



1506
UNIVERSITÀ
DEGLI STUDI
DI URBINO
CARLO BO

Basic concepts of microeconomics and industrial organization: Coinsumer and producer behaviour

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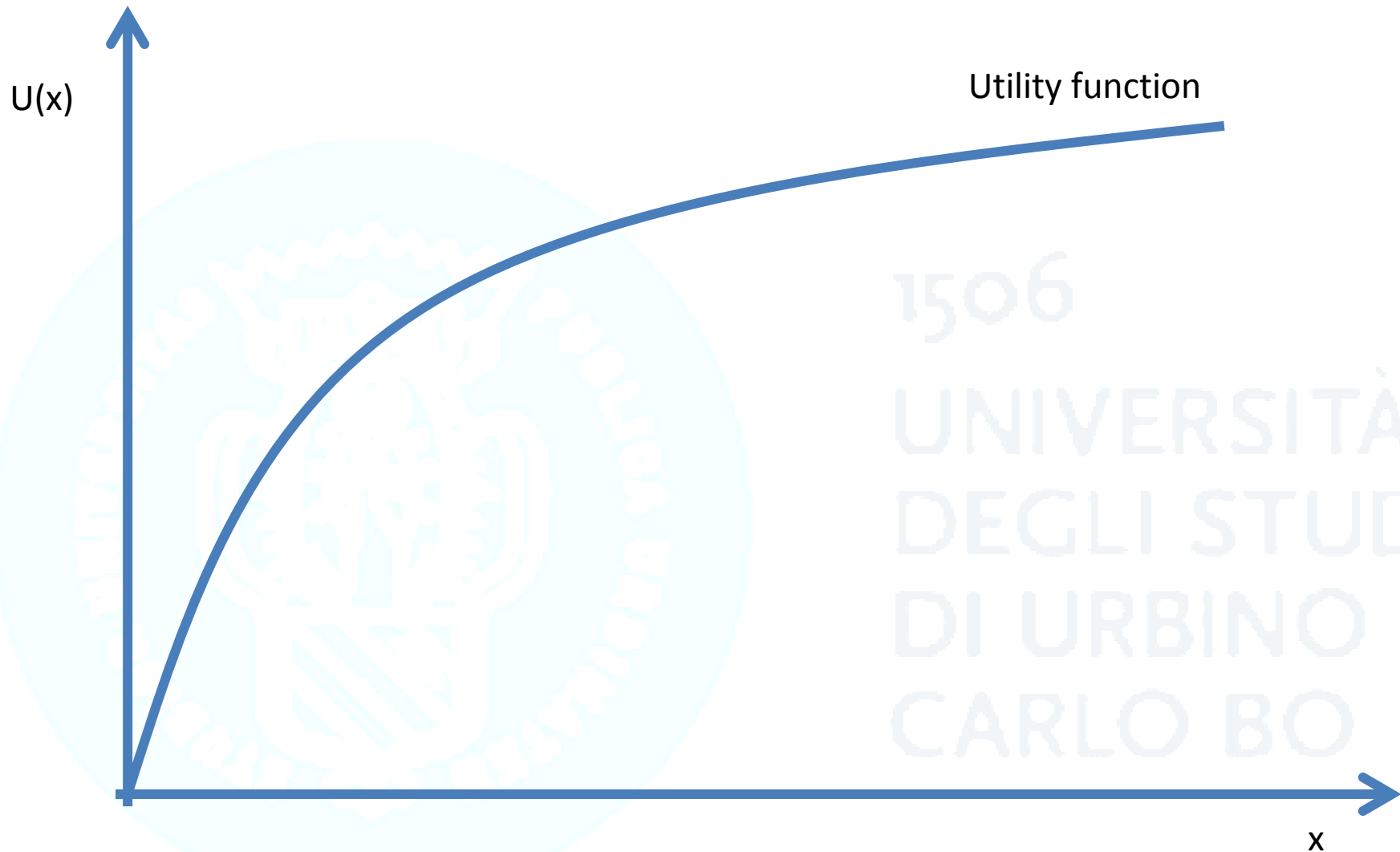
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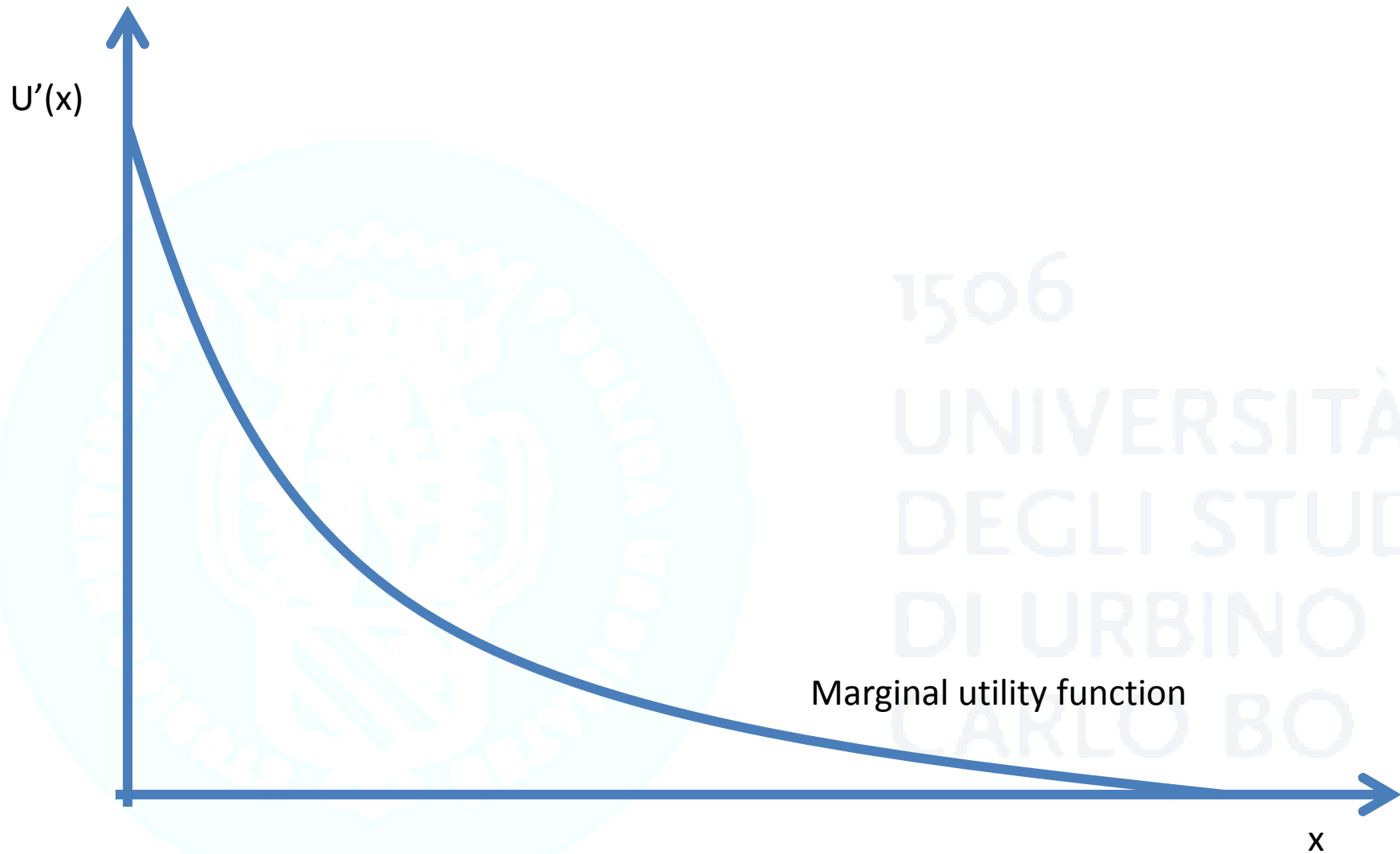
Utility function

- **Utility** can be defined as the **satisfaction** a **consumer** derives from the **consumption** of commodities
- Utility is an **'ordinal' concept**
 - $U(2 \text{ beers}) > U(1 \text{ beer})$
 - Is the $U(2 \text{ beers}) = 2 \times U(1 \text{ beer})$? $3x$? $10x$?
Cardinal differences cannot be measured

Utility function

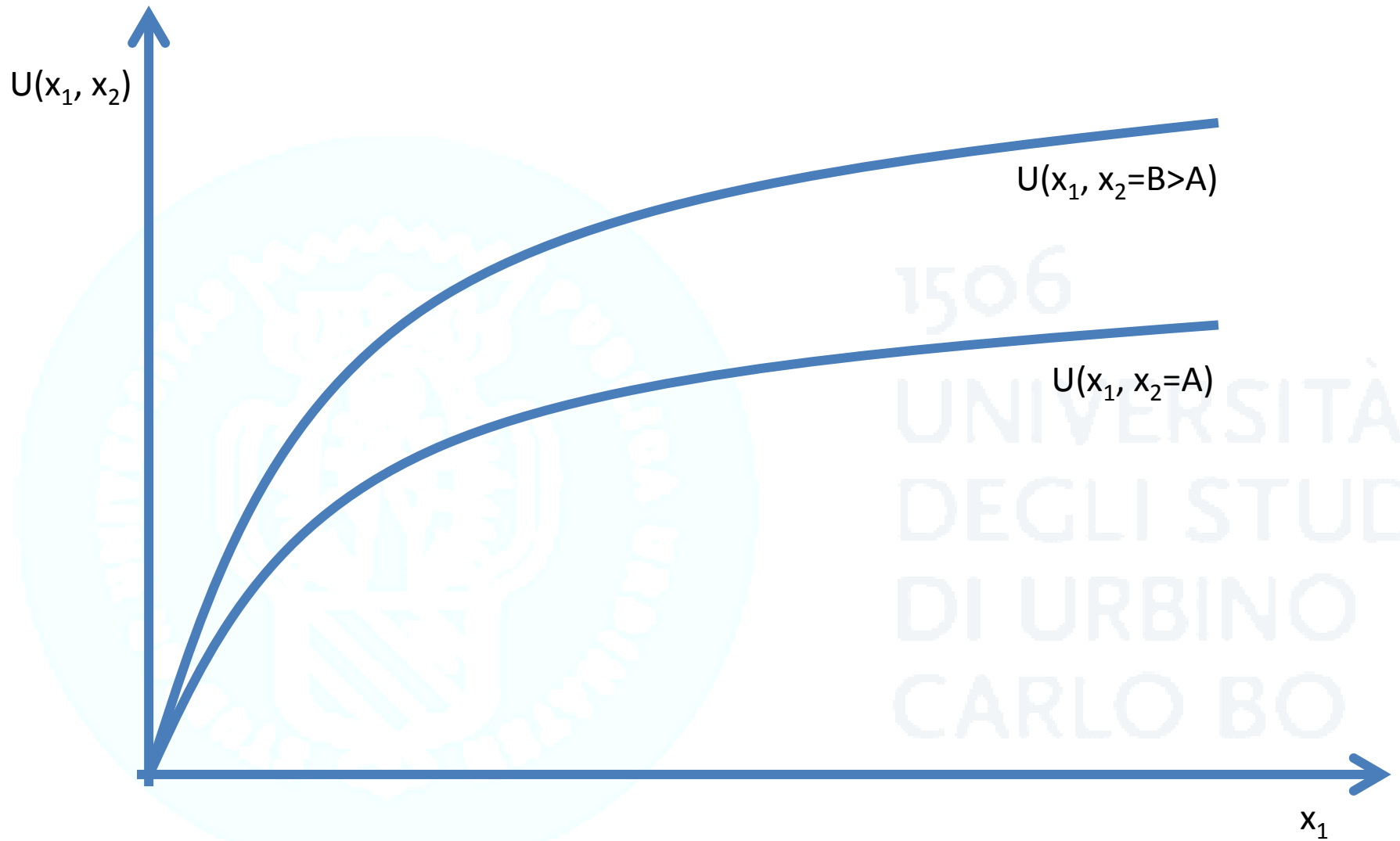
- **'Well behaved'** utility functions:
 - Utility is **increasing** in **consumption**
 - Utility is increasing at a **decreasing rate** → **marginal utility** of consumption is **decreasing**



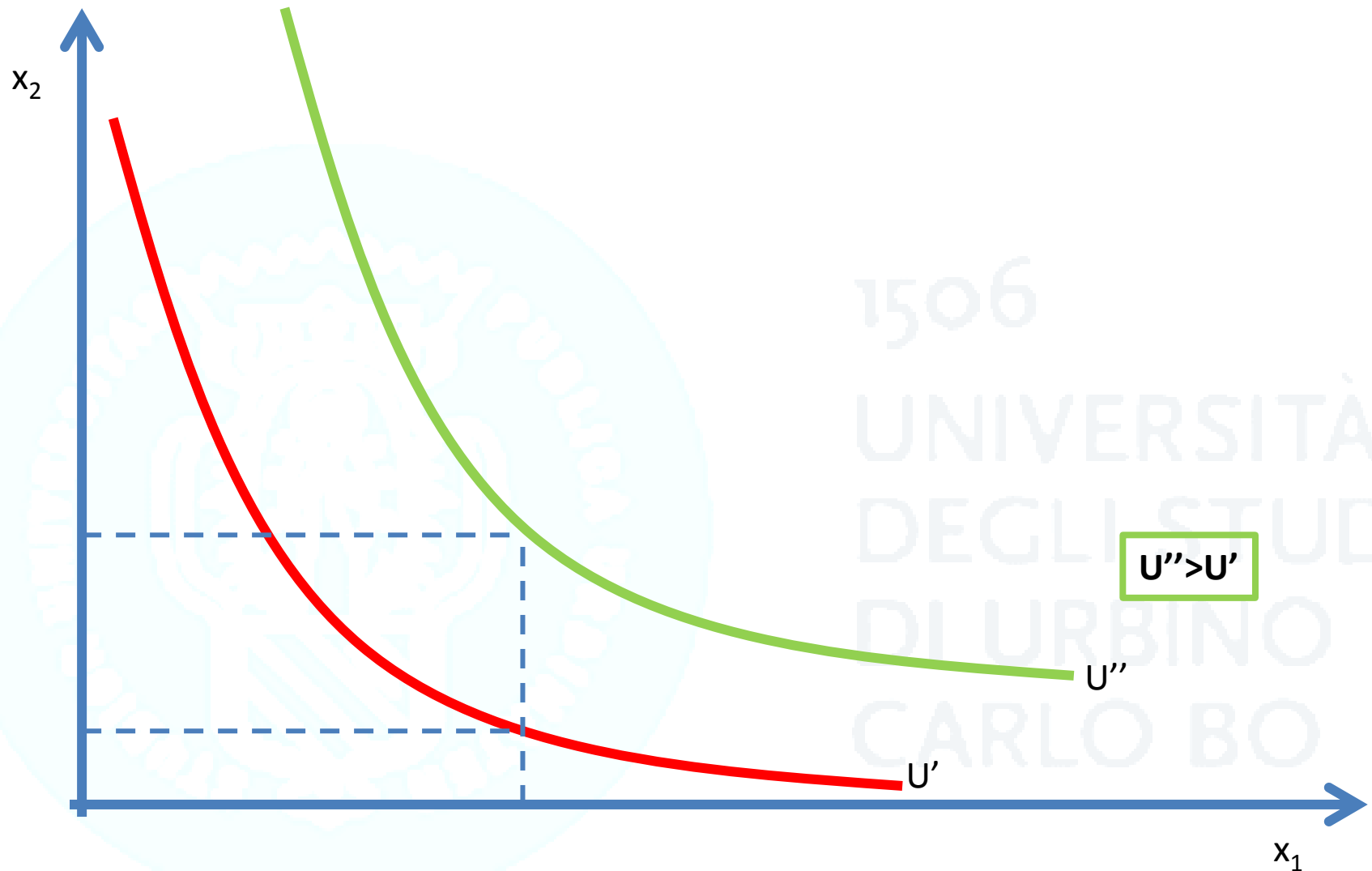


Utility function with two goods

- We derive utility from the consumption of a **bundle of goods**
- Assume we can consume **two goods**: x_1 and x_2
- $U=U(x_1,x_2)$
 - $dU/dx_1>0$; $ddU/ddx_1<0$
 - $dU/dx_2>0$; $ddU/ddx_2<0$



Indifference curves



Marginal rate of utility substitution

- The **same** level of **utility** can be attained by consuming **different bundles** of goods x_1 and x_2 (i.e. along the **indifference curve**)
- The **Marginal Rate of Utility Substitution** (MRUS) is the rate at which x_1 can be substituted for x_2 at the margin while maintaining the same level of utility
- This measures **how much** of x_1 the individual is willing to **give up** for a **marginal increase** in x_2 in order to attain the **same level of utility**

$$MRUS = \frac{dU(x_1, x_2) / dx_1}{dU(x_1, x_2) / dx_2}$$

- The MRUS represents the **slope** of the **indifference curve**

Equilibrium of the consumer

- When **choosing** the amount of x_1 and x_2 to consume, the individual is subject to the **budget constraint**

$$p_1x_1 + p_2x_2 \leq w$$

- The individual can spend at most w (its **disposable wealth**) in the consumption of x_1 and x_2 taking goods' **prices** as **given**

Utility maximization

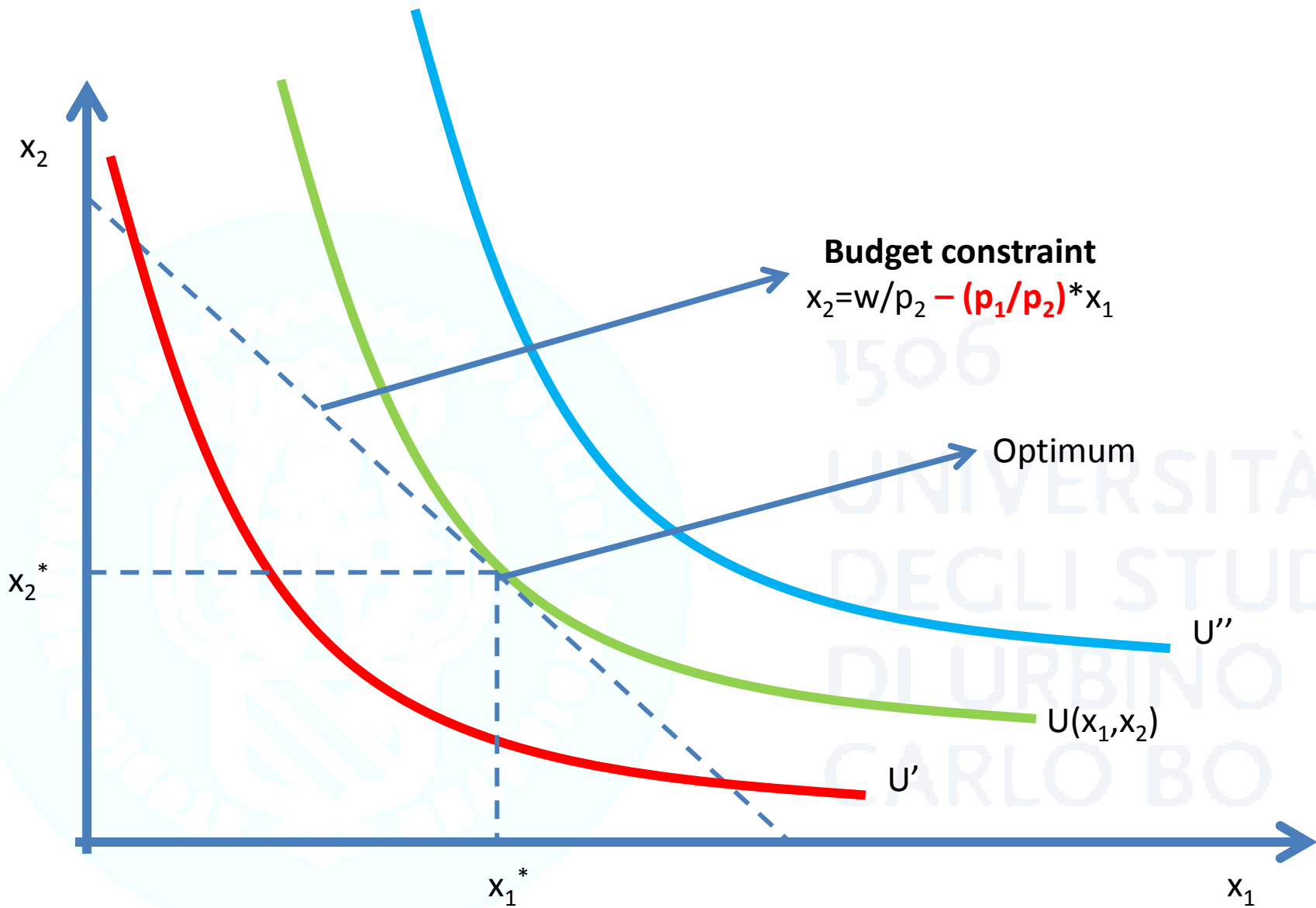
- The individual **maximizes** its **utility** subject to the **budget constraint**:

$$\max_{\{x_1, x_2\}} U(x_1, x_2) = f(x_1, x_2)$$

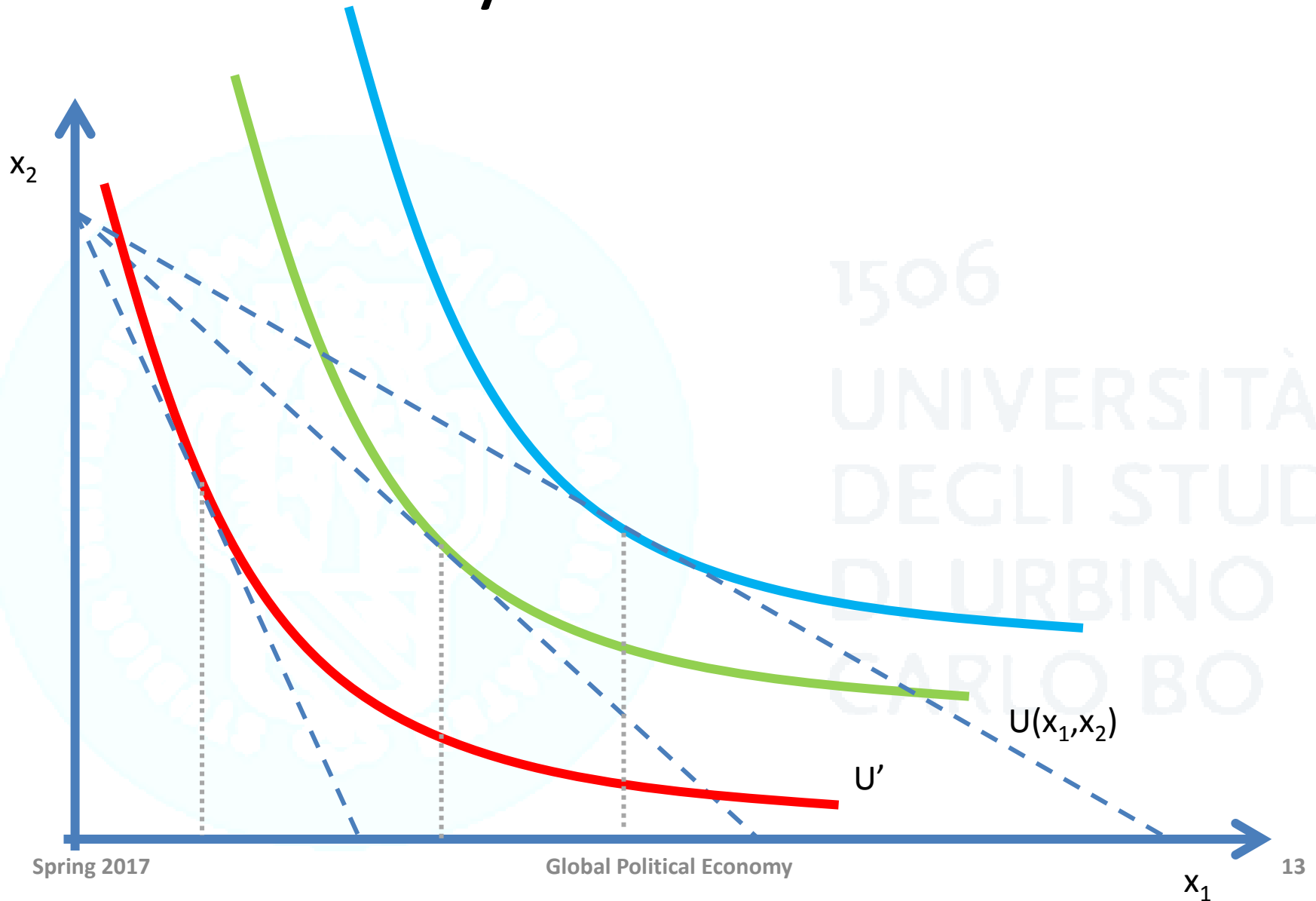
s.t.

$$p_1x_1 + p_2x_2 \leq w$$

- Utility is maximized when the **marginal rate of utility substitution** is **equal** to the **ratio** between **prices**
- **Rationale** → the rate at which the individual is willing to renounce to a marginal amount of good x_1 in exchange of a marginal increase in the consumption of good x_2 is equal to the relative price of good x_2 in with respect to good x_1



From utility to demand function



Production with a single input

- **Technology** describes how the **input X** (in quantity) is transformed into the **output Y** (in quantity)
 - Total product (production function) → $Y=Y(X)$
- **Marginal product**
 - It is the **increase in output Y** that is produced by a **marginal increase in input X**

$$MP=dY(X)/dX$$

Production costs

- The **cost** of producing a certain level of Y depends on:
 - The **quantity of input X** that is needed to produce Y
 - The **price** of input X
- $Y=Y(X) \Rightarrow X=Y^{-1}(Y) \Rightarrow$ is the **amount of input** needed to **produce Y** (and is the **inverse** function of the **total product function**)
- **Total costs** of production as a **function of Y** :
$$TC(Y)=P_x * Y^{-1}(Y) = f(Y)$$

Average and marginal costs

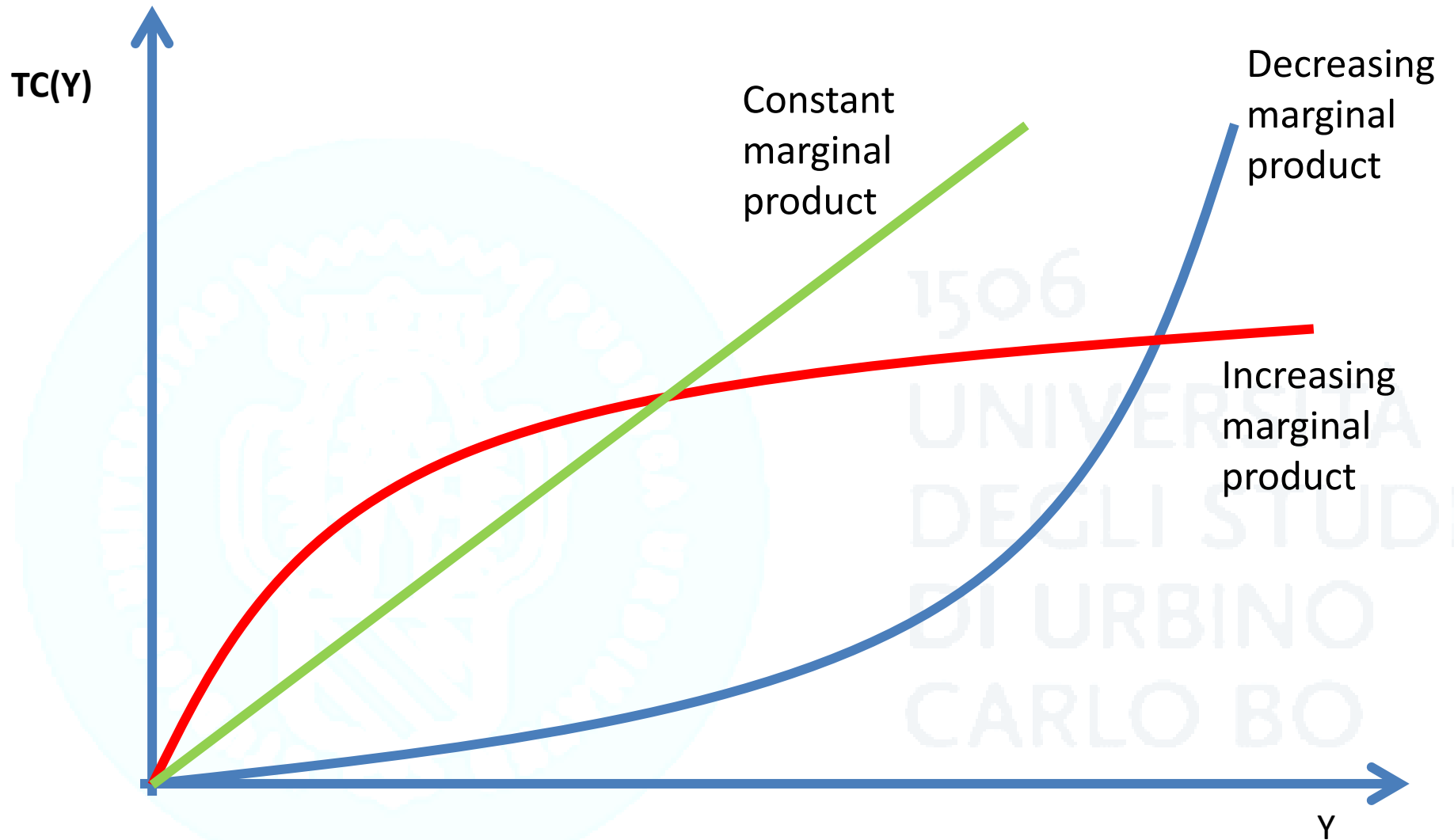
- **Average costs** are defined as the **unitary cost** of producing a **certain output Y**

$$AC(Y) = TC(Y) / Y$$

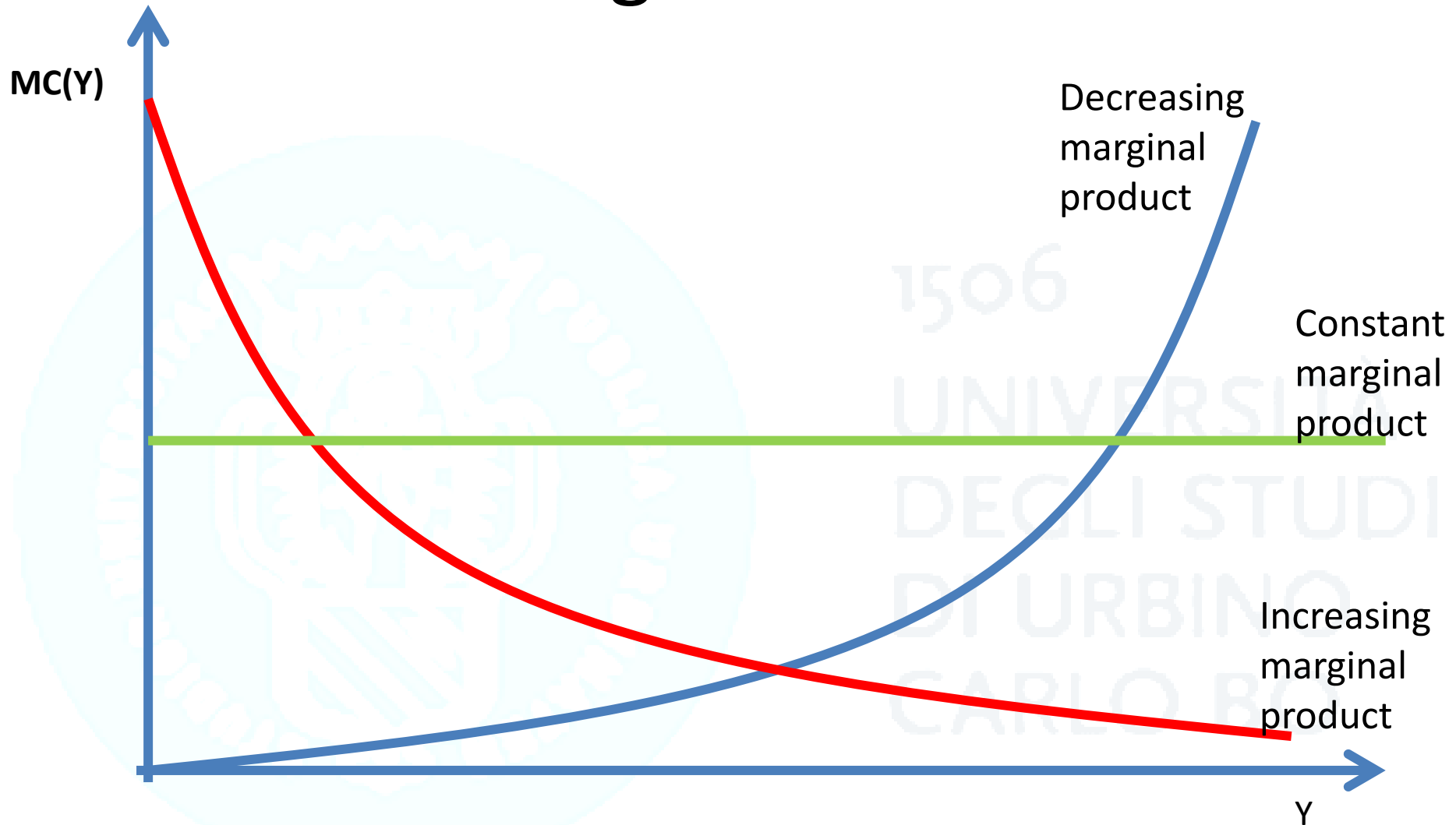
- **Marginal costs** are defined as the **cost** of producing an **additional unit** of Y

$$MC(Y) = dTC(Y) / Y$$

Total cost



Marginal costs

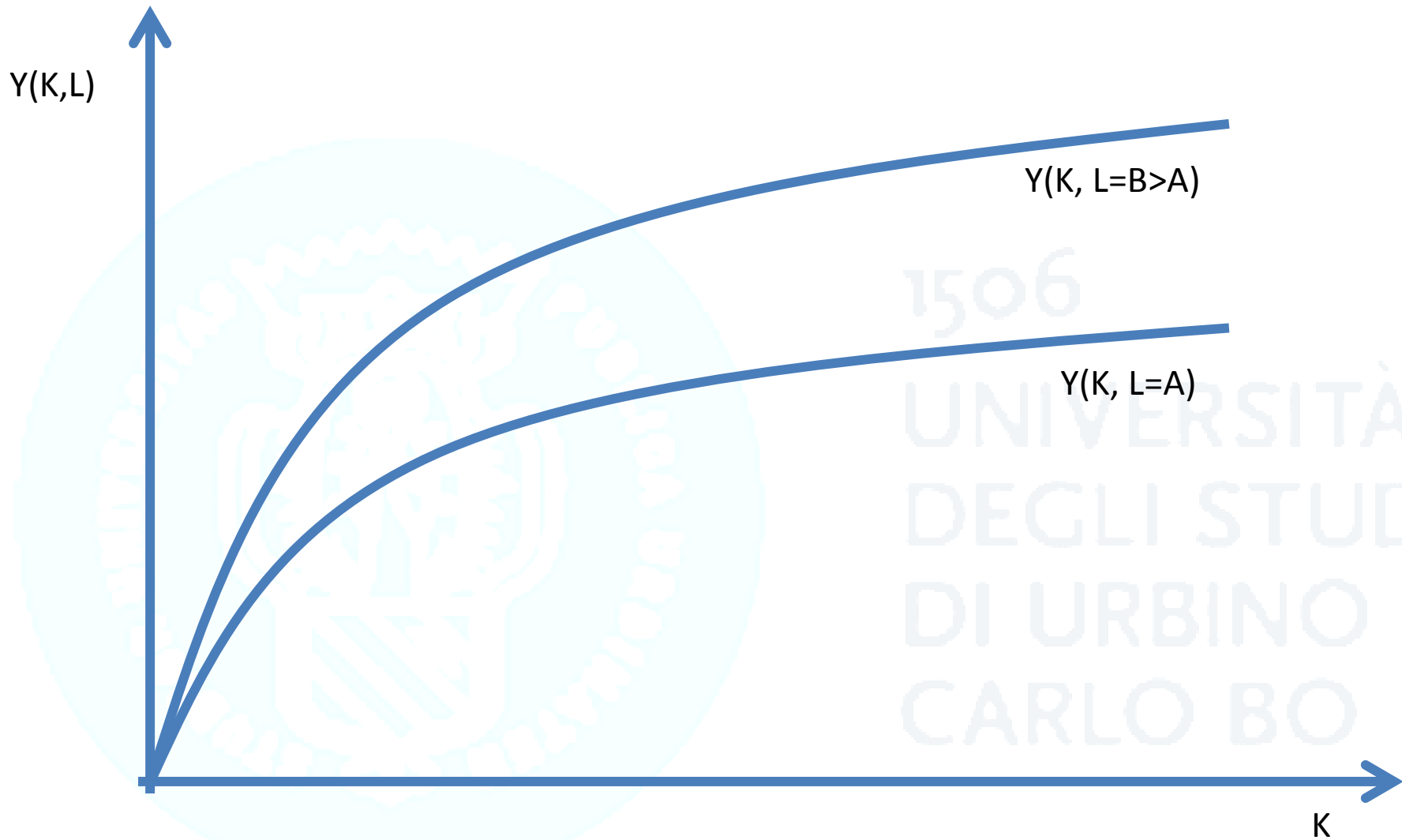


Costs and marginal product

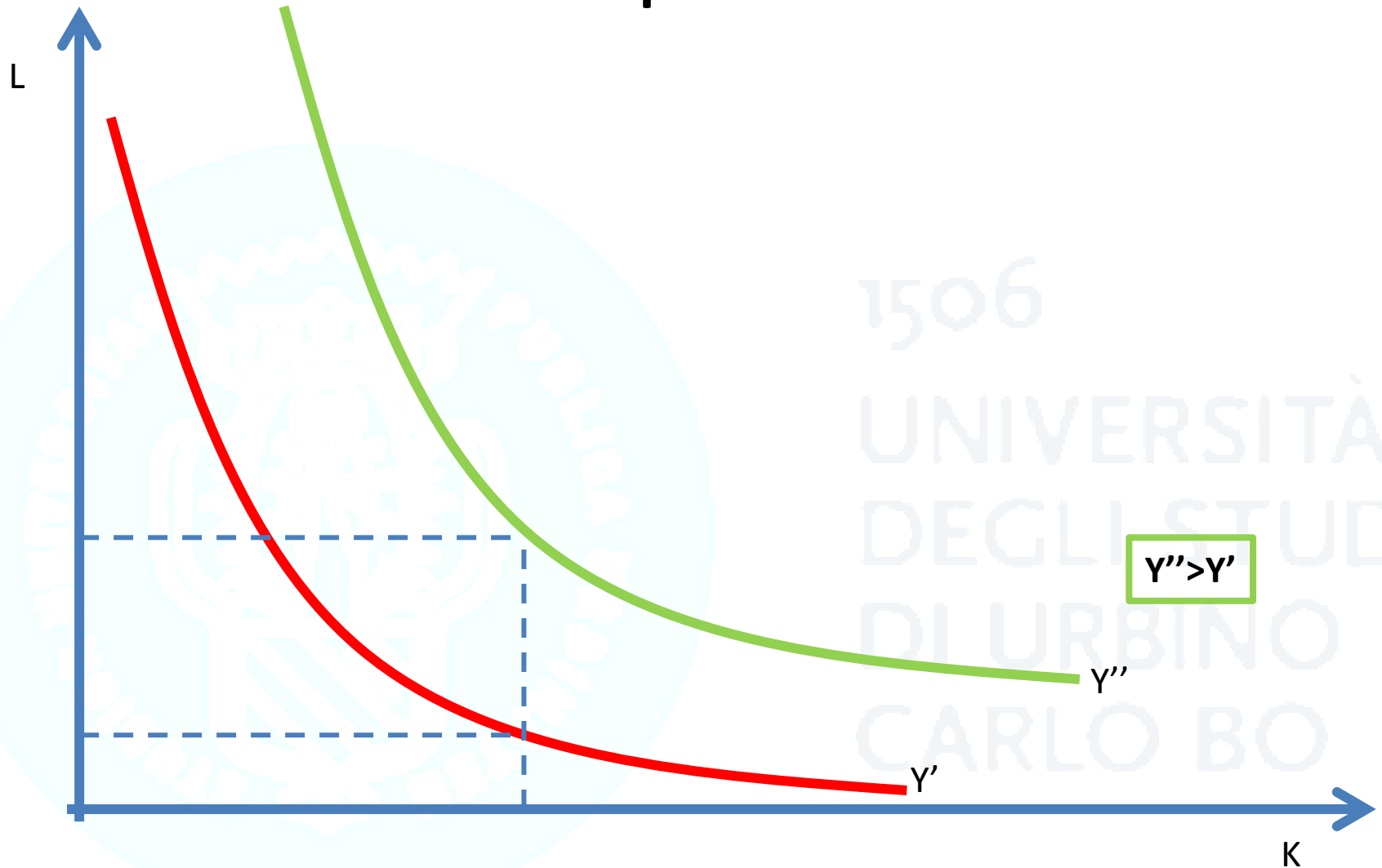
- **Decreasing marginal products** => convex total costs => increasing marginal costs
- **Constant marginal product** => linear total costs => constant marginal costs
- **Increasing marginal product** => concave total costs => decreasing marginal costs

Production with two inputs

- Assume that production of Y requires **two** different **inputs**
 - Labour (L)
 - Capital (K)
- **Production function**
 - $Y=Y(K,L)$
 - A sort of **recipe** \Rightarrow a certain combination of K and L generates a certain amount of Y
 - The production function describes the **production technology**



Isoquants



Marginal rate of technical substitution

- The **same** level of **output** can be produced by using different **bundles** of **inputs** L and K (i.e. along the **isoquant**)
- The **Marginal Rate of Technical Substitution** (MRTS) is the rate at which L can be substituted for K at the margin while maintaining the same level of production
- This measures **how much** of **K** the firm can **reduce** for a **marginal increase** in **L** in order to obtain the **same** level of **production**

$$MRTS = \frac{dY(K, L) / dK}{dY(K, L) / dL}$$

- The MRTS represents the **slope** of the **isoquant**

Properties of the production function

- The production function is **strictly increasing** in the level of **inputs** $\Rightarrow dY/dL > 0; dY/dK > 0$
- **Constant returns to scale** $\Rightarrow Y(2K, 2L) = 2 * Y(K, L)$
- **Marginal production** of inputs is **decreasing**
 - For a given level of L, a marginal increase in K also increases output, but at an ever decreasing rate (same for K and L) $\Rightarrow ddY/ddK < 0; ddY/ddL < 0$

Equilibrium of the producer

- When choosing the **amount of K and L** to use in production, the producer should also consider the total **cost of production** associated with a **given bundle** of inputs:

$$C(K, L) = p_L L + p_K K$$

Cost minimization

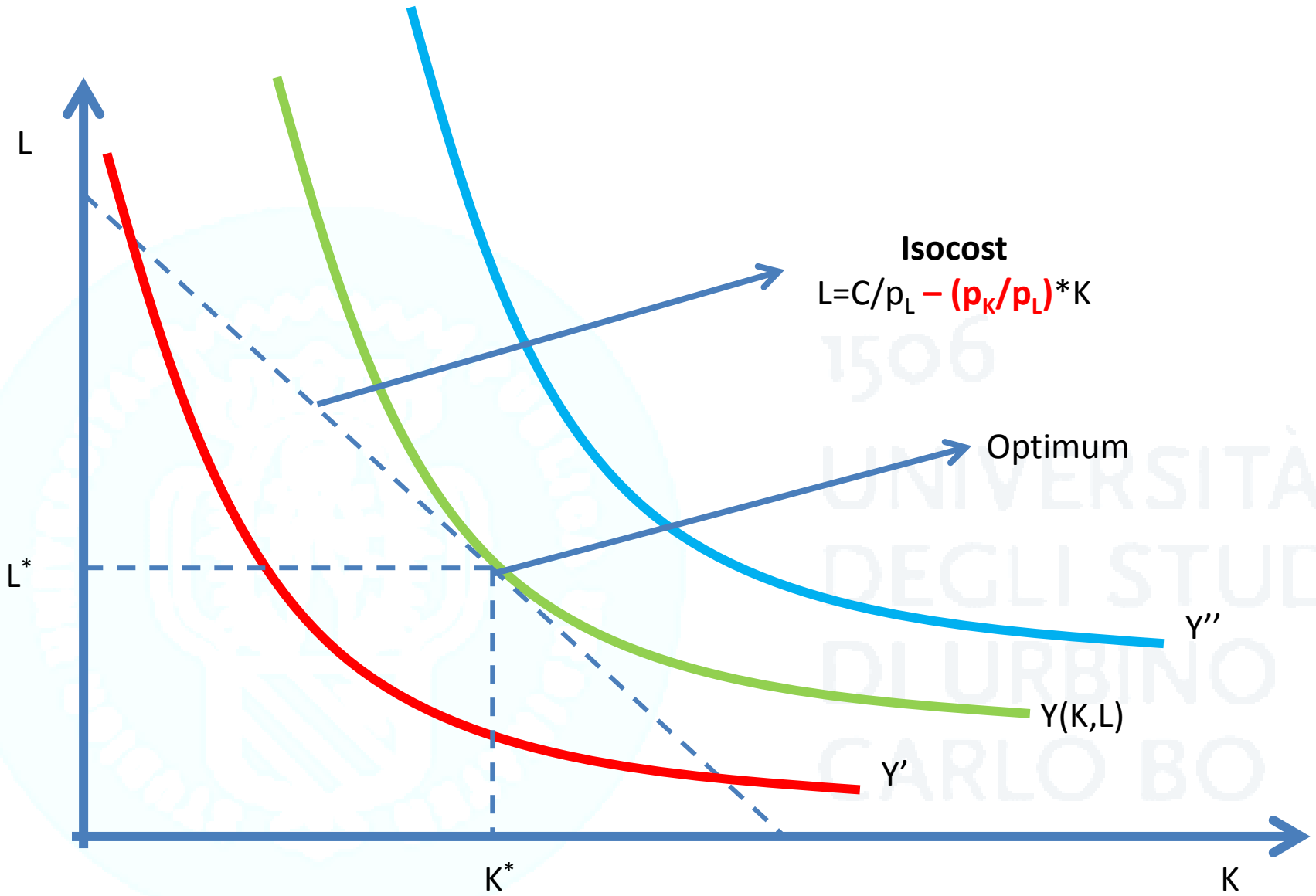
- The firm **minimize** its **costs** provided the (monetary) **output remains at a certain level (isoquant)**

$$\min_{\{K,L\}} C(K,L) = p_L L + p_K K$$

s.t.

$$p_Y Y(K,L) \geq p_Y \bar{Y}$$

- Costs are minimized when the **marginal rate of technical substitution** is equal to the **ratio** between **prices of inputs**
- Rationale → the **value of marginal product** (i.e. price times the marginal quantity produced with a small increase in one input given the other input) of each input should **equal** the **price** of that **input**



Structure of production costs

- **Fixed costs** (FC)
 - They do **not vary** with the **quantity** of output that is produced
 - The producer will incur fixed costs **even** with **no production**
 - **Average fixed costs** per unit of output decrease as output grows → FC/Q
- **Variable costs** (VC)
 - Variable costs are **function** of the **quantity** of output produced → $VC(Q)$
 - As output grows, total variable costs **grow**
 - $VC(Q=0)=0$

Structure of production costs

- **Marginal costs** (MC)

- Marginal costs represent the **change in total costs** when **output changes** marginally

- **Fixed costs** are **constant**
- **Variable costs** depend on **Q**

$$dTC/dQ = dFC/dQ + dVC(Q)/dQ = 0 + dVC(Q)/dQ$$

- They are (usually) **function of output** → **MC(Q)**

- **Average costs** (AC)

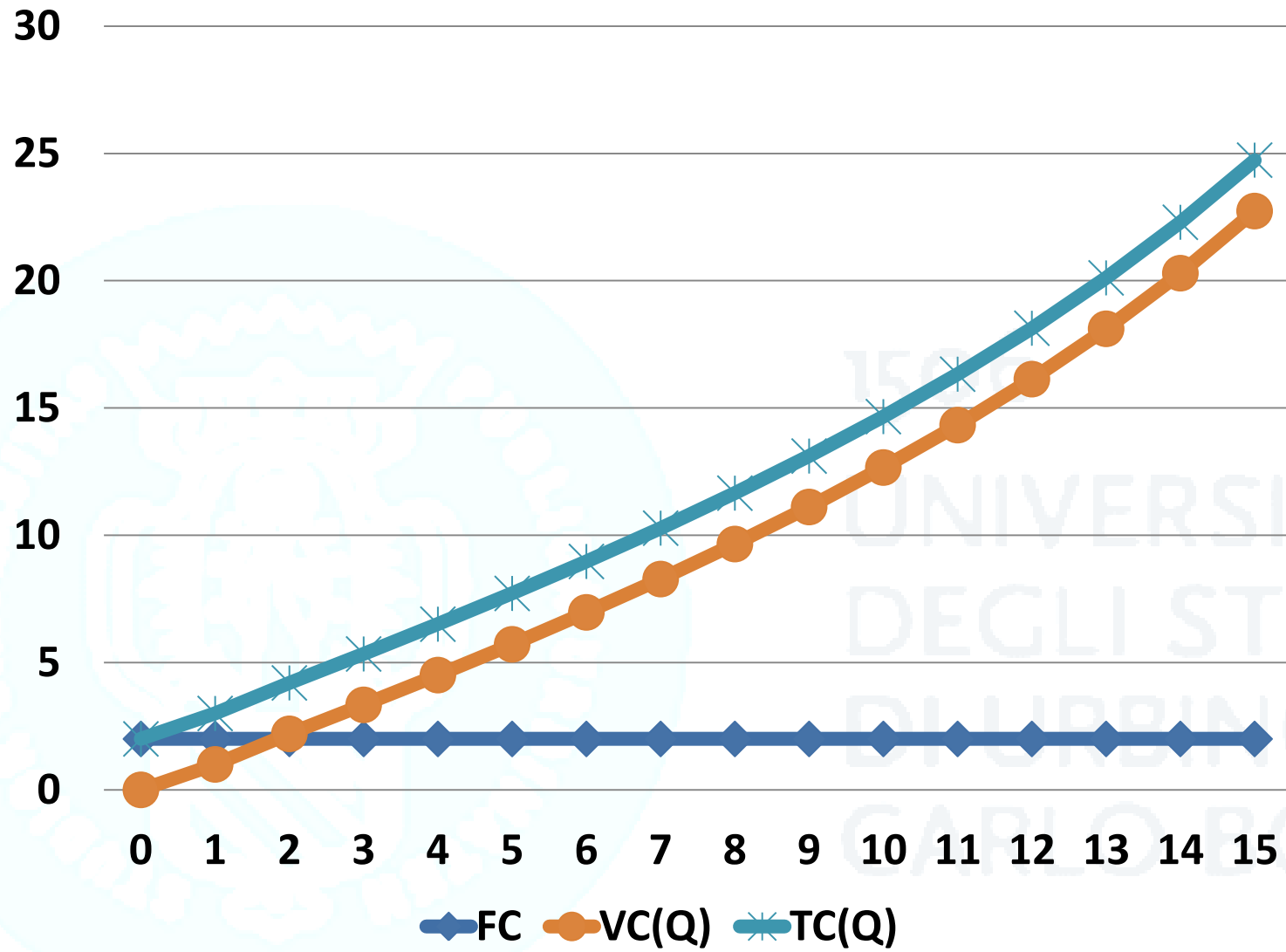
- Average costs represent the **average total cost** of producing a certain quantity **Q**

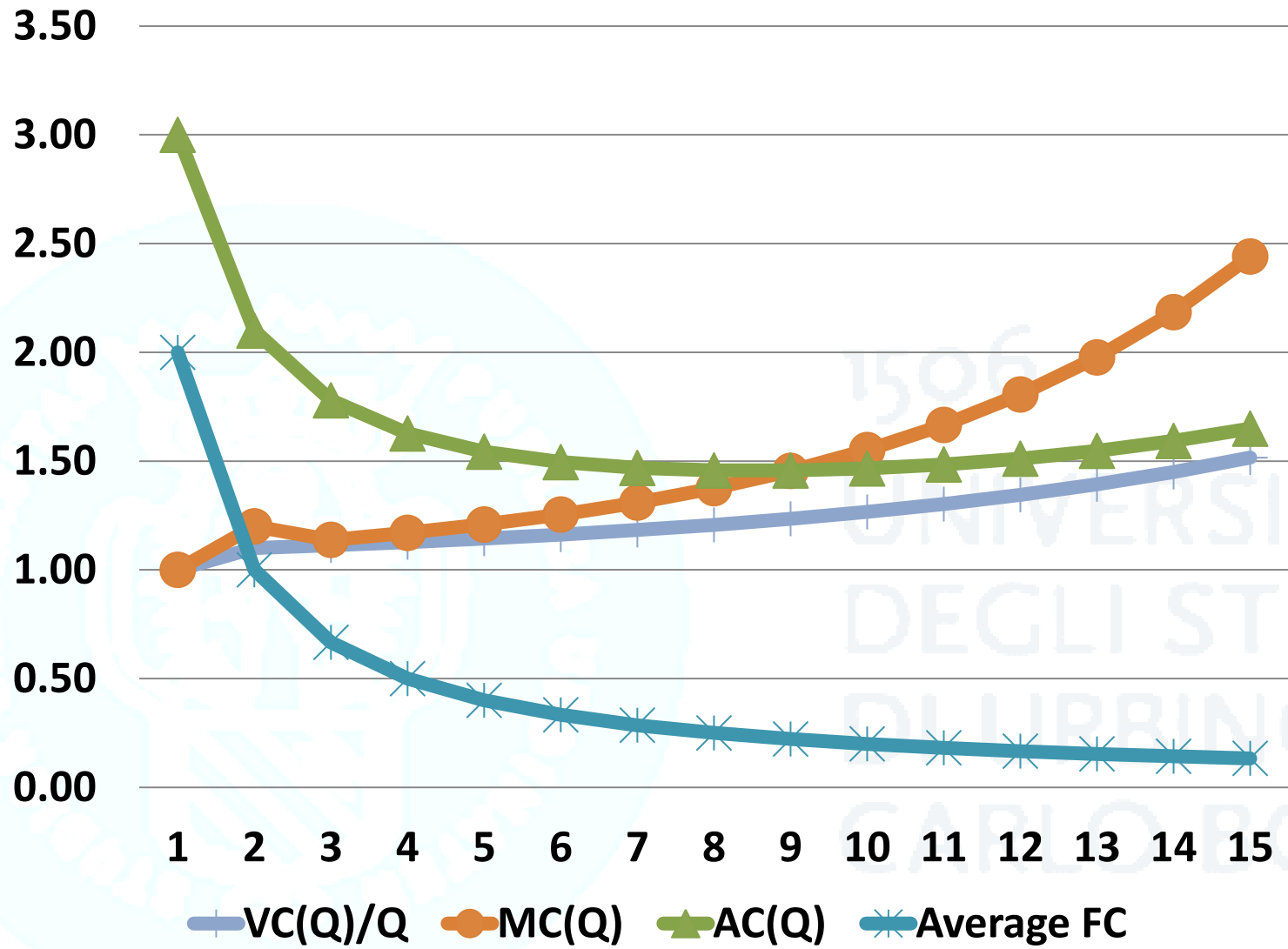
$$AC(Q) = FC/Q + VC(Q)/Q$$

Q	FC	VC(Q)/Q	VC(Q)	MC(Q)	AC(Q)	TC(Q)	Average FC
0	2	0	0	-	-	2	-
1	2	1.00	1.00	1.00	3.00	3.00	2.00
2	2	1.10	2.20	1.20	2.10	4.20	1.00
3	2	1.11	3.34	1.14	1.78	5.34	0.67
4	2	1.13	4.51	1.17	1.63	6.51	0.50
5	2	1.14	5.72	1.21	1.54	7.72	0.40
6	2	1.16	6.97	1.25	1.50	8.97	0.33
7	2	1.18	8.28	1.31	1.47	10.28	0.29
8	2	1.21	9.66	1.38	1.46	11.66	0.25
9	2	1.23	11.11	1.46	1.46	13.11	0.22
10	2	1.27	12.66	1.55	1.47	14.66	0.20
11	2	1.30	14.33	1.67	1.48	16.33	0.18
12	2	1.34	16.13	1.81	1.51	18.13	0.17
13	2	1.39	18.11	1.98	1.55	20.11	0.15
14	2	1.45	20.30	2.18	1.59	22.30	0.14
15	2	1.52	22.74	2.44	1.65	24.74	0.13

Q	FC	VC(Q)/Q	VC(Q)	MC(Q)	AC(Q)	TC(Q)	Average FC
0	2	0	0	-	-	2	-
1	2	1.00	1.00	1.00	3.00	3.00	2.00
2	2	1.10	2.20	1.20	2.10	4.20	1.00
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14	2	1.45	20.30	2.18	1.59	22.30	0.14
15	2	1.52	22.74	2.44	1.65	24.74	0.13

$$MC(Q) = TC(Q) - TC(Q-1) = VC(Q) - VC(Q-1)$$

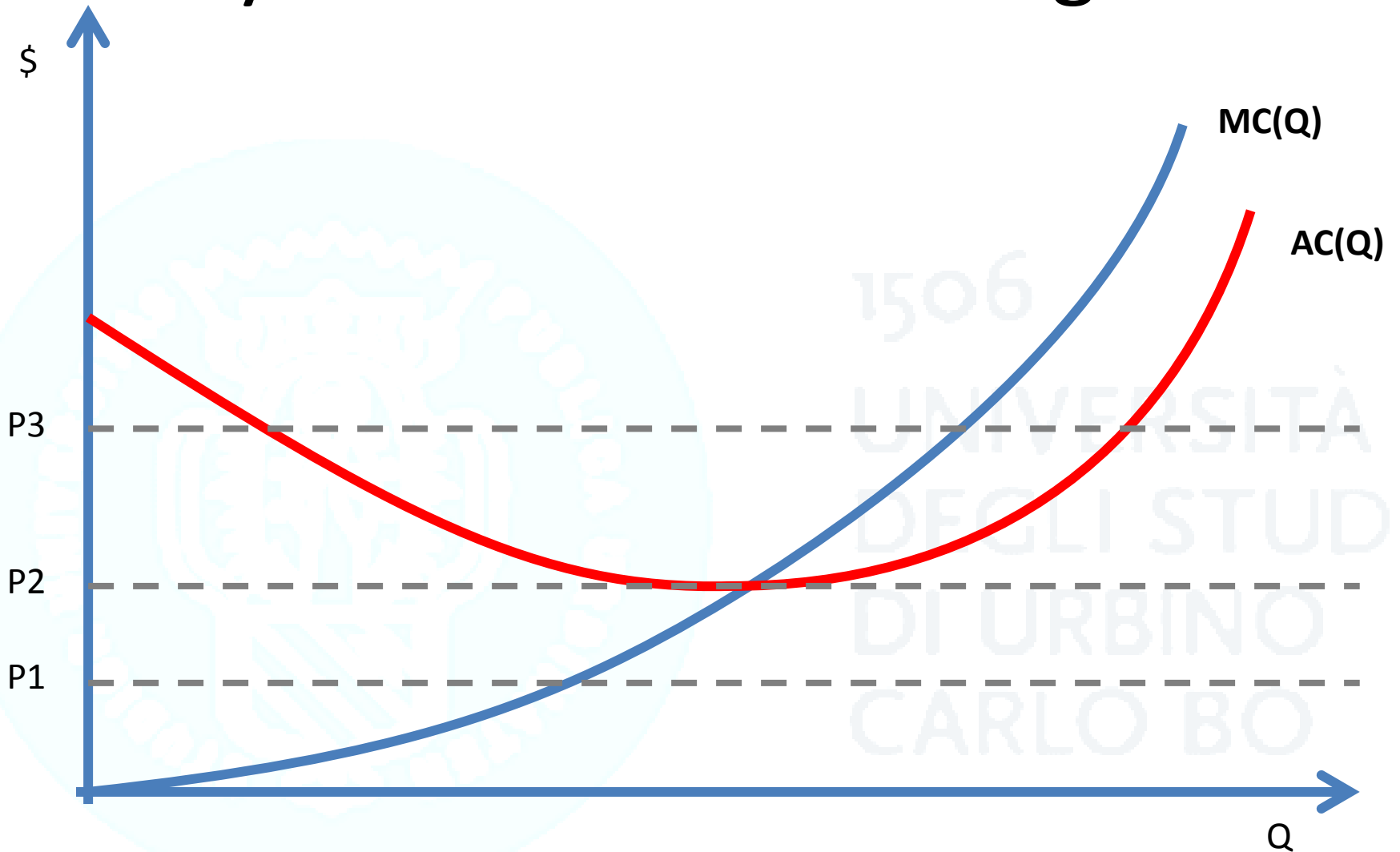




Short run vs long run

- In the **short run** some **inputs** are **fixed**
 - A factory cannot be phased out easily
 - In the very short run even labour could be fixed (notice period for firing workers)
 - Other inputs are variable even in the very short run (e.g. you can decide to fill the tank of your truck at any time)
- In the **long run** all **inputs** are **variable**
 - Factories can be built or dismantled
 - Workers can be hired or fired
 - ...

Stay or exit? Short vs long run



Marginal costs and supply function

- **Marginal cost** are equivalent, ultimately, to the **supply curve**
 - In the **short run**, the producer is willing to **accept any price greater** or equal to the **marginal cost** to produce a certain quantity Q
 - **Even if** prices are **below average costs** and thus the company will experience a negative profit due to too high fixed costs, it will produce Q anyways to **cover as much fixed costs as possible**
 - **Marginal profits** ($P - MC(Q)$) are **positive** as long as $P > MC(Q)$

Market structure

- The market structure → how **prices** and **quantity** are set on the **market**
- The market structure **depends on** (among other things):
 - The **number** of **consumers** and **producers**
 - The **bargaining power** of each producer and consumers
- These factors **ultimately** depend on:
 - **Cost** structure
 - Shape of **demand**
 - **Institutional** setting (e.g. strength of the antitrust)

Market structures

- **Perfect competition**

- Large number of (atomistic) consumers and producers
- Each consumer and producer is price taker (i.e. has no direct influence on prices)

- **Monopoly**

- One single producer and multiple consumers
- Consumers are price takers, the producer is price maker

- **Monopsony**

- One single consumer and multiple producers
- The consumer is price maker

Market structures

- **Oligopoly**

- Few producers and multiple consumers
- Consumers are price takers
- Producers have some influence on prices, that also depends on the behaviour of other producers

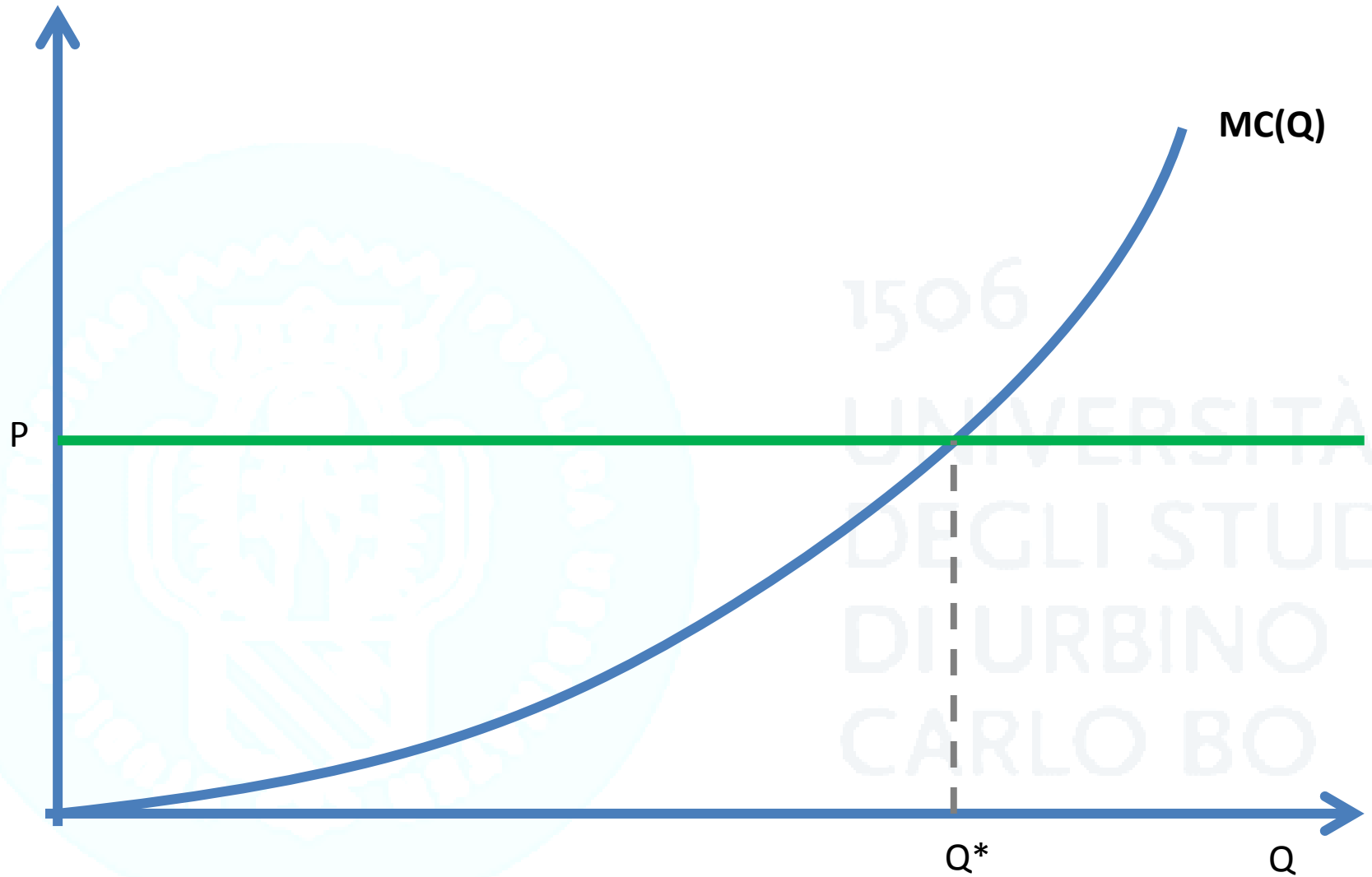
- **Monopolistic competition**

- Many consumers with preferences over variety of goods (that are substitute)
- Each producer is the monopolist for the production of a certain variety
- Varieties compete on the market

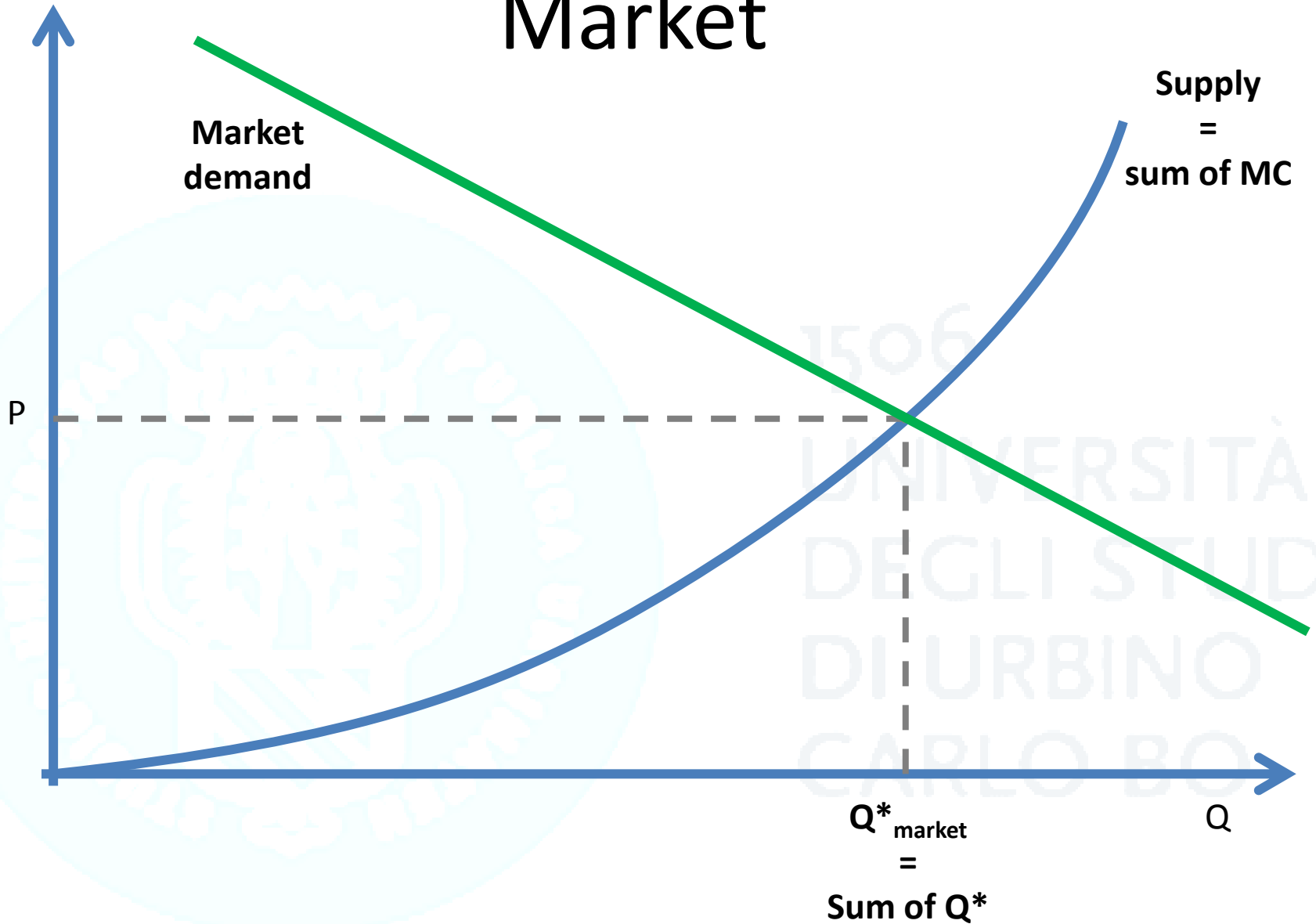
Perfect competition

- **Many** firms
- **Identical** and **homogenous** product
- Each firm is a **small part** of the **market**
- Each firm in the market takes the market **price** as being **predetermined** → firms are **price takers**
- Firms **only** decide **how much** to **produce** for a given price
- Each **firm** faces a **'flat'** demand curve

Firm



Market



Entry and exit in perfect competition

- In the **short run**, firms will **produce** as long as **marginal costs** are **below** the market **price** (even if average costs are larger than market prices)
- **New firms** will enter the market if their **expected marginal cost** is **below** the prevailing market **price**
- In the **long run**, firms with **average costs larger** than the market **price** will **exit** the market

Monopoly

- Only **one producer** is on the market
- This happens for a **number of reasons** that generate **barrier to entry** for potential competitors:
 - High **fixed or sunk costs** prevent potential entrants from entry => **natural monopoly**
 - Building a **railway infrastructure**
 - Building an **electricity transmission** network
 - **Strategic behaviour** of the **incumbent** that deter entry
 - **Predatory prices**
 - Large expenditure in **advertising**
 - Government **regulation**
 - **Gambling** and casino (in Italy)

Monopoly

- **Differently** from firms in **perfectly competitive** markets, the **monopolist** faces a **downward sloping demand** function
- The monopolist is **not price-taker**
- The **price** is **set** by the **monopolist**

Profit maximization in monopoly

- The monopolist will **maximize** the following **profit function**:

$$\max_{\{Q\}} \pi = Q * P(Q) - C(Q)$$

- Where **$Q * P(Q)$** are **total revenues** and **$C(Q)$** are **total costs**
- Recall that **revenues** in **perfectly competitive** markets **were $Q * P$** and not $Q * P(Q)$

Profit maximization in monopoly

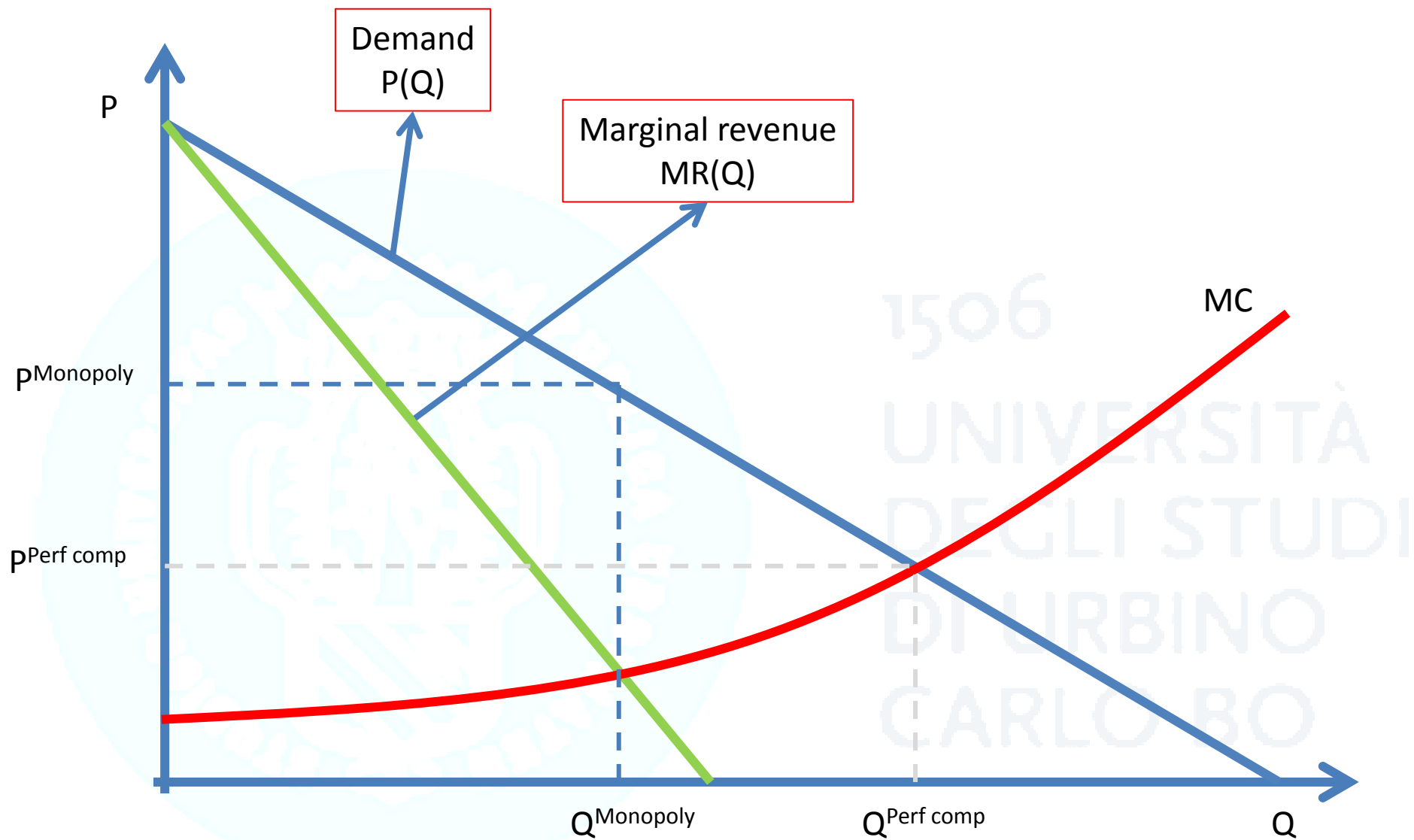
- Profits are **maximized** when:

$$MR(Q) = MC(Q)$$

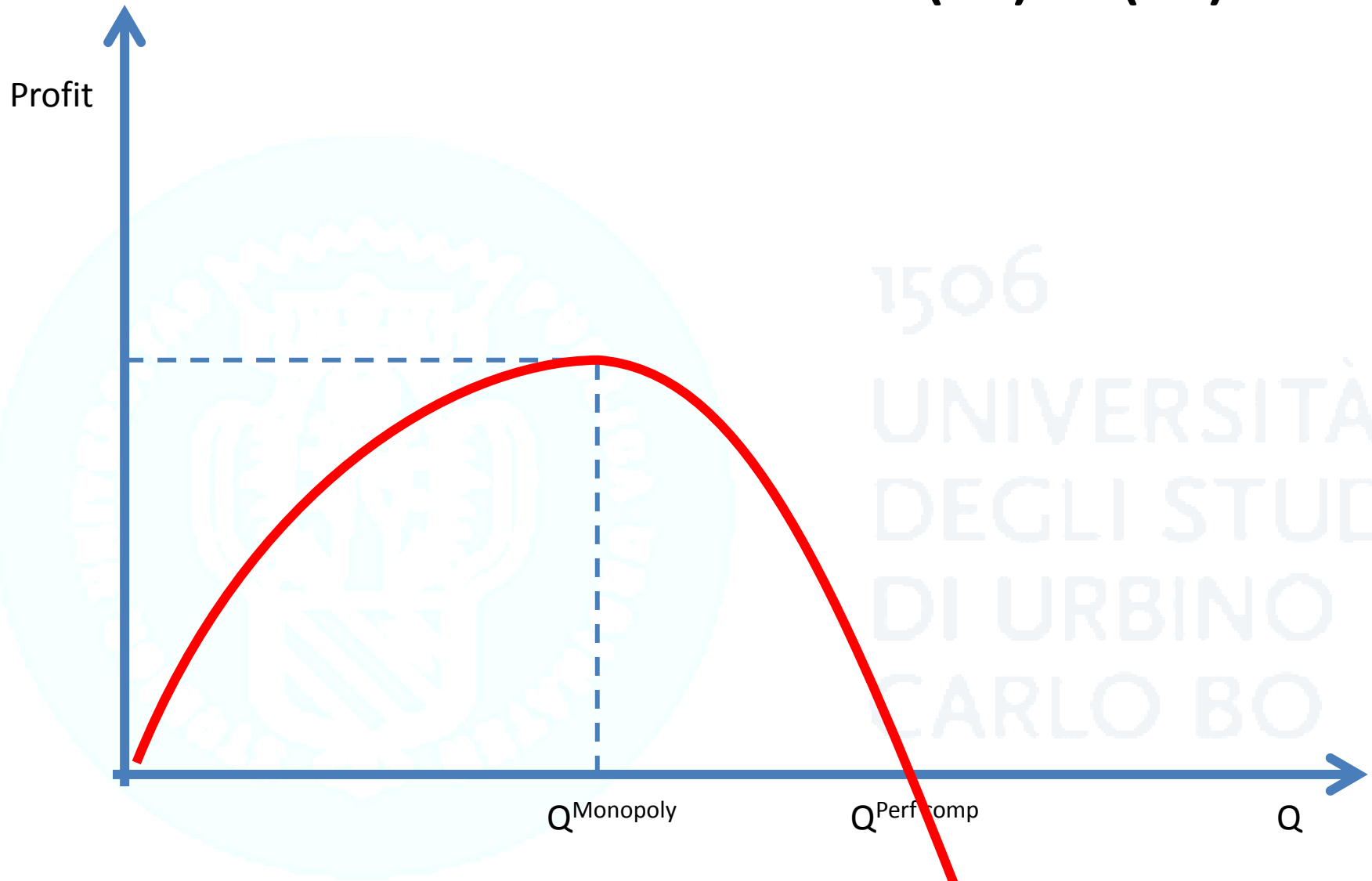
- **where:**

$$MR(Q) = d[Q * P(Q)] / dQ = P(Q) + dP(Q) / dQ$$

$$MC(Q) = dC(Q) / dQ$$



$$\text{Profit function} = Q * P(Q) - C(Q)$$



Oligopoly

- **Few firms** operate on the market
- Firms interact **strategically** to **maximize** their **profits**
- A firm decides **either prices** or **quantities**, taking into **account** the **behaviour** of **other firms** → optimal response function

Competition on prices (Bertrand)

- **Two firms** on the market with the **same marginal cost** function and **no fixed costs**
- Firms **decide** the **price**
- The firm that sets the **lowest price** on the market will serve the **whole market**
- Firms choose their price **'given'** the **price** set by **other firms**
- Firms choose prices **simultaneously**

Competition on prices (Bertrand)

- Firm 1 **maximizes profits**
- Profits of firm 1 will be
 - 0 if $P_1 > P_2$
 - $P_1 * Q(P_1) / 2 - C(Q/2)$ if $P_1 = P_2$ → the two firms split equally the market
 - $P_1 * Q(P_1) - C(Q)$ if $P_1 < P_2$ → firm 1 becomes the monopoly
- Firm 2 does the same
- As long as $P_1 * Q(P_1) - C(Q) > 0$ (positive profits), firm 1 will set $P_1 < P_2$

Competition on prices (Bertrand)

- In the end, firms will choose a **price such that profits of each firm are zero** →
 $MC_1 = MC_2 = P_1 = P_2$
- **No firm has incentive to deviate**
 - Increasing the **price** leads to **null production**
 - Reducing the **price** leads to **negative profits**
- **Same result as in perfect competition!**

Competition on quantity (Cournot)

- Each firm will set its level of **production** given the **expected production** of the **other** firm(s)
- All firms decide their quantity **simultaneously**
- Firms **maximize** their **profits** for **given quantities** produced by **other firms**

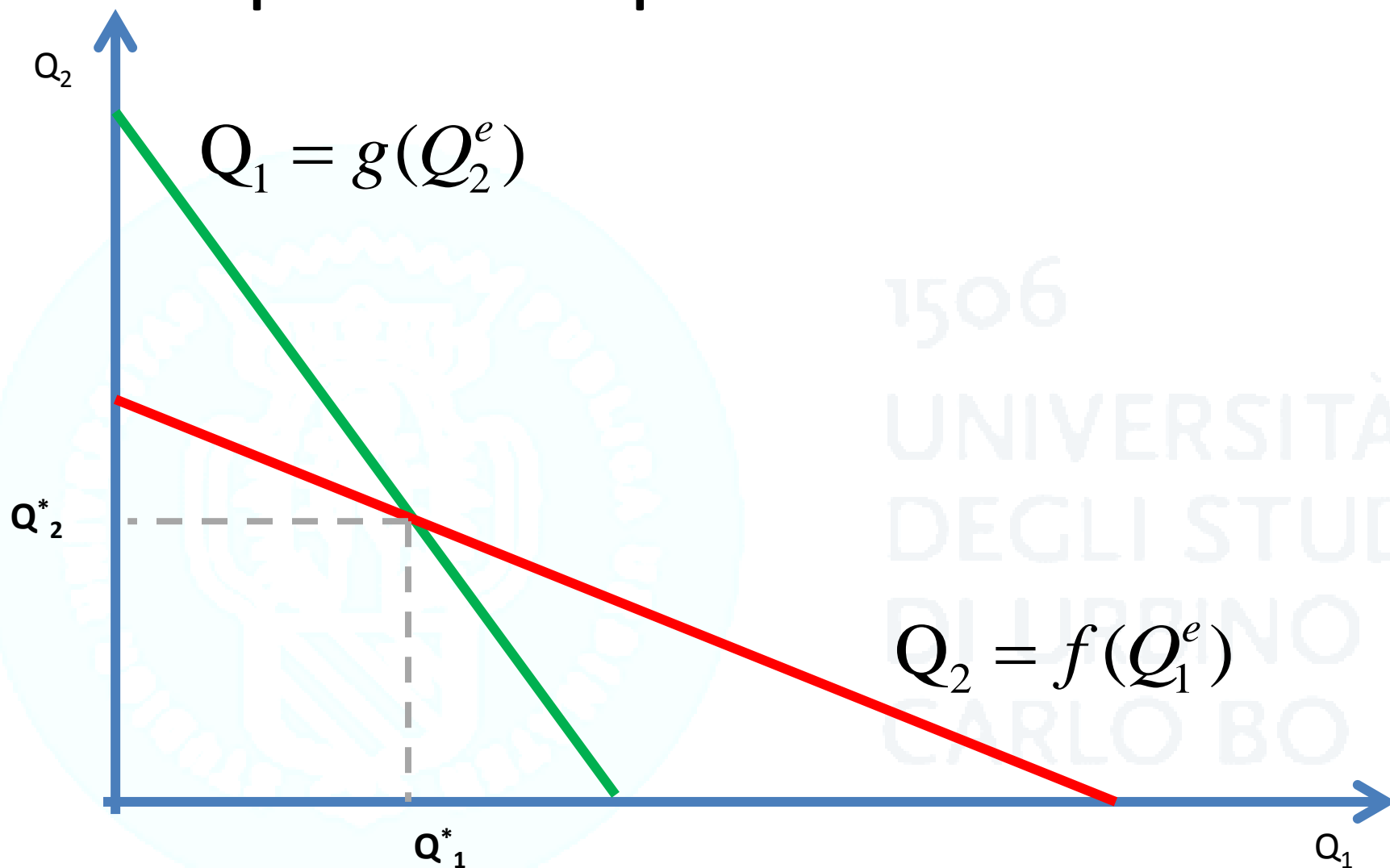
Competition on quantity (Cournot)

- Assume that **two firms** operate in the market
- **Firm 1 maximizes its profits given the expected output produced by firm 2**

$$\max_{\{Q_1\}} Q_1 P(Q_1 + Q_2^e) - C(Q_1)$$

- **Firm 2 will do the same**
- The **optimal** solution for **firm 1** is a decreasing **function** of the **expected quantity** produced by **firm 2**
- The **larger** the **quantity** produced by **firm 2**, the **lower** the **'residual demand'** for **firm 1** (or alternatively, the lower the expected price)

Optimal response functions



Oligopoly and collusion

- The **Cournot** model results in
 - **Prices higher** than in perfect **competition** (and Bertrand oligopoly) and **lower** than in **monopoly**
 - **Quantity lower** than in perfect **competition** (and Bertrand oligopoly) and **higher** than in **monopoly**
- Firms could **potentially increase** their **profits** (i.e. total profits earned by producers) by producing the **same quantity** as the **monopolist** at the **monopoly price** → **collusion**
- Firms have great **incentive** to **deviate** from **collusion** as, at the **margin**, they will earn **additional profits** from **deviating**