

# **Environmental Economics**

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EPFL ENAC LEUrE

ENV-471

Master semester 2 or 4

**Catch a parrot and teach him to say  
'supply and demand', and you have  
an excellent economist**



**Popular joke in 19<sup>th</sup> century**

## **Basics DEMAND**



# Determinants of willingness to pay (WTP)

- Potential buyers ("demanders") are willing to buy an item for a maximum price = "**willingness to pay**"
- Demanders bid at or below their willingness to pay, depending on strategic considerations (e.g., what will other buyers bid?)

## Determinants of willingness to pay (WTP)

Personal assessment of the item's qualities: performance, design, label

Personal assessment of the terms of purchase (e.g. seller's reputation, speed of delivery, warranties, down-payment required)

Personal alternatives: other sellers, other products, later purchase (arbitrage)

Speculation: planning to resell the item with a profit

Possible gains from influencing the seller: related deals

Personal capacity to pay: income, savings, access to credit, means of payment

# Who should get the item ?

## What if there is more than one item ?

Possible allocation criteria:

- Those whose name is drawn randomly
- Those who need it most
- Those who deserve it most (buyers' qualities)
- Those who entered their bids first (first come first serve, queuing)
- Those who can best take care of the item
- Those with the highest bids (presumably the highest WTP)

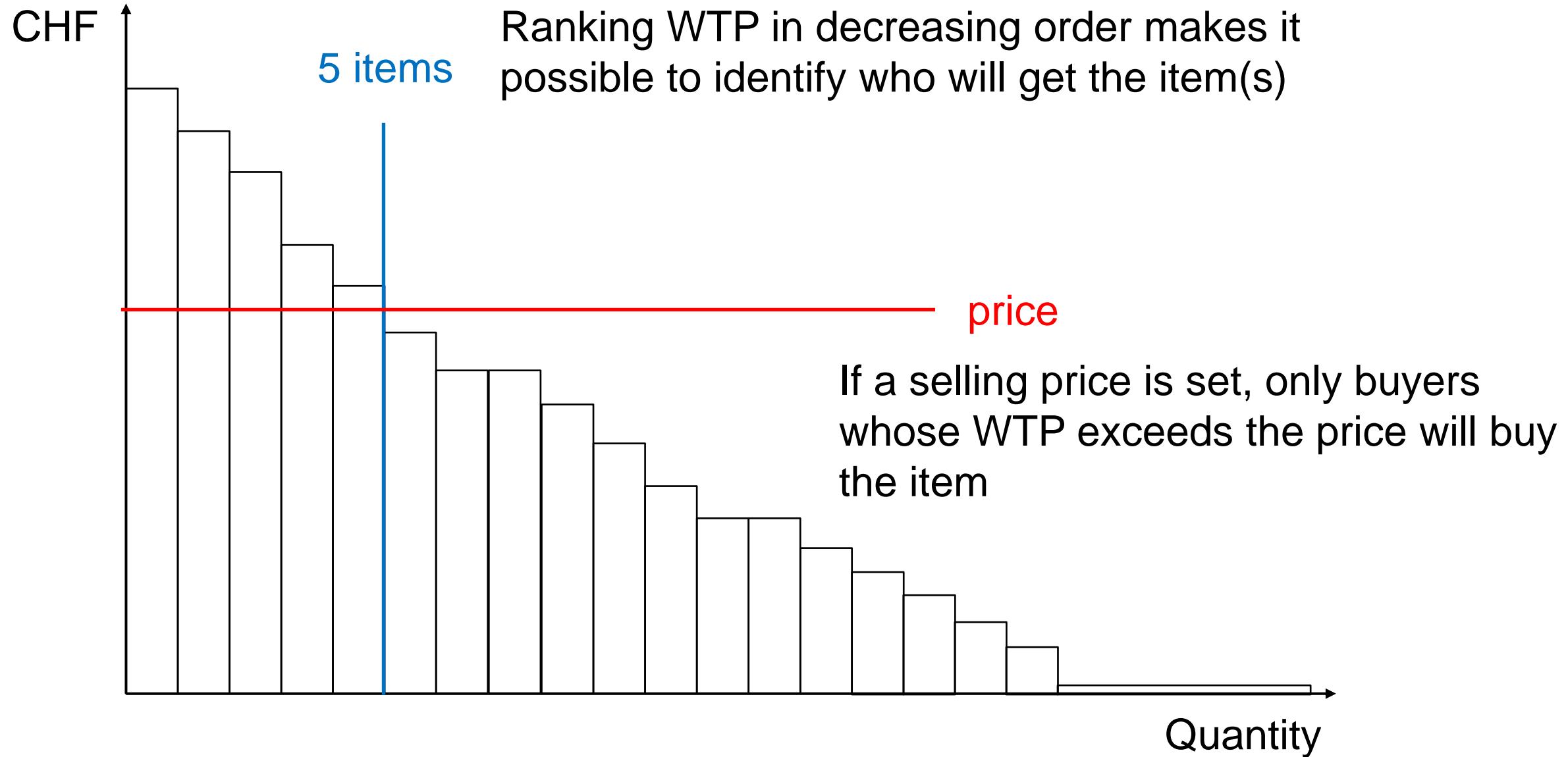


Sellers who strive for maximum profit will sell to the highest bidders

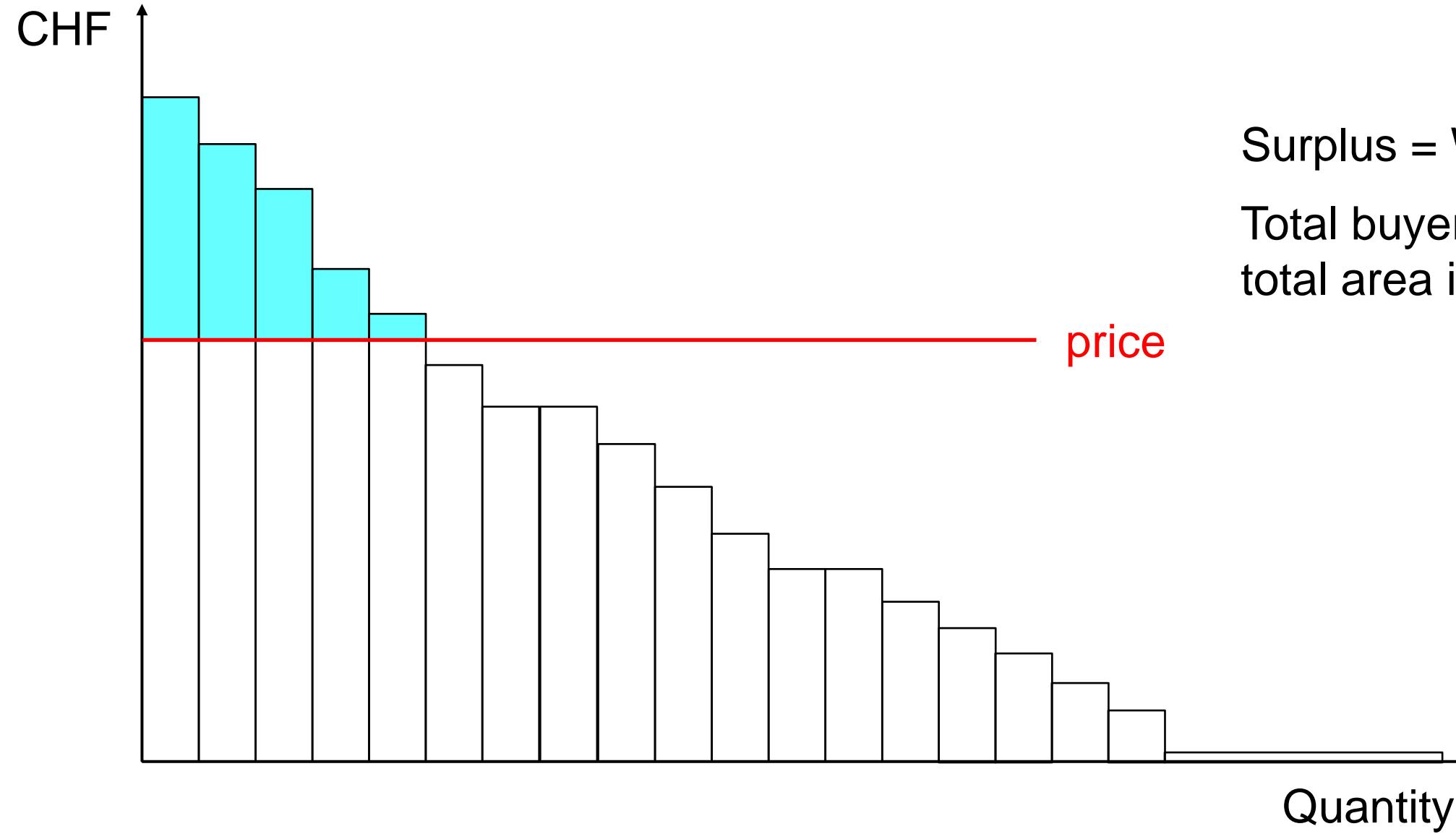
This is assumed to be the standard market outcome

It is seen as acceptable, as high WTP could reflect high need, strong preference, merit-based high capacity to pay, best capacity to use the item, etc.

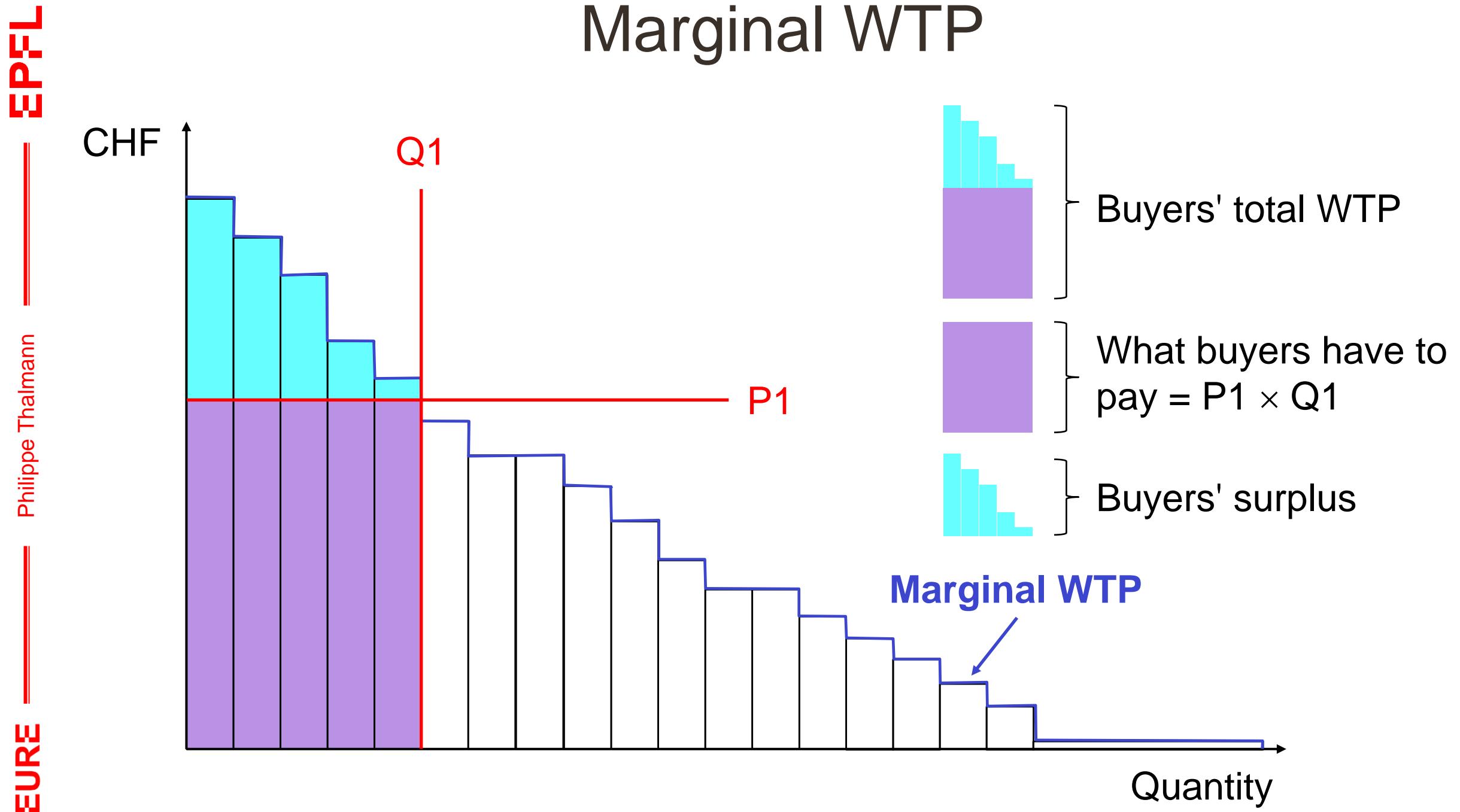
# Ranking bids by decreasing WTP



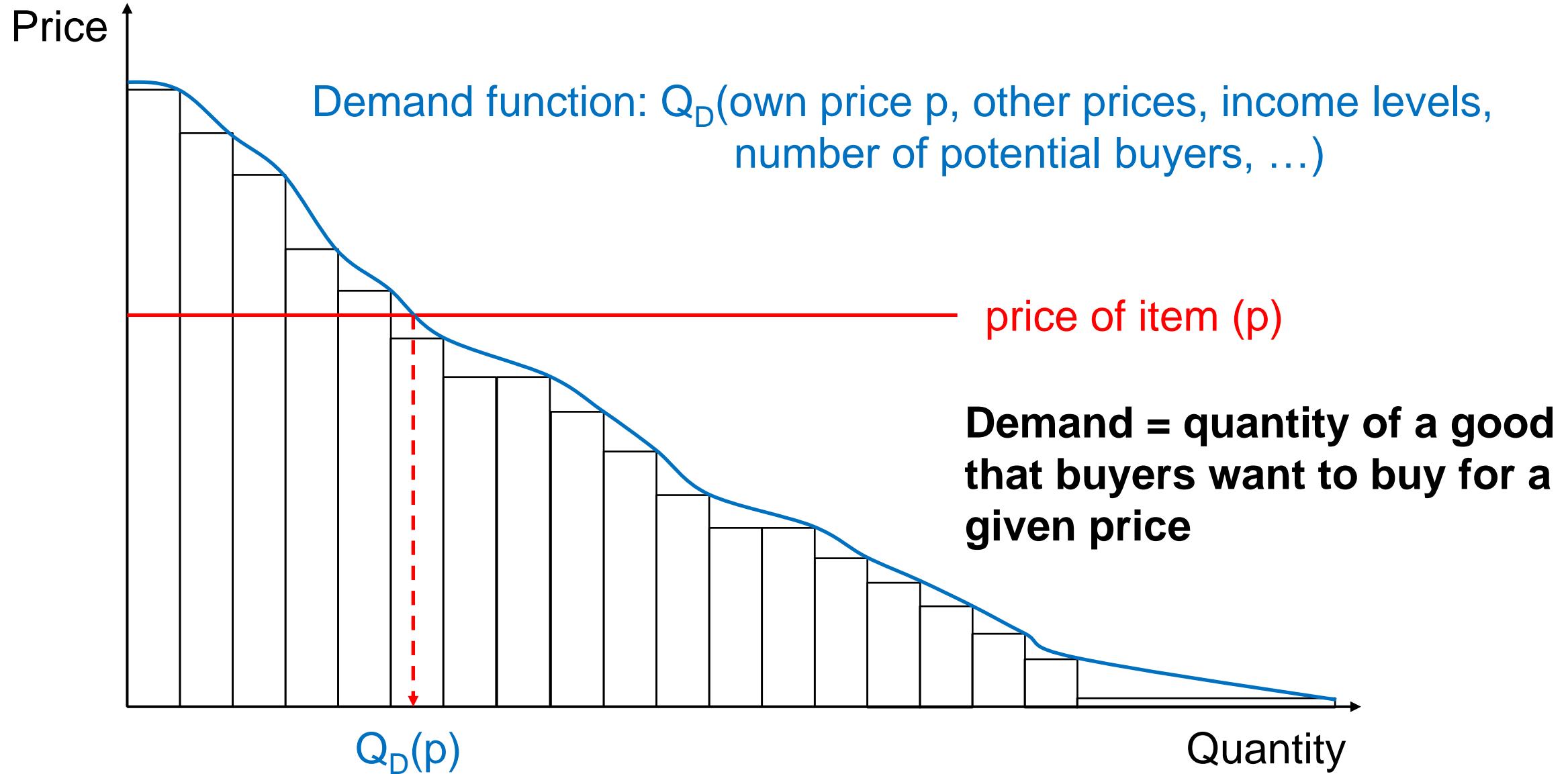
# Buyers' surplus



# Marginal WTP



# Demand function



# Elasticity of demand

- The **elasticity** measures the responsiveness of a variable to another one

$$y = f(X) \rightarrow \text{elasticity} = \frac{\frac{\partial f(X)}{\partial x_i}}{\frac{y}{x_i}}$$

- Demand  $q = Q_D$  (own price  $p$ , other prices, income levels, etc.)

$$\text{elasticity of demand} = \frac{\frac{\partial Q_D}{\partial p}}{\frac{q}{p}} \approx \frac{\frac{dq}{q}}{\frac{dp}{p}} = \frac{\% \text{change } q}{\% \text{change } p}$$



# Calculating or estimating the elasticity of demand

## Example 1

$$\text{Demand: } q = \frac{\alpha Rp'}{p^2}$$

R is income,  $p'$  is price of other goods,  $\alpha$  is preference parameter

$$\frac{\partial Q}{\partial p} = -2 \frac{\alpha Rp'}{p^3}$$

$$\frac{q}{p} = \frac{\alpha Rp'}{p^3}$$

$$\text{elast} = \frac{\frac{\partial Q}{\partial p}}{\frac{q}{p}} = -2$$

## Example 2

$$\text{Demand: } q = \alpha - \frac{\beta p}{Rp'}$$

$$\frac{\partial Q}{\partial p} = -\frac{\beta}{Rp'}$$

$$\frac{q}{p} = \frac{\alpha}{p} - \frac{\beta}{Rp'}$$

$$\text{elast} = \frac{\frac{\partial Q}{\partial p}}{\frac{q}{p}} = -\frac{1}{\frac{\alpha Rp'}{\beta p} - 1}$$

For  $\alpha=100$ ,  $\beta=5000$ ,  $R=1000$ ,  $p'=5$

For  $p = 1$ ,  $\text{elast} = -0.01$

For  $p = 10$ ,  $\text{elast} = -0.11$

For  $p = 50$ ,  $\text{elast} = -1$

For  $p = 90$ ,  $\text{elast} = -9$

## Example 3

Data on gasoline sales in Switzerland

|      | conso.<br>prix<br>ct/l | finale<br>kt | prix<br>%var | quantité<br>%var |
|------|------------------------|--------------|--------------|------------------|
| 2017 | 151                    | 2373         |              |                  |
| 2018 | 163                    | 2342         | 7.9%         | -1.3%            |

Empirical elasticity:

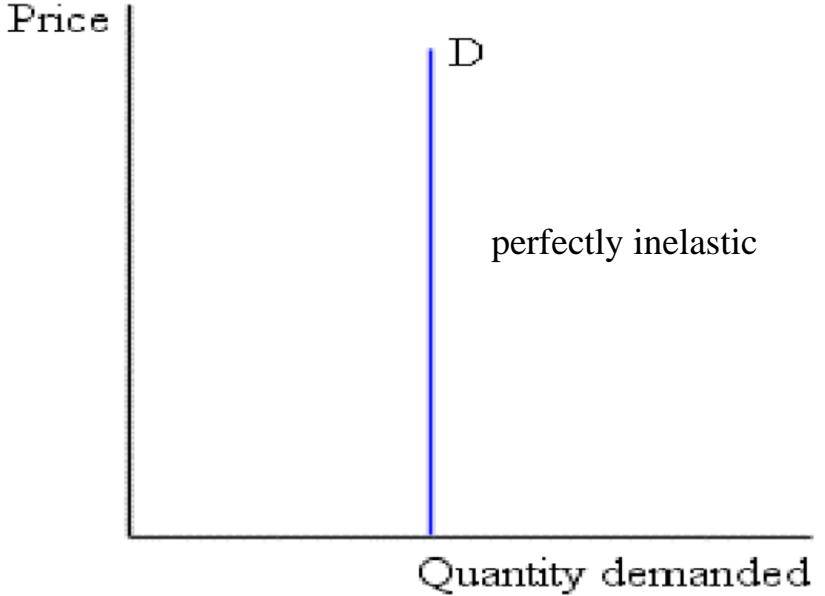
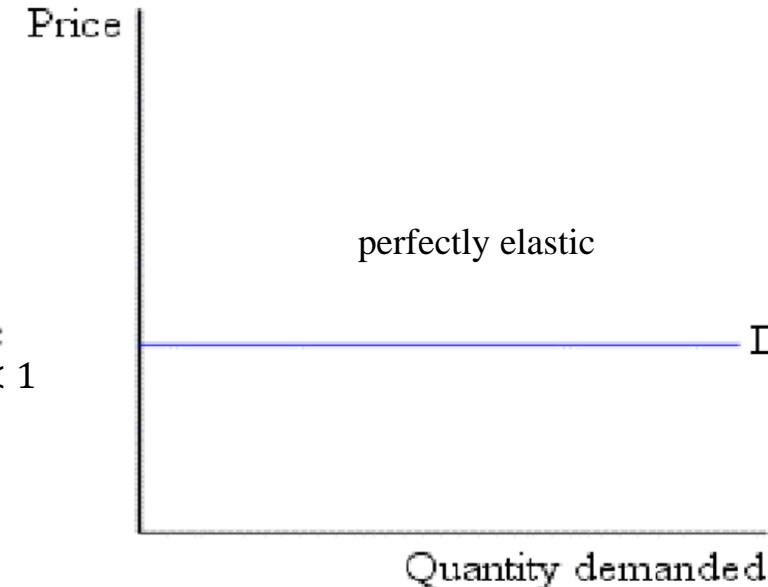
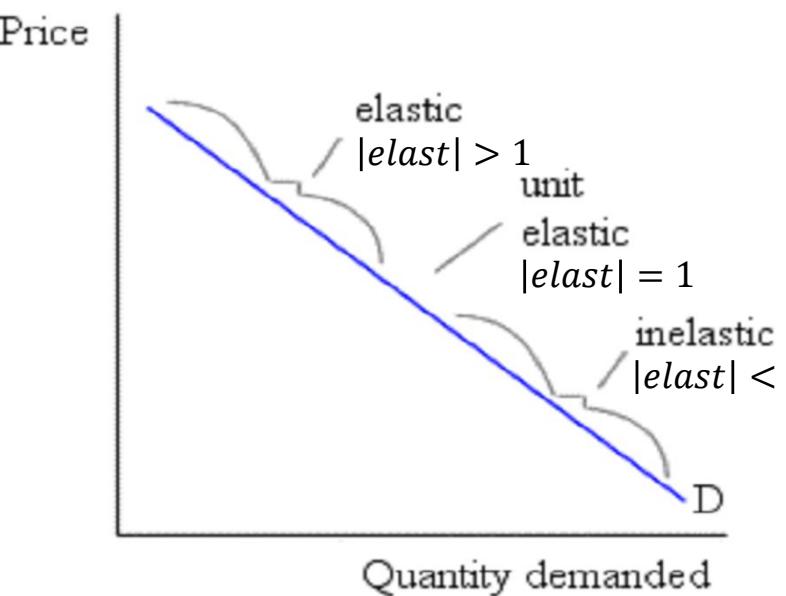
$$\text{elast} = \frac{\% \text{change } q}{\% \text{change } p}$$

$$\text{elast} = \frac{-1.3\%}{7.9\%} = -0.16$$

Caution: the variation in sales was not only caused by the change in price

# More or less elastic demand curves

$$\text{elasticity of demand} = \frac{\frac{\partial Q_D}{\partial p}}{\frac{q}{p}} \approx \frac{\% \text{change } q}{\% \text{change } p}$$



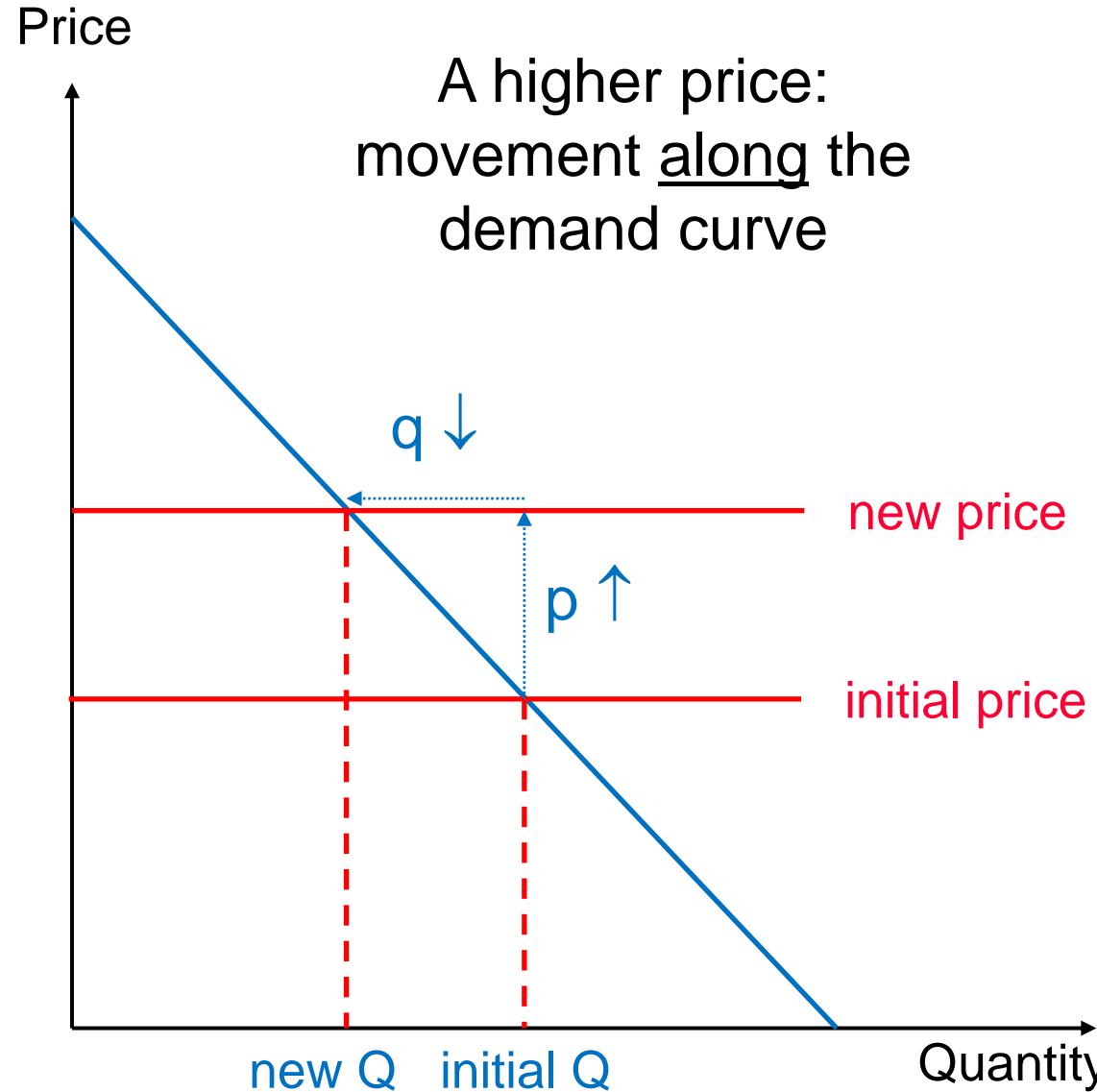
High elasticity (in absolute value) when

- close substitutes are available
- the good or service represents a large share of the consumer's budget
- a longer time horizon is considered

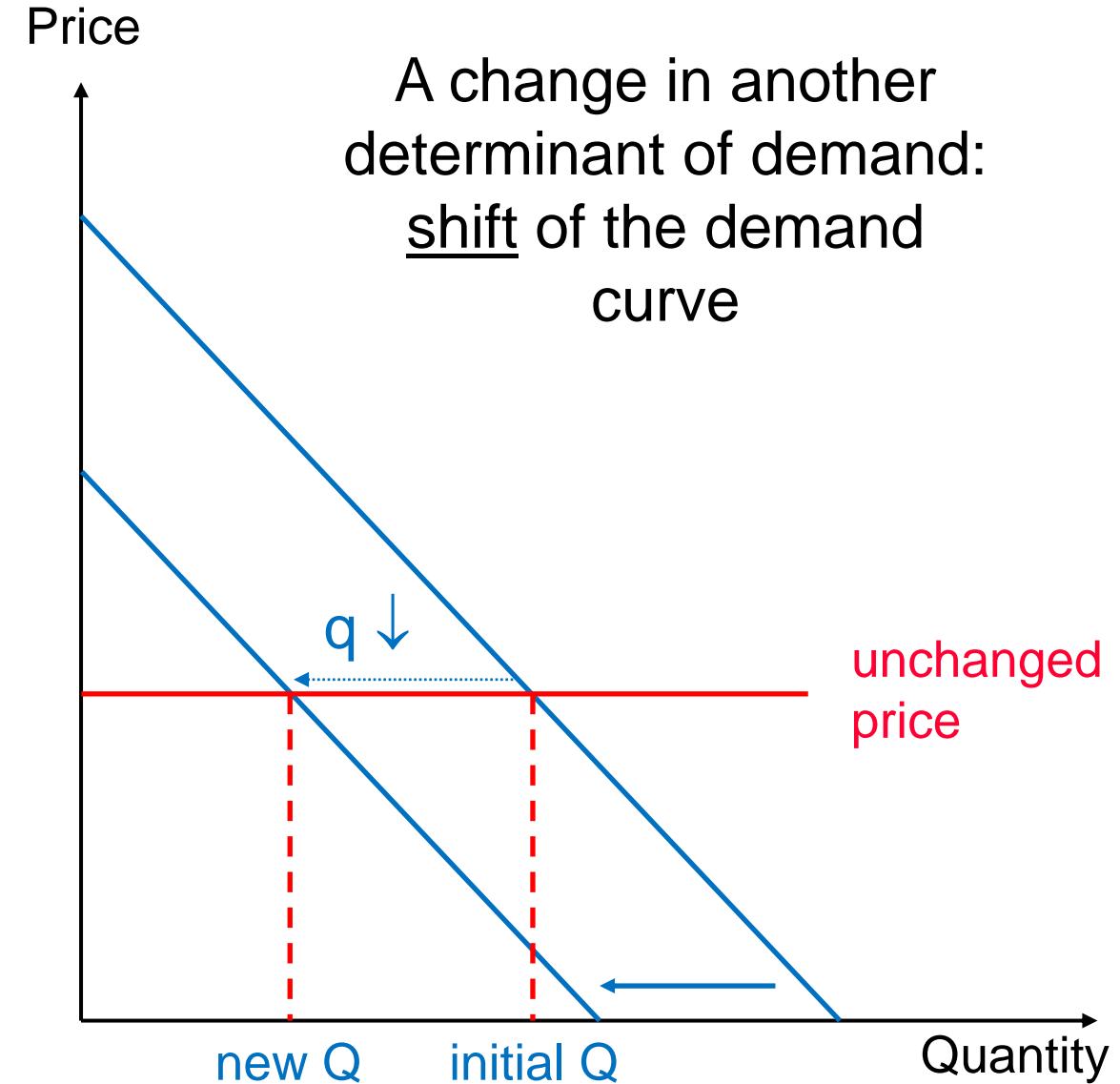
# Other elasticities

- Own-price elasticity of demand = 
$$\frac{\% \text{ change in quantity demanded of good } j}{\% \text{ change in price of good } j}$$
- Cross-price elasticity of demand = 
$$\frac{\% \text{ change in quantity demanded of good } j}{\% \text{ change in price of good } k}$$
  - positive for **substitutes**
  - negative for **complements**
- Income elasticity of demand = 
$$\frac{\% \text{ change in quantity demanded of good } j}{\% \text{ change in income}}$$
  - positive for **normal goods**
  - negative for **inferior goods**

# What explains a decrease in sales?



A higher price:  
movement along the  
demand curve



A change in another  
determinant of demand:  
shift of the demand  
curve