

ECC1000: Principles of Microeconomics



Lecture 3

Elasticity and Applications



Outline

- Elasticities
 - General definition
 - Various elasticities
- Price elasticity of demand
 - Definition
 - How to calculate it
 - Its determinants
 - Price elasticity and total revenue
- Applications



On Valentine's Day the price of roses always increases more sharply than the price of greeting cards. Why?

Elasticity: general definition

- Is a measure of how responsive one variable (dependent variable, 'caused by', say Y) is to changes in another variable (independent variable, 'causes', say X).
- It is generally defined as
$$\frac{\% \text{ change in } Y}{\% \text{ change in } X} = \frac{\Delta Y / Y}{\Delta X / X} = \frac{\Delta Y}{\Delta X} \frac{X}{Y}.$$
- and called "X elasticity of Y".
- For those familiar with calculus, $\frac{\Delta Y}{\Delta X}$ is the derivative of Y with respect to X, so 'X elasticity of Y' is $\frac{dY}{dX} \frac{X}{Y}.$

Why elasticity, not slope?

- Suppose that when the price of wine rises from \$20 to \$30 a bottle, the quantity demanded falls from 150 bottles to 100 bottles a day.
- Slope = $\Delta Q / \Delta P = (-50) / 10 = -5$.
- But what does -5 mean?
- If the price was measured in cents instead of dollars, then the slope would be -0.05.
- Elasticity is free of measurement units (or 'unit-less') since it is the ratio of percentage changes.

Various elasticities

- (Own) Price elasticity of demand: $\frac{\Delta Q^d / Q^d}{\Delta P / P}$
 - Independent variable – price (P)
 - Dependent variable – quantity demanded (Q^d)
 - Since it's always negative (law of demand!), we drop the negative sign.
- Cross price elasticity of demand: $\frac{\Delta Q_Y^d / Q_Y^d}{\Delta P_X / P_X}$
 - Independent variable – price of a related good (P_X) (substitute or complement)
 - Dependent variable – quantity demanded (Q_Y^d)
 - If it is positive (negative), the two goods are substitutes (complements).

Various elasticities

● Income elasticity of demand: $\frac{\Delta Q^d / Q^d}{\Delta Y / Y}$

- Independent variable – income (Y)
- Dependent variable – quantity demanded
- If it is positive, the good is normal (examples?).
- If it is negative, the good is inferior (examples?).

● Price elasticity of supply: $\frac{\Delta Q^s / Q^s}{\Delta P / P}$

- Independent variable – price
- Dependent variable – quantity supplied (Q^s)

Some estimates of price elasticities of demand (1970, US)

Restaurant meals	1.63
Taxi service	1.34
Furniture	1.01
Housing	1.00
Alcohol	0.92
Movies	0.87
Overseas air travel	0.77
Tobacco	0.4
Auto repair	0.36
Medical insurance	0.31
Gasoline and oil	0.14

Some estimates of income elasticities of demand (1970, US)

Alcohol	1.54
Housing (owner)	1.49
Furniture	1.48
Dental service	1.42
Restaurant meals	1.40
Medical insurance	0.92
Gasoline and oil	0.48
Butter	0.42
Coffee	0.00
Margarine	-0.20
Flour	-0.36

Some estimates of cross-price elasticities of demand (1977, US)

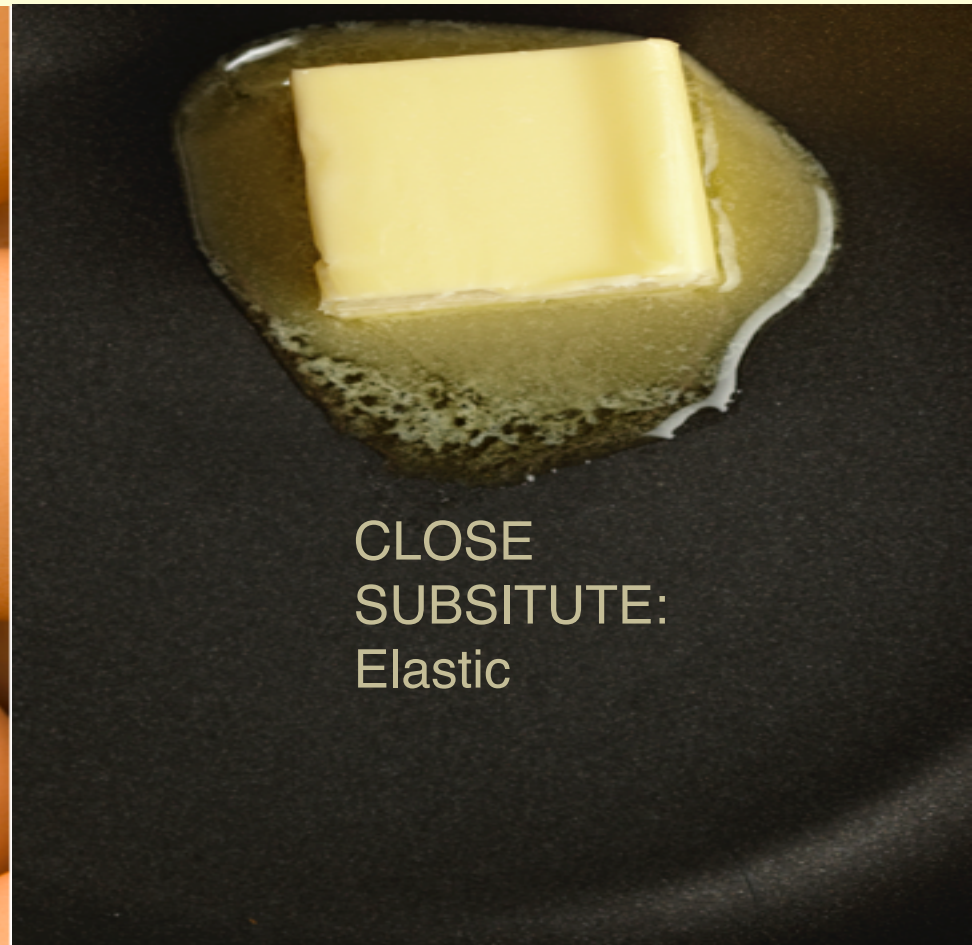
Commodity	With respect to	Cross-price elasticity
Beef	Pork	0.28
Pork	Beef	0.14
Butter	Margarine	0.67
Margarine	Butter	0.81
Electricity	Natural gas	0.20
Natural gas	Fuel oil	0.44



Price elasticity of demand

- Since quantity demanded and price are negatively related, we drop the negative sign.
- Demand is
 - perfectly elastic if the elasticity is infinity;
 - elastic if the elasticity > 1 ;
 - unit elastic if the elasticity $= 1$;
 - inelastic if the elasticity < 1 ;
 - perfectly inelastic if the elasticity $= 0$.
- Generally, demand tends to more elastic if people can find substitutes more easily.

Determinants of price elasticity of demand 1: availability of substitutes



Determinants of price elasticity of demand 2: necessities vs luxuries

NECESSITY: Inelastic

LUXURY: Elastic



Determinants of price elasticity of demand 3: market definition



CLASSICAL MUSIC
(Broad definition of
market): Inelastic

PUCCINI OPERAS
(Narrow definition of
market): Elastic



Determinants of price elasticity of demand 4: time horizon

When the price of petrol goes up,



NOW (less likely to switch):
Inelastic demand in the
short run



FUTURE (more likely to
switch): Elastic demand in
the long run

Calculating price elasticity of demand

- Suppose the quantity demanded (Q) for wine is 150 bottles a day when price (P) is \$20 and 100 bottles when the price is \$30. Calculate the price elasticity of demand.
- We need to calculate $\frac{\% \text{ change in } Q}{\% \text{ change in } P} = \frac{\Delta Q/Q}{\Delta P/P}$.
- We know $\Delta P = 10$ and $\Delta Q = 50$.
- But which P and Q do we use for the base?
- If we use $P = 20$ as the base, then the elasticity is $\frac{50/150}{10/20} = \frac{2}{3}$.
- If we use $P = 30$ as the base, then the elasticity is $\frac{50/100}{10/30} = \frac{3}{2}$.
- What do we do?

Calculating price elasticity of demand: mid-point method

- Suppose the quantity demanded (Q) for wine is 150 bottles a day when price (P) is \$20 and 100 bottles when the price is \$30. Calculate the price elasticity of demand.
- We need to calculate $\frac{\% \text{ change in } Q}{\% \text{ change in } P} = \frac{\Delta Q / Q}{\Delta P / P}$.
- But which P and Q do we use for the base?
- Use the mid-point (average) of the two prices (and quantities) as the base: mid-point P = 25, mid-point Q = 125.
- Then the elasticity is $\frac{50/125}{10/25} = 1$.

When to use (or not to use) the mid-point method?

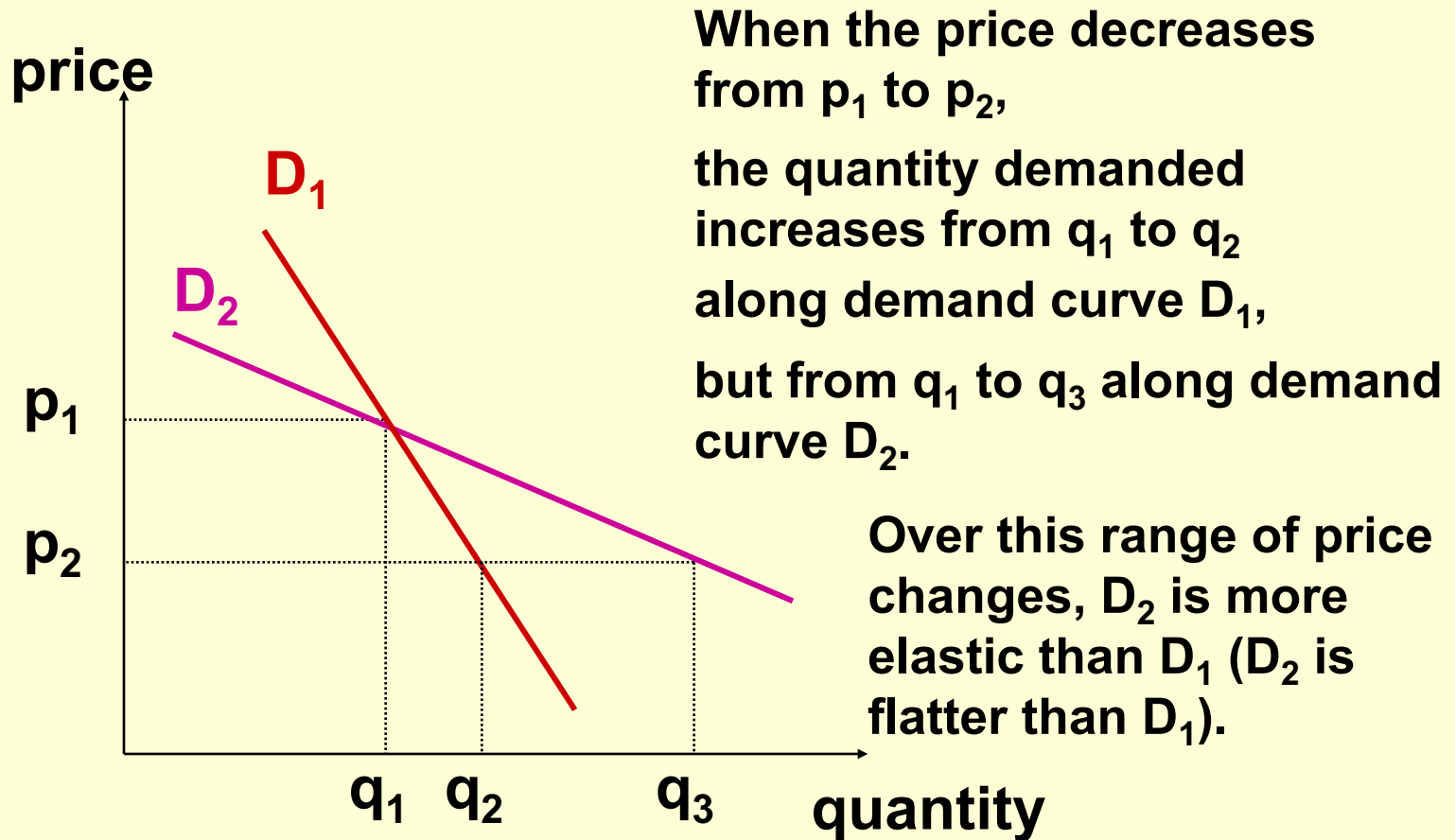
- Use the mid-point method when it is stated clearly that you should use the mid-point method.
 - Example: [...] calculate the elasticity using the mid-point method.
- If the base point (where the change started) is clear from the question, and if you are not asked to use the mid-point method, then use the starting point as the base.
 - Example: When price changed from \$10 to \$12, the quantity demanded decreased from 20 to 10. What is the price elasticity of demand?

Shapes of demand curve and the price elasticity of demand

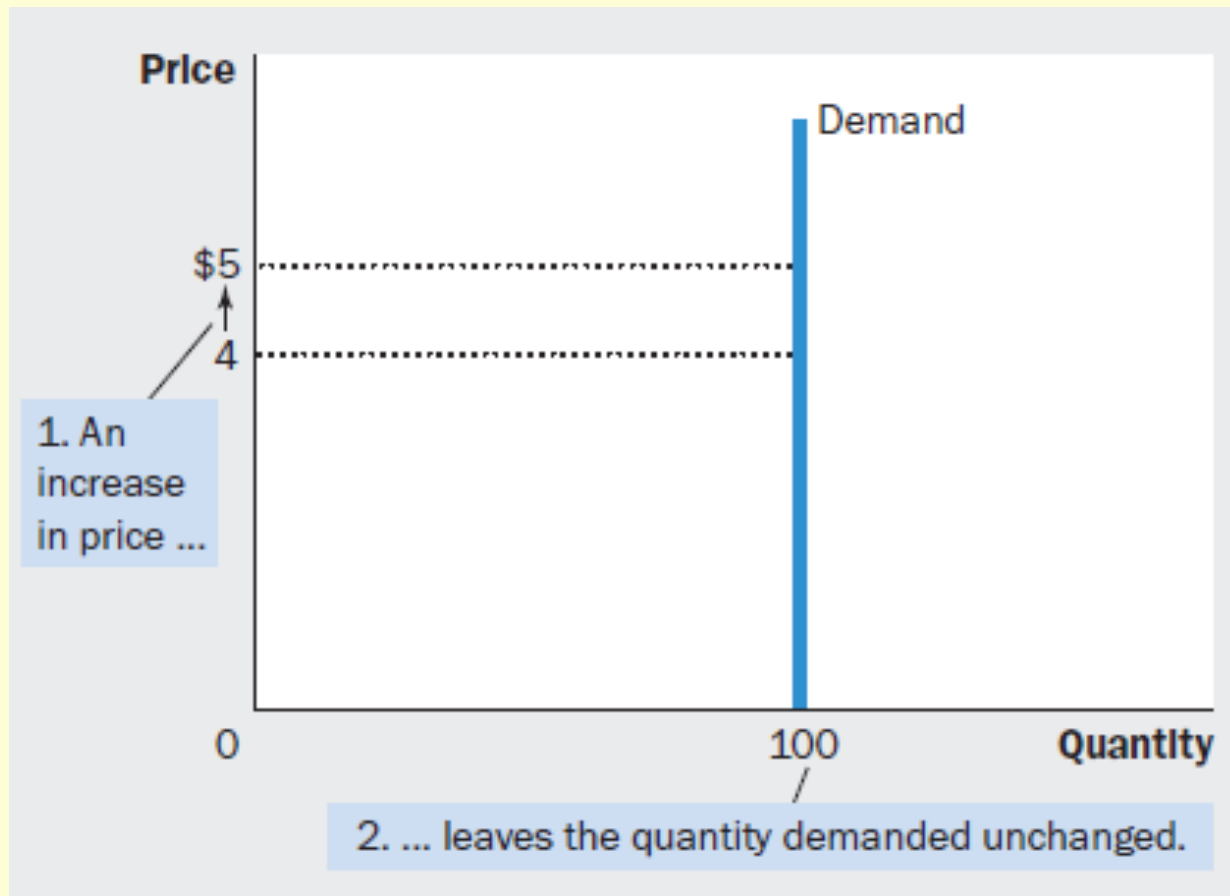
- Since the slope of demand curve is related to how quantity demanded changes as price changes, the shape of demand curve tells us something about the price elasticity of demand.
- Recall price elasticity of demand is $\frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{\Delta P} \frac{P}{Q}$.

$\frac{1}{\text{slope}}$
- So the price elasticity of demand and the slope of demand curve “tend to be” inversely related.

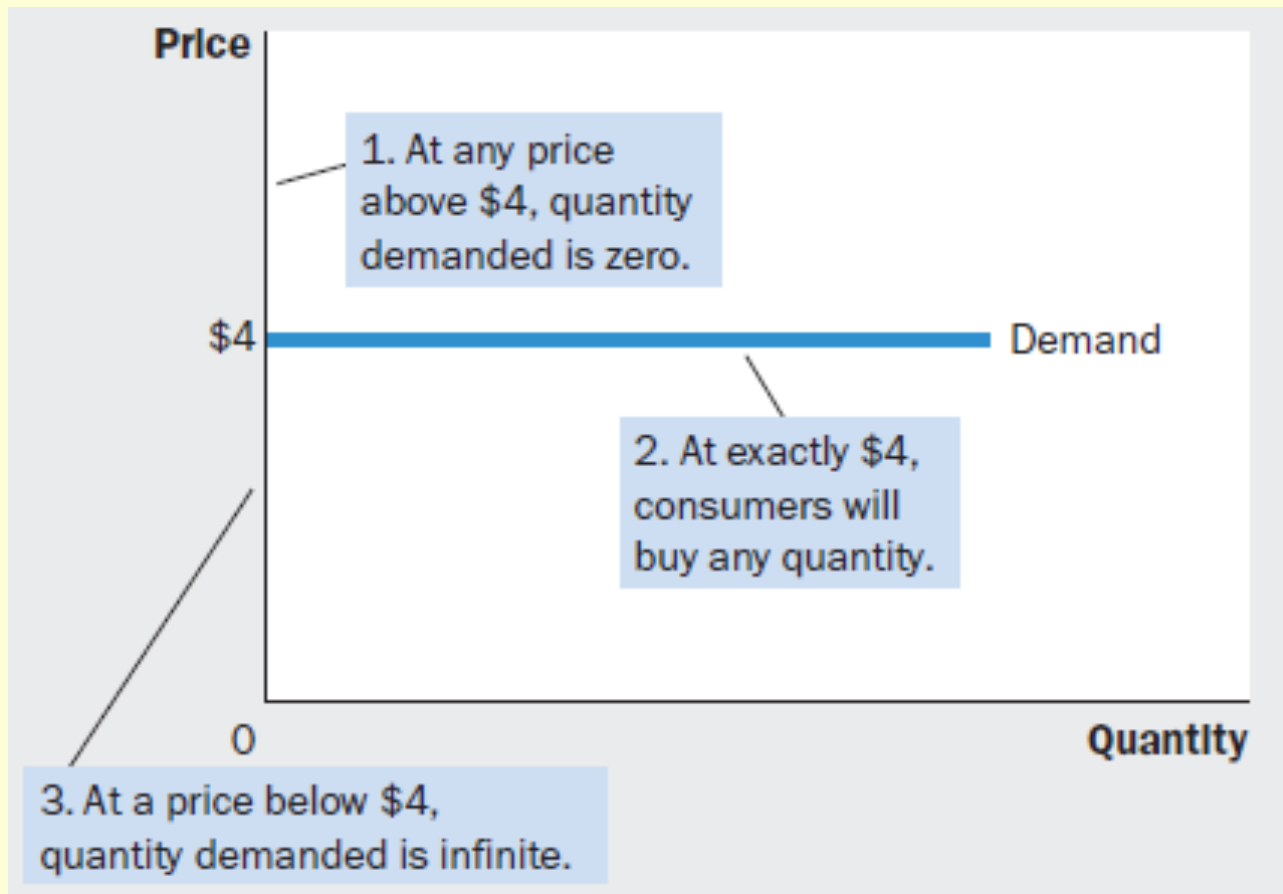
Demand curve and the price elasticity of demand



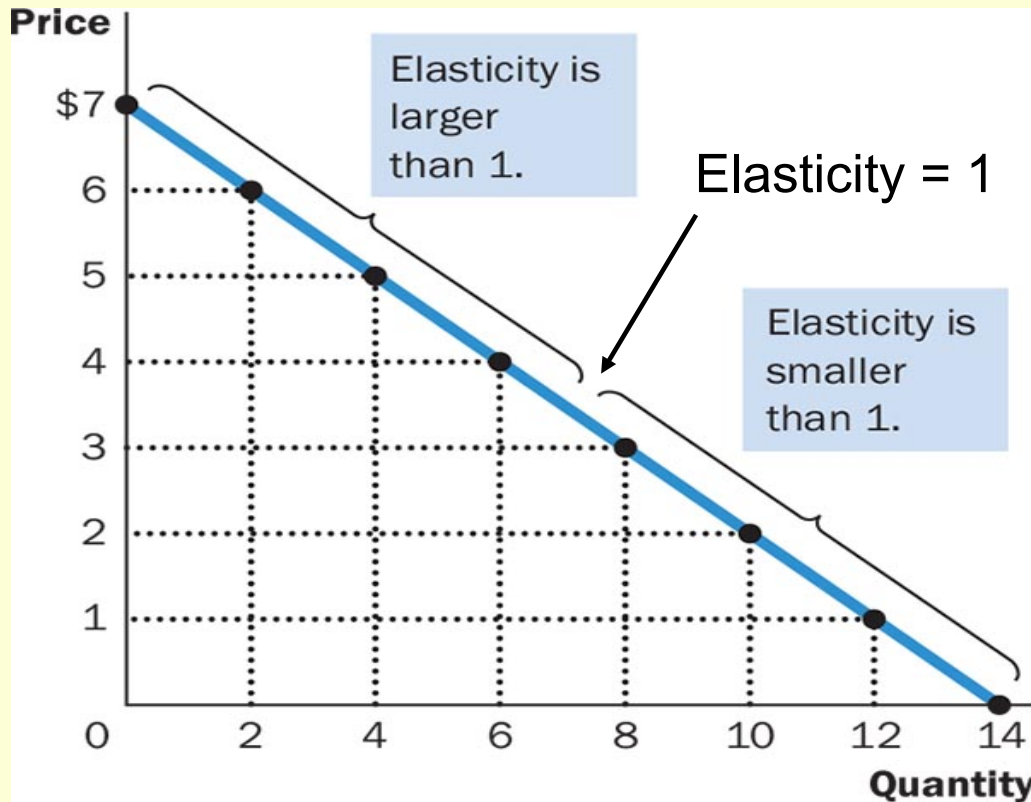
Perfectly inelastic demand = vertical demand curve



Perfectly elastic demand = horizontal demand curve



Linear demand curve:
elasticity rises as price rises (recall $\frac{\Delta Q}{\Delta P} \frac{P}{Q}$)



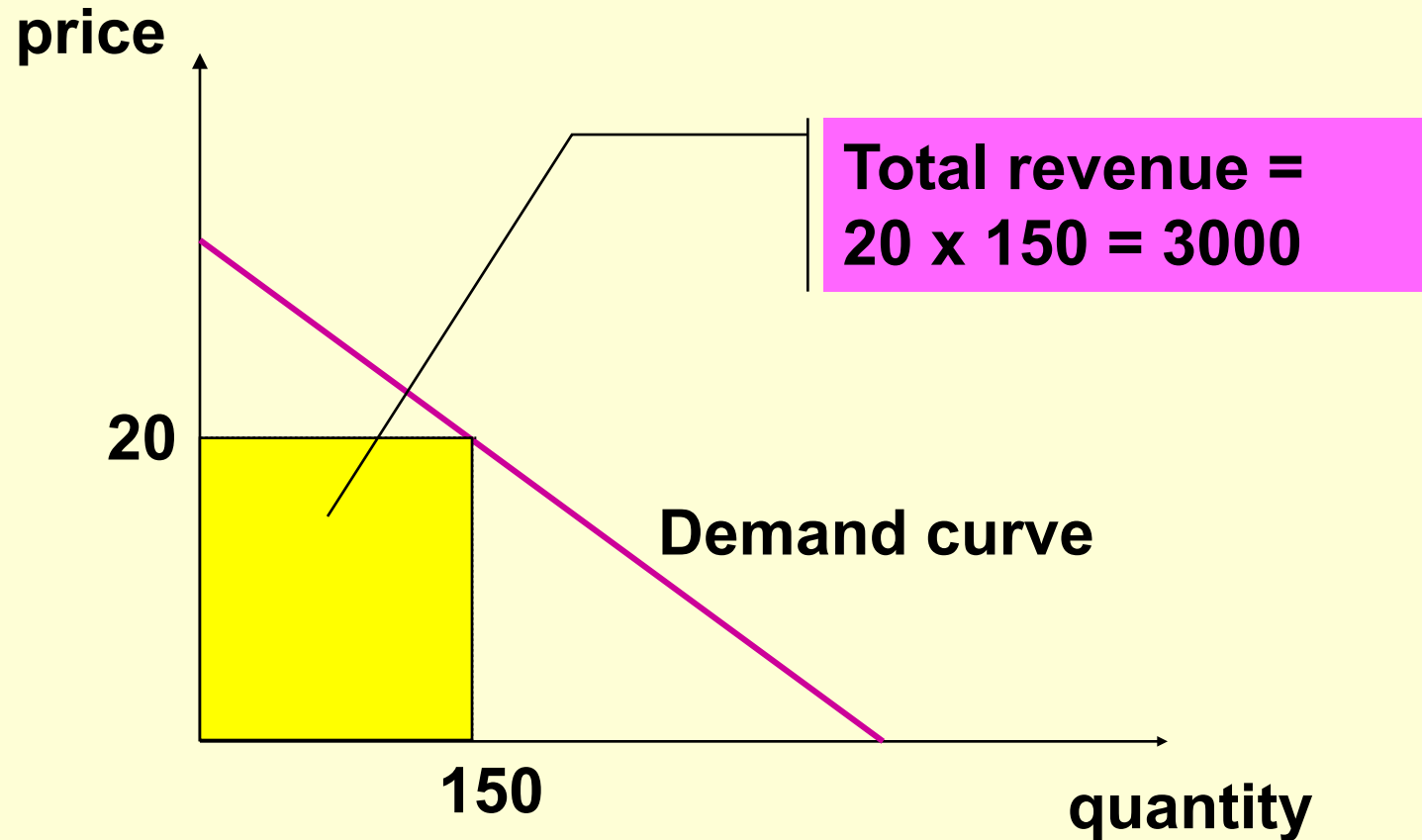
As price increases, elasticity increases. As price decreases, elasticity decreases. At the mid-point on the demand curve, elasticity is 1.



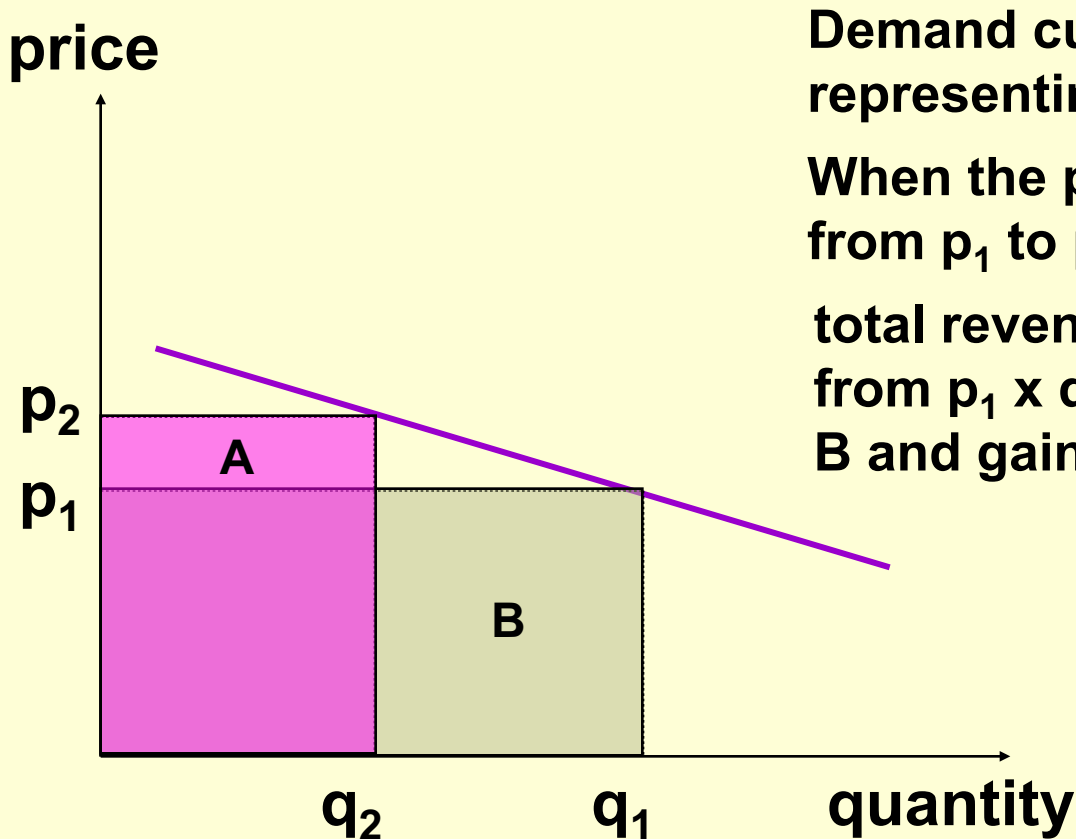
Application: total revenue and the price elasticity of demand

- Total revenue is the amount paid by buyers and received by sellers of a good.
- It is computed as the price of the good times the quantity sold.

Application: total revenue and the price elasticity of demand



Application: total revenue and the price elasticity of demand



Demand curve is rather flat, representing elastic demand.

When the price increases from p_1 to p_2 , total revenue decreases from $p_1 \times q_1$ to $p_2 \times q_2$ (you lose B and gain A).



Application: total revenue and the price elasticity of demand

- If demand is elastic, then an increase in price leads to a decrease in quantity demanded that is proportionately larger.
- Thus, if demand is elastic, then a price increase (decrease) leads to a decrease (increase) in total revenue.
- If demand is inelastic, then an increase in price leads to a decrease in quantity that is proportionately smaller.
- Thus, if demand is inelastic, then a price increase (decrease) leads to an increase (decrease) in total revenue.



Question for discussion: what's bad for agriculture can be good (or bad) for farmers

- In 2013 New Zealand was in the grip of a drought (worst since 1945!). This led to a reduction in milk supplies and a rise in the price. But does this mean New Zealand dairy farmers made more or less money?

Price elasticity of supply

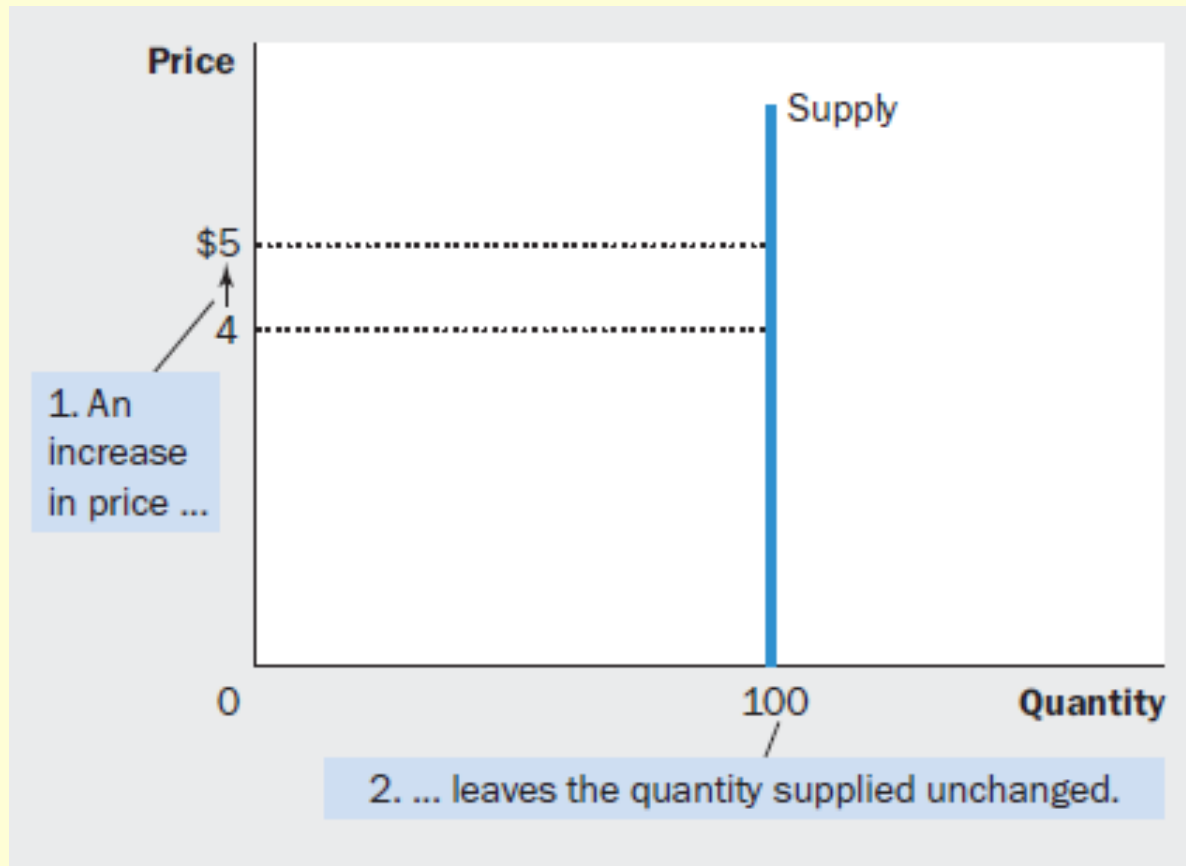
● Price elasticity of supply: $\frac{\Delta Q^S / Q^S}{\Delta P / P} = \frac{\Delta Q^S}{\Delta P} \frac{P}{Q^S}$

- independent variable – price (P)
- dependent variable – quantity supplied (Q^S)

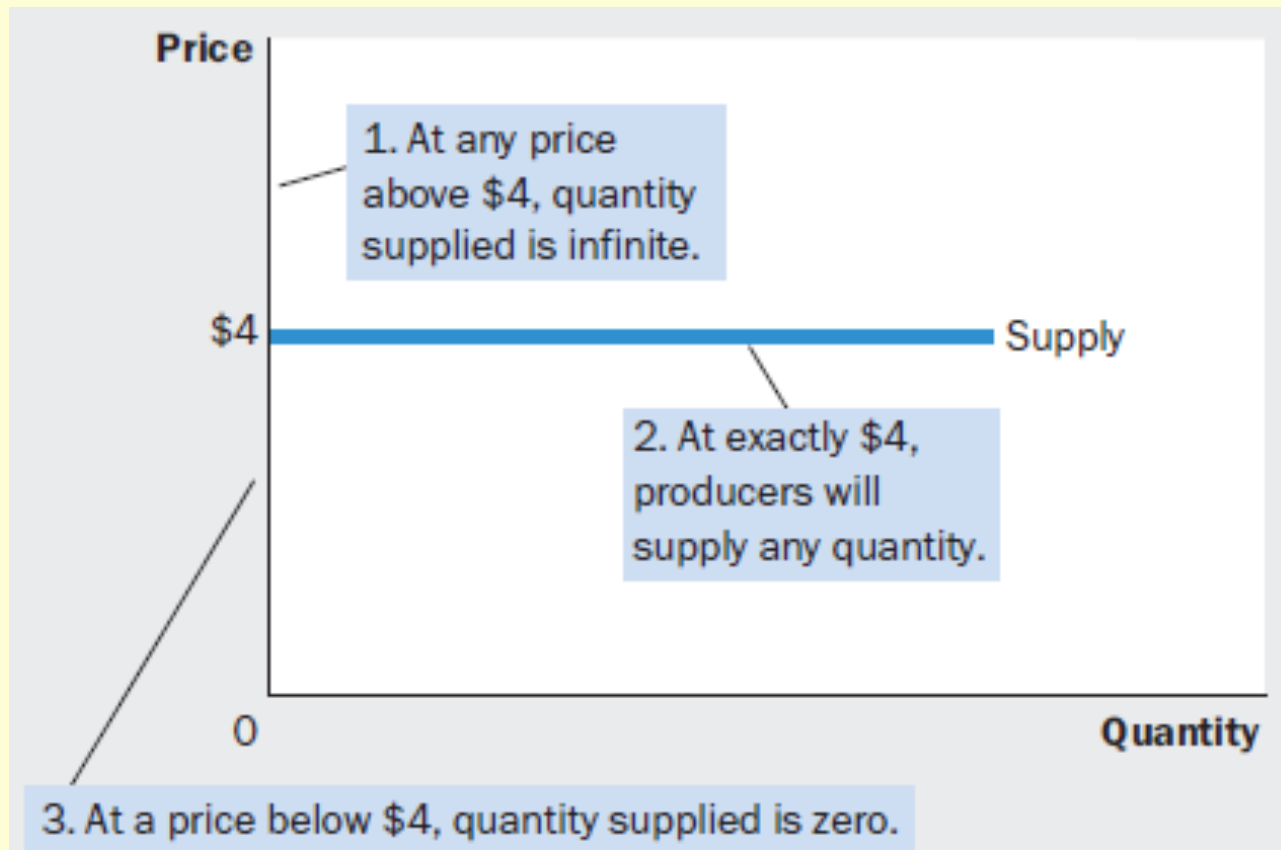
● Price elasticity of supply depends on how flexibly the seller can change the quantity supplied when price changes

- More elastic if production capacity is more flexible (e.g., newspaper vs beachfront land)
- More elastic in the long run

Perfectly inelastic supply = vertical supply curve



Perfectly elastic supply = horizontal supply curve





Questions for discussion: fight against drugs

- Governments around the world put in lots of resources in their fight against drugs. There are largely two approaches.
 - Hawks' approach – tackle supply side by arresting, imprisoning drug dealers, destroying confiscated drugs, etc.
 - Doves' approach – tackle demand side by providing drug education, medical treatments of users, etc.
- What would be the effect of the Hawks' approach?
- What would be the effect of the Doves' approach?
- Which approach do you think is more effective in reducing drug use?



On Valentine's Day the price of roses always increases more sharply than the price of greeting cards. Why?



Recap and what's to come

- Elasticity is a measure how responsive one variable is to a change in another variable.
- It is a ratio of percentage changes, hence free from measurement units.
- We've studied various elasticities: price elasticity of demand, income elasticity of demand, cross price elasticity of demand, and price elasticity of supply.
- We've also looked at how total revenue is related to elasticities, and how we can use this relationship to understand the implications of changes in market equilibrium.
- Next week, we discuss and assess various government policies such as price controls and taxation (Ch 7 first, and then 6, 8).