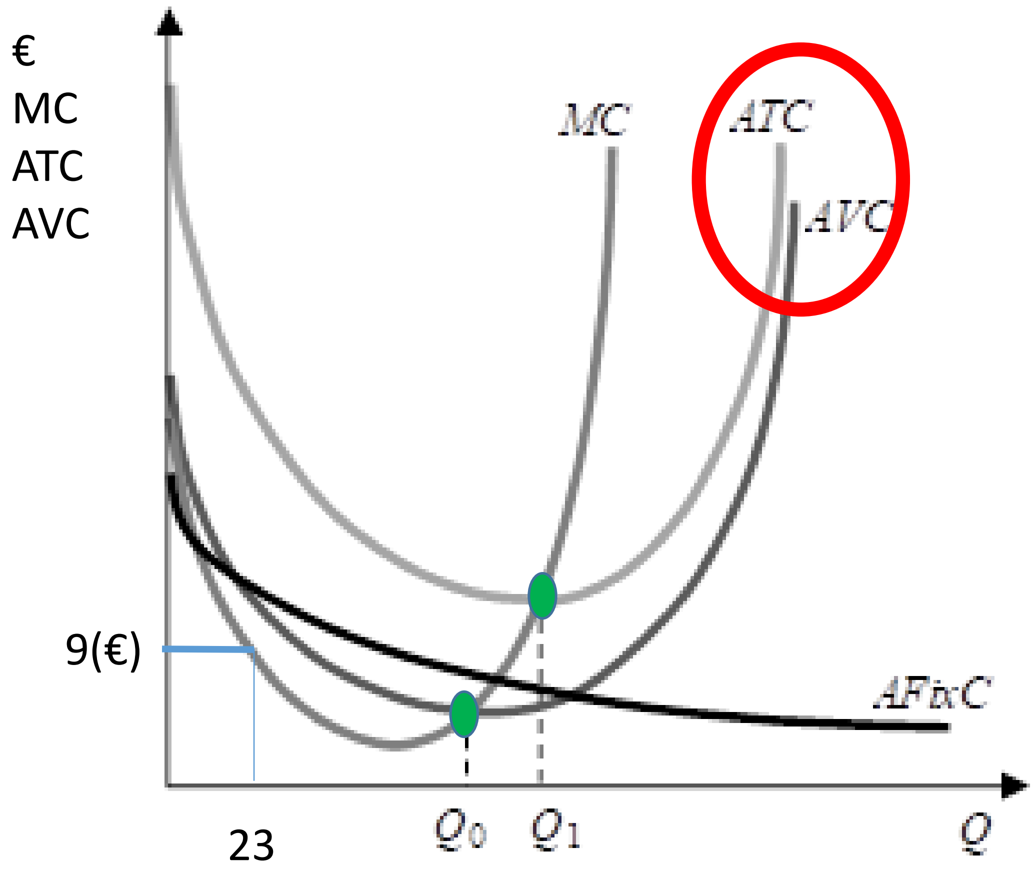
Short term cost functions VIP!



Cost Functions Long Term

The long-term: marginal «does not apply»?

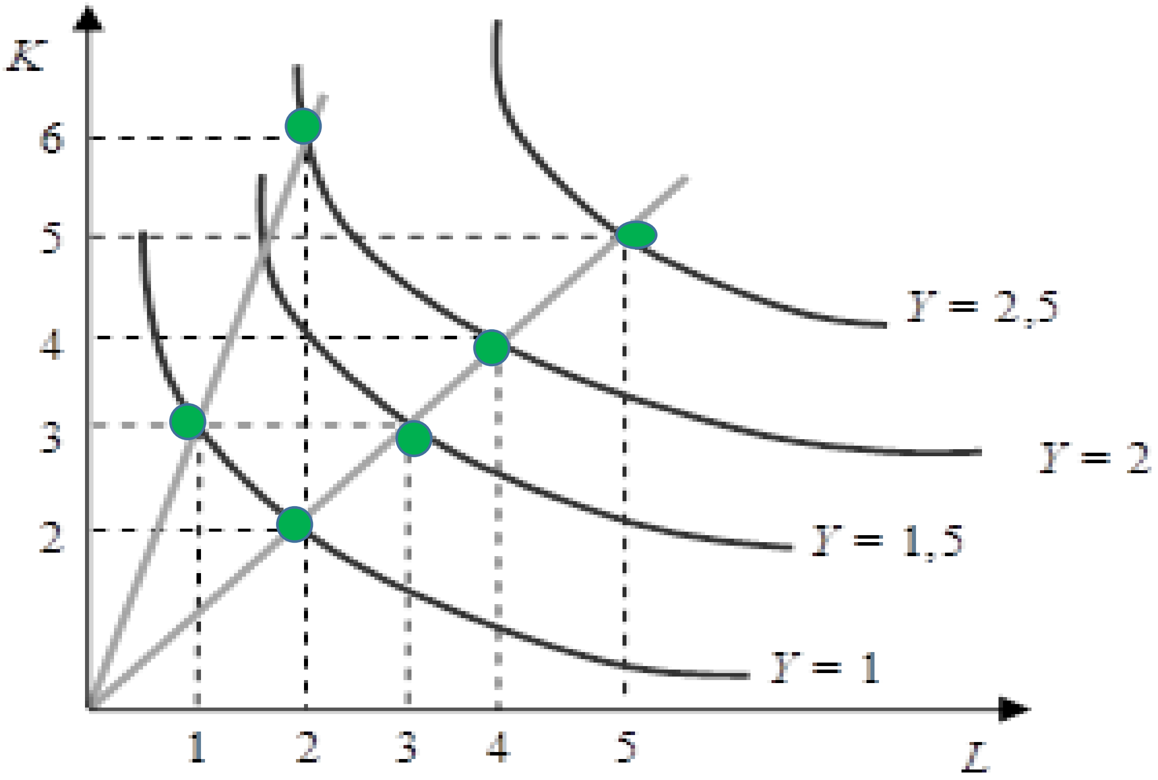
We will call technologies with **constant returns to scale**, those which, if the use of all the production factors were to increase by a certain same proportion, would result in an exactly proportional increase in output.

For example, at the simultaneous doubling of the use of capital and labour, the (maximum) output obtained doubles.

It denotes a skill in producing that is not influenced by the size of the production (and therefore of the company): the ability of the firm remains the same independent of size.

PS:
Marginal productivity…
Changes of one input keeping constant the other, an excellent concept of technology for the short term! But in the long term, when all factors are changing?

The long-term: constant returns to scale

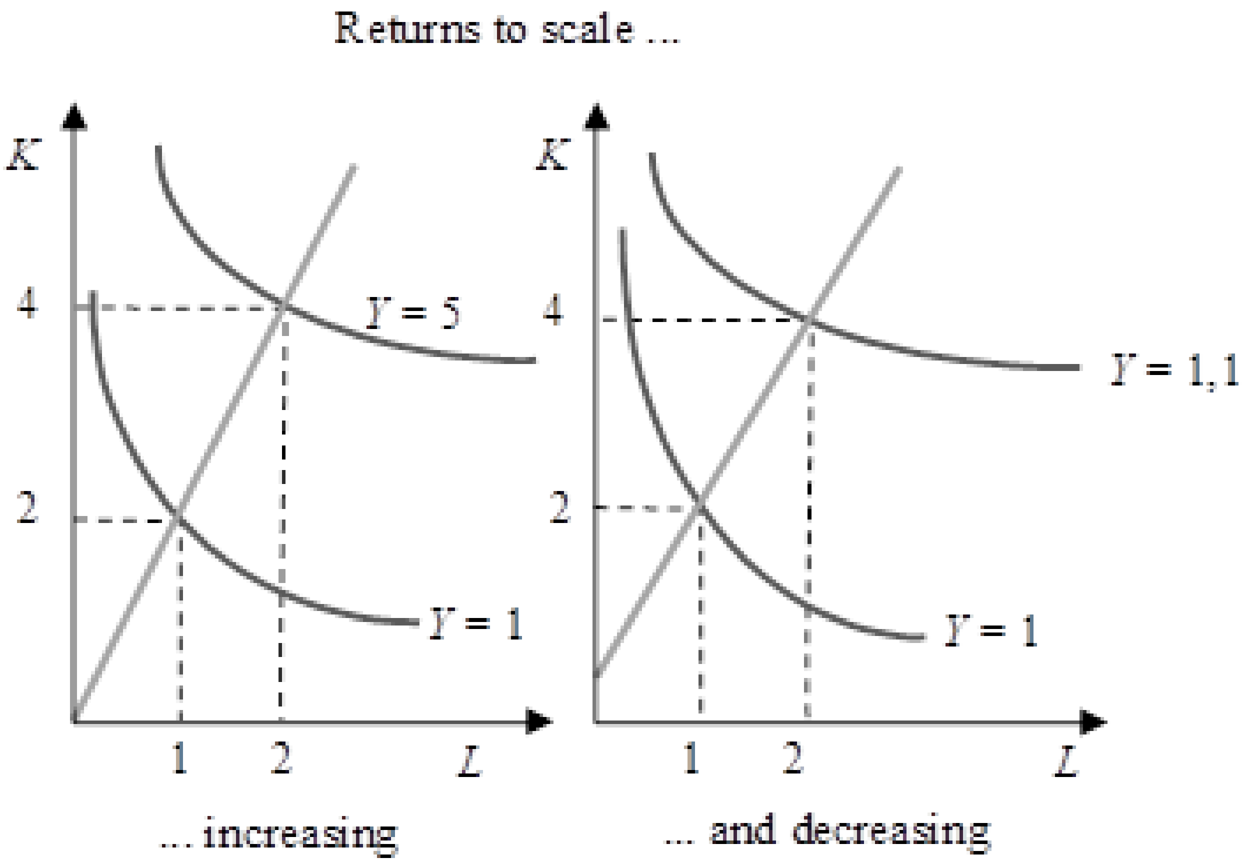


1 ice cream?
1h of L and 200g of milk

2 ice creams ?
2h of L and 400g of milk

Long term: returns to scale

Companies that transport oil via pipelines: as the diameter of the pipeline **doubles** in size, and with it the materials used to transport oil, the section of the pipeline will **quadruple**, thus increasing more than twice the amount of oil transported.



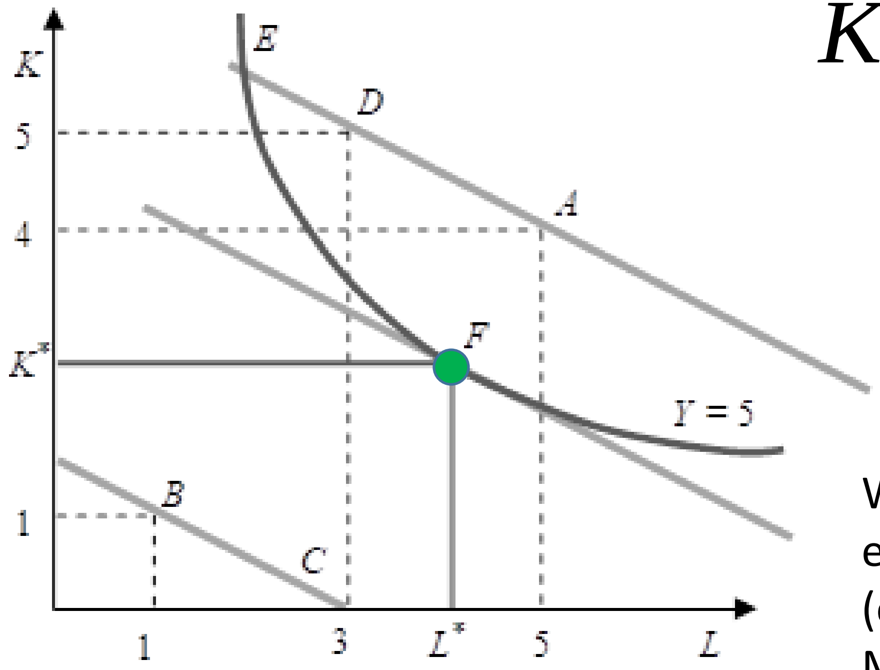
1 ice cream?
1h of L and 200g of milk

2 ice creams ?
2h of L and 400g of milk

?

Long term costs

$$\frac{dK}{dL} = -\frac{f^l}{f^k} = -\frac{PmaL}{PmaK}$$



$$K = \frac{TC^0}{r^\circ} - \left(\frac{w^\circ}{r^\circ}\right) \times L$$

What if the condition does not hold?
e.g. (w/r) equal to 1/2
(e.g. w = 2 and r = 4 euro per unit).
Marginal productivity of labor twice as high as the one of capital.
(MPL = 2 and MPK = 1).

(w°/r°)<(MPL/MPK)

+ 1 L and – 2 K? What happens to cost?

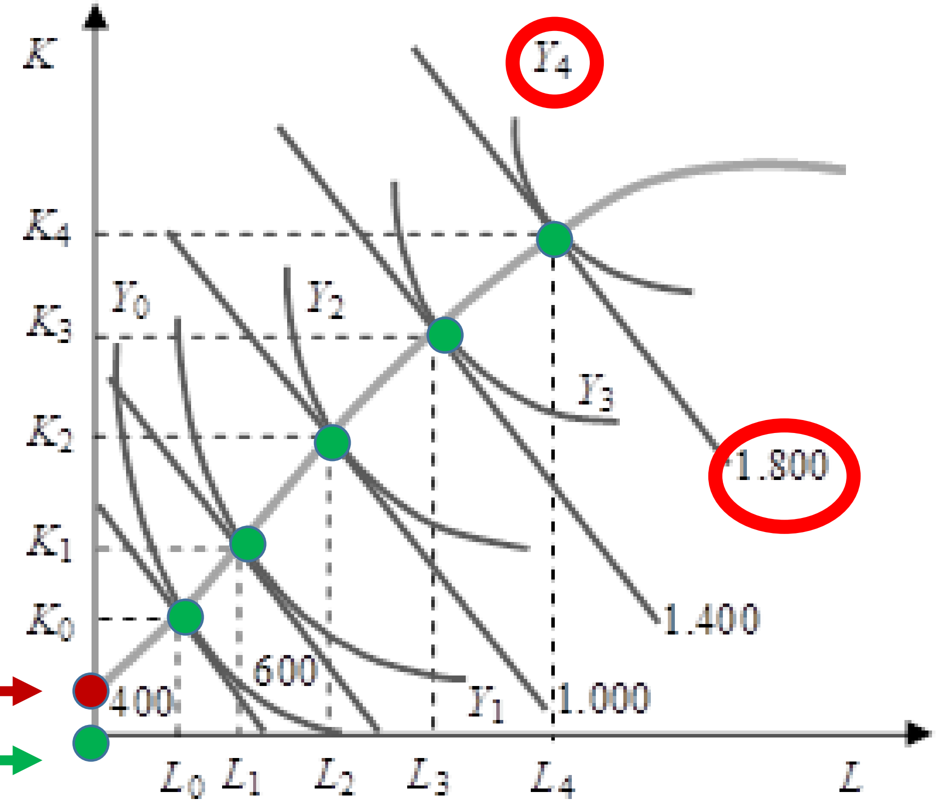
$$\frac{MPL}{MPK} = \frac{w}{r} \qquad \frac{MPL}{w} = \frac{MPK}{r}$$

Long term technology expansion path

TC_{min}^{LP} ($Q(L,K)$; w°; r°)

TC_{min}^{LP} ($Y4$; w°; r°) = 1800 €

CAREFUL MISTAKE IN THE GRAPH! The green point is the right one



Long term: cost and technology, again!

Production function with **constant** returns to scale.

Hypothesis: to produce **a unit** of good, when the factor costs are fixed and equal to (w°, r°) the minimum cost is equal to TC (1, w°, r°) which corresponds to the use of the optimal production technique for 1, (K1, L1): w°L1+r°K1.

We know that by doubling the quantity produced to **two** output units, the most efficient way to produce it will be to **double** the quantity of production factors, i.e. using K2 = 2K1 and L2 = 2L1.

Therefore, note that the minimum cost to produce the quantity 2, TC (2, w°, r°), will necessarily be equal to double the cost of producing a unit of product: w°(2L1)+r°(2K1)= 2 CT(1,w°,r°).

This would not change if we decided to produce **n units** of product therefore, given the particular property of returns to scale: the total costs would be equal to n times the costs of producing one unit.

Considering the definition we have given of the **average cost function**, namely the ratio between the minimum total costs of producing a given quantity and the quantity itself, we have that:

ATC (Y, w°, r°) and ATC (nY, w°, r°) ?

$$ATC(w_0, r_0, Y) = \frac{TC(w_0, r_0, Y)}{Y}$$

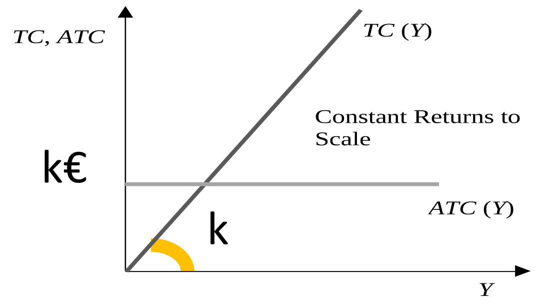
ATC (Y, w°, r°) = ATC (**nY**, w°, r°) for any n ≥ 0

$$ATC(w_0, r_0, nY) = \frac{TC(w_0, r_0, nY)}{nY} = \frac{nTC(w_0, r_0, Y)}{nY}$$

Draw ATC and TC!

Long term: cost and average cost functions

Rendimenti di scala Costanti : tecnologia che denota un'abilità nel produrre che non è influenzata dalla dimensione della produzione (e quindi dell'azienda).

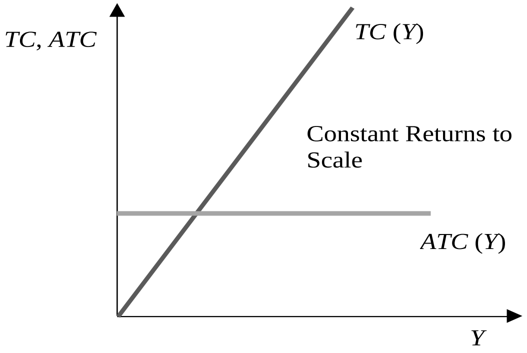


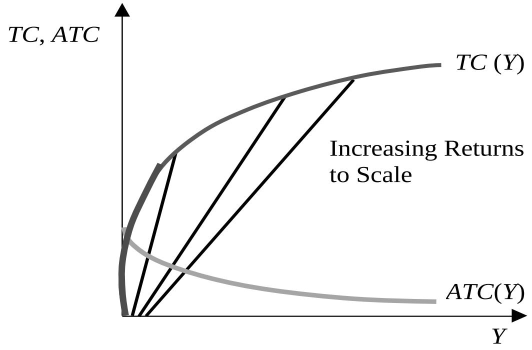
Long term: cost and average cost functions

$$ATC(w_0,r_0,Y)=\frac{TC(w_0,r_0,Y)}{Y}$$

(n-x)

$$ATC(w_0,r_0,nY)=\frac{TC(w_0,r_0,nY)}{nY}=\frac{TC(w_0,r_0,Y)}{nY}$$





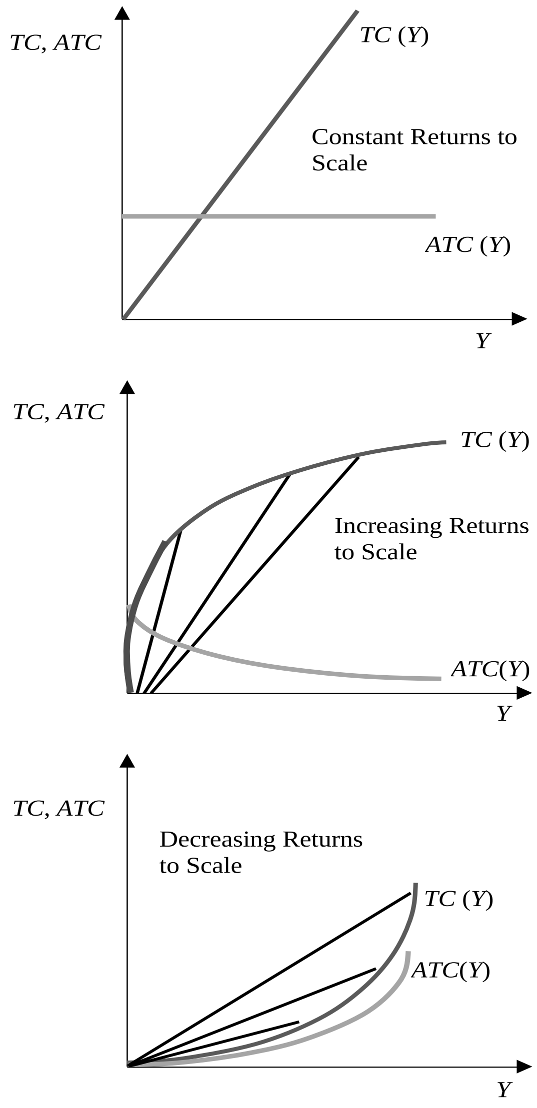
ATC (Y, w°, r°) > ATC (nY, w°, r°) for all n ≥ 1

IRTS generate economies of scale

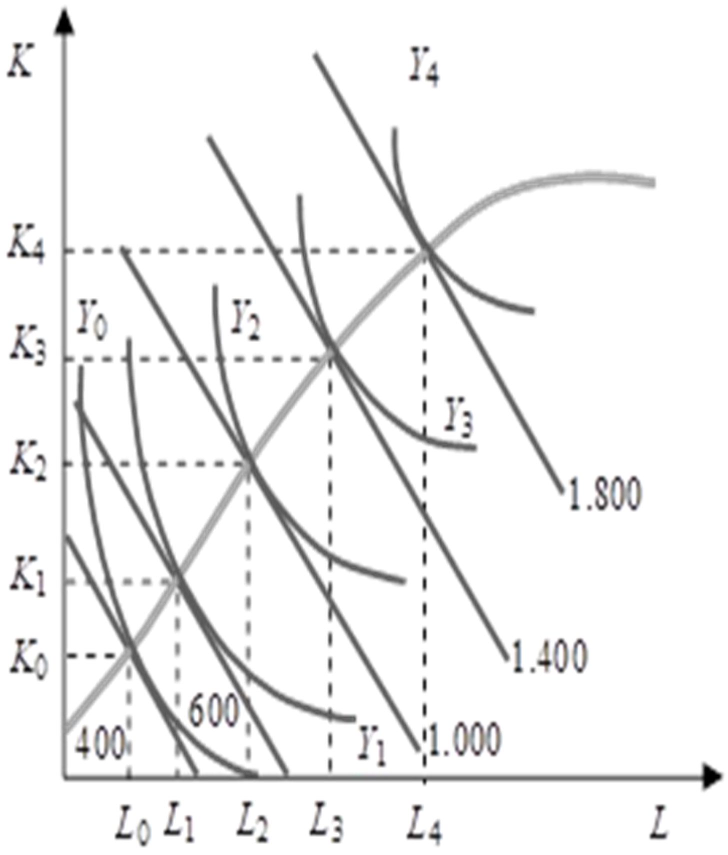
Economies of scale: the «virtuous» circle of growing. Specialization, learning by doing: .

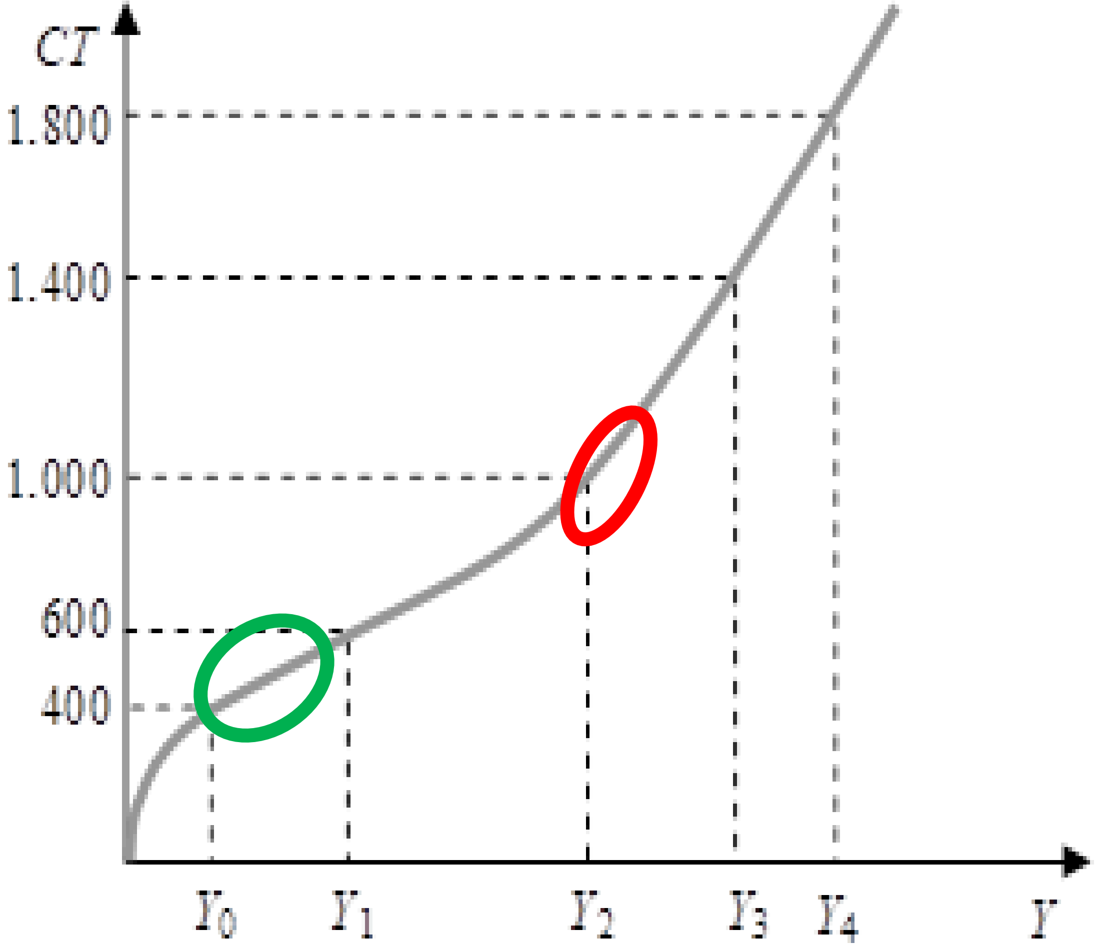
$${}_{LT}\Pi^{E}(Q) = [p(Q) - \mathbf{ATC\ (Q,\ r°,\ w°)}]Q$$

Long term: cost and average cost functions



Long Term: technology and costs. Change along the curve





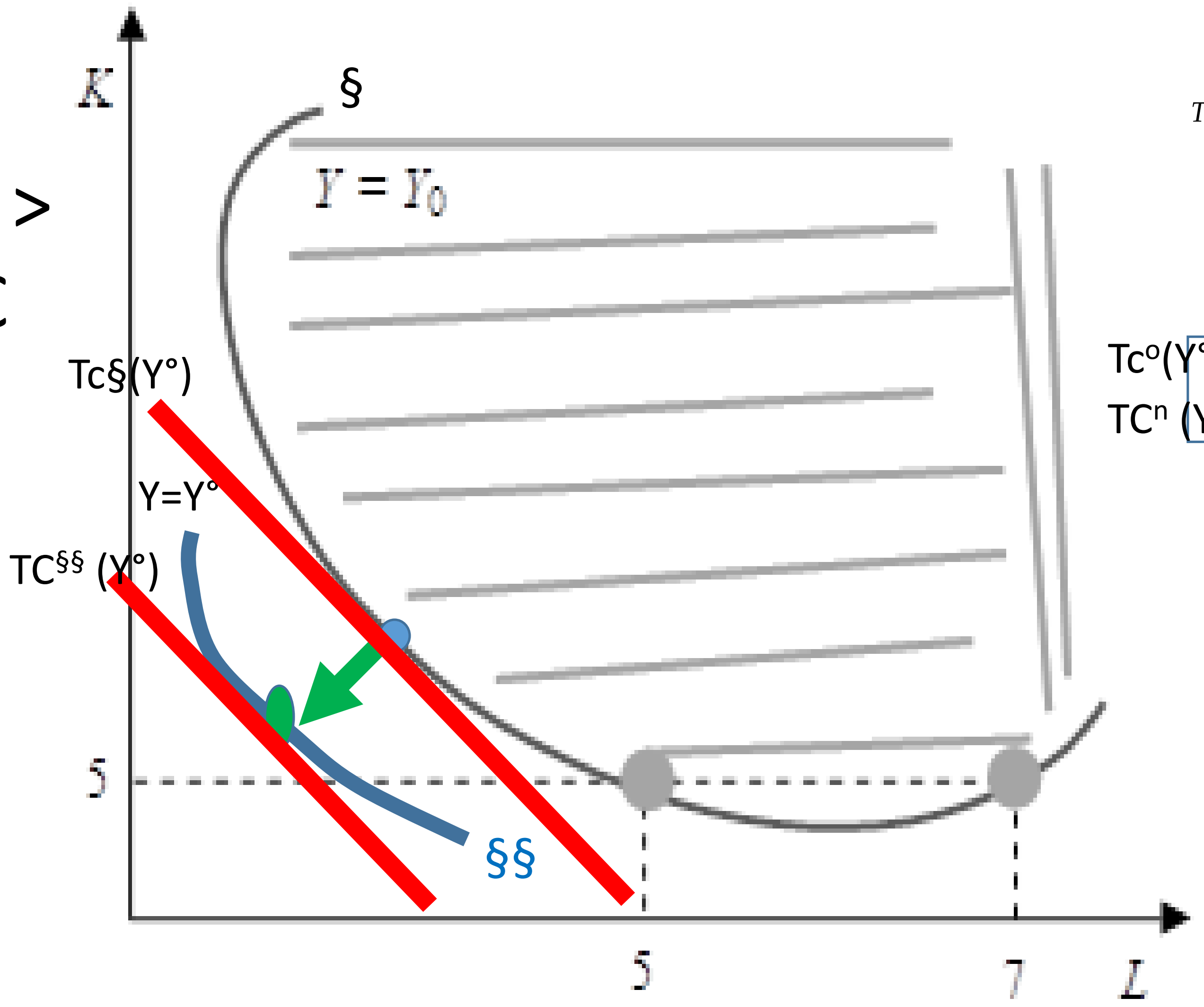
How do Cost Curves Shift?

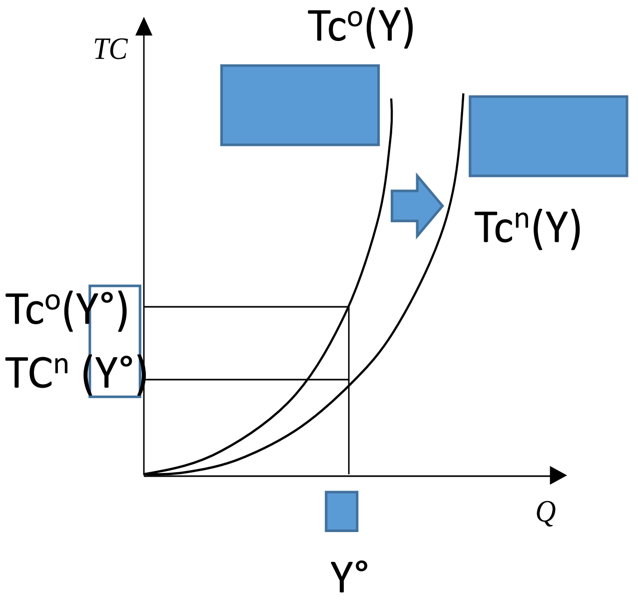
Cost curves are drawn for a given technology (production function) and for given unit costs of factors of production.

If technology or unit costs change, cost functions change: shift of the curve, not change along the curve.

PS: technological progress

$CT^{\S}(Y°) = CT_0€ >$
$CT^{\S\S}(Y°) = CT_1 €$





Short-Term, fixed cost: cost and factor price changes

From w° to w°’ with w°’> w°

TC?

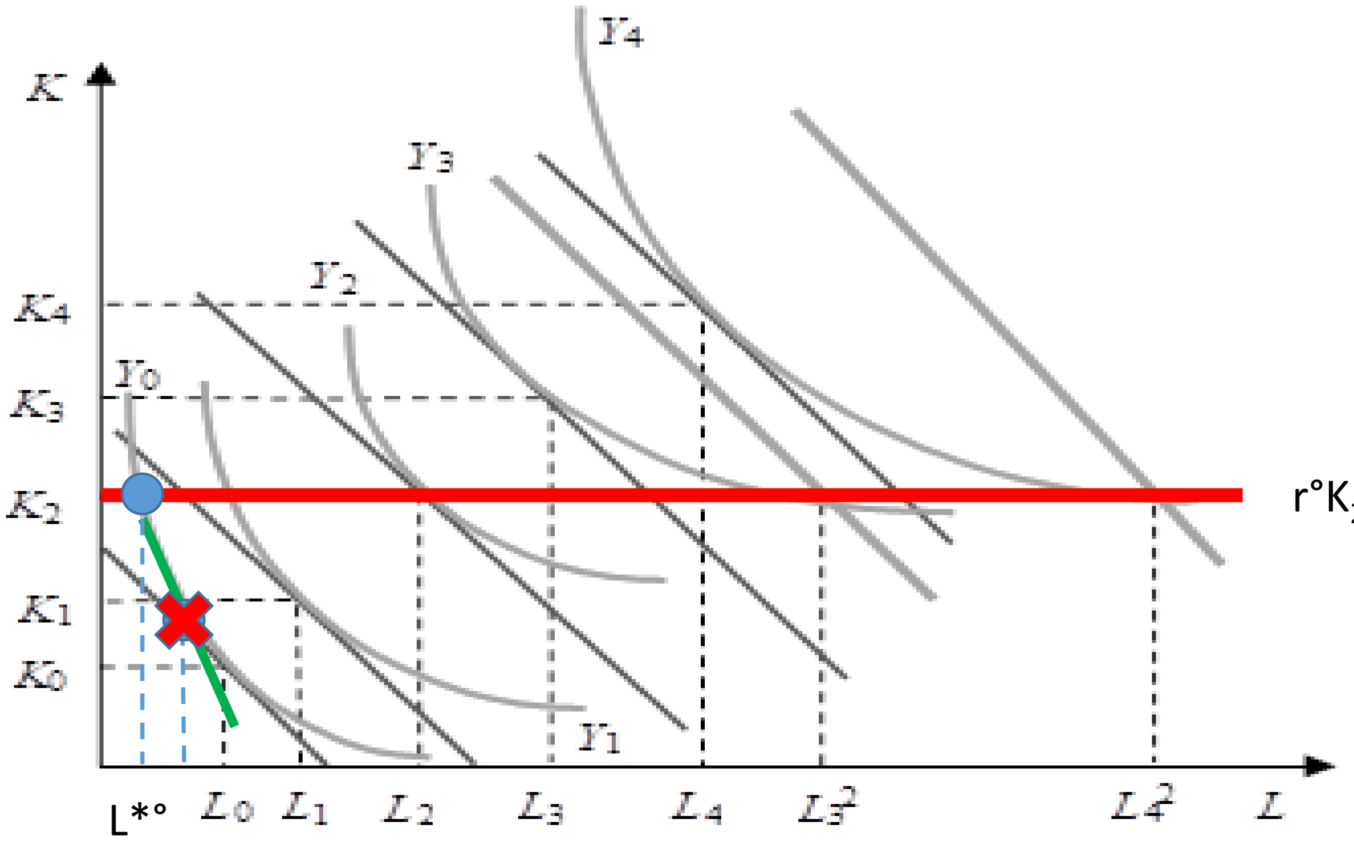
Before:

TC = w°L°*+r°K_2

Now?

TC= w°’L°*+r°K_2

↗ The minimum cost rises and the cost function shifts north west.



ST, variable cost or LT: cost and factor price changes Case A

Case a: w and r rise by the same proportion, 10%

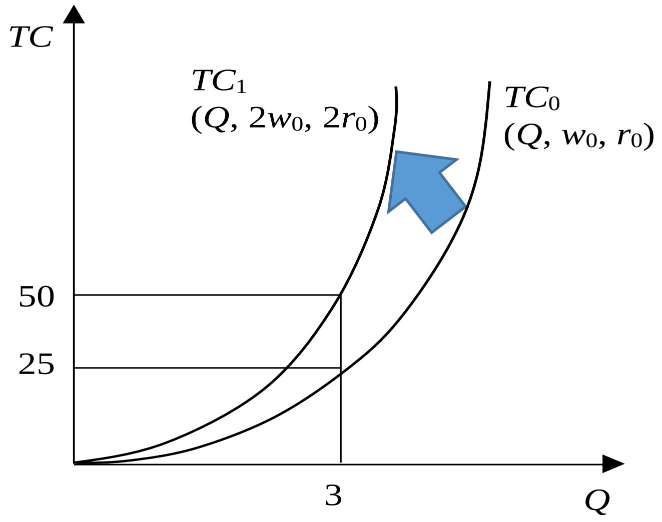
TC (Q°; w°; r°) = w° L° + r° K° rises to?

TC (Q°; w°x1,1; r°x1,1) = w°(1,1) L + r°(1,1) K **What new (L, K)?**

TC (Q°; 1,1 w°; 1,1 r°) = w° (1,1) L° + r° (1,1) K° **The same!**

TC (Q°; 1,1 w°; 1,1 r°) = 1,1 TC (Q°; w°; r°)

Cost function moves northwest



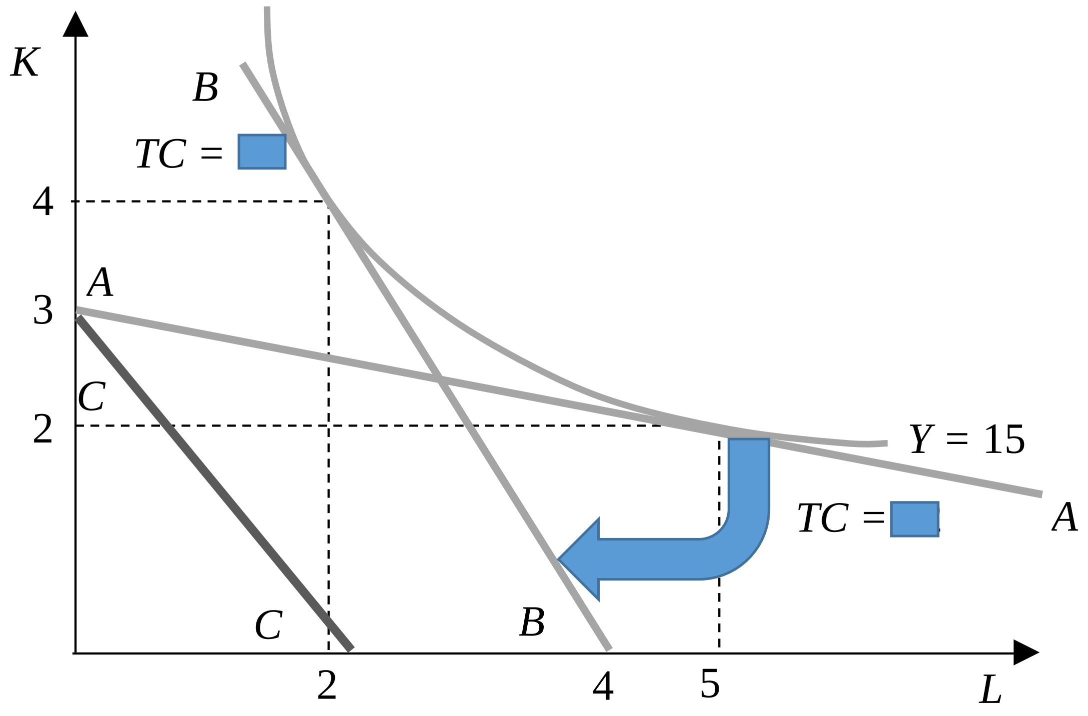
ST, variable cost or LT: case B

TC (15, w°, r°)

<

TC (15, w’, r°)

because…



From:

w° = (4/5) €

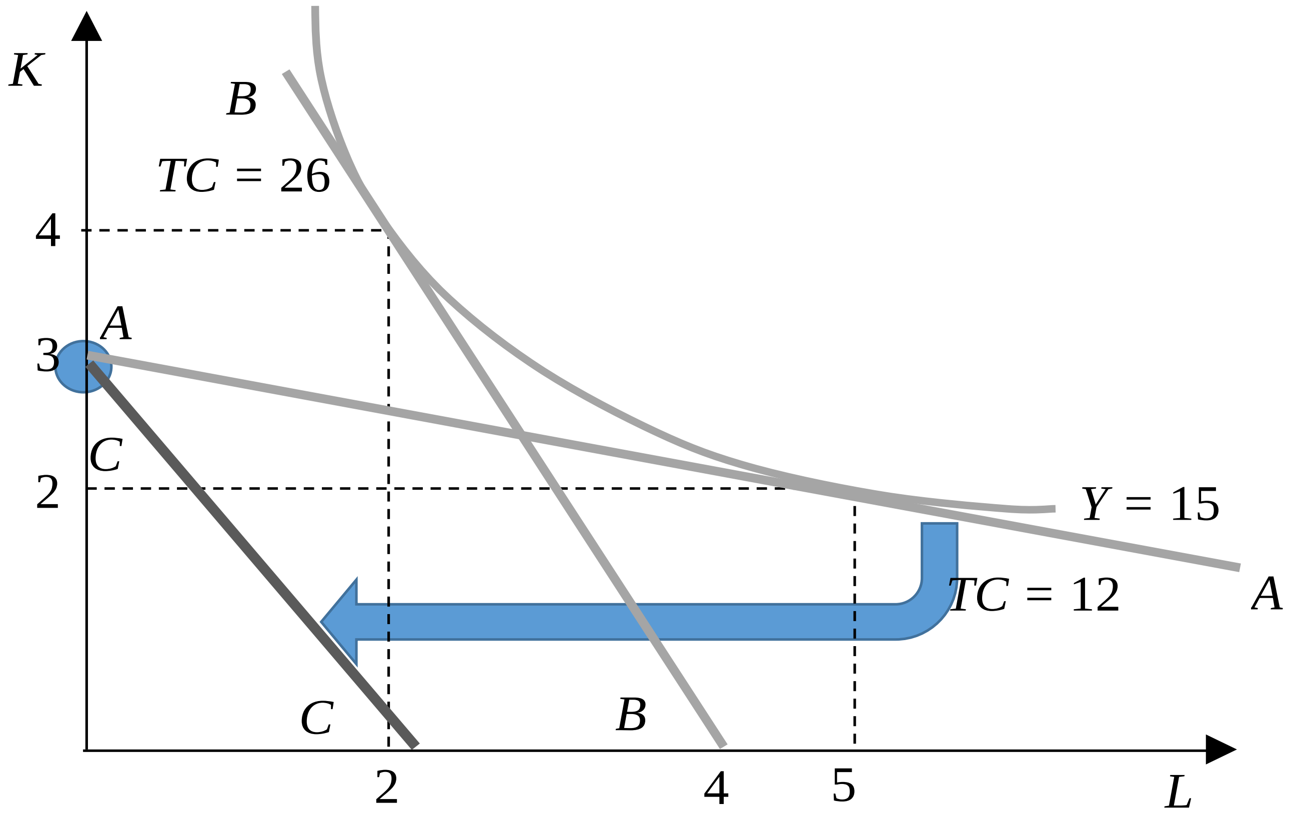
r° = 4€

To:

w’ = 5€

r° = 4€

ST, variable cost or LT: case B



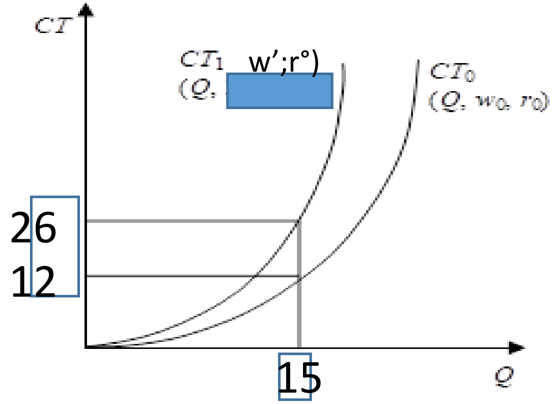
What are the costs in **CC ?**
(new unitary costs w’ and r° but with (0,3))?

w° = (4/5) €

r° = 4€

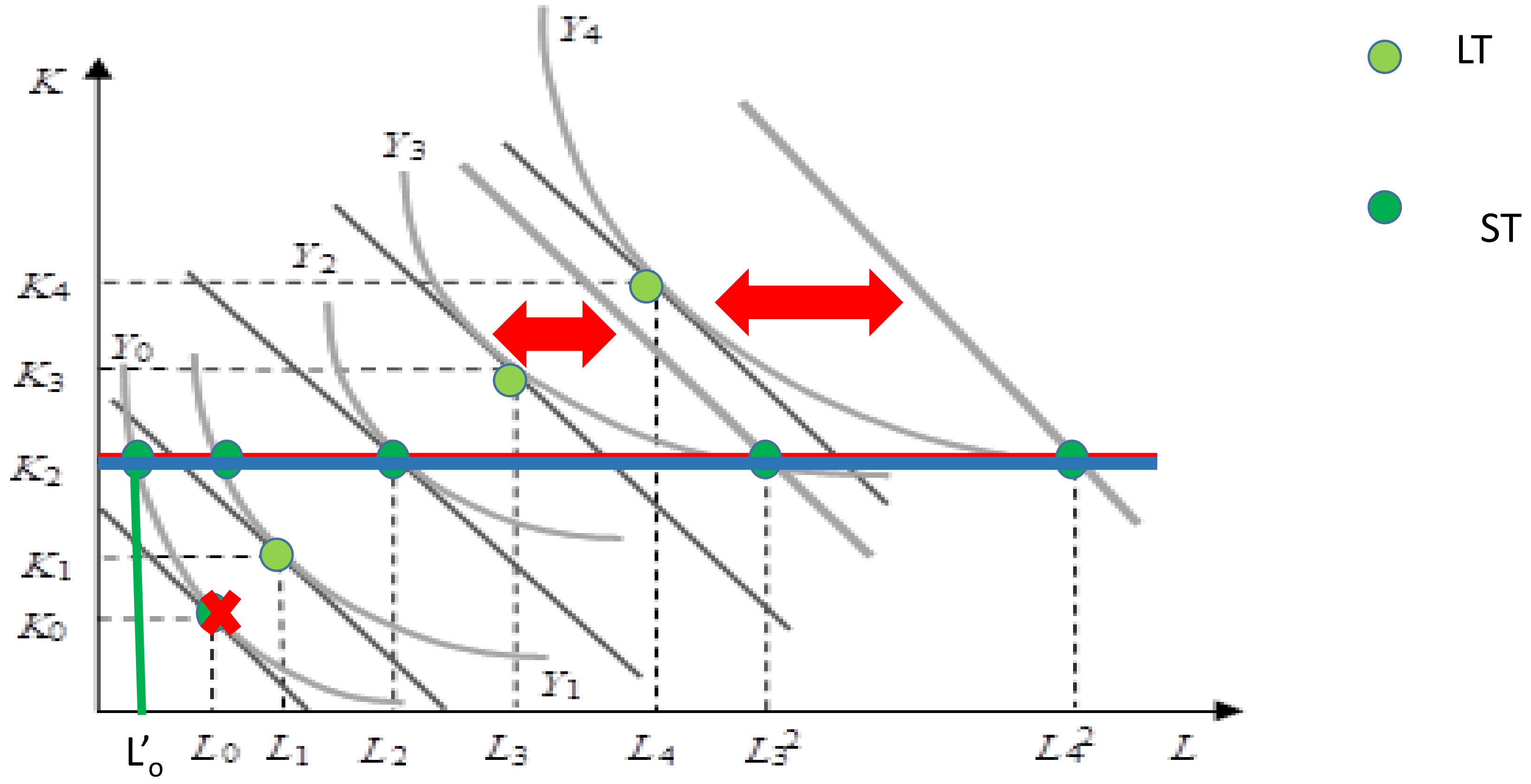
w’ = 5€

r° = 4€



The cost function goes north-west.

Short term and Long term cost functions



Relationship between ST and LT cost functions

Today

FC (K) = 10.000 € for Q = 10 BIKES

Tomorrow?

FC (K) = 1.000.000 € ? ~~Q = 10 BIKES~~

K = 4

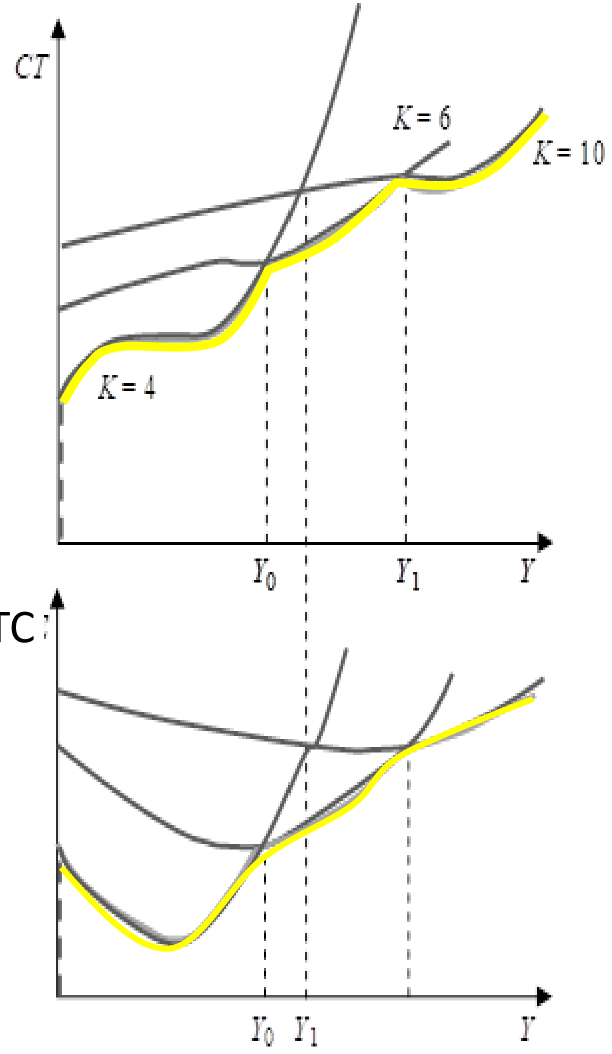
K= 6

K = 10

ST: Fixed costs? ST: Variable costs?

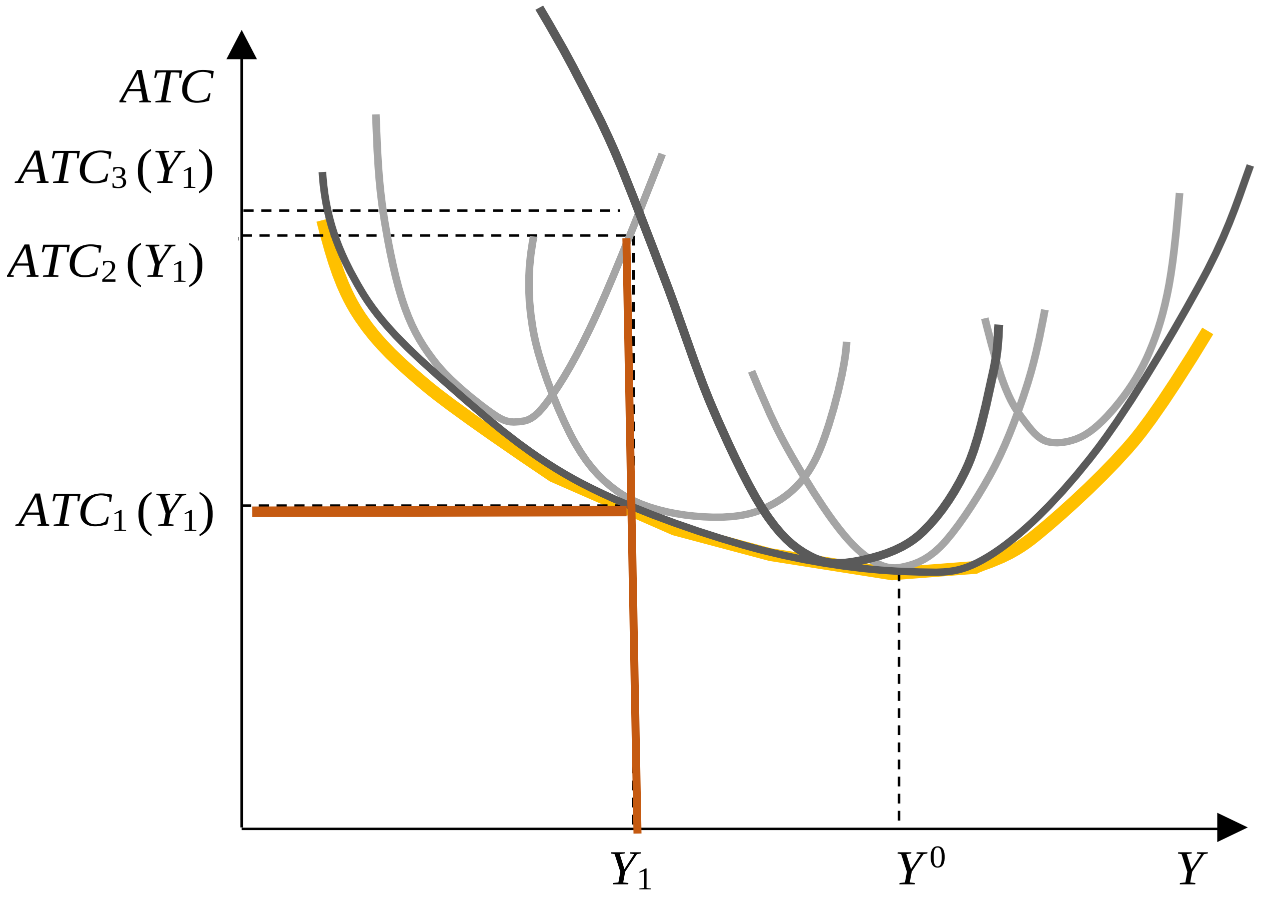
LT: ?

ATC



Relationship between ST and LT cost functions

Y° : minimum efficent scale of the firm, minimum of minima, end of economy of scales



Which Isoquant? Short-Term

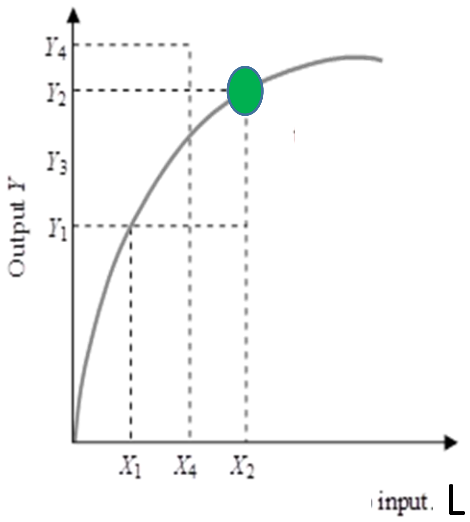
$$\underset{Q}{Max}\,\Pi^{i}(Q) = TR^{i}(Q) - TC^{i}(Q) = PQ - TC^{i}(Q)$$

s.t. $P = P^{d}(Q)$ → $P = P°$ (perfect competition)
s.t. $Q = f^{i}(K, L)$
s.t. $K = K°$ (or better $K \leq K°$?) **SHORT TERM PERIOD!**
s.t. $TC^{i}(Q, w°, r°) = w°\, L(Q, K) + r°\, K$

PS: which profits?

Maximization of profit, ST

K=K°



Q* such that:
Max Π (Q) = P° **Q** – TC (**Q**)
Or L* such that:
Max Π (L)= P° f (K°, **L**) – w° **L** – r° K°

$$P_0 \frac{\delta f(K_0 L)}{\delta L} - w_0 = 0$$

P° MPL (K°, L*) = w°

$$MPL(K_0 L^*) = \frac{w_0}{P_0}$$

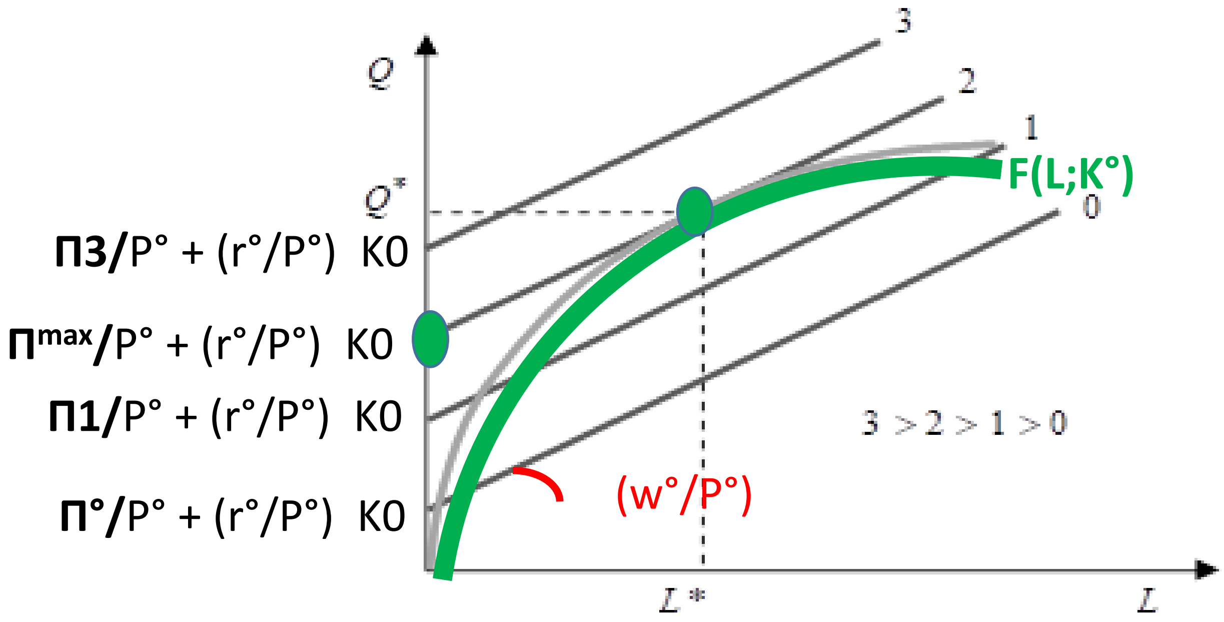
PS: r°K°?

Isoprofits and Maximization of profits, ST

$$\Pi° = P°\,Q - w°\,L - r°\;K°$$

What is the optimal condition for Q* and L*?

$$Q = \frac{\Pi_0}{P_0} + \frac{r_0}{P_0}K_0 + \frac{w_0 L}{P_0}$$



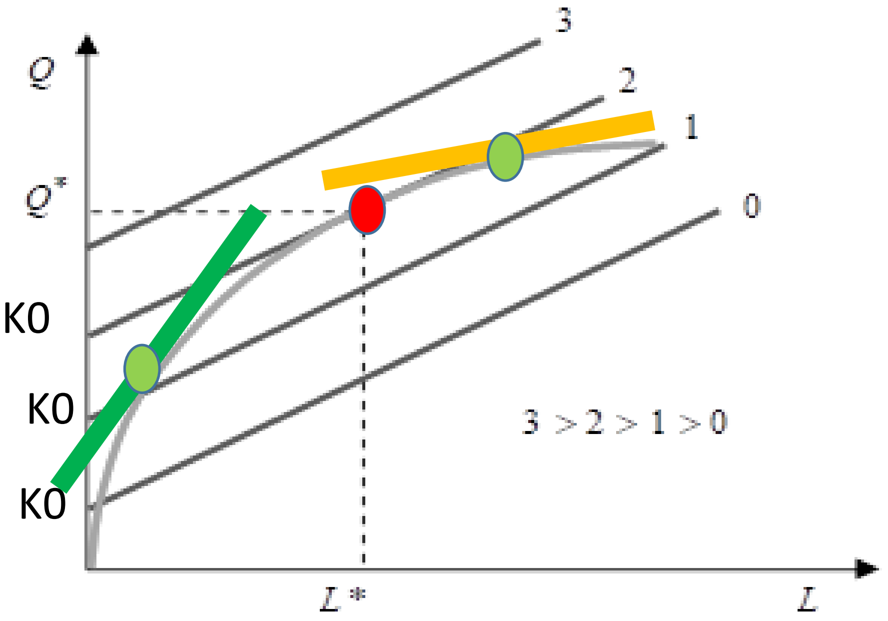
Isoprofits and Maximization of profits, ST

$\Pi° = P°\,Q - w°\,L - r°\;K0$

Do you spot the supply curve?

Do you spot the labor demand curve?

$$Q = \frac{\Pi_0}{P_0} + \frac{r_0}{P_0}K_0 + \frac{w_0 L}{P_0}$$



What if P declines? (a lot?)

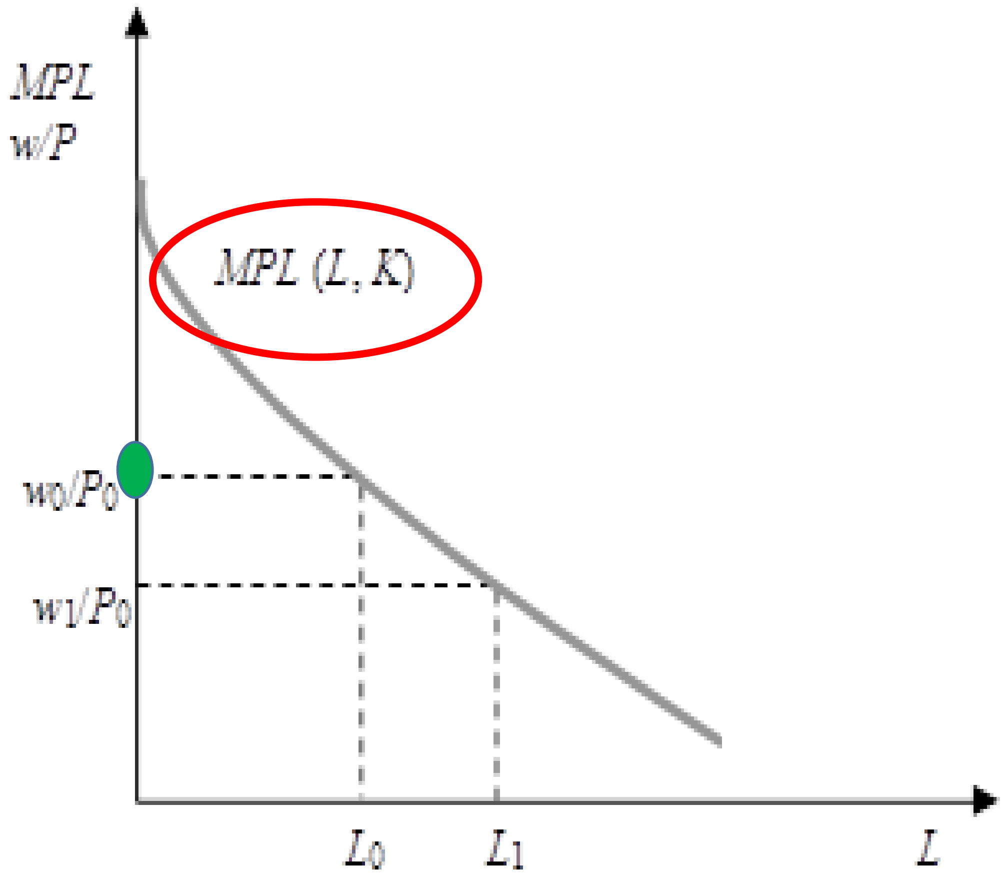
What if w declines?

What iF r°K° grows?

The labor demand curve of the firm?

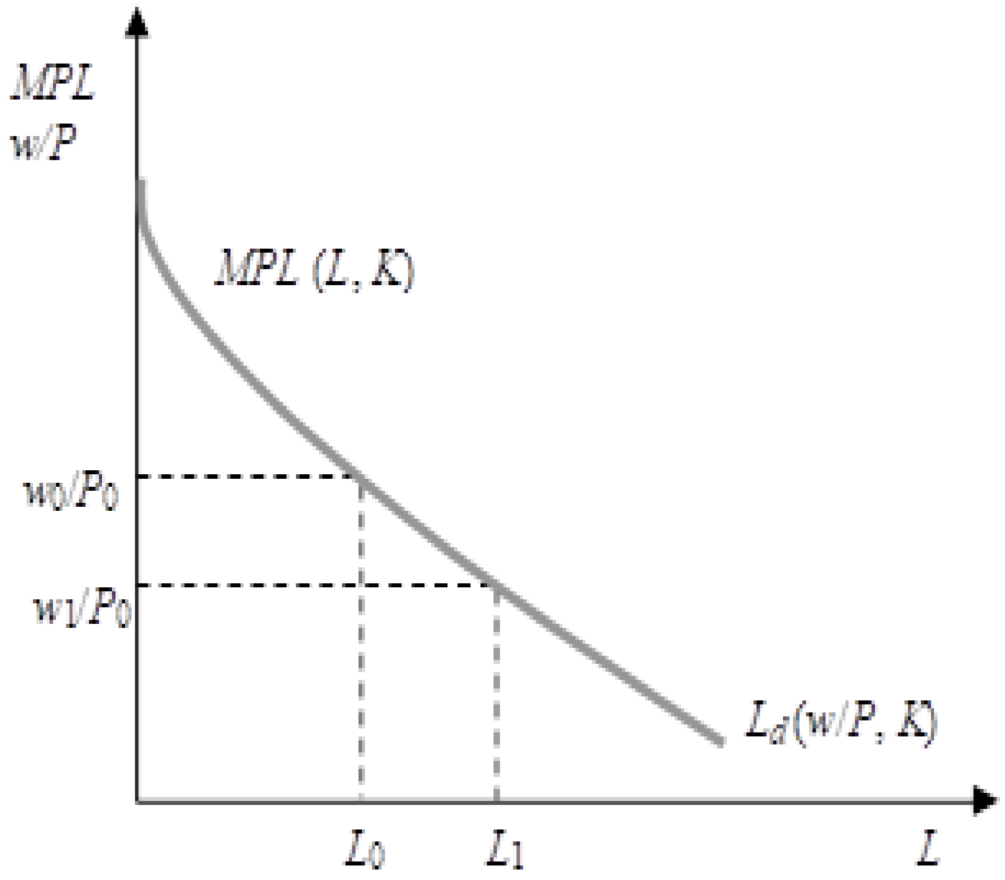
At the real wage w°/P°,
How many workers will the firm demand/desire?

And at the wage w1/P°?



TOR VERGATA UNIVERSITY OF ROME

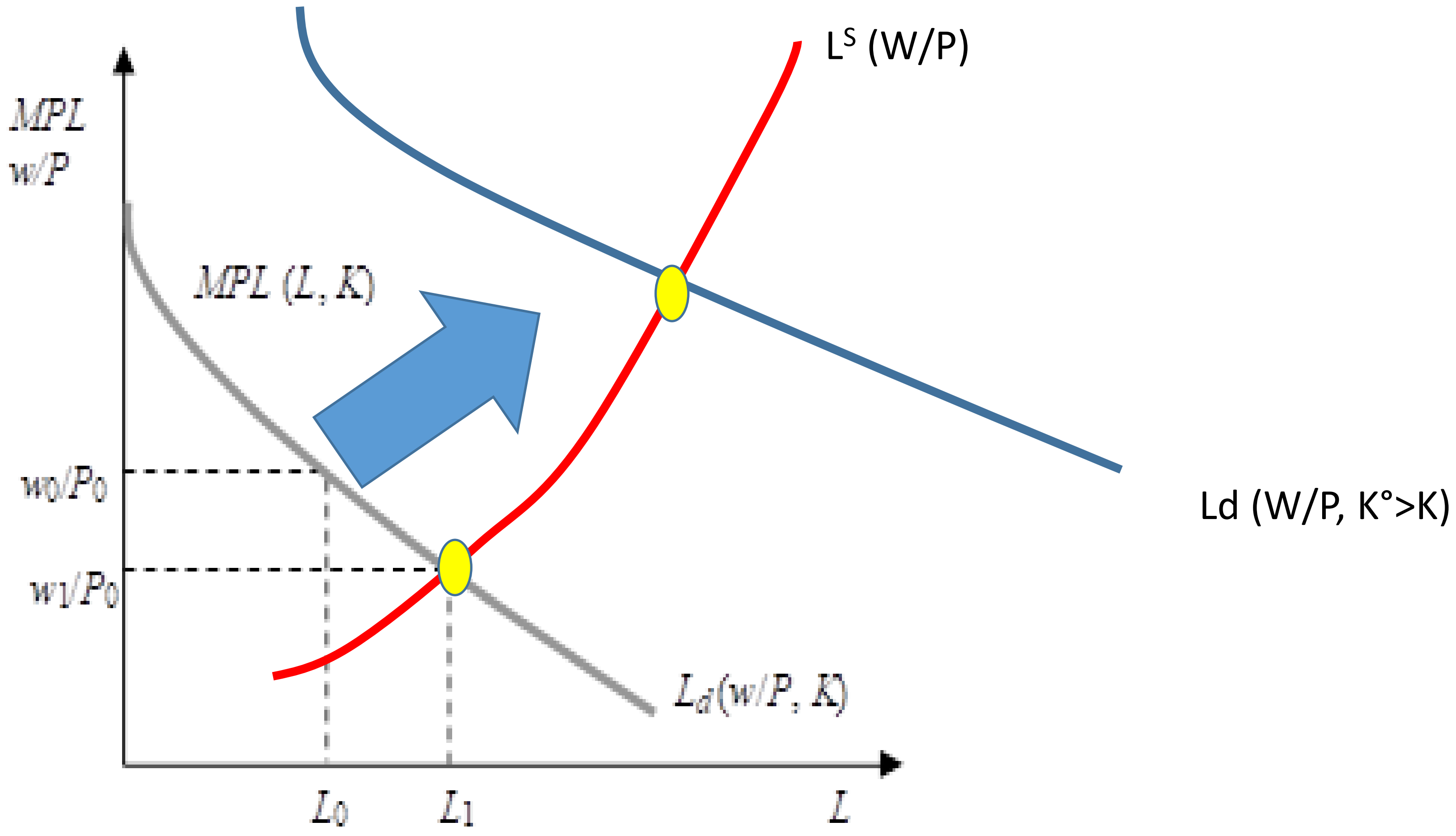
The labor demand curve of the firm!



!!!!!!

The impact of technological progress on labor demand

How can employment and wages simultaneously go up?



Which Isoquant? Maximization of profits, LT

Maximum profit

Economically efficient

Technologically efficient

Output efficient

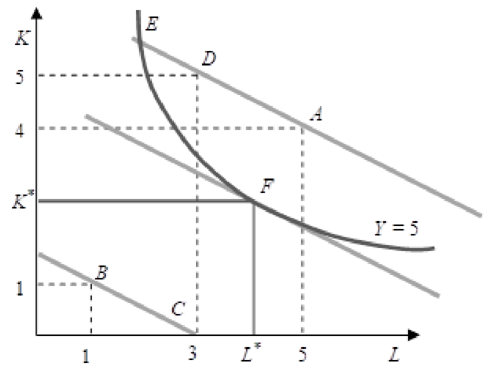
K* and L*

$$\Pi (K, L) = P° f(K, L) - w° L - r° K$$

$$P° \, MPL(K^*, L^*) = w°$$

$$P° \, MPK(K^*, L^*) = r°$$

Notice anything?



Maximizing profits requires minimizing costs (not necessarily viceversa)!

$$\frac{MPL(K^*, L^*)}{MPK(L^*, K^*)} = \frac{w_0}{r_0}$$

Chapter 5

The Maths of Profit

Q* such that

$$\operatorname*{Max}_{Q} \Pi(Q) = TR(Q) - TC(Q)$$

$$\frac{\delta TR(Q^*)}{\delta Q} - \frac{\delta TC(Q^*)}{\delta Q} = 0$$

?

In any market regime!

Market Power and Market Regime

Market regime identifies the market power of those firms populating that market.

Market Power: inversely related to the degree of market loss when a firm raises its price (elasticity). In perfect competition, it is minimum, as it would lose the whole market.

Perfect Competition

Perfect Competition: **defined** as that market regime in which the firm is a *price-taker*, i. e. with no market power.

Firms **can** change the price with respect to the market prevailing price, **but it is not profitable/convenient**:
if they raise it, they lose all clients; they do not lower it as they conjecture being able to sell at that market price any quantity they wish.

Perfect Competition

Perfect Competition: **defined** as that market regime in which the firm is a *price-taker*, i. e. with no market power.

What conjectures on rivals are coherent with this belief of being able to sell whatever quantity at that price? Would other firms not react?

How can we have Perfect Competition? The role of size

A) Large number of firms

Our impact on price? Our impact on rival's profits? Minimal.

Example: Industry made of 10.000 identical firms, each producing 100 units of the product, for a total quantity produced of 1.000.000 units, sold at a price of 10 euro per unit.

If one firm were to double (!!!) the produced quantity to 200 units?

Total quantity would rise by 0,01%. Assuming a reasonable elasticity of market demand, equal to e.g. 2, price would decline by ?

0,005% to 9,9995 euro!

The elasticity of demand of the firm instead would equal – (100%/-0,005%) or 20.000.

To make the price go down by 1%, the single firm would have to raise production … 200-fold times. Impossible! So … they think they can sell at the market price any quantity they wish.

Perfect Competition

Perfect Competition: **defined** as that market regime in which the firm is a *price-taker*, i. e. with no market power.

Firms are therefore rightly convinced not to be able to influence, with their choice on how much to produce and sell, the choices of the other firms. Therefore they make no conjecture about the other's reactions, **we lack strategic interaction** (=monopoly!).

How can we have PC (a price taker)?

A) Not enough.

Ever taken a cappuccino at a Tor Vergata bar? Which one?

B) **Homogeneous good, perfecf substitute, or perceived as such, MRS = 1** among bar customers

How can we have PC?

A) and B) not enough.

One million consumers, one million firms selling the same identical good. But…

C) **Perfect** information

How can we have PC?

«If B) or C) do not hold,

why do we lose perfect competition?»

How can we have PC, in the LT?

D) Free entry, in the long term