Lecture 2

Elasticity and its applications

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Presentation is based on:
http://www.swlearning.com/economics/mankiw/mankiw3e/powerpoint_micro.html

Key concepts

- Elasticity
- Price elasticity of demand
- Income elasticity of demand
- Cross-price elasticity of demand
- Price elasticity of supply
- Total revenue…

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

Elasticity

Elasticity: is a measure of the responsiveness of quantity demanded or quantity supplied to one of its determinants.

The elasticity of demand

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

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.

Elastic or inelastic?

- The demand for good is said to be elastic, if the quantity demanded responds substantially to changes in price.

- The demand for good is said to inelastic, if the quantity demanded responds only slightly to changes in the price.

The Price Elasticity of Demand and Its Determinants

- Availability of close substitutes
- Necessities versus luxuries
- Definition of the market
- Time horizon…

The Price Elasticity of Demand and Its Determinants

- Availability of close ssubstitutes:
  - Goods with close subsitutes tend to have more elastic demand, because it is easier to switch from one good to another.

  - Eggs (don't have close substitutes) have rather inelastic demand (or less elastic than butter)

The Price Elasticity of Demand and Its Determinants

- Necessities versus luxuries:
  - Necessities have inelastic demands
  - Luxuries have elastic demands
  - Whether the good belong to one of these categories depends on consumer's preferences.

The Price Elasticity of Demand and Its Determinants

- Definition of the market:
  - Narrowly defined markets tend to have more elastic demand, than broadly defined markets, because it is easier to find substitutes for narrowly defined goods.

Elasticity increases…

The Price Elasticity of Demand and Its Determinants

- Time horizon:
  - Good tend to have more elastic demand over longer time horizons.

Other determinants of demand price elasticity

Price level:

When the price is low, the price increase by e.g. 5% do not influence on the consumers as much as the same increase of price by the initial higher price.

Other determinants of demand price elasticity

Income level

Poorer consumers usually react on the price change stronger than the richer consumers.

Consumers' preferences

If the consumers prefer one good over another, they do not respond so much on the price change.

The Price Elasticity of Demand and Its Determinants

- Demand tends to be more elastic :
  - the larger the number of close substitutes
  - if the good is a luxury
  - the more narrowly defined the market
  - the longer the time period.

Example

For each of the following pairs of goods, which good would you expect to have more elastic demand and why?

- Required textbooks or mystery novels
- Beethoven recordings or classical music recordings in general
- Heating oil during the next six months or heating oil during the next five years
- Root beer or water.

Computing the Price Elasticity of Demand

- The price elasticity of demand is computed as the percentage change in the quantity demanded divided by the percentage change in price.

$$E_p = \frac{\%\Delta Q_x}{\%\Delta P_x} = \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_x}{P_x}}$$

Example:

- If the price of bikes rises by 5%, ceteris paribus, the quantity demanded decreases by 7%. What is the price elasticity of demand for bikes?

$$E_p = \frac{\%\Delta Q_x}{\%\Delta P_x} = \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_x}{P_x}} = \frac{\frac{Q_{x2} - Q_{x1}}{Q_{x1}}}{\frac{P_{x2} - P_{x1}}{P_{x1}}} = \frac{-0{,}07}{0{,}05} = -1{,}4$$

Example:

- If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand would be calculated as:

$$E_p = \frac{\frac{(8-10)}{10}\cdot 100\%}{\frac{(2.20-2)}{2}\cdot 100\%} = \frac{-20\%}{10\%} = -2$$

The Ep=-2 reflects that the change in the quantity demanded is proportionately twice as large as the change in the price!

Is elasticity positive or negative?

- Price elastitcities are sometimes reported as negative numbers.
- It is also allowed to present them as absolute values (dropping the minus sign).

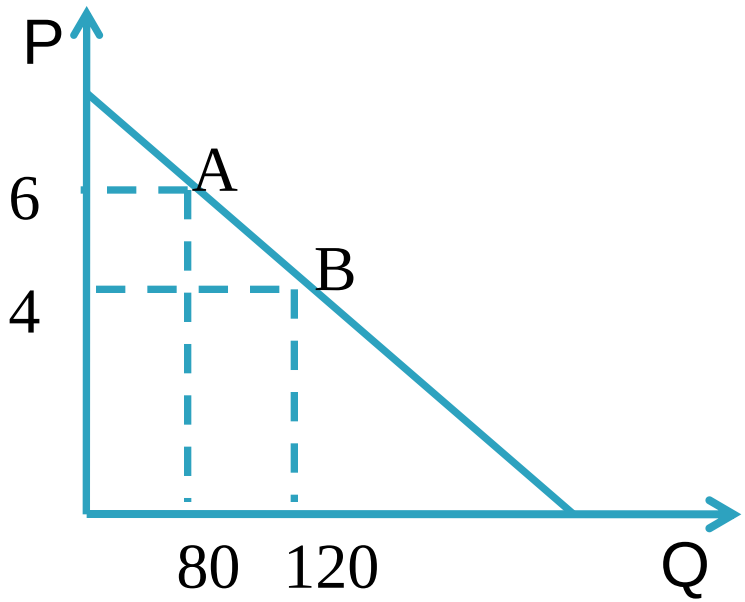
$$E_p = \frac{\frac{(8-10)}{10}\cdot 100\%}{\frac{(2.20-2)}{2}\cdot 100\%} = \frac{-20\%}{10\%} = -2 = |2|$$

- 20% reflects the increase in quantity and 10% reflects the decrease in price.

Example

- Calculate the price elasticity between two points on a demand curve:
  - Point B: Price =$4 Quantity =120
  - Point A: Price =$6 Quantity = 80

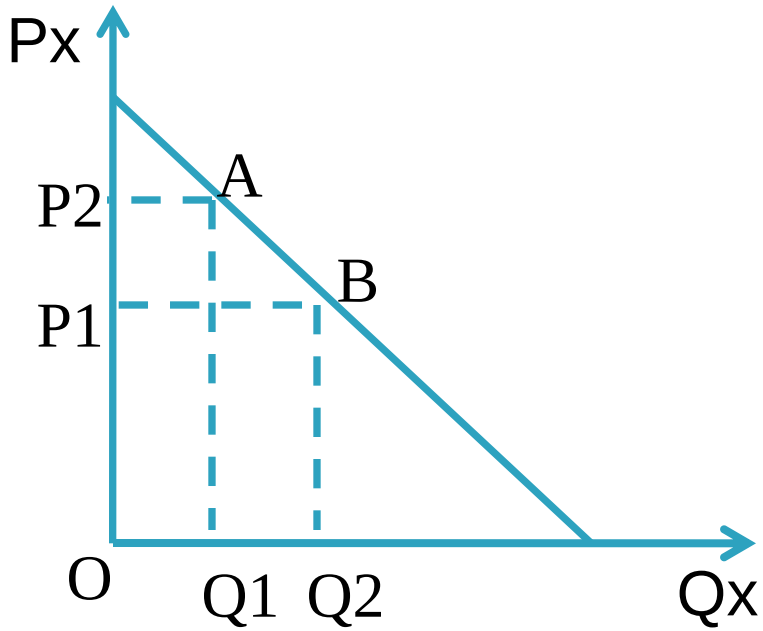
- Going from point B to A, E_p=-0.66
- Going from point A to B, E_p=-1.5
- What is true?



The Midpoint Method: A Better Way to Calculate Percentage Changes and Elasticities

- The midpoint formula is preferable when calculating the price elasticity of demand because it gives the same answer regardless of the direction of the change.

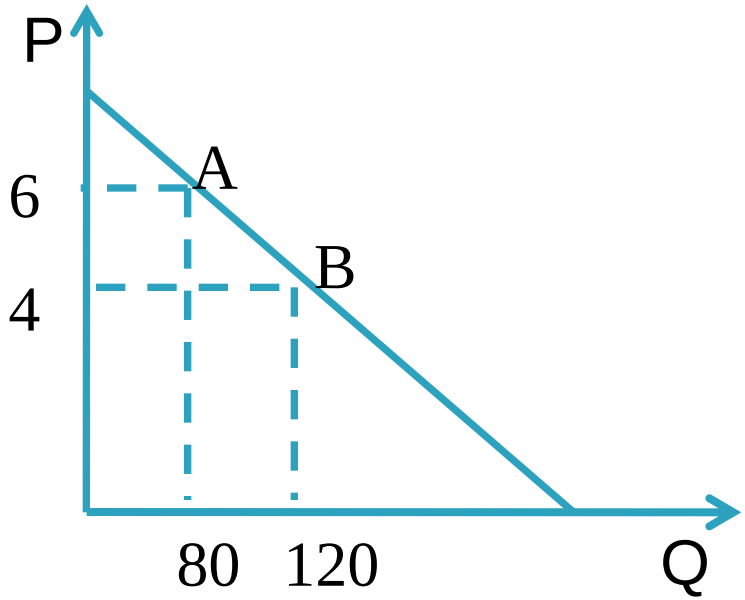
$$E_p = \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_x}{P_x}} = \frac{\frac{(Q_2 - Q_1)}{\frac{(Q_2 + Q_1)}{2}}}{\frac{(P_2 - P_1)}{\frac{(P_2 + P_1)}{2}}}$$



Example

- Compete the price elasticity between two points on a demand curve with the midpoint method:
  - Point A: Price $=\$4$ Quantity $=120$
  - Point B: Price $=\$6$ Quantity $=80$

$$E_P = \frac{\frac{(80-120)}{(80+120)}}{\frac{(6-4)}{(6+4)}} = \frac{-\frac{1}{5}}{\frac{2}{10}} = -1$$



Example:

- If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand, using the midpoint formula, would be calculated as:

$$E_p = \frac{\frac{(8-10)}{(8+10)/2} \cdot 100\%}{\frac{(2.20-2)}{(2.20+2)/2} \cdot 100\%} = \frac{-22\%}{9.5\%} = -2.32$$

Example:

Suppose that business travelers and vacationers have the following demand for airline tickets from New York to Boston:

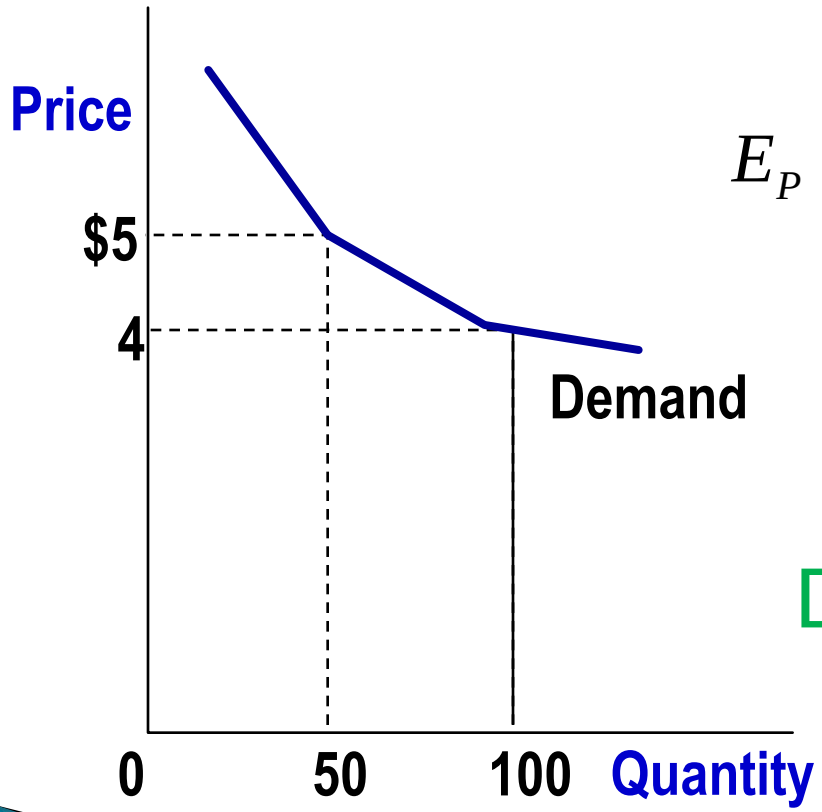
- As the price of tickets rises from $200 to $250, what is the price elasticity of demand for (i) business travelers and (ii) vacationers (use the midpoint method in your calculations)
- Why might vacationers have a different elasticity than business travelers?

price[$]	Quantity demanded (business travelers)	Quantity demanded (vacationers)
150	2100	1000
200	2000	800
250	1900	600
399	1800	400

The Variety of Demand Curves

- Inelastic Demand
  - Quantity demanded does not respond strongly to price changes.
  - Price elasticity of demand is less than one.
  - $E_p < 1$
- Elastic Demand
  - Quantity demanded responds strongly to changes in price.
  - Price elasticity of demand is greater than one.
  - $E_p > 1$

Example:

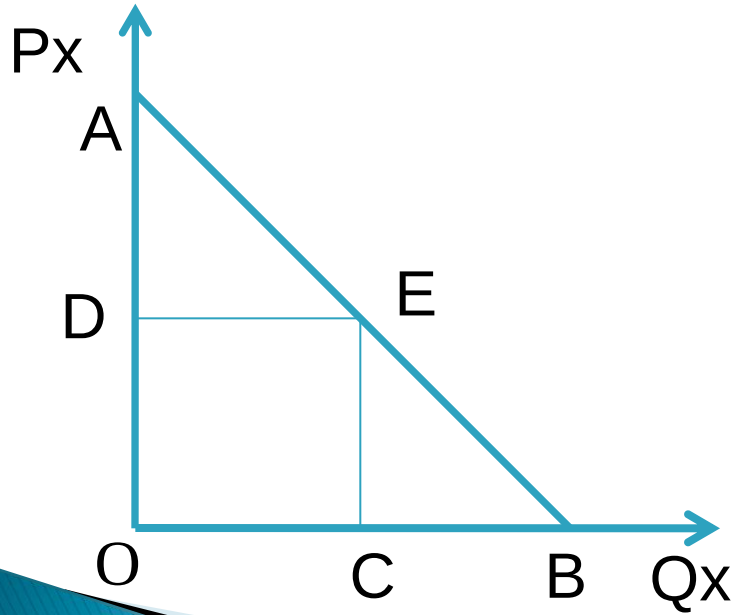


$$E_P = \frac{\dfrac{(100-50)}{(100+50)/2}}{\dfrac{(4-5)}{(4+5)/2}} = \frac{67\%}{-22\%} = -3$$

Demand is price elastic

Another way to calculate elasticity

If we want to calculate elasticity in the certain point on the demand curve, we use the following formula:



$$E_c = f'(P) \cdot \frac{P}{Q_x}$$

$$E_c = \frac{CB}{OC} = \frac{OD}{DA}$$

Example:

- Demand curve has a following equation: $Q=20-2P$
- Fill the table in:

P	10	9	8	7	6	5	4	3	2	1	0
Q											

- Calculate the demand price elasticity between prices: $P=2$ & $P=0$ and $P=6$ & $P=4$.
- What is the demand price elasticity for $P=5$.

The Variety of Demand Curves

- Perfectly Inelastic
  - Quantity demanded does not respond to price changes.
- Perfectly Elastic
  - Quantity demanded changes infinitely with any change in price.
- Unit Elastic
  - Quantity demanded changes by the same percentage as the price.

Figure 1 The Price Elasticity of Demand

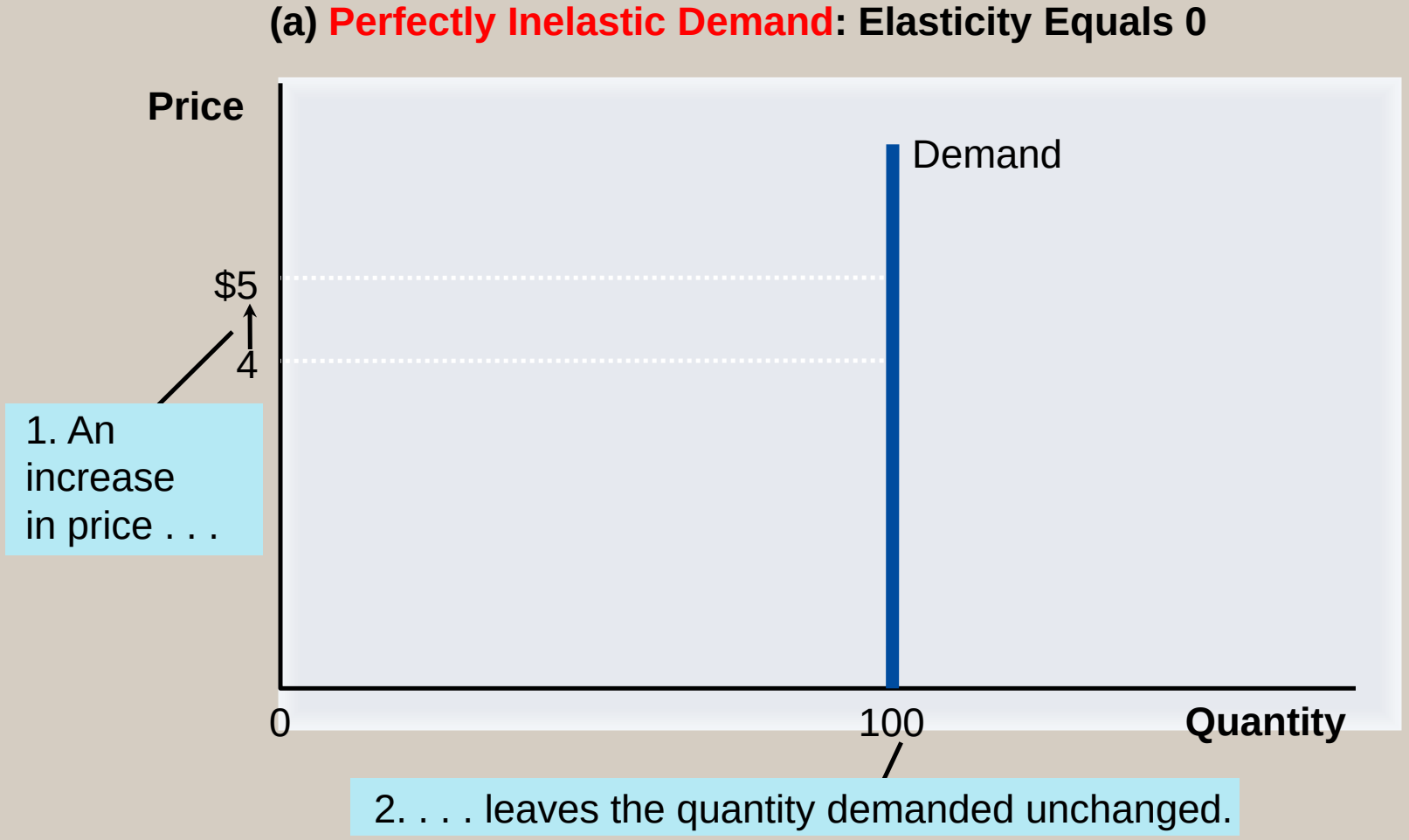
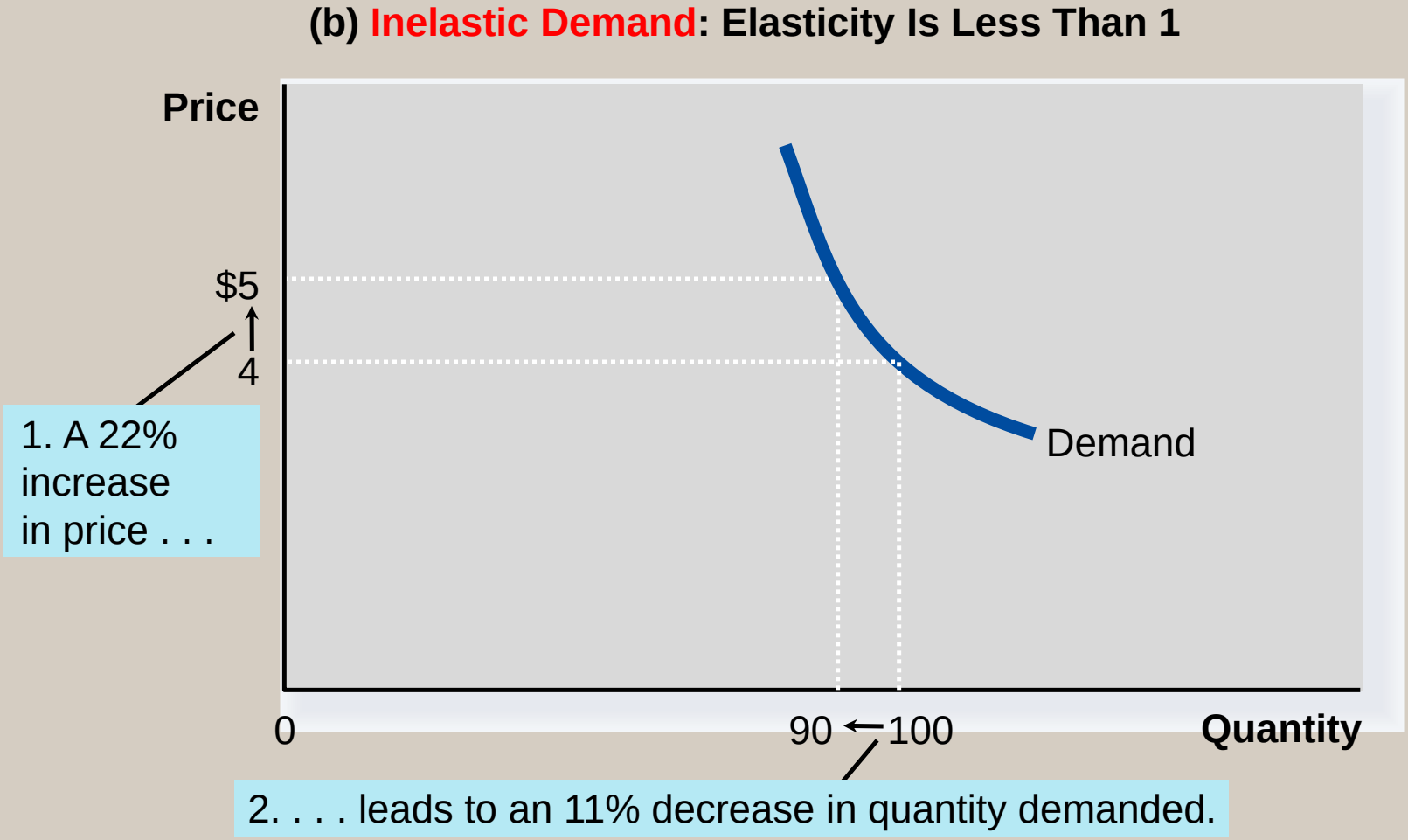


Figure 1 The Price Elasticity of Demand



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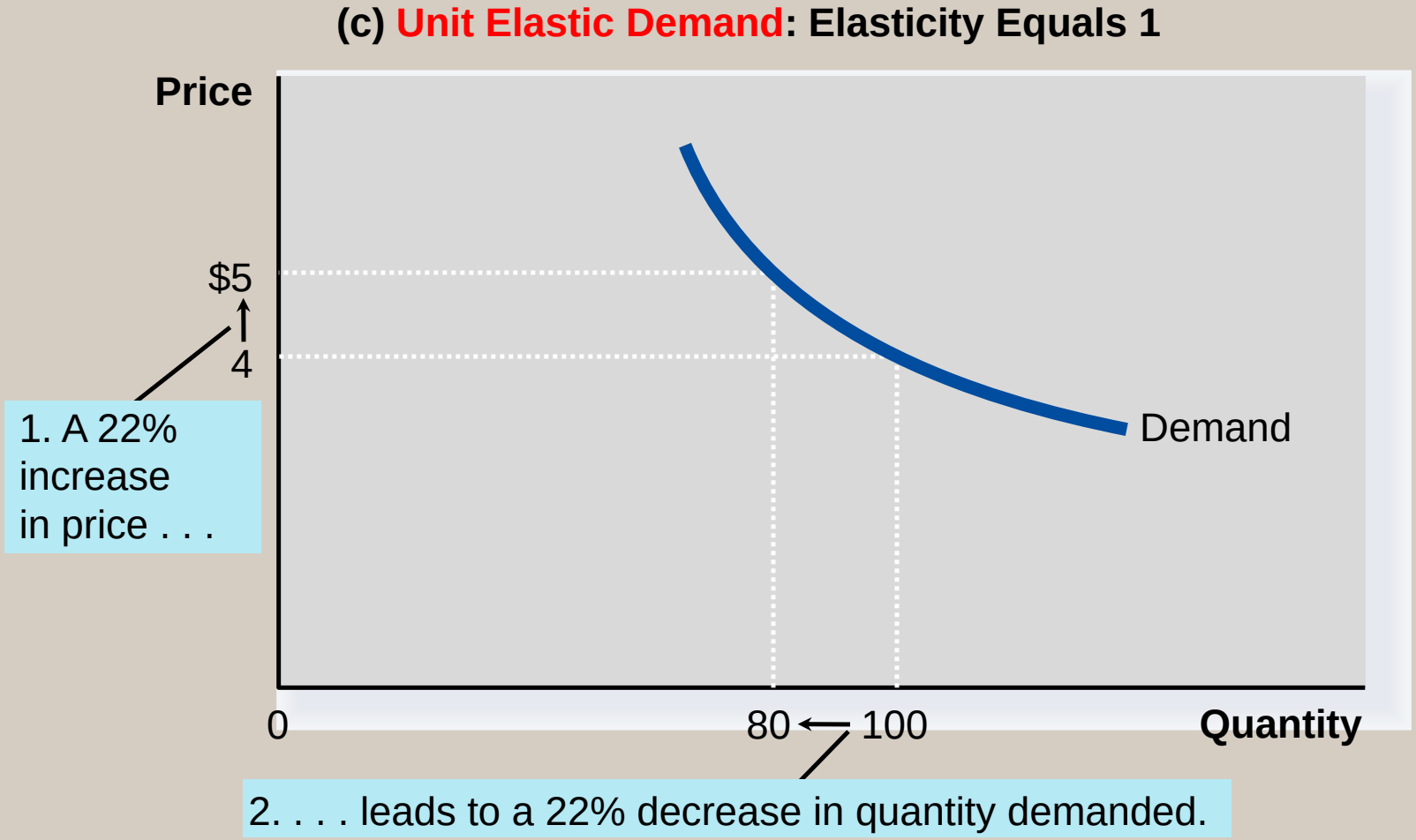

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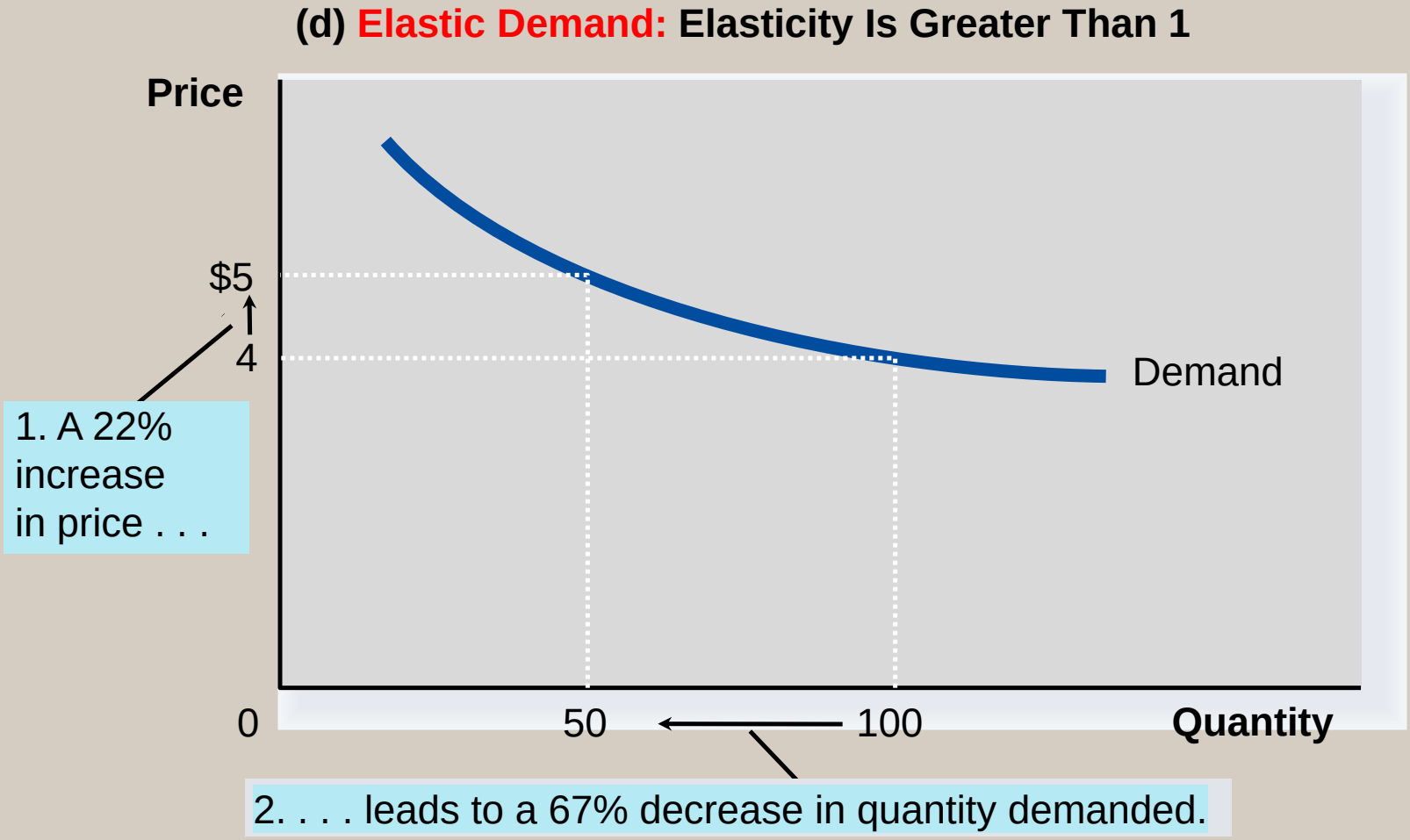

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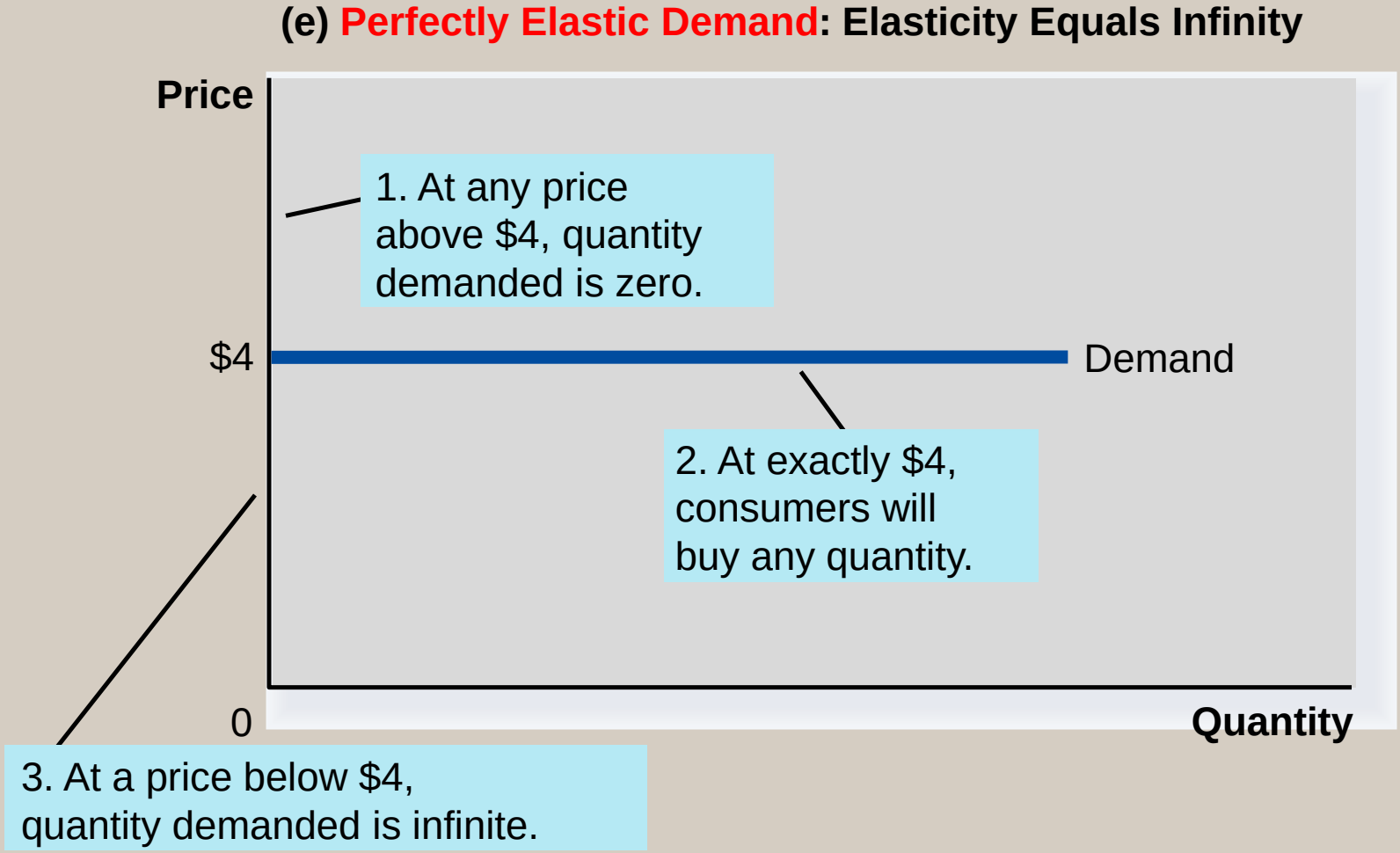


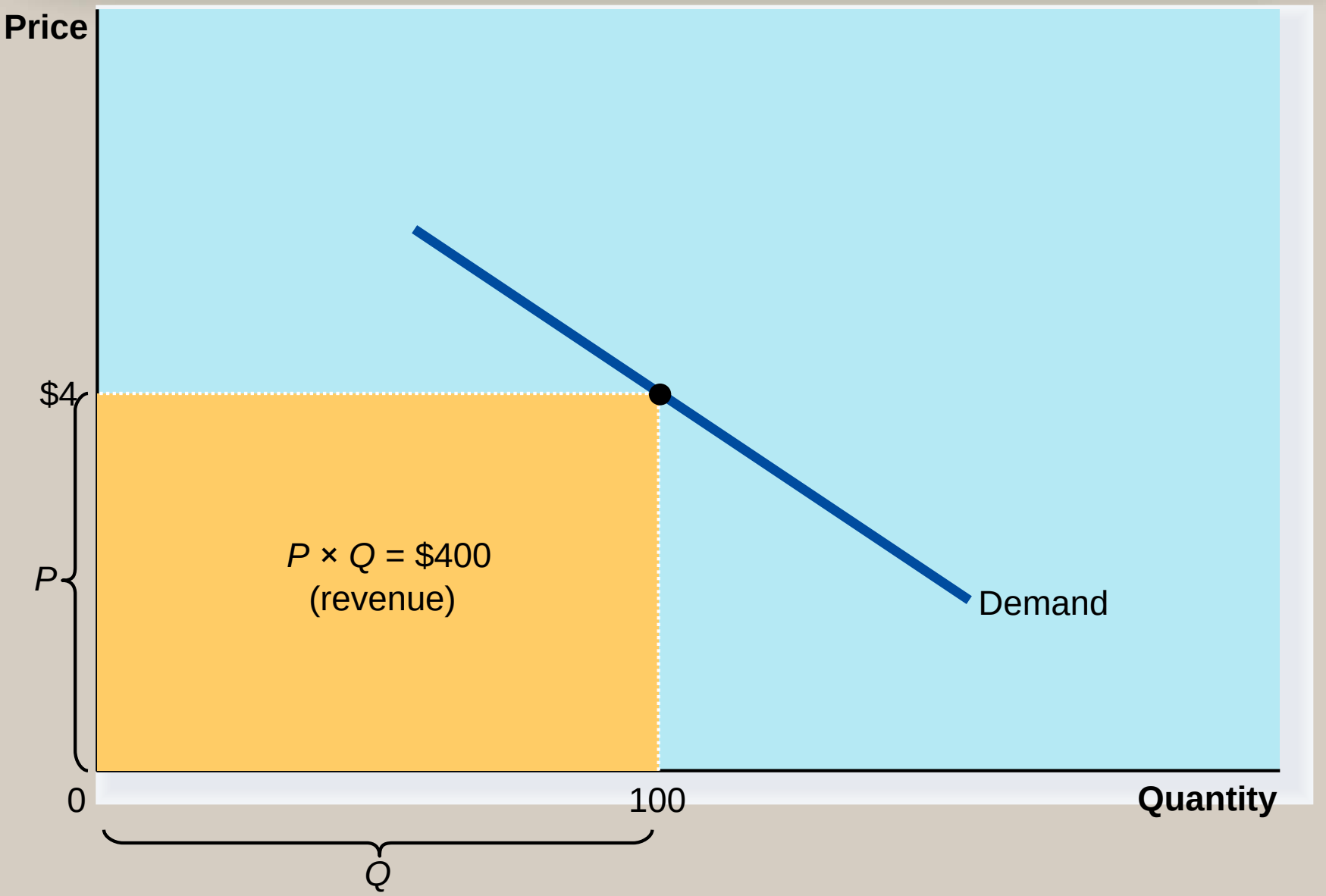
Total Revenue and the Price Elasticity of Demand

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.

$$TR = P \times Q$$

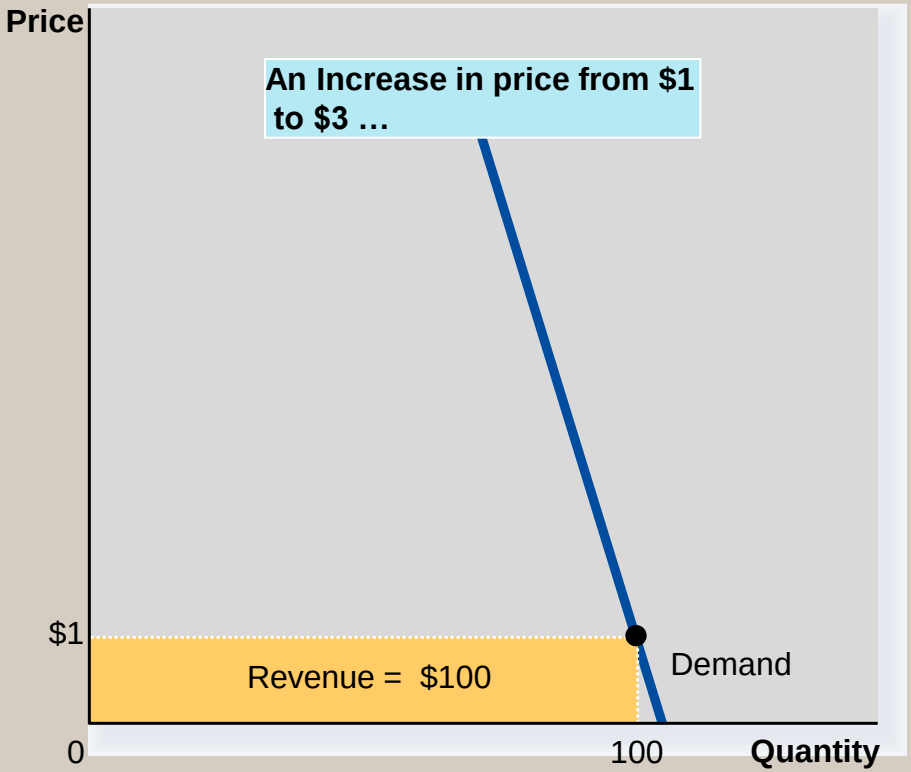
Figure 2 Total Revenue

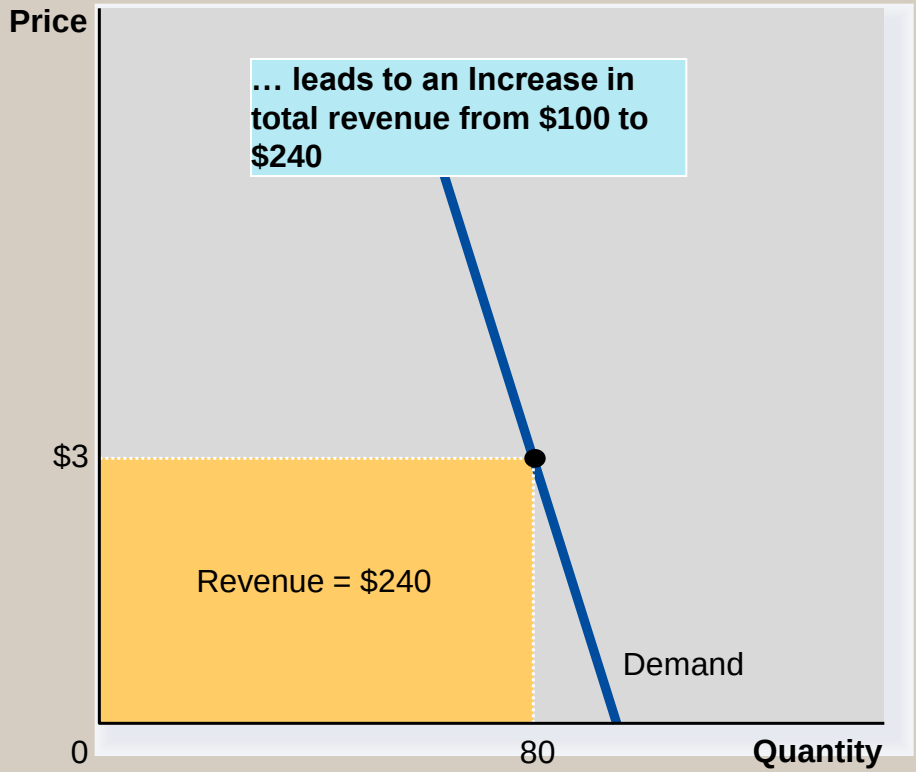


How does TR change as one moves along the demand curve?

- It depends on the price elasticity of demand:
  - With an inelastic demand curve, an increase in price leads to a decrease in quantity that is proportionately smaller.
  - Thus, *total revenue increases.*

Figure 3 How Total Revenue Changes When Price Changes: Inelastic Demand

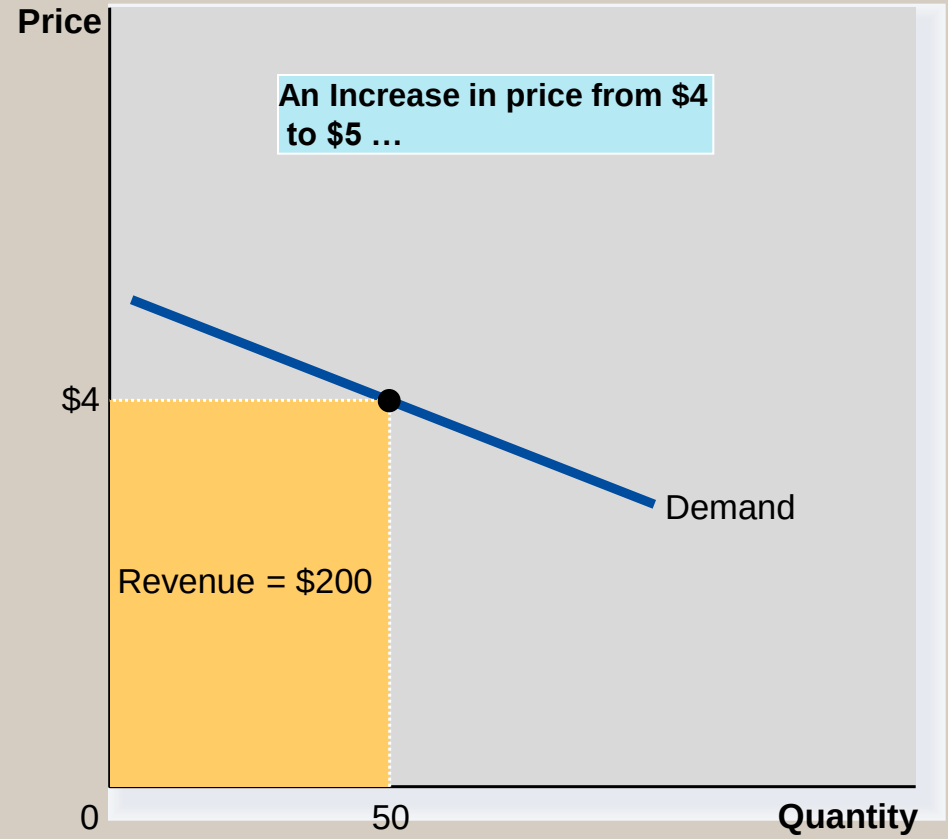


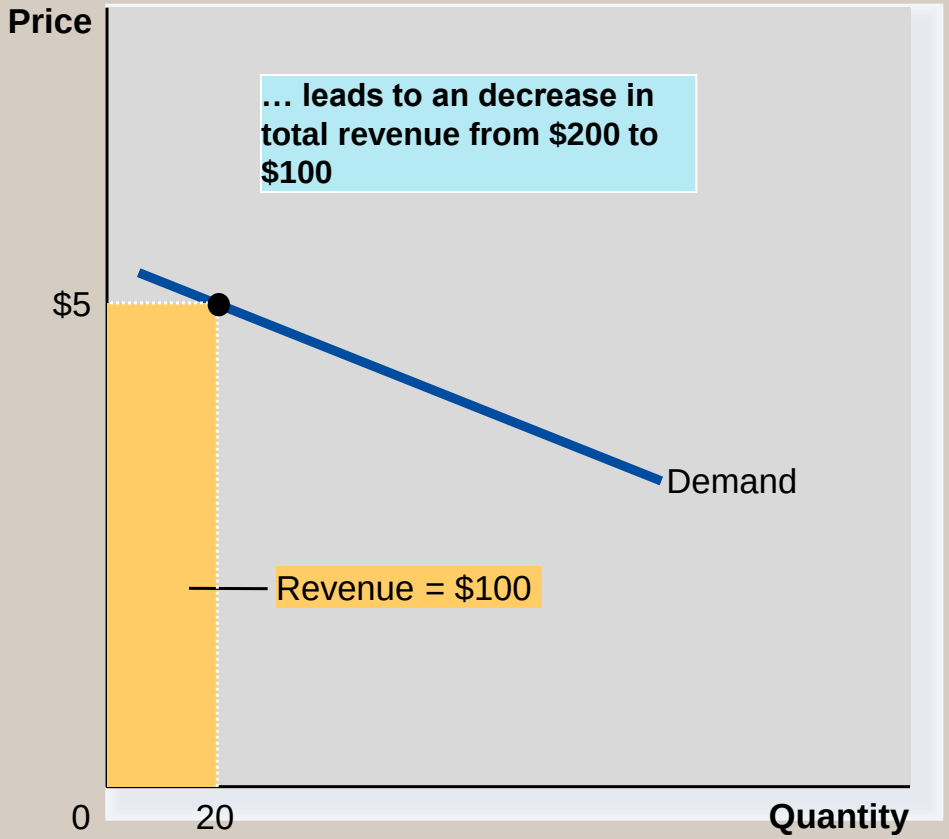


How does TR change as one moves along the demand curve?

- With an elastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately larger.
- Thus, *total revenue decreases.*

Figure 4 How Total Revenue Changes When Price Changes: Elastic Demand





Elasticity and the total revenue

- TR (total revenue) must be equal to TE (total consumer expenditures)

	P increase	P decrease
E>1 (elastic demand)	TR=TE decrease	TR=TE increase
E<1 (inelastic demand)	TR=TE increase	TR=TE decrease

To cut the long story short…

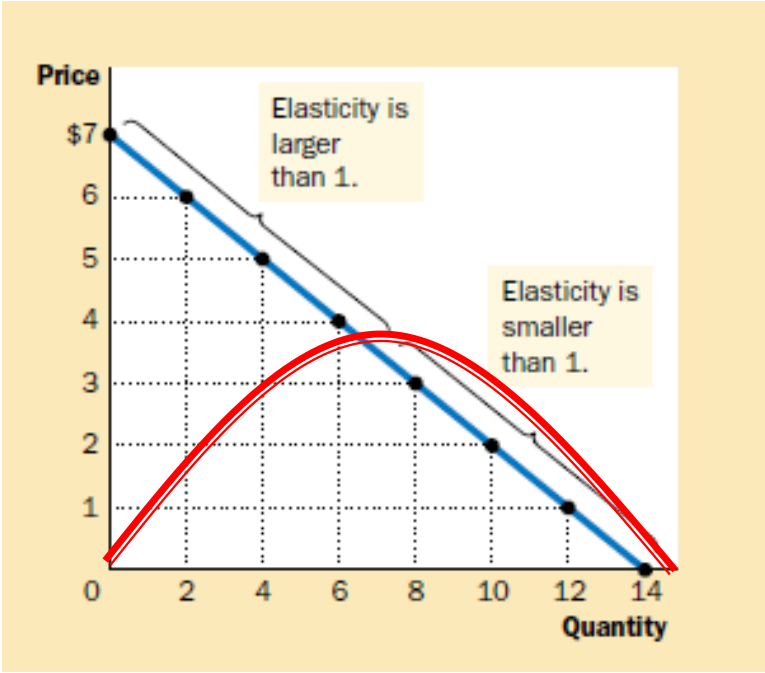
- When a demand curve is inelastic (Ep < 1), a price and TR change in the same direction.
- When a demand curve is elastic (Ep>1), a price and TR change in opposite direction.
- In the special case of unit elastic demand (Ep=1) a change in the price does not affect TR.

But what happens when the elasticity is not the same along the demand curve?

A linear demand curve

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

TR is maximum at the $E_p=1$



Price	Quantity	Total Revenue (Price × Quantity)	Percent Change in Price	Percent Change in Quantity	Elasticity	Description
$7	0	$ 0				
			15	200	13.0	Elastic
6	2	12				
			18	67	3.7	Elastic
5	4	20				
			22	40	1.8	Elastic
4	6	24				
			29	29	1.0	Unit elastic
3	8	24				
			40	22	0.6	Inelastic
2	10	20				
			67	18	0.3	Inelastic
1	12	12				
			200	15	0.1	Inelastic
0	14	0				

Case study: pricing admission to the museum

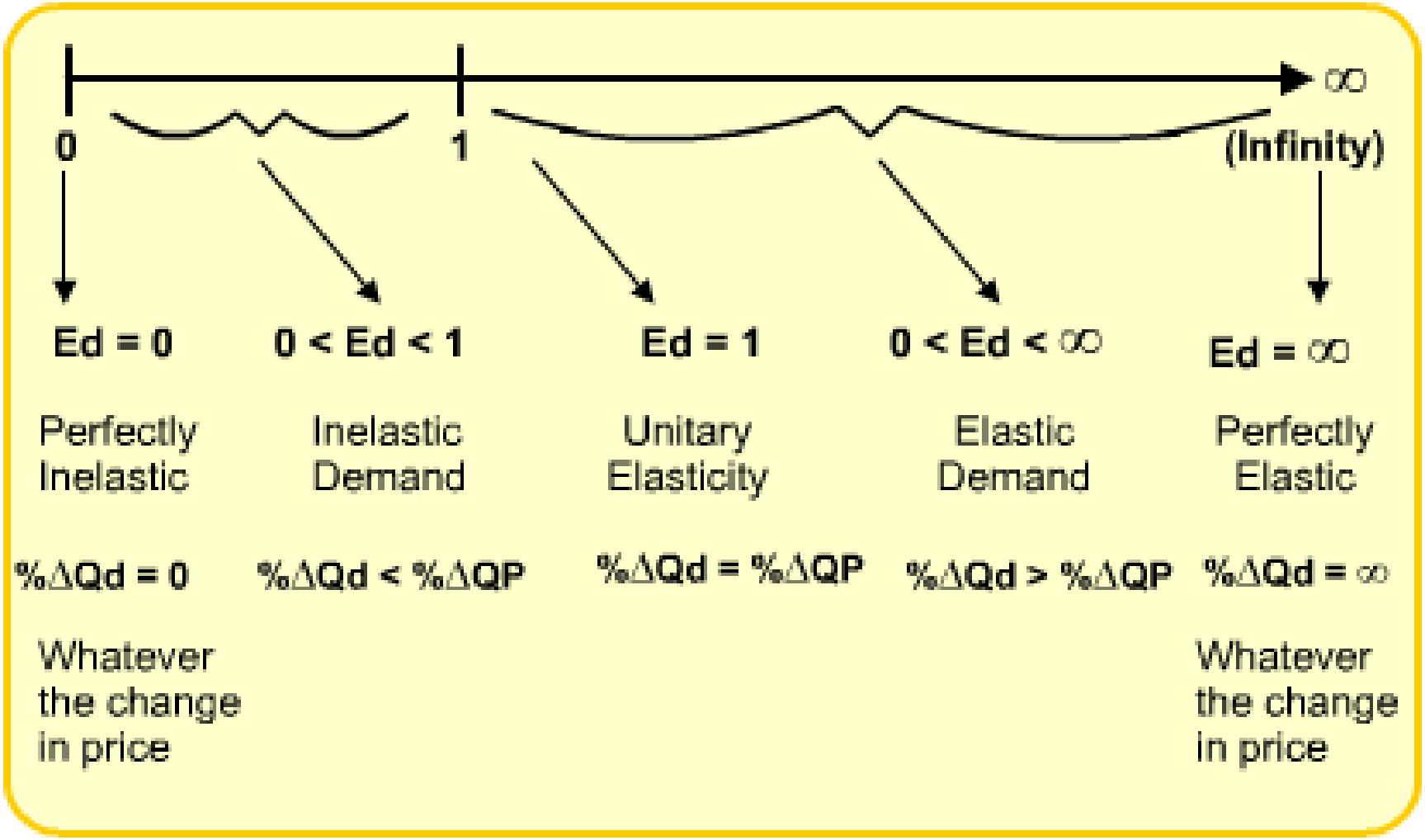
- Imagine that your a curator of a major art museum. Your director of finance tells you that the museum is running short of funds and suggest changing the price of admission to increase total revenue.
- What do you do? Do you raise the price of admission or do you lower it?

Example

Pharmaceutical drugs have an inelastic demand, and computers have an elastic demand. Suppose that technological advance doubles the supply of both products (that is, the quantity supplied at each price is twice what it was):

- What happens to the equilibrium price and quantity in each market?
- Which product experiences a larger change in price?
- Which product experiences a larger change in quantity?
- What happens to total consumer spending on each product?

To sum up…


0
1
∞
(Infinity)
Ed = 0
0 < Ed < 1
Ed = 1
0 < Ed < ∞
Ed = ∞
Perfectly Inelastic
Inelastic Demand
Unitary Elasticity
Elastic Demand
Perfectly Elastic
%ΔQd = 0
%ΔQd < %ΔQP
%ΔQd = %ΔQP
%ΔQd > %ΔQP
%ΔQd = ∞
Whatever the change in price
Whatever the change in price

Examples

Study	Product	Method	short-run price elasticity	long-run price elasticity	long-run income elasticity
Dahl and Sterner (1991)	gasoline	literature survey	-0.26	-0.86	1.21
Espey (1998)	gasoline	literature survey	-0.26	-0.58	0.88
Graham and Glaister (2004)	gasoline				
Brons, et. al. (2008)	gasoline				
Dahl (1993)	oil (developing countries)				
Cooper (2003)	oil (average of 23 countries)				

Foodstuffs	Price elasticity
beef	0,57
fresh fish	0,83
milk	0,43
kefir	0,72
wheatmeal bread	0,4
apples	0,59
tea	0,41
vegetable oil	0,45
boiled sausage	1,36
sausage	1,38
chocolate	1,42
spice-cake	1,38
cookie	1,29
vodka	1,56
wine	1,31
champagne	0,95

Other demand elasticities

- Income elasticity of demand
- Cross-price elasticity of demand…

Income Elasticity of Demand

- It is computed as the percentage change in the quantity demanded divided by the percentage change in income.

Income elasticity of demand measures how much the quantity demanded of a good responds to a change in consumers' income.

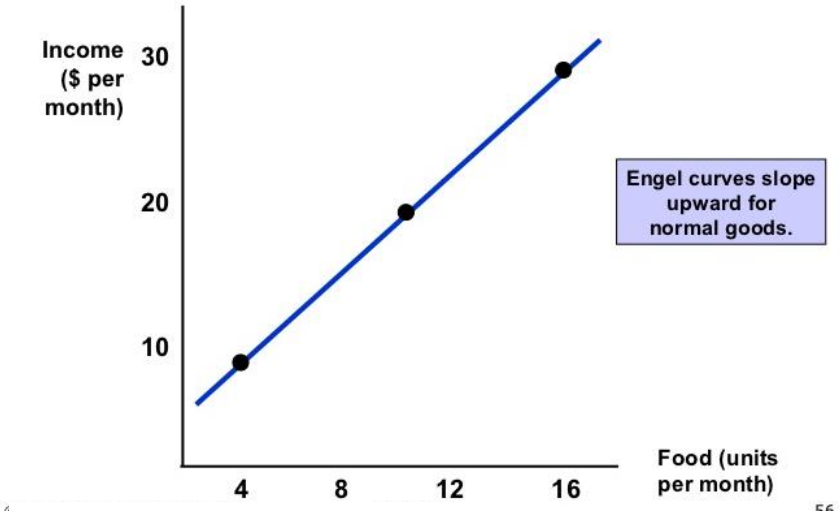
Computing Income Elasticity

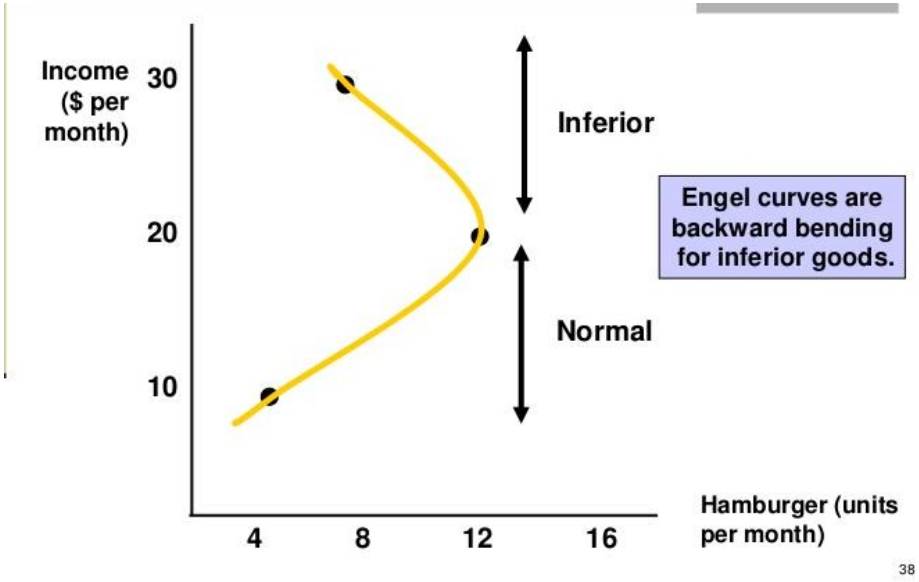
$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

$$E_I = \frac{\%\Delta Q_x}{\%\Delta I} = \frac{\dfrac{\Delta Q_x}{Q_x}}{\dfrac{\Delta I}{I_x}}$$

Engle curves

- They present the relation between quantity demanded and real income.
- In panel (a) food is a normal good, and the curve is upward sloping.
- In panel (b) hamburger is a normal good by the income lower than $20/month and an inferior good by the higher income.





Engel law

Engel law: when the real income increases, the share of consumer's expenditures on inferior and normal goods decreases and the share of expenditures on the luxury goods increases.

Income Elasticity

- Types of Goods
  - Normal Goods
  - Inferior Goods
- Higher income raises the quantity demanded for normal goods, but lowers the quantity demanded for inferior goods.

Income elasticity

Type of goods	Income elasticity	Change in income	Change in the quantity demanded	example
normal	>0	increase	increase	soap
• necessities	0-1	increase	increase lower than 1%	food
• luxuries	>1	increase	increase greater than 1%	sailboat, yacht
inferior	<0	increase	decrease	bus rides

Income Elasticity

- Goods consumers regard as necessities tend to be income inelastic:
  - Examples include food, fuel, clothing, utilities, and medical services.
- Goods consumers regard as luxuries tend to be income elastic:
  - Examples include sports cars, furs, and expensive foods.

The cross-price elasticity of demand

Cross-price elasticity of demand: a measure of how much the quantity demanded of one good responds to a change in the price of another good.

$$E_C = \frac{\%\Delta Q_x}{\%\Delta P_y} = \frac{\frac{\Delta Q_x}{Q_x}}{\frac{\Delta P_y}{P_y}}$$

The cross-price elasticity of demand

- In case of substitutes the cross-price elasticity is positive.
- In case of complements the cross-price elasticity is negative.

Example

- What is the cross-price elasticity of demand for good X, if the quantity demanded for this good has decreased by 10% in reaction on price increase of good Y from 10000 euro to 10500 euro?
- Are goods X and Y substitutes or complements? Explain.

Examples

- Cross-price elasticity of electrical energy in reaction on the change of gas price is 0.13.
- Cross-price elasticity of beef in reaction on the change of price of pork is 0.12.
- Are those goods substitues or complements?

The elasticity of supply

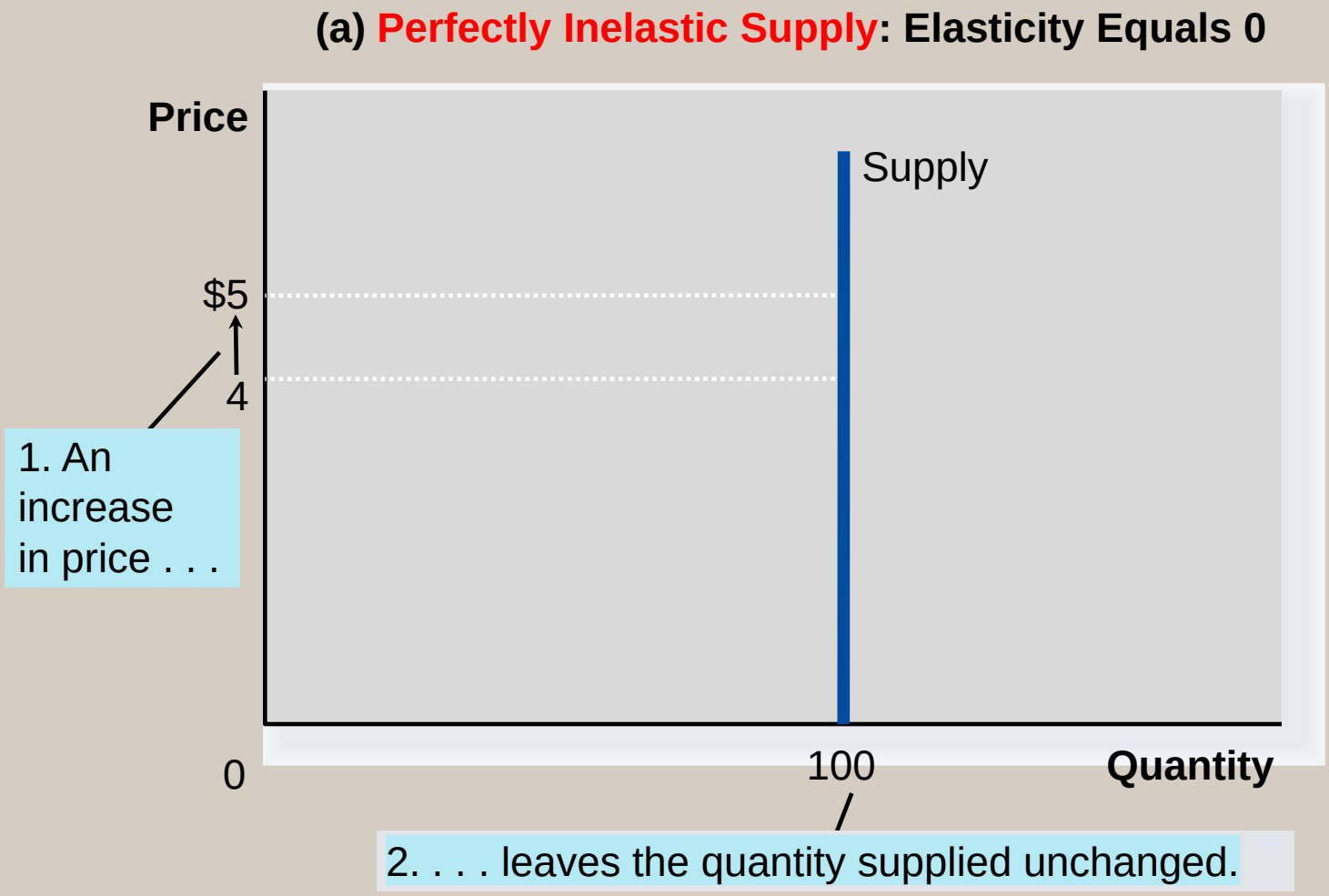
- Price elasticity of supply is the percentage change in quantity supplied resulting from a percent change in price.

Price elasticity of supply
is a measure of how much the quantity supplied of a good responds to a change in the price of that good.

Determinants of Elasticity of Supply

- Ability of sellers to change the amount of the good they produce
  - Beach (seaside) is inelastic
  - Books, cars, or manufactured goods are elastic.
- Time period
  - Supply is more elastic in the long run.

Figure 6 The Price Elasticity of Supply



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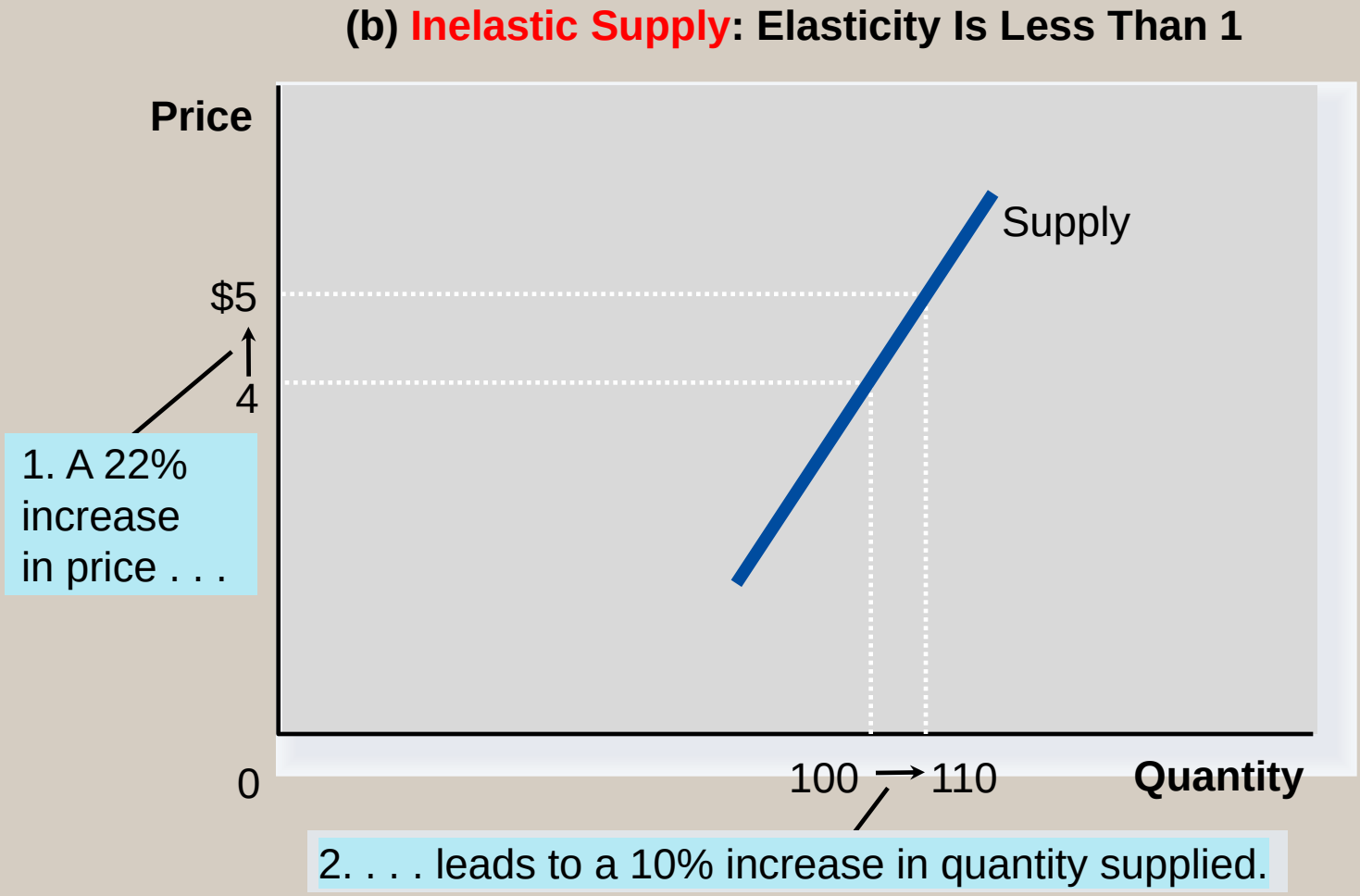

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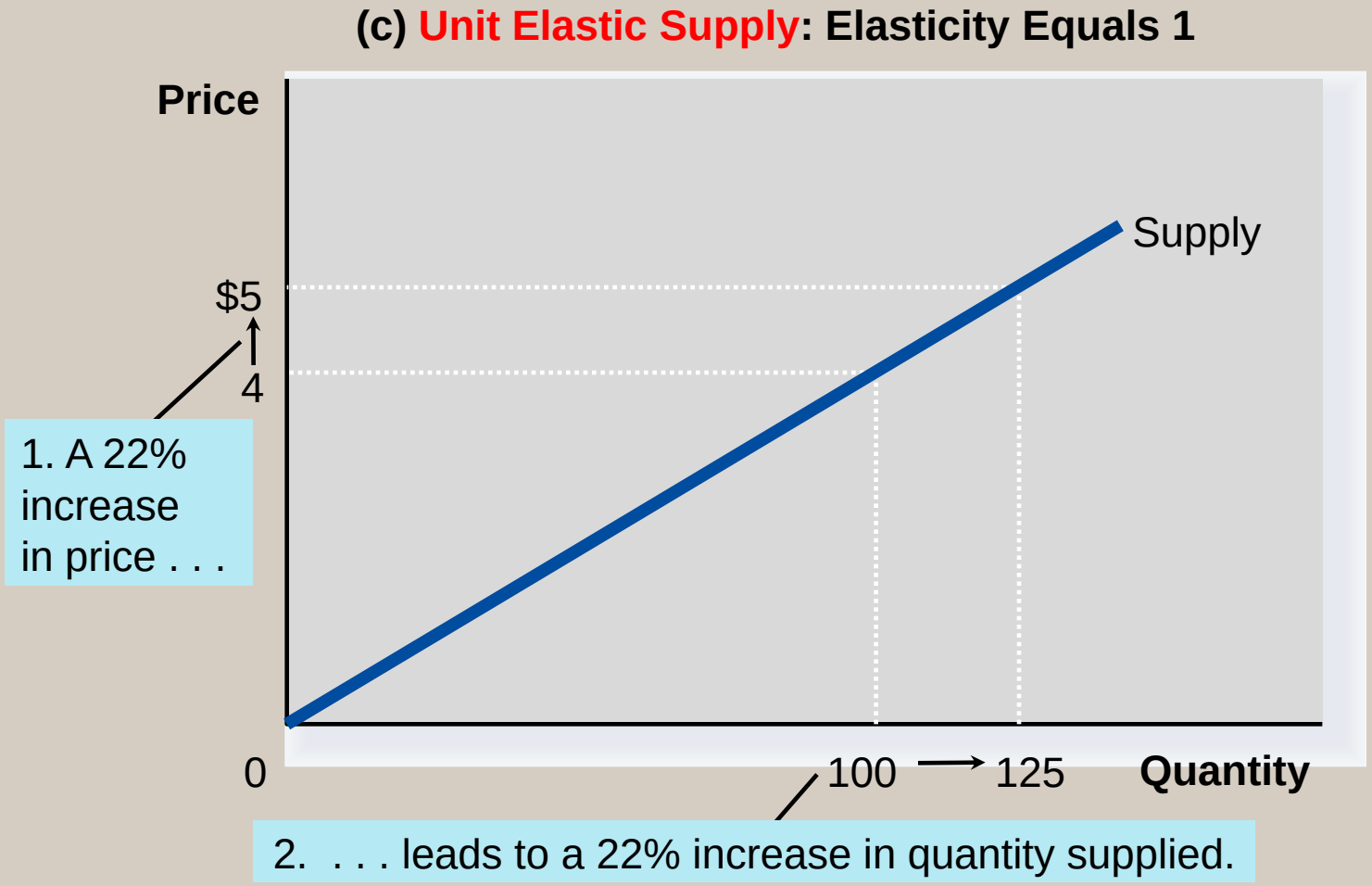

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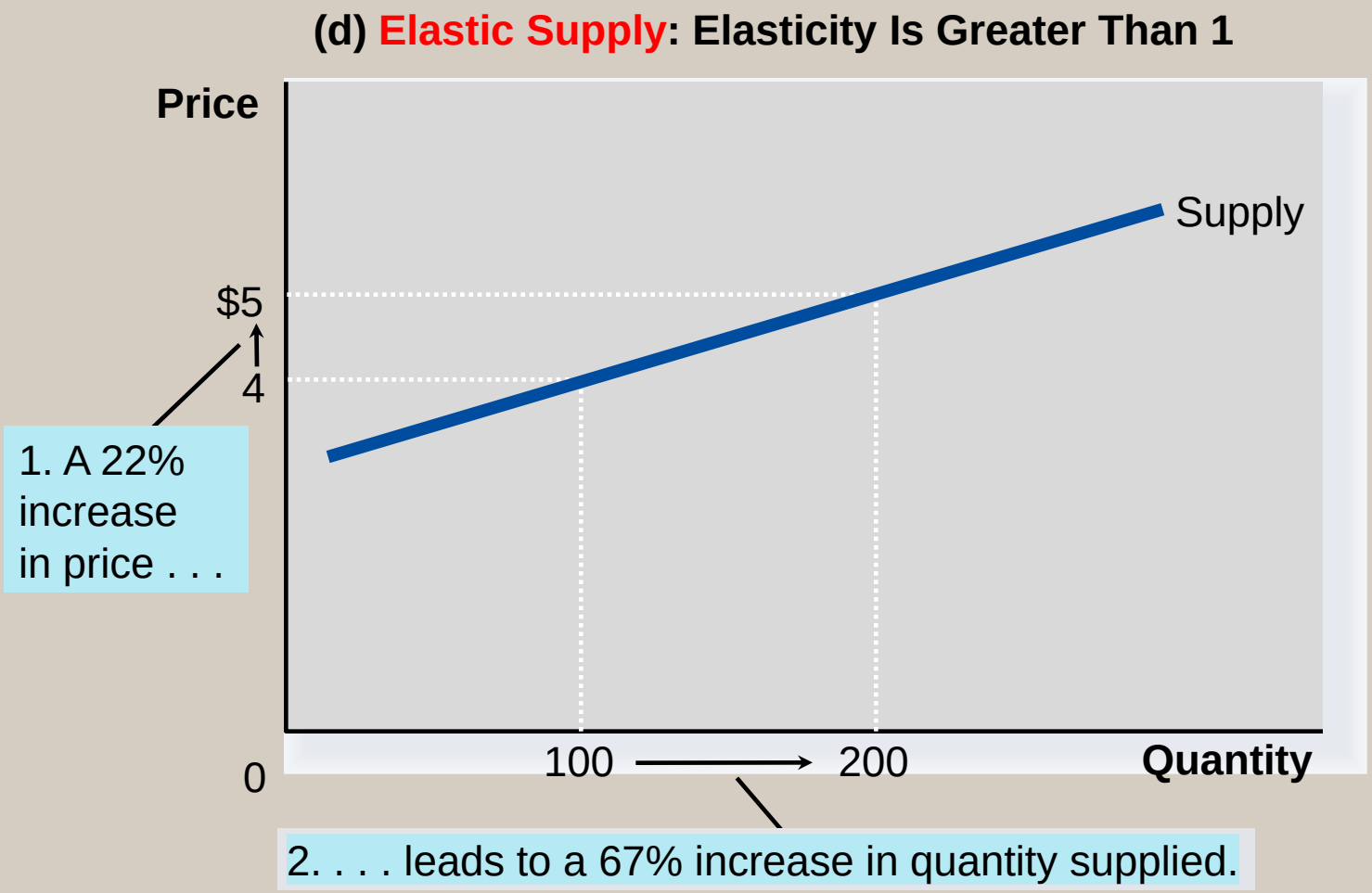

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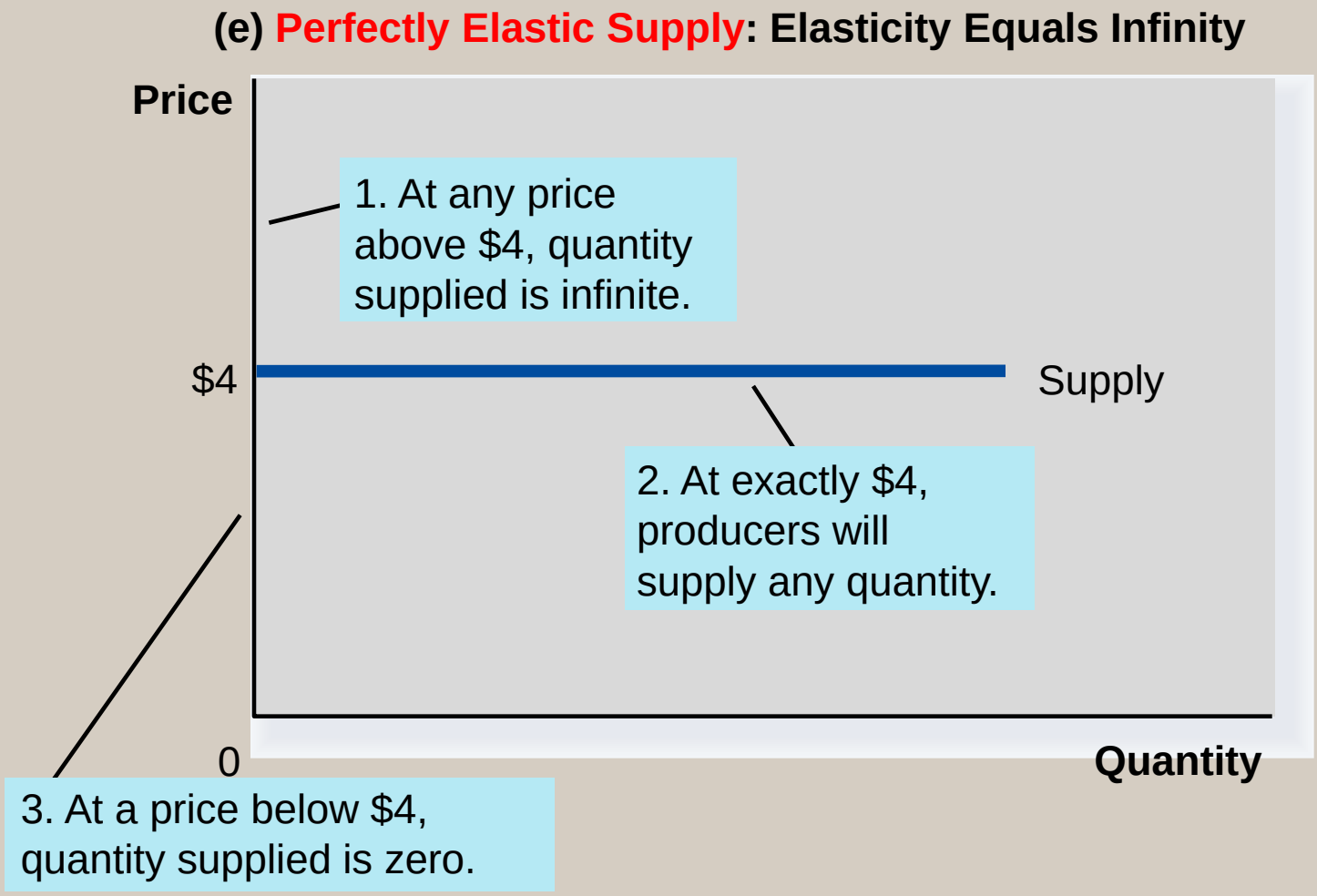
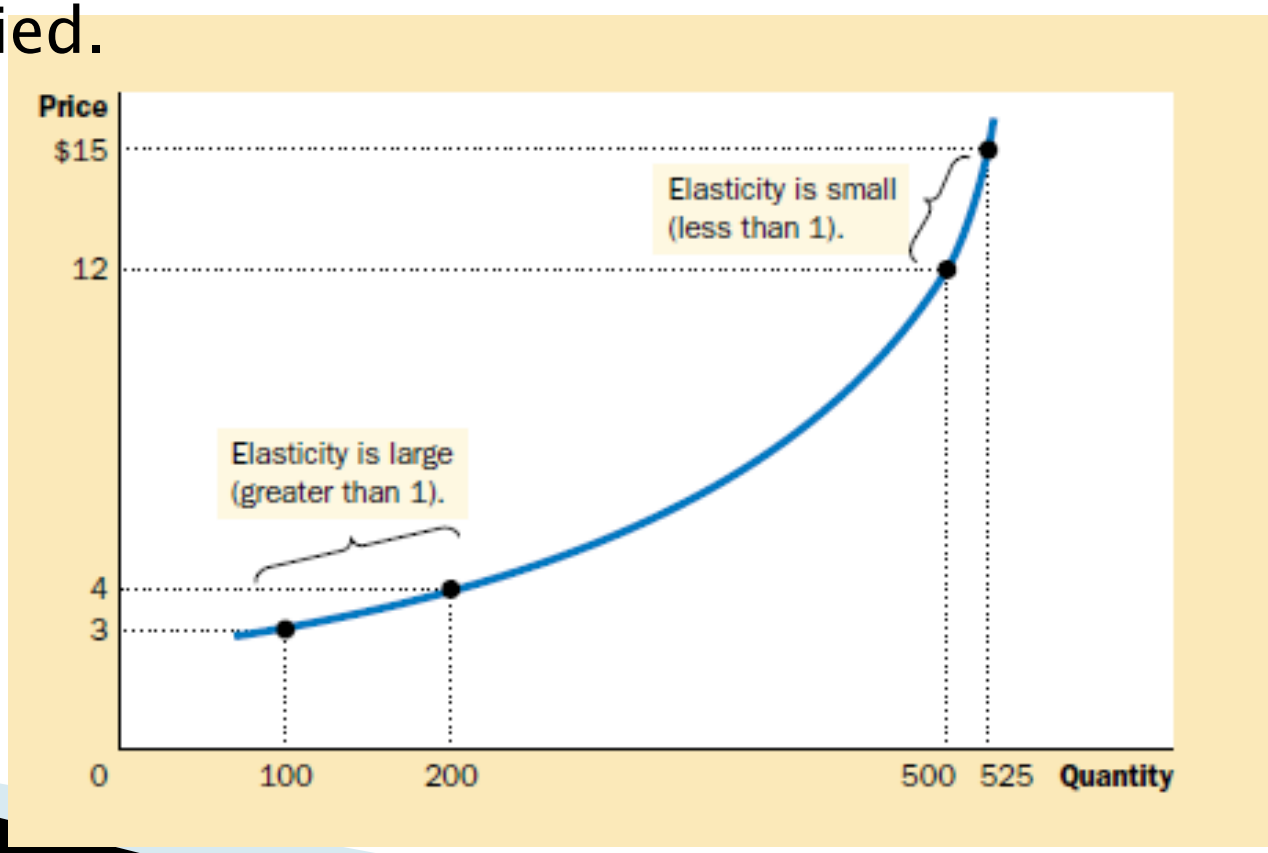


How the Price Elasticity of Supply can vary?

- Because firms often have a maximum capacity for production, the Es may be very high at low levels of quantity supplied and very low at high levels of quantity supplied.



Computing the Price Elasticity of Supply

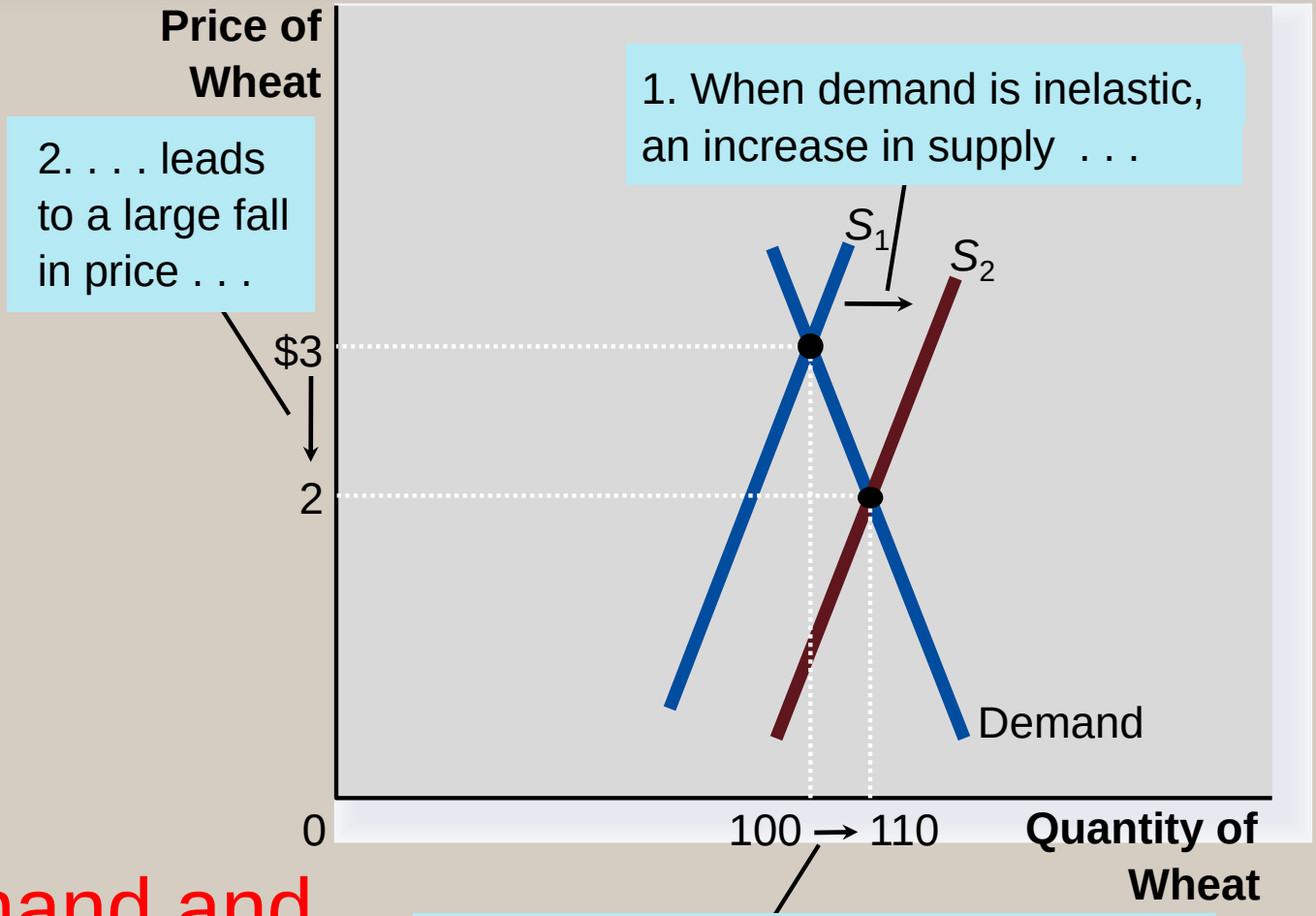
- The price elasticity of supply is computed as the percentage change in the quantity supplied divided by the percentage change in price.

$$E_s = \frac{\%\Delta Q_{sx}}{\%\Delta P_x} = \frac{\frac{\Delta Q_{sx}}{Q_{sx}}}{\frac{\Delta P_x}{P_x}}$$

Applications of 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?

Figure 8 An Increase in Supply in the Market for Wheat

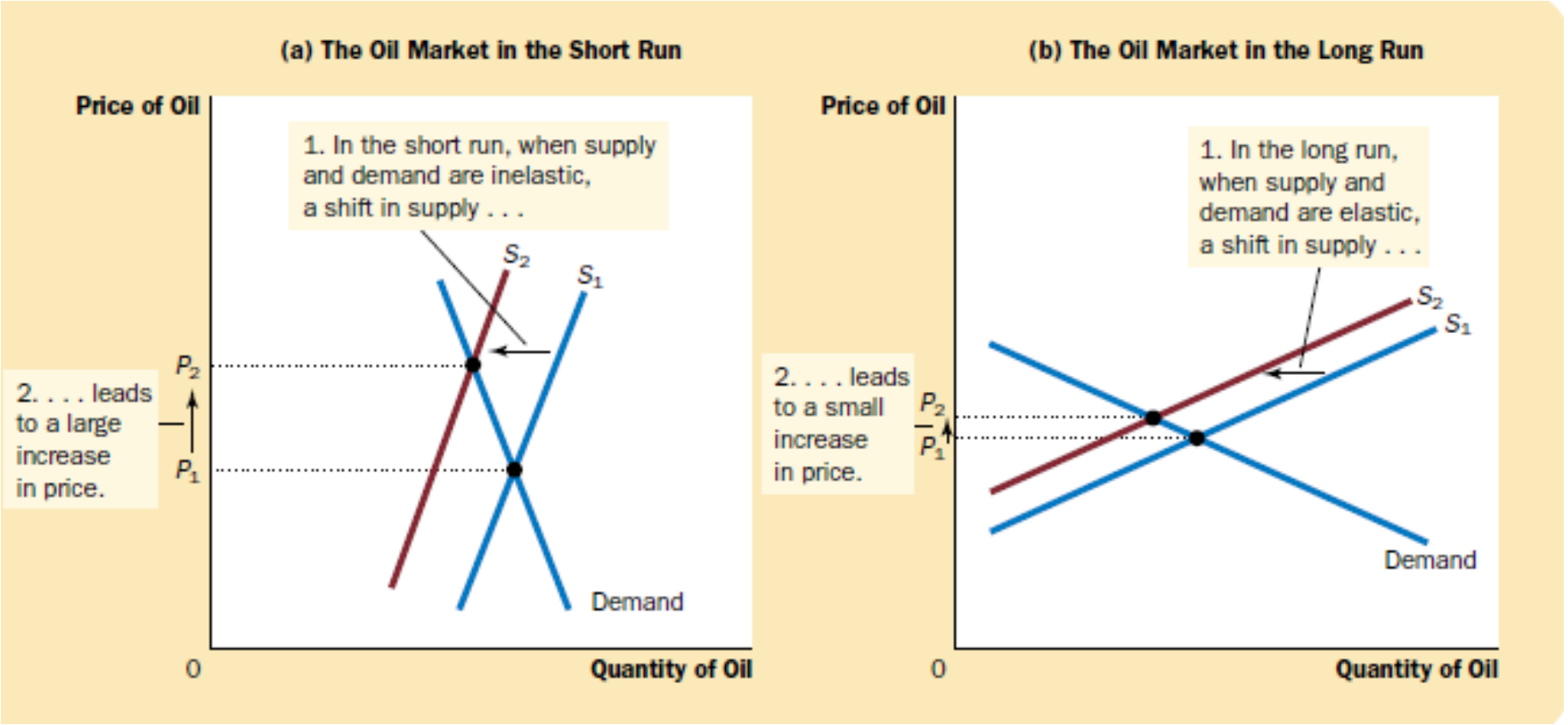


Demand and supply are inelastic

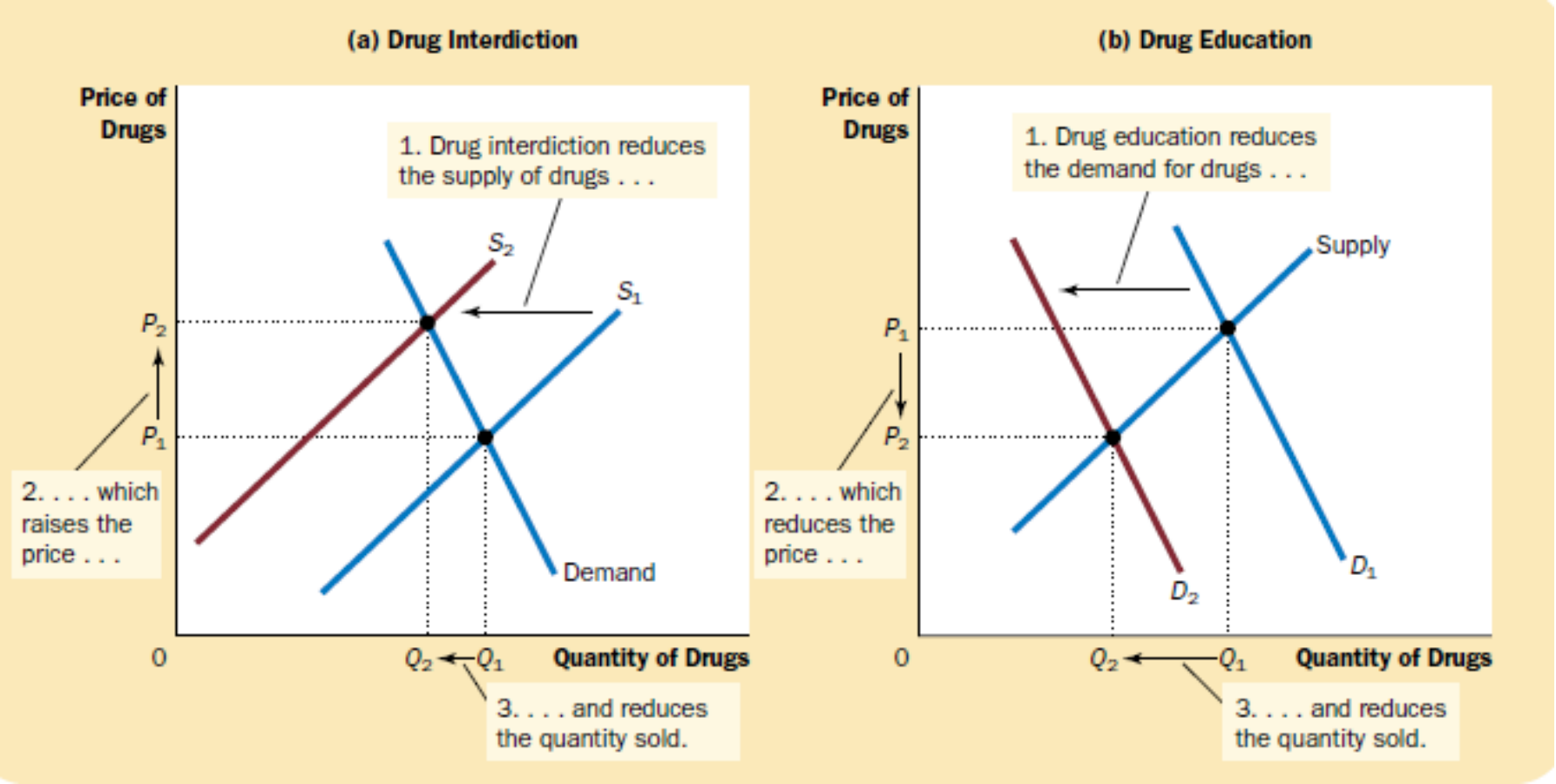
Conclusions

- In the U.S. in 1950 10 milion people worked in agricultare, representing 17% of the labor force.
- In 1998 only 3 milion people worked on farms, representing 2% of the labor force.
- Simultanesly, farms produced more than twice the output in 1998 as they did in 1950!

Why did OPEC fail to keep the price of oil high?



Does drug interdiction increase or decrease drug-related crime?



Example

Consider public policy aimed at smoking:

- Studies indicate that the price elasticity of demand for cigarettes is about 0.4. If a pack of cigarettes currently costs $2 and the government wants to reduce smoking by 20%, by how much should it increase the price?
- If the government permanently increases the price of cigarettes, will the policy have a larger effect on smoking one year from now of five years from now?
- Studies also find that teenagers have a higher price elasticity than do adults. Why might this be true?

Summary

- www.youtube.com/watch?v=VhKI8cOaYLI
- www.youtube.com/watch?v=E6n61c7G6K0
- www.youtube.com/watch?v=N-k8509h9bc