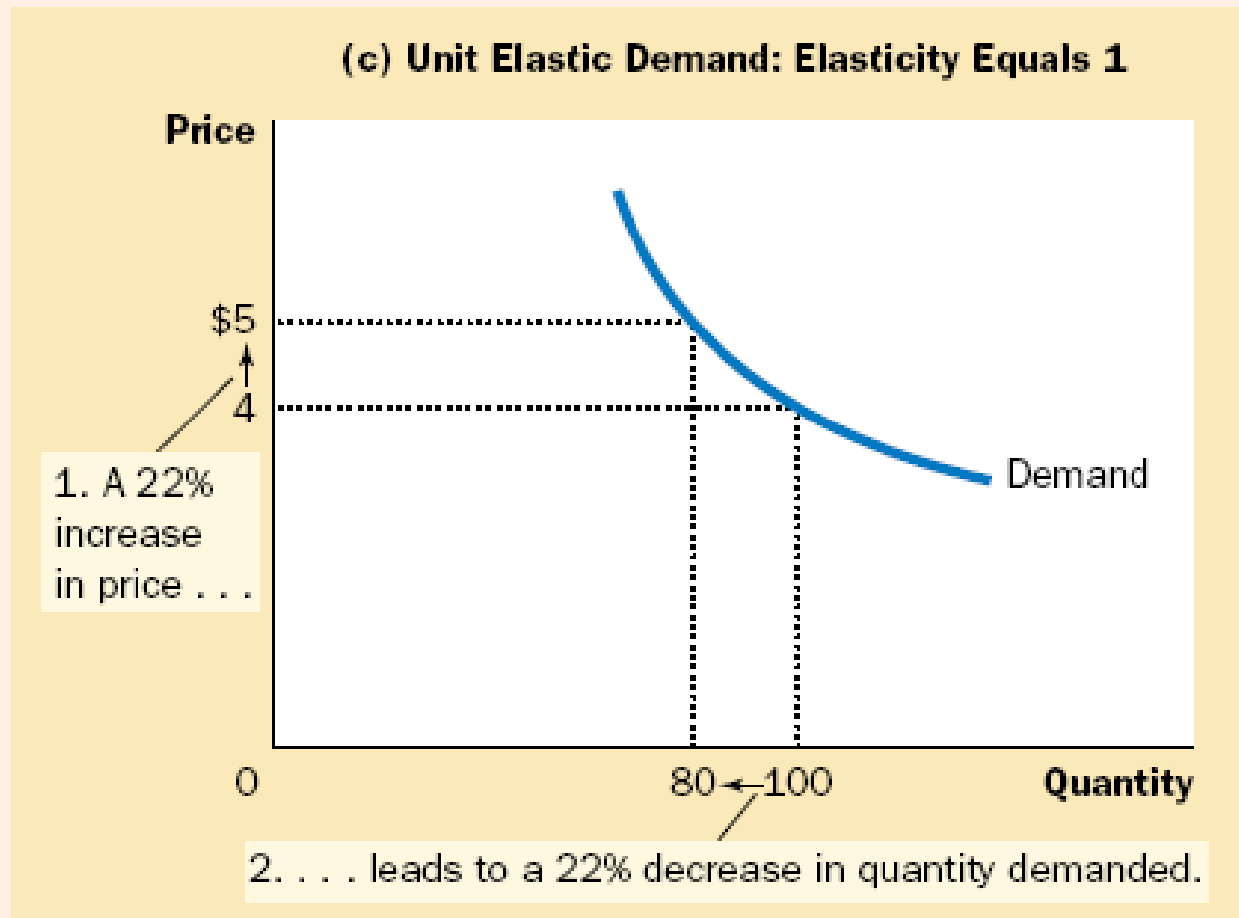


## (b) Inelastic demand; $E < 1$



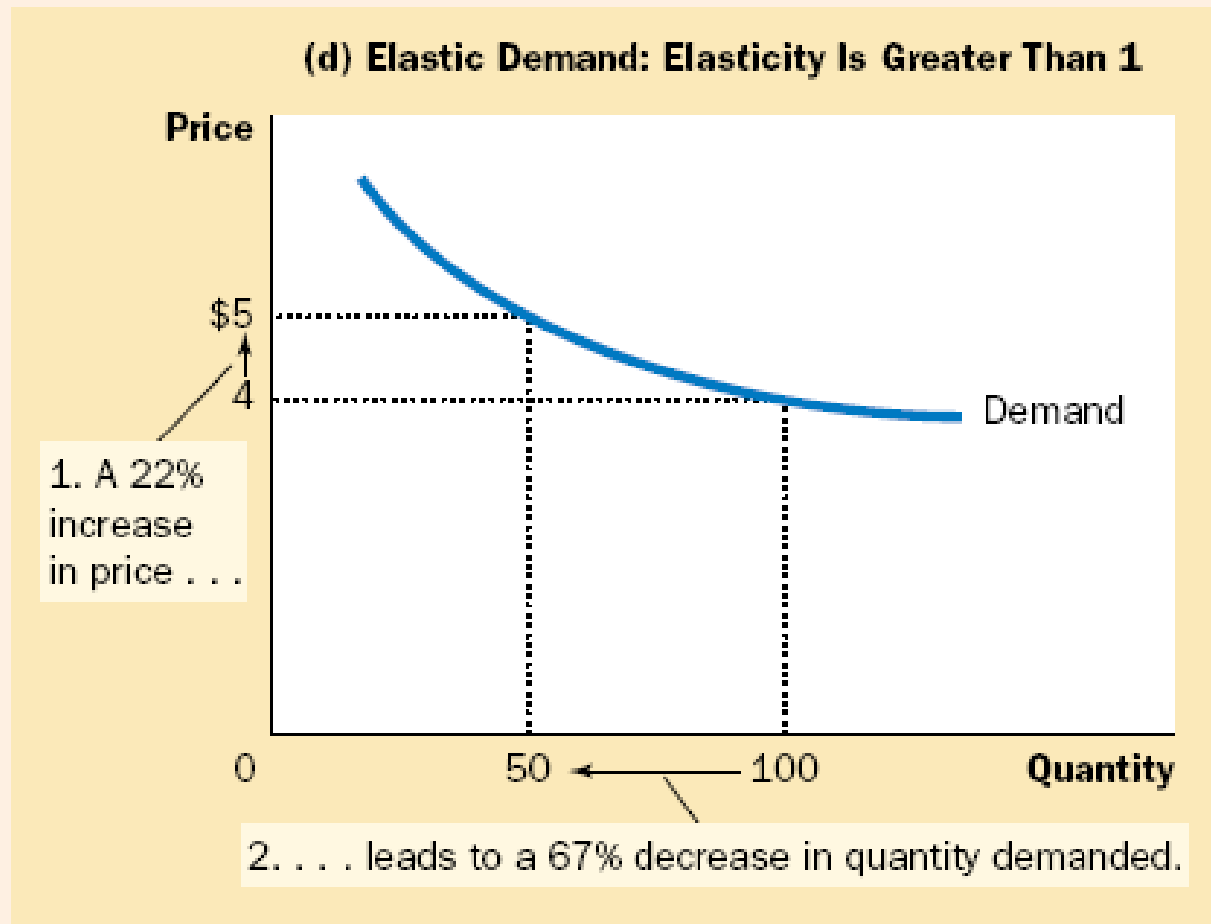
# Demand Elasticity

## (c) Unit elastic demand; $E=1$



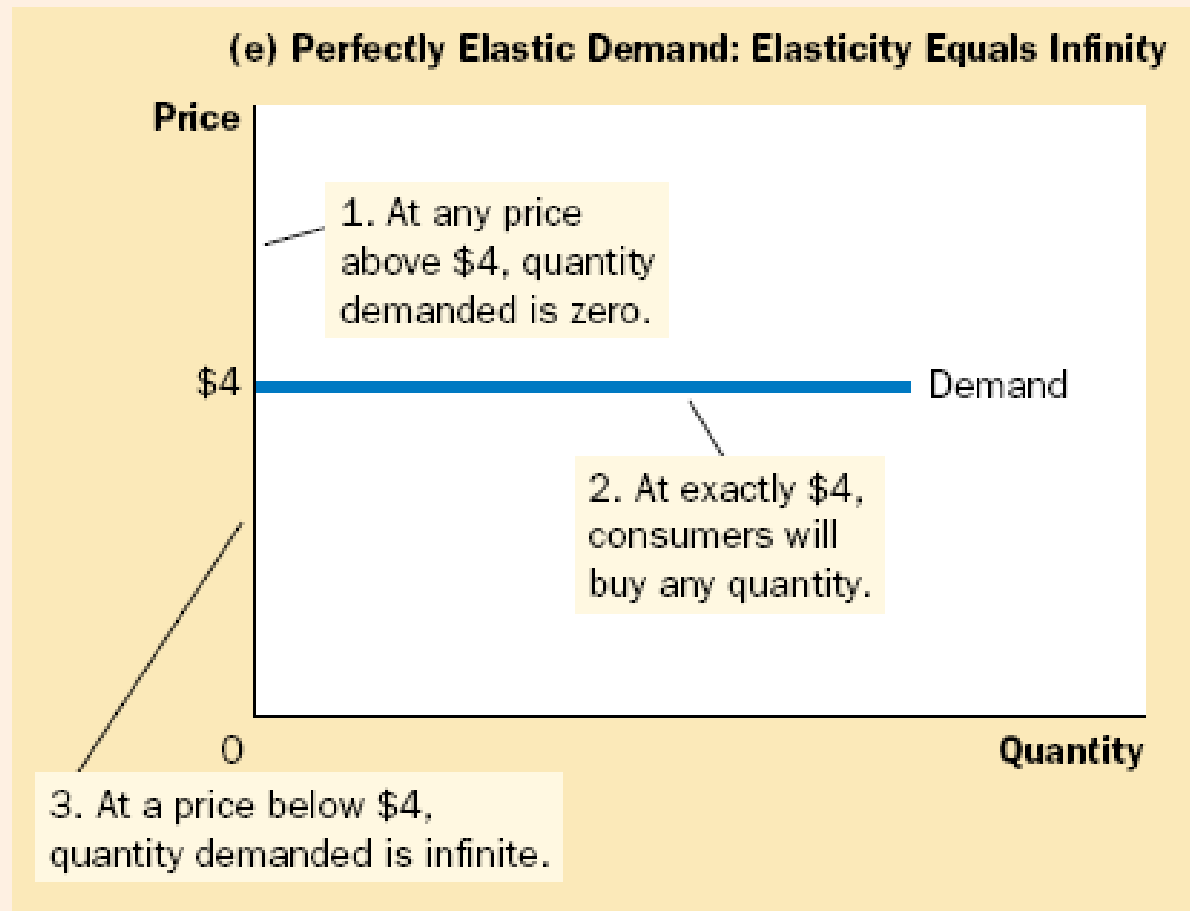
# Demand Elasticity

## (d) Elastic demand; $E > 1$



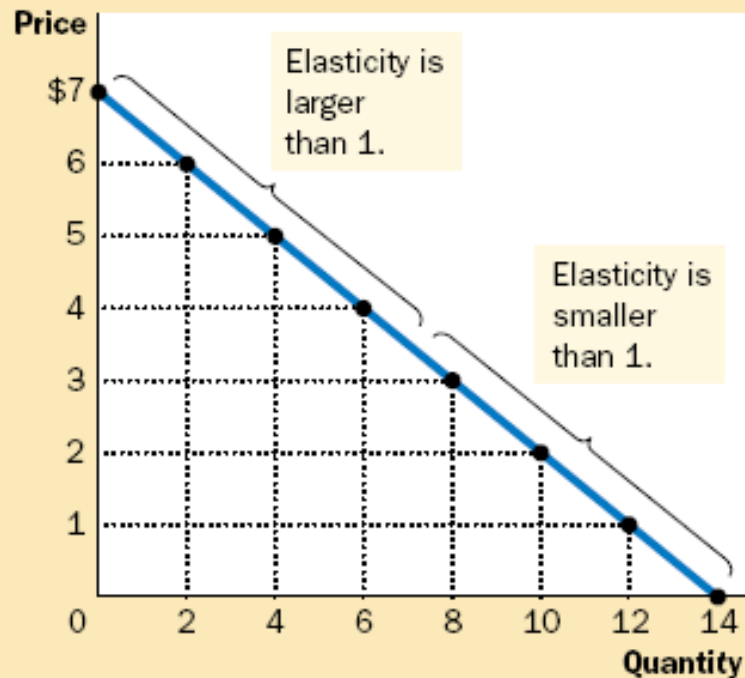
# Demand Elasticity

## (e) Perfectly elastic demand; $E = \infty$



# Demand Elasticity

- **Elasticity of linear demand function:**
  - Slope of the function - Constant
  - Elasticity of the function - Varies from infinity to 0

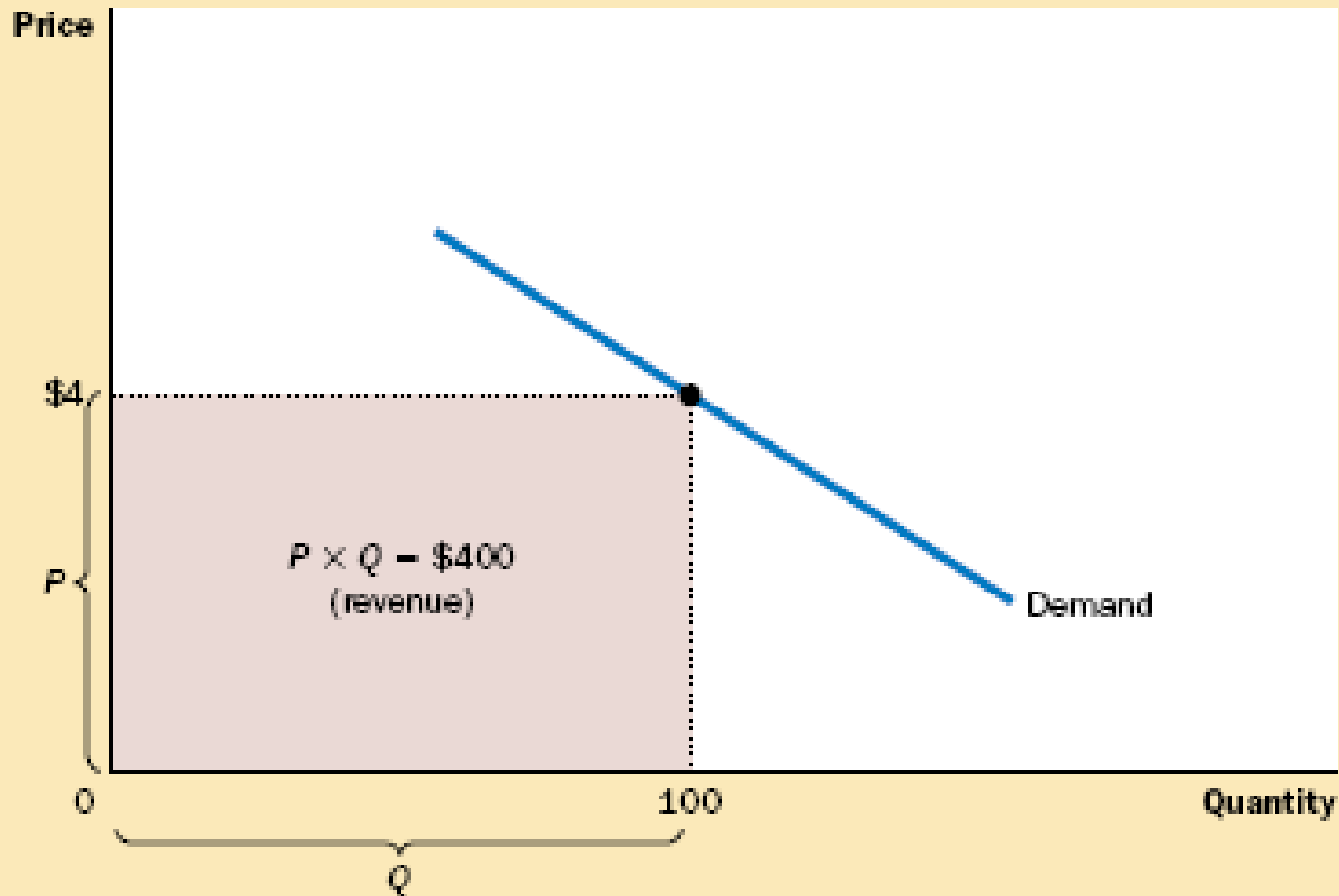


# Elasticity – Total Revenue

- *Total revenue* is the amount paid by buyers and received by sellers of a good
- Computed as the price of the good times the quantity sold:  $TR = P \times Q$
- Changes with changes in  $Q / P$  – how much?

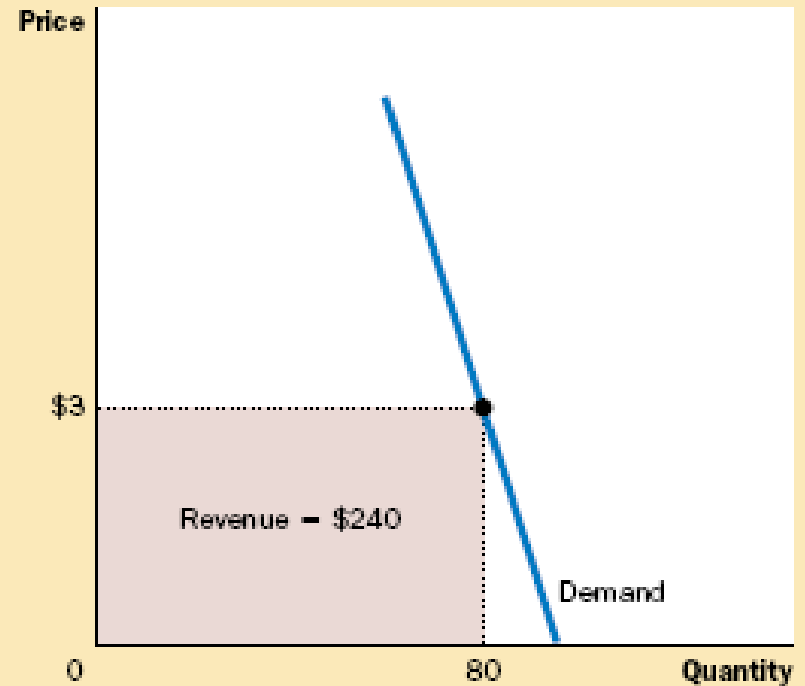
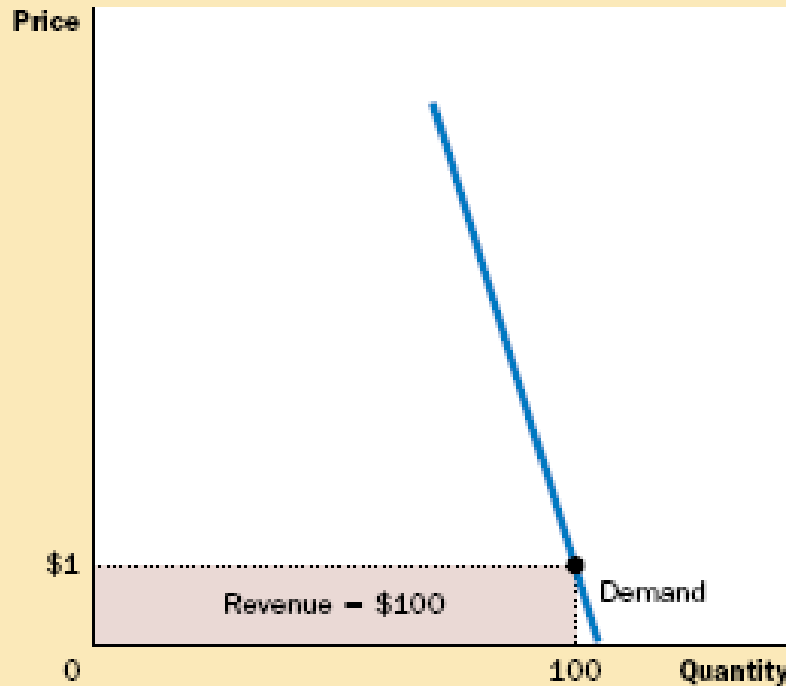


# Elasticity - Total Revenue



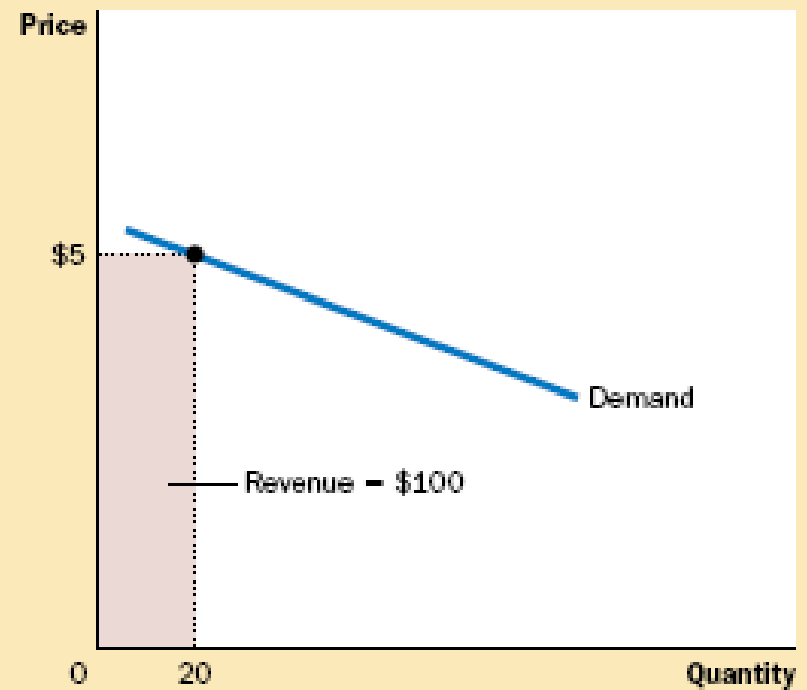
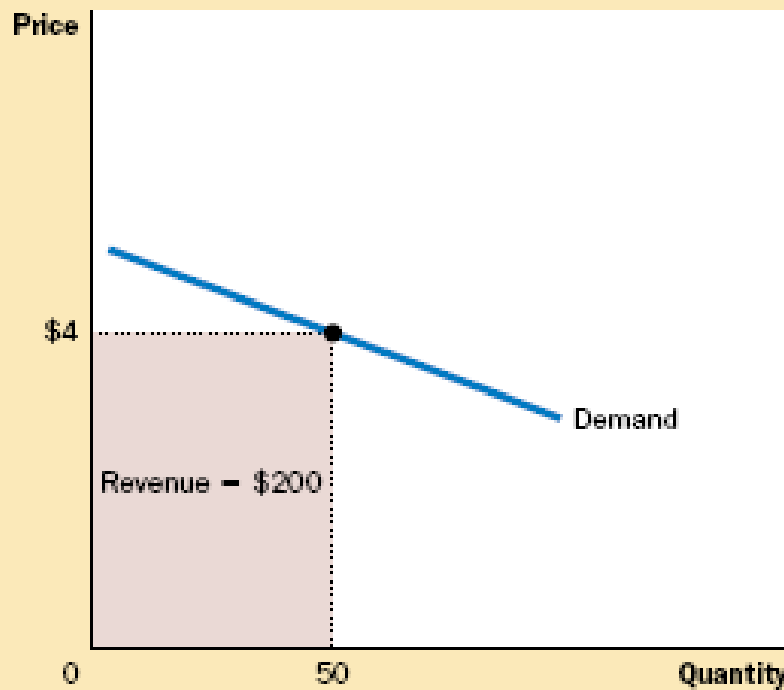
# Elasticity - Total Revenue

## Change in Total revenue - inelastic demand



# Elasticity - Total Revenue

Change in Total revenue - elastic demand



# Elasticity – Total Revenue

- Total revenue:
  - Increases with an increase in price with inelastic demand
  - Decreases with an increase in price with elastic demand

# Elasticity - Relevance for Firm

- Informs about:
  - The possible effect of the price change on quantity demanded
  - The impact on the Total Revenues for the company
  - The effect of tax changes on the prices/quantity demanded and the extent to what business can pass the tax on the consumers
  - Possibly used for price discrimination—pricing policies

# Income Elasticity

- Income elasticity of demand:
  - Responsiveness of demand to changes in income
  - Percentage change in quantity demanded in response to percentage change in income

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

# Income Elasticity

## Normal vs. inferior goods:

- Normal goods – demand increases with income
- Inferior goods – demand decreases with income
- About the sign of elasticity rather than its size

## Necessities vs. luxuries

- Necessities – income inelastic
- Luxuries – income elastic

# Income Elasticity

- Relation to the cycles of the economy
- E.g. air travel – normal good with positive income elasticity of demand = cyclical industry
  - Increase in demand with growing economy
  - Decrease in demand in recession
- Car ownership – high/low income elasticity?
- High income elasticity – strong relation to the GDP – makes it difficult to predict future development



# Cross Elasticity

- Cross-elasticity of demand
  - Responsiveness of demand for good 1 to changes in price of good 2 (any two goods)

$$\text{Cross elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in the price of good 2}}$$

# Cross Elasticity

## Substitutes vs. complements

- Substitutes
  - If increasing price of good 1 leads to an increase in demand of good 2
  - Weak substitutes – low cross-elasticity
  - Close substitutes – high cross-elasticity
- Complements
  - If increasing price of good 1 leads to a decrease in demand of good 2
  - Weak/close complements

# Cross Elasticity

Identify close and weak substitutes for:

- Coca-cola
- Student agency trip to Brno
- Ticket to a U2 concert

Identify close and weak complements to

- i-Pod
- Ticket for ice-hockey game
- Goods with no relationship?
  - What is the cross-elasticity
  - Examples of such in relation to those above?

# Cross Elasticity

Important concept for firms to:

- Predict the impact of competitor's pricing strategies
- Define the optimal pricing strategy for related goods

# Elasticity of Supply

**Price elasticity of supply** = a measure of how much the quantity supplied responds to a change in the price of the good

Computed as the percentage change in quantity supplied divided by the percentage change in price

# Elasticity of Supply

Price elasticity – ratio of two changes

$$\begin{aligned} \text{Price elasticity of supply} &= \\ & \frac{\text{percentage change in quantity supplied}}{\text{percentage change in price}} \\ &= 20\% \text{ change in } Q / 10\% \text{ change in } P = 2 \end{aligned}$$

# Elasticity of Supply - Determinants

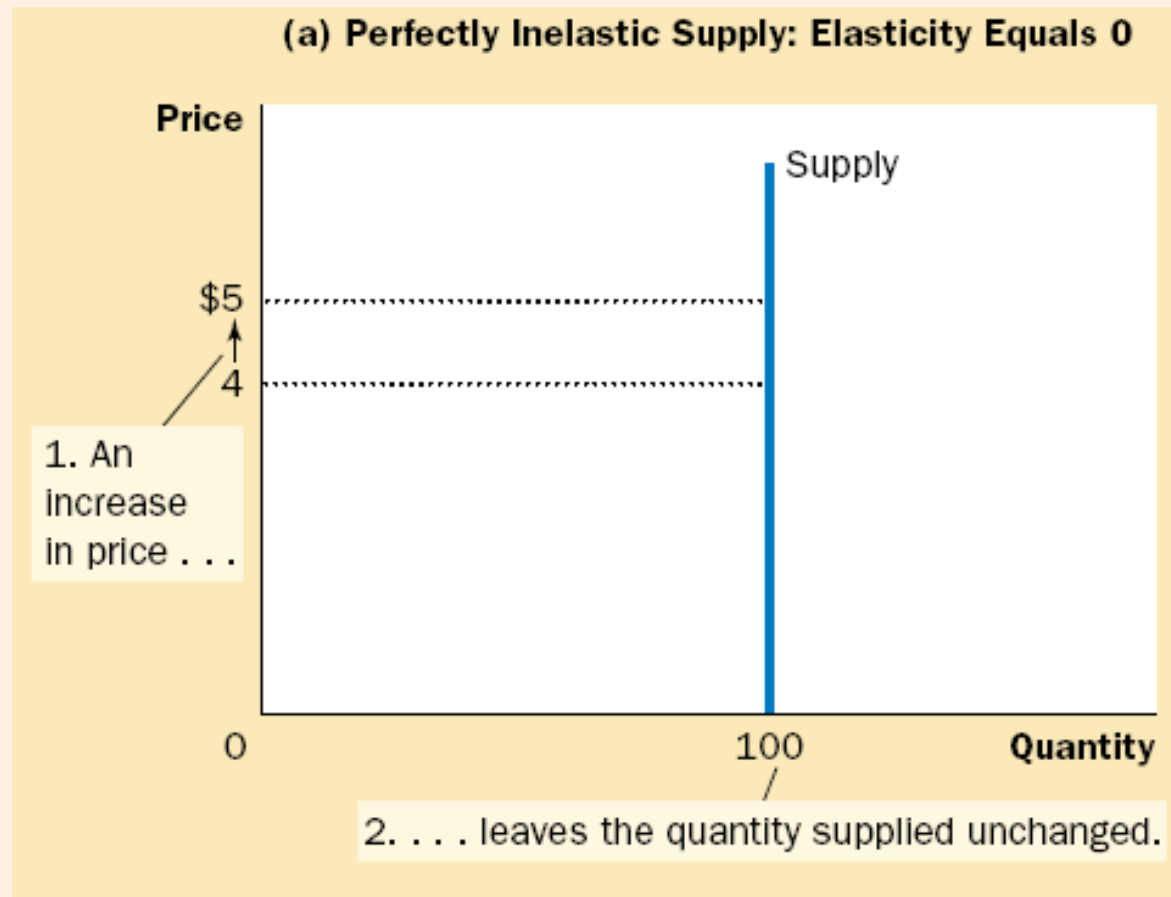
- Ability of sellers to adjust their production
  - Limited resources
  - Factor substitution possibilities
  - Spare capacity for production
  - Inventories/stock
  - External limits on supply (patents, regulations,...)

## Time horizon

- Momentary period/short run/long run
- It is possible to adjust everything in the long run (price elasticity of supply is higher in the long run)

# Supply Elasticity

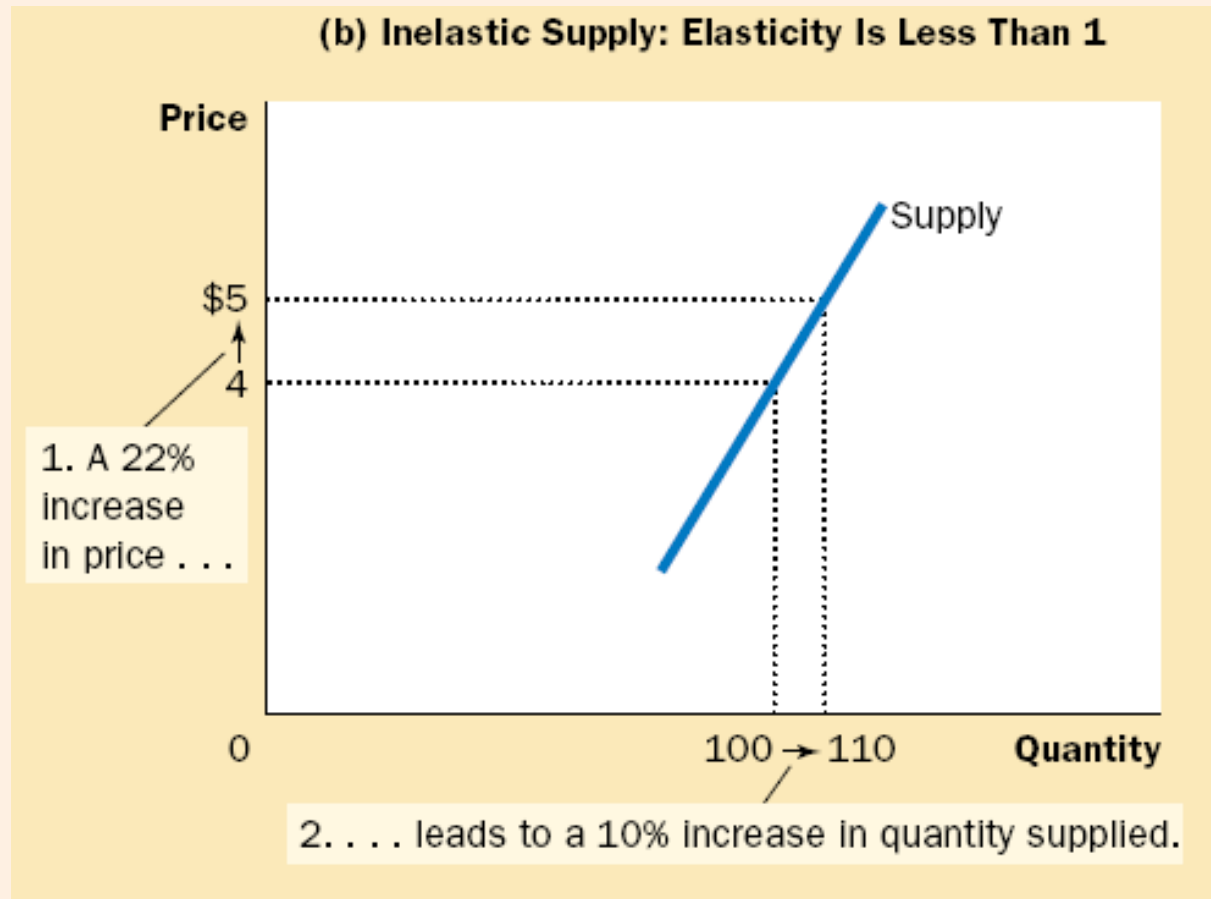
## (a) Perfectly inelastic supply; $E=0$





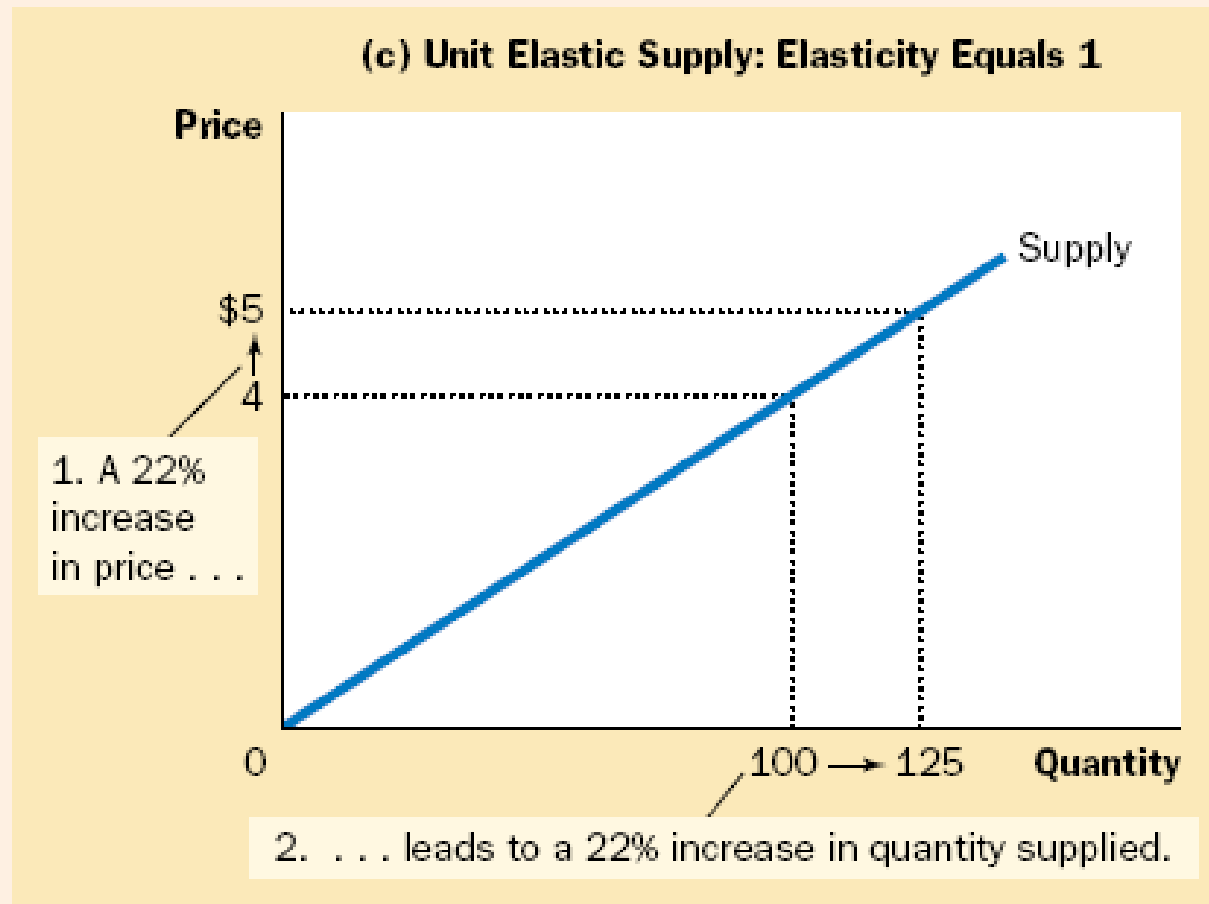
# Supply Elasticity

## (b) Inelastic supply; $E < 1$



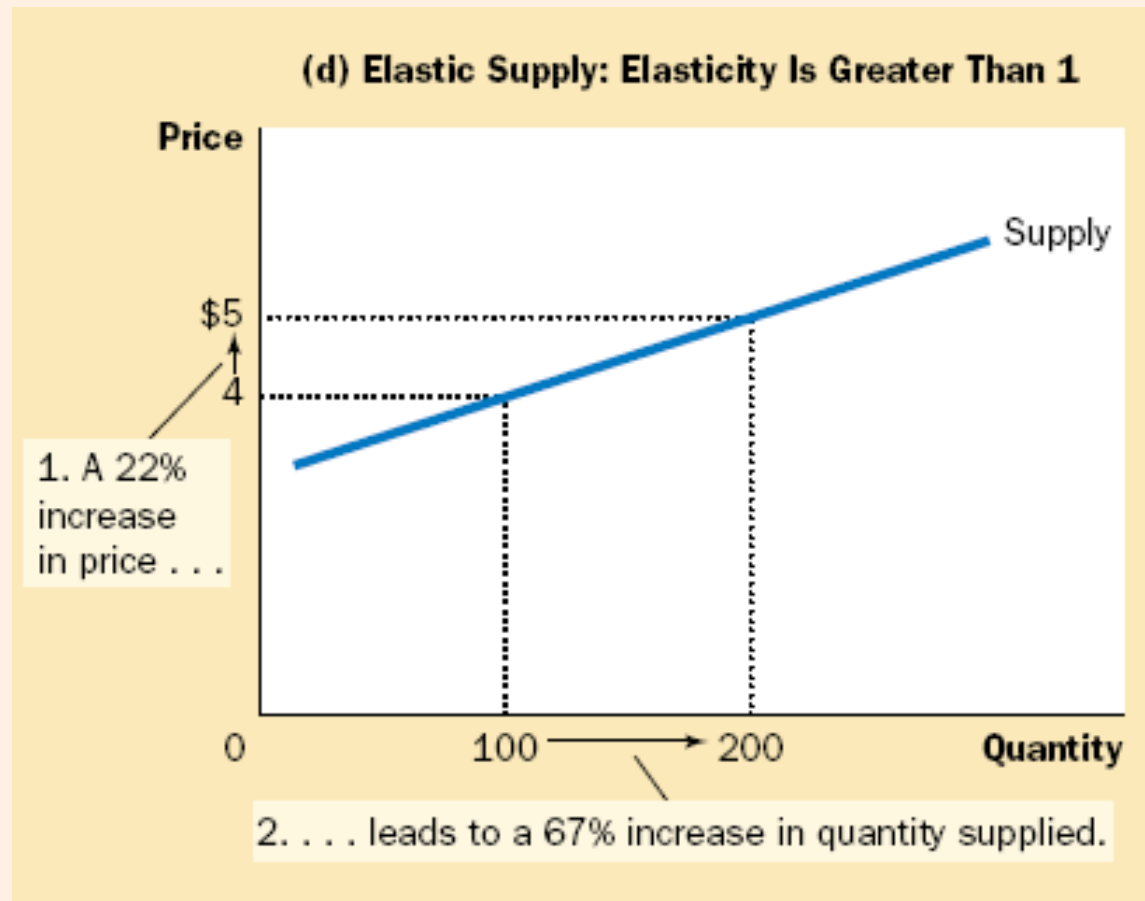
# Supply Elasticity

## (c) Unit elastic supply; $E=1$



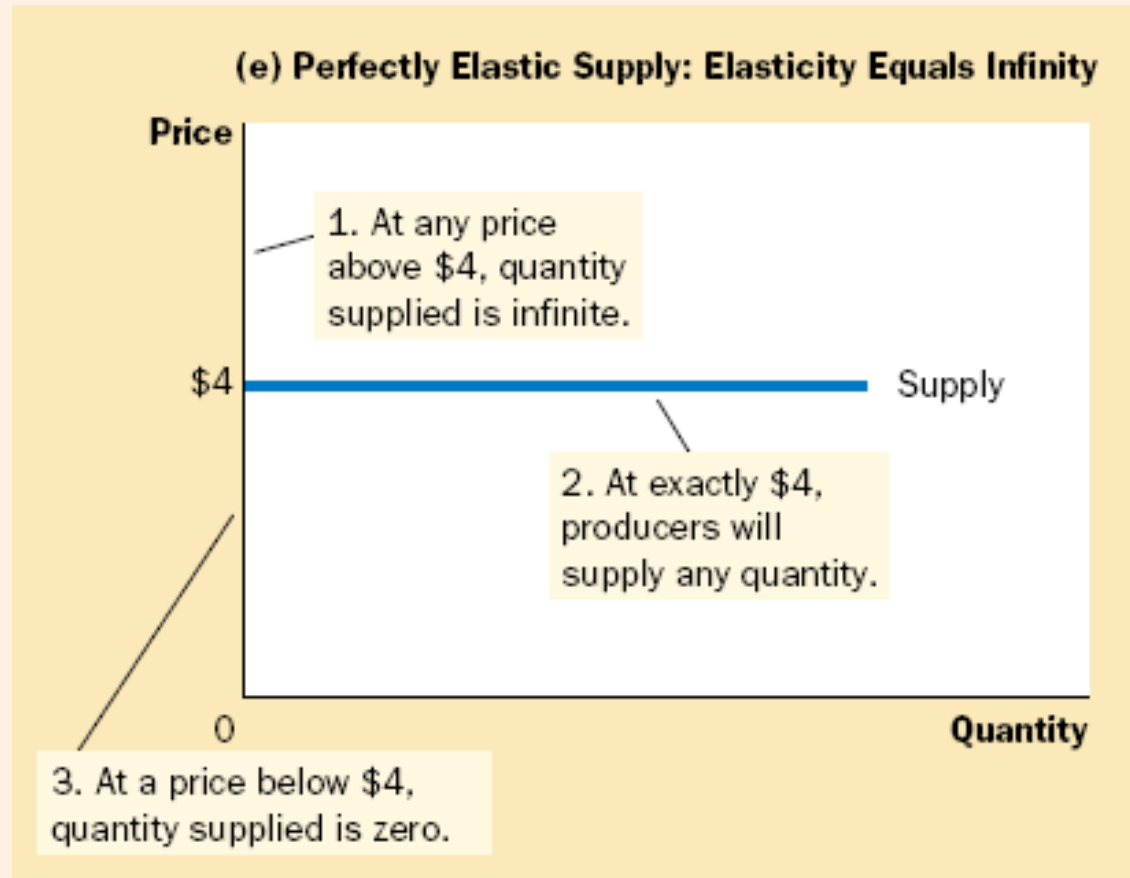
# Supply Elasticity

(d) Elastic supply;  $E > 1$



# Supply Elasticity

## (e) Perfectly elastic supply; $E = \infty$



# Demand, Supply, Elasticity

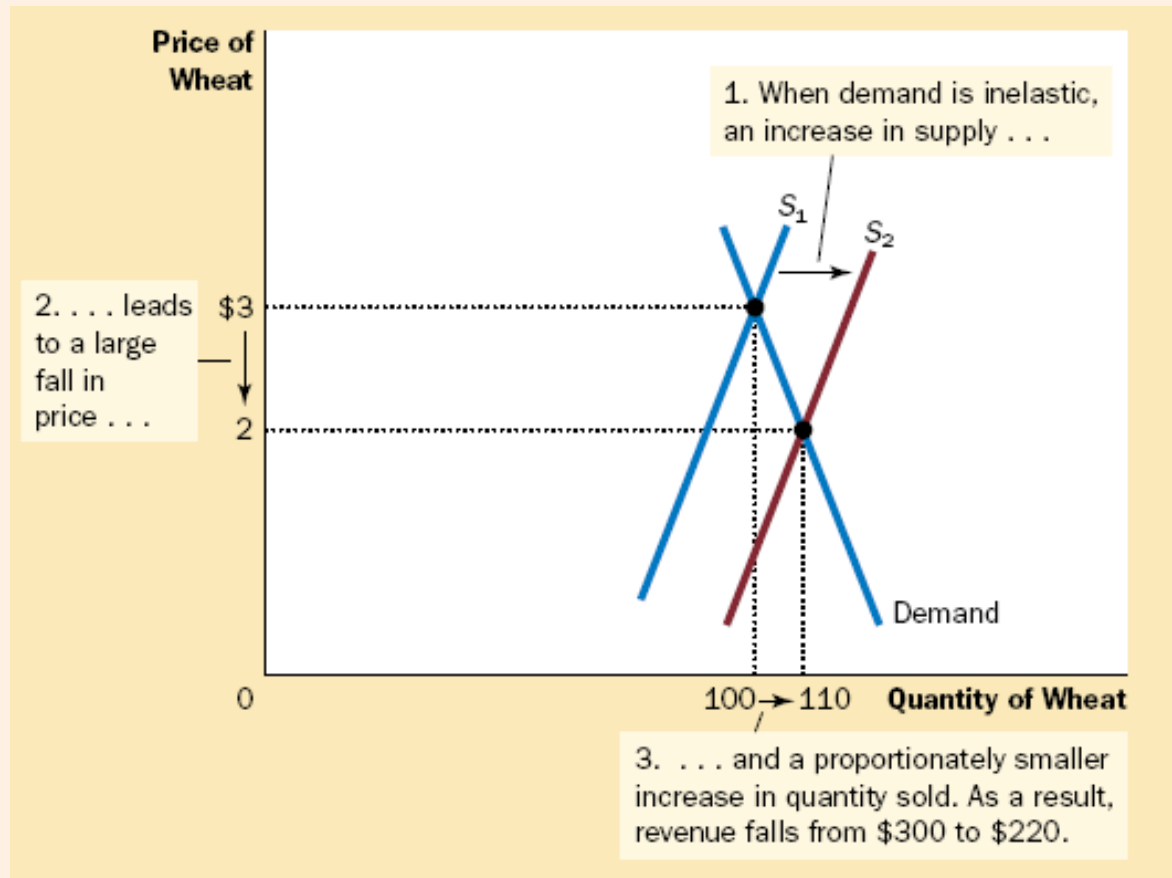
- Can good news for farming be bad news for farmers?
- What happens to wheat farmers and the market for wheat when university agronomists discover a new wheat hybrid that is more productive than existing varieties?

# Demand, Supply, Elasticity

- Examine whether the supply or demand curve shifts
- Determine the direction of the shift of the curve
- Use the supply-and-demand diagram to see how the market equilibrium changes

# Demand, Supply, Elasticity

- New wheat hybrid discovered



# Demand, Supply, Elasticity

- Price elasticity of supply:

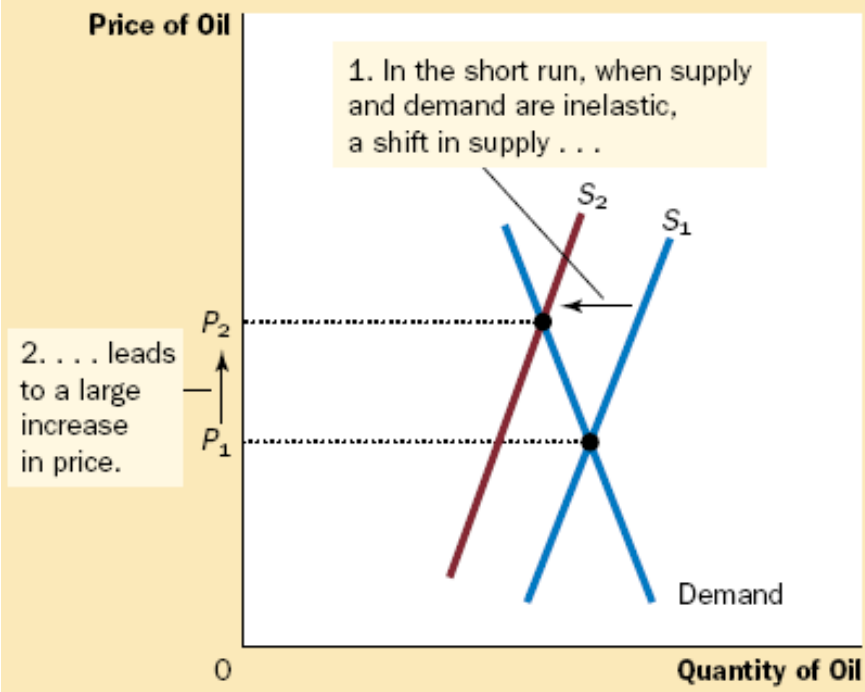
$$E_D = \frac{(100-110) / (100+110)/2}{(3.00-2.00) / (3.00+2.00)/2} = \frac{-0.095}{0.4} \approx -0.24$$



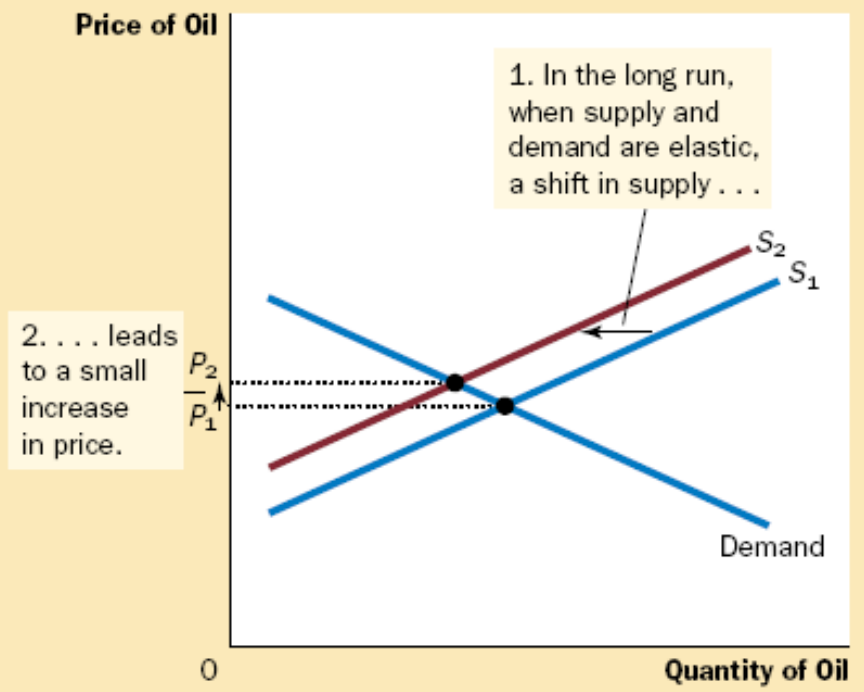
# Demand, Supply, Elasticity

- Reduction in world market oil supply:

(a) The Oil Market in the Short Run



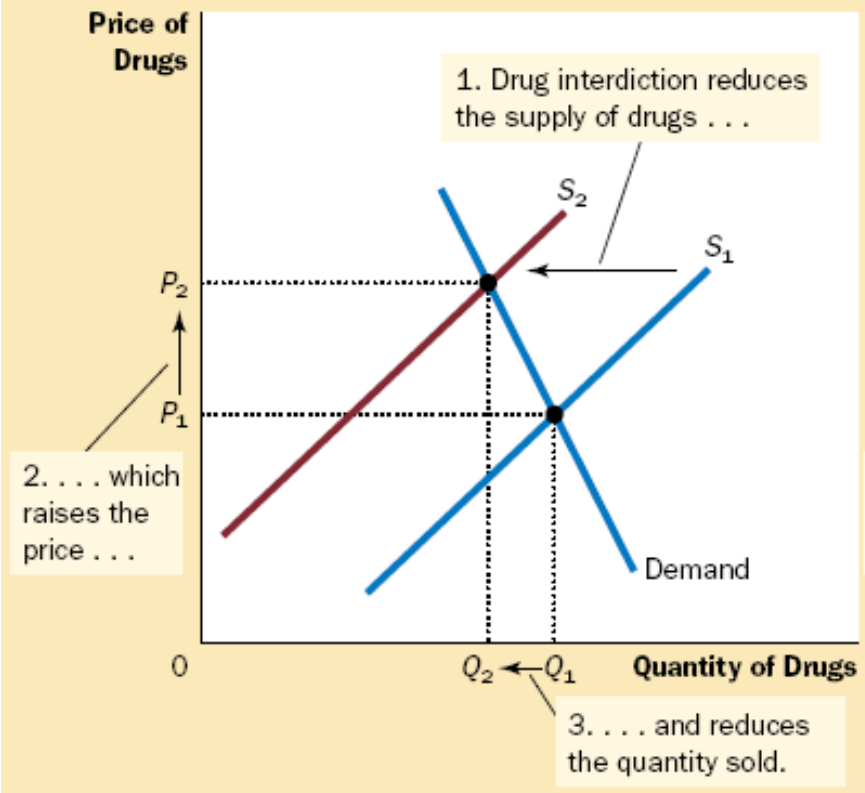
(b) The Oil Market in the Long Run



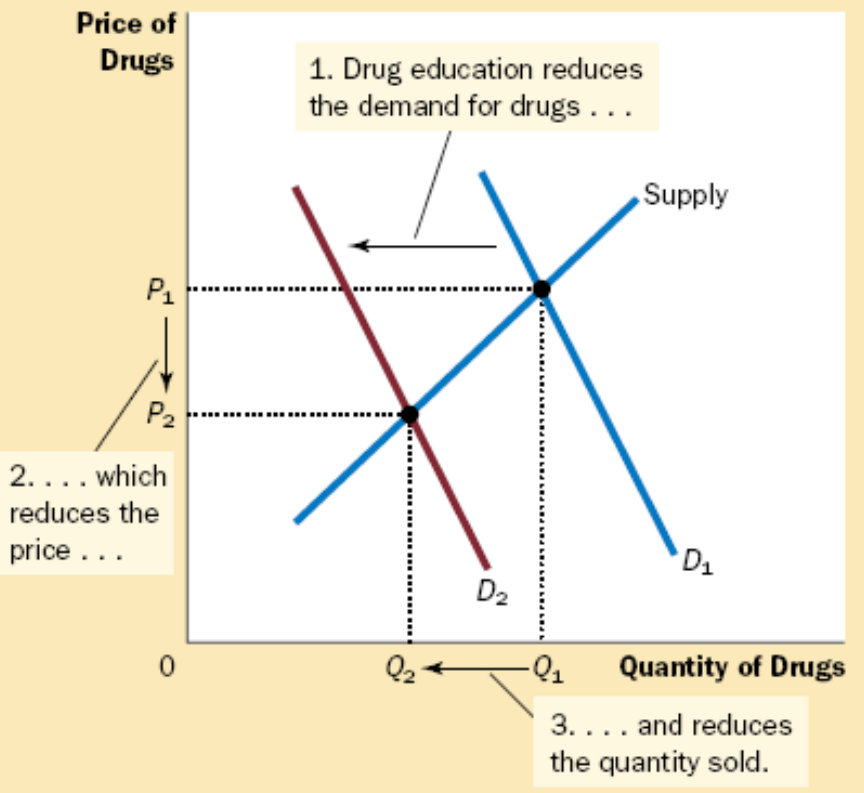
# Demand, Supply, Elasticity

- Reduction of illegal drug use:

(a) Drug Interdiction



(b) Drug Education



# Summary I

- Price elasticity of demand measures how much the quantity demanded responds to changes in the price
- Price elasticity of demand is calculated as the percentage change in quantity demanded divided by the percentage change in price
- If a demand curve is elastic, total revenue falls when the price rises
- If it is inelastic, total revenue rises as the price rises

# Summary II

- The income elasticity of demand measures how much the quantity demanded responds to changes in consumers' income
- The cross-price elasticity of demand measures how much the quantity demanded of one good responds to the price of another good
- The price elasticity of supply measures how much the quantity supplied responds to changes in the price

# Summary III

- In most markets, supply is more elastic in the long run than in the short run
- The price elasticity of supply is calculated as the percentage change in quantity supplied divided by the percentage change in price
- The tools of supply and demand can be applied in many different types of markets