# Long term: Increasing Returns to Scale

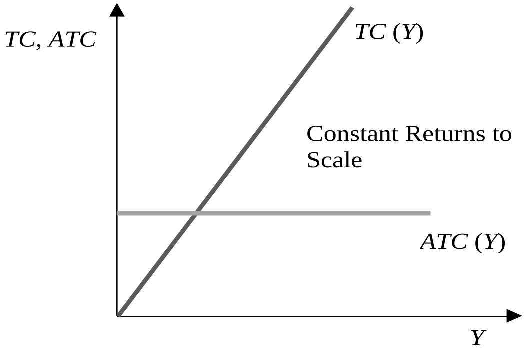
$$ATC(w_0, r_0, Y) = \frac{TC(w_0, r_0, Y)}{Y}$$

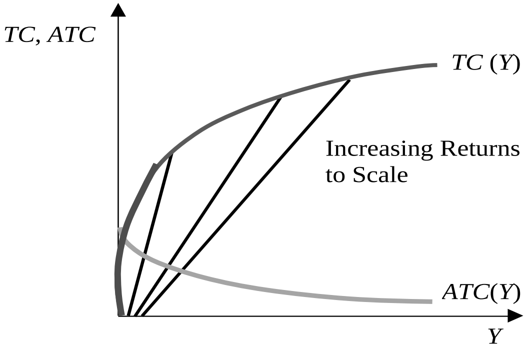
(n-x)

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

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

IRTS generate **economies** of scale



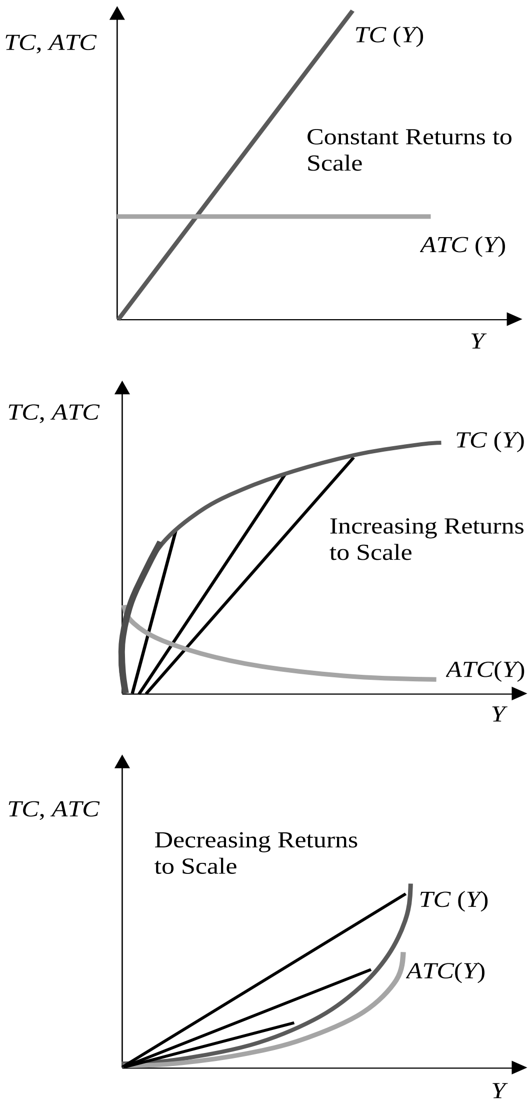

Higher wages, lower turnover, lower average costs, higher profits, higher wages...

Economies of scale: the «virtuous» circle of growing. Specialization, learning by doing: the more you grow the more competitive you become:

Dehumanizing assembly lines

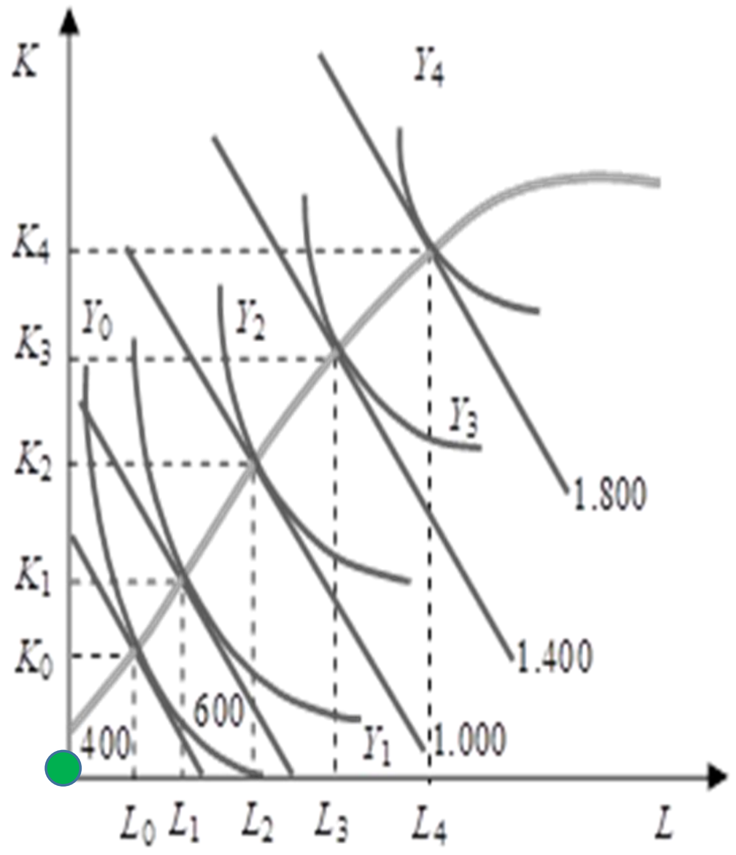
$${}_{LT}\Pi^{E}(Q) = [p(Q) - \mathbf{ATC\ (Q, r°, w°)}]Q$$

# Long term: cost and average cost functions

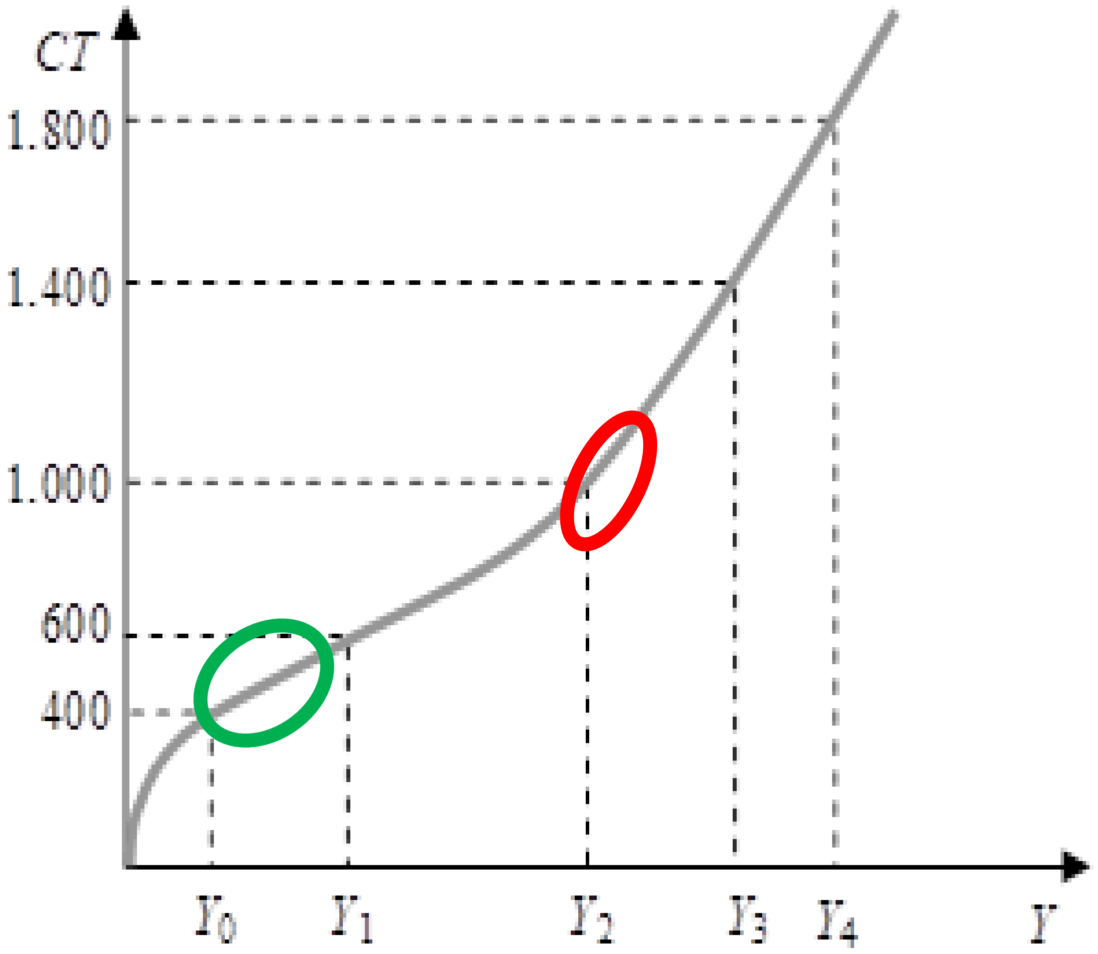



**PS: The average cost function is calculated looking at the slope of the line connecting the origin with the point on the cost curve.**

# Long Term: technology and costs. Change along the curve




TC (Y, w°, r°, T°)



# How do Cost Curves Shift?

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

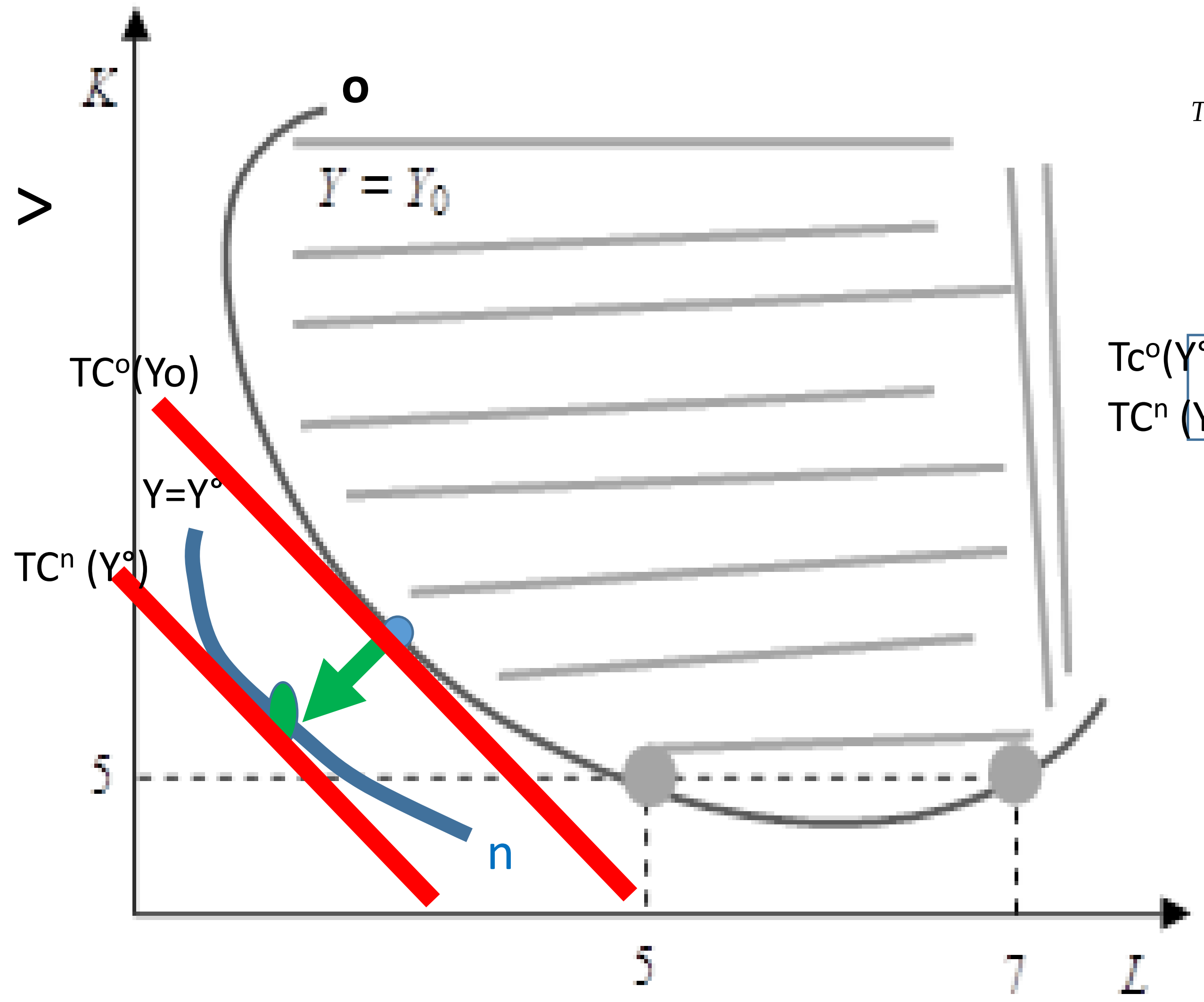
**So far, we have moved along a given cost curve.**

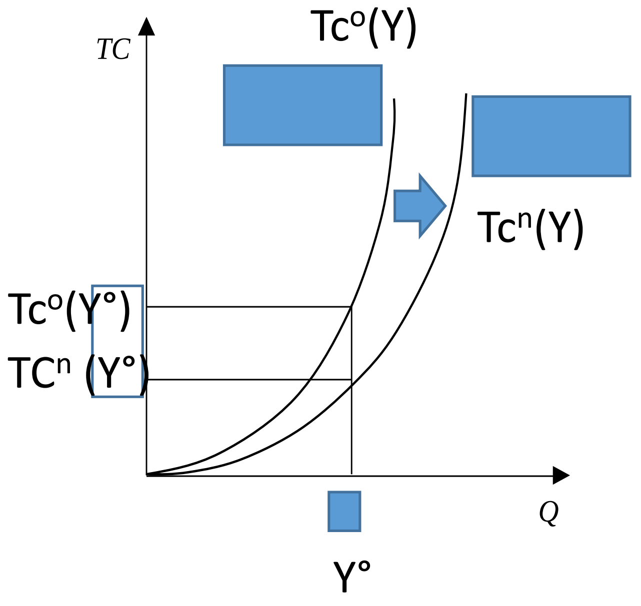
**If technology or unit costs change, cost functions change: shift of the curve, not change along the curve.**

# PS: technological progress

$TC^o\ (Y°) = TC_0€\ >$

$TC^n\ (Y°) = TC_1\ €$



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

From w° to w°’ with w°’> w°

TC?

Before:

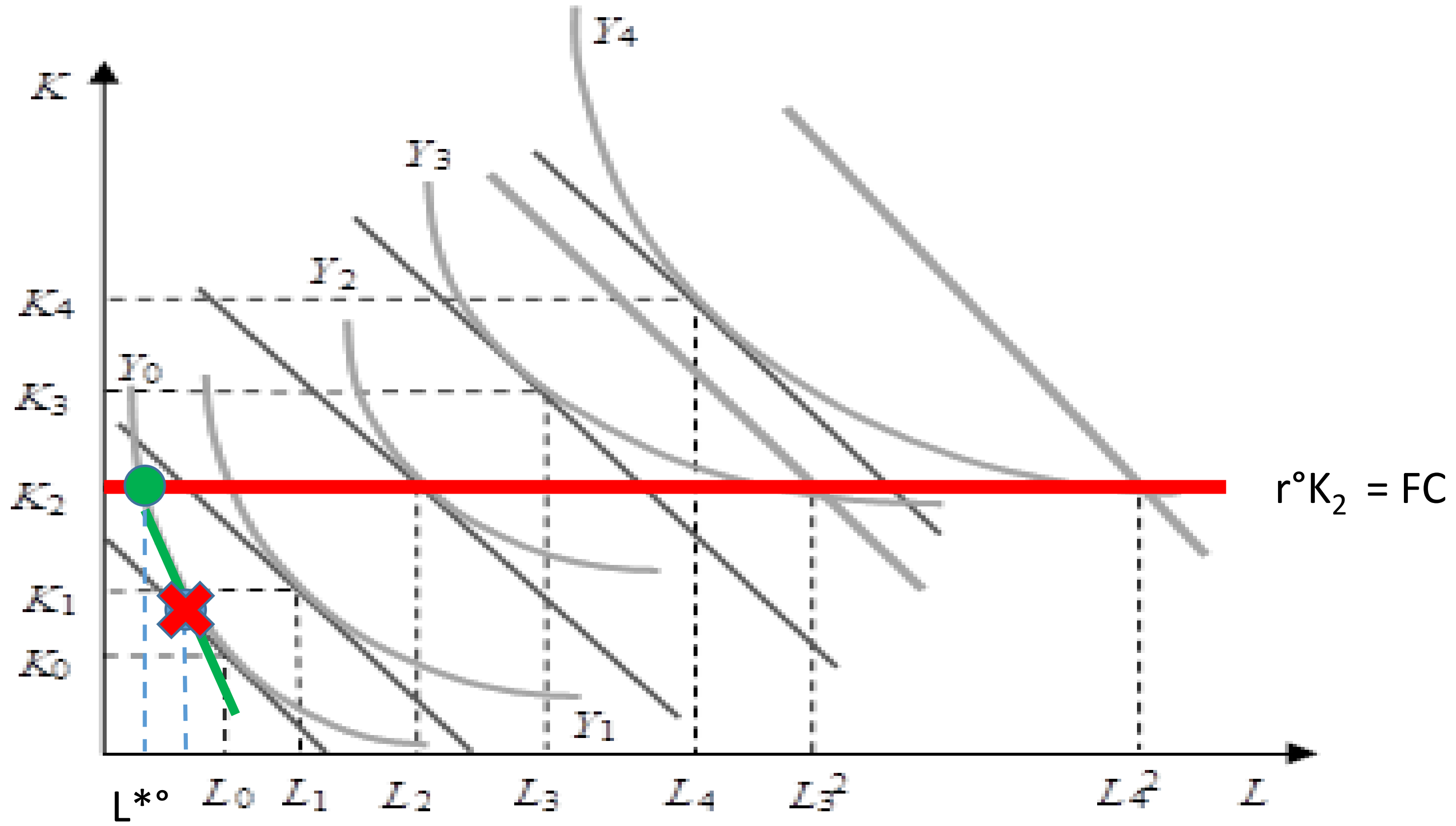
$TC = w°L°^{*}+r°K_2$

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%

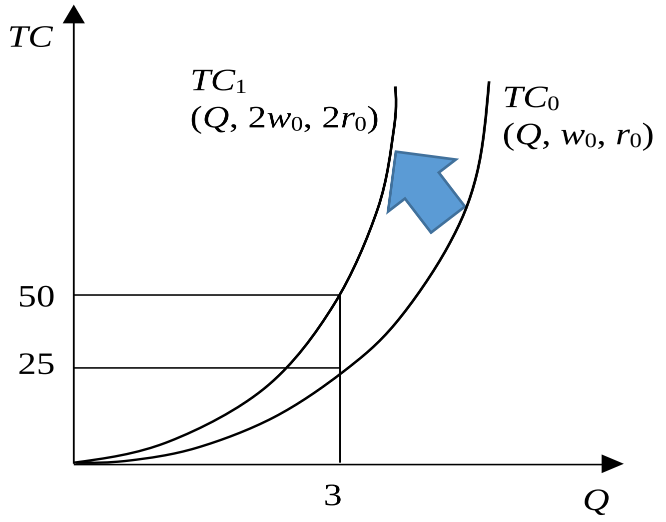
TC (Q°; w°; r°) = w° L° + r° K° rises to?

TC (Q°; w°x1,1; r°x1,1) = w°(1,1) L + r°(1,1) K **What new (L, K)?**
**Still L° and K°! Why? What is the new tangency point between isoquant and isocost?**

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

Cost function moves northwest

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




All inputs double in unitary cost: doubling of total costs.

The cost function moves «northwest» and the firm becomes less competitive.

# ST, variable cost or LT: case B, a rise in w

TC (15, w°=4/5, r°= 4) = ?

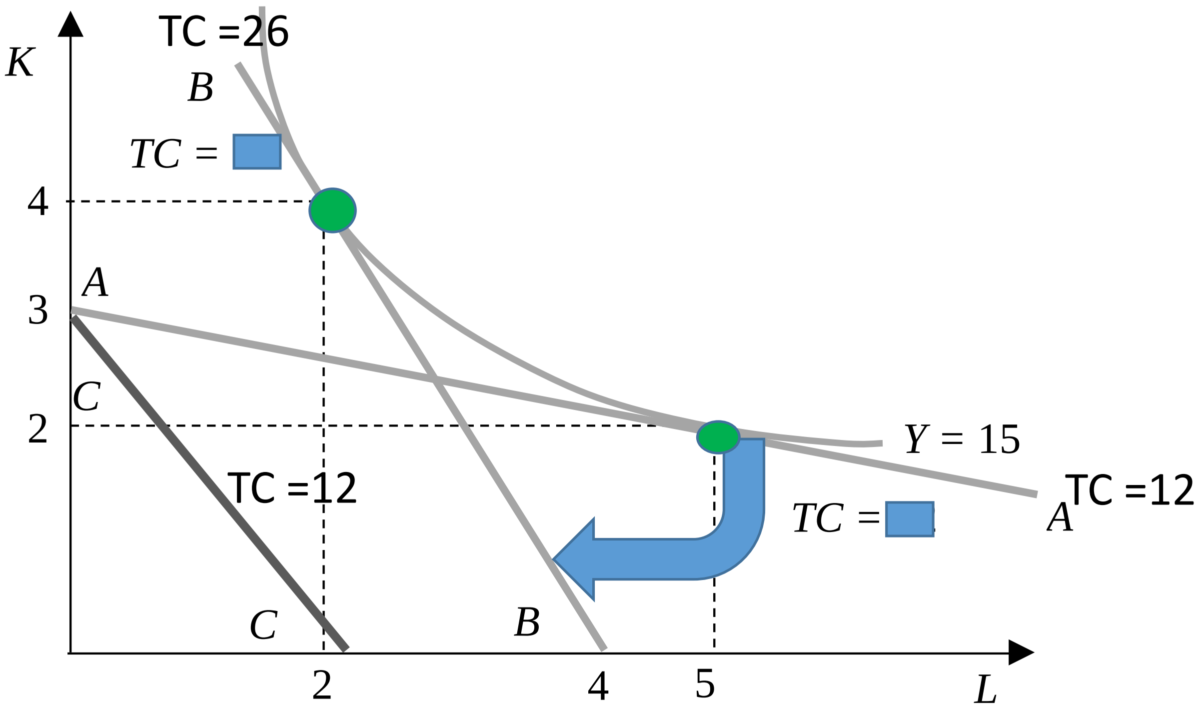
<

TC (15, w' =5, r°=4) = ?

Proving that cost rise (above 12€) when w rises even if L declines.

Which techniques now cost 12 € at the new unitary costs w' and r° ?

Any of the old ones on AA which costed 12 €?




From AA:

w° = (4/5) €

r° = 4€

Rise from w to w'

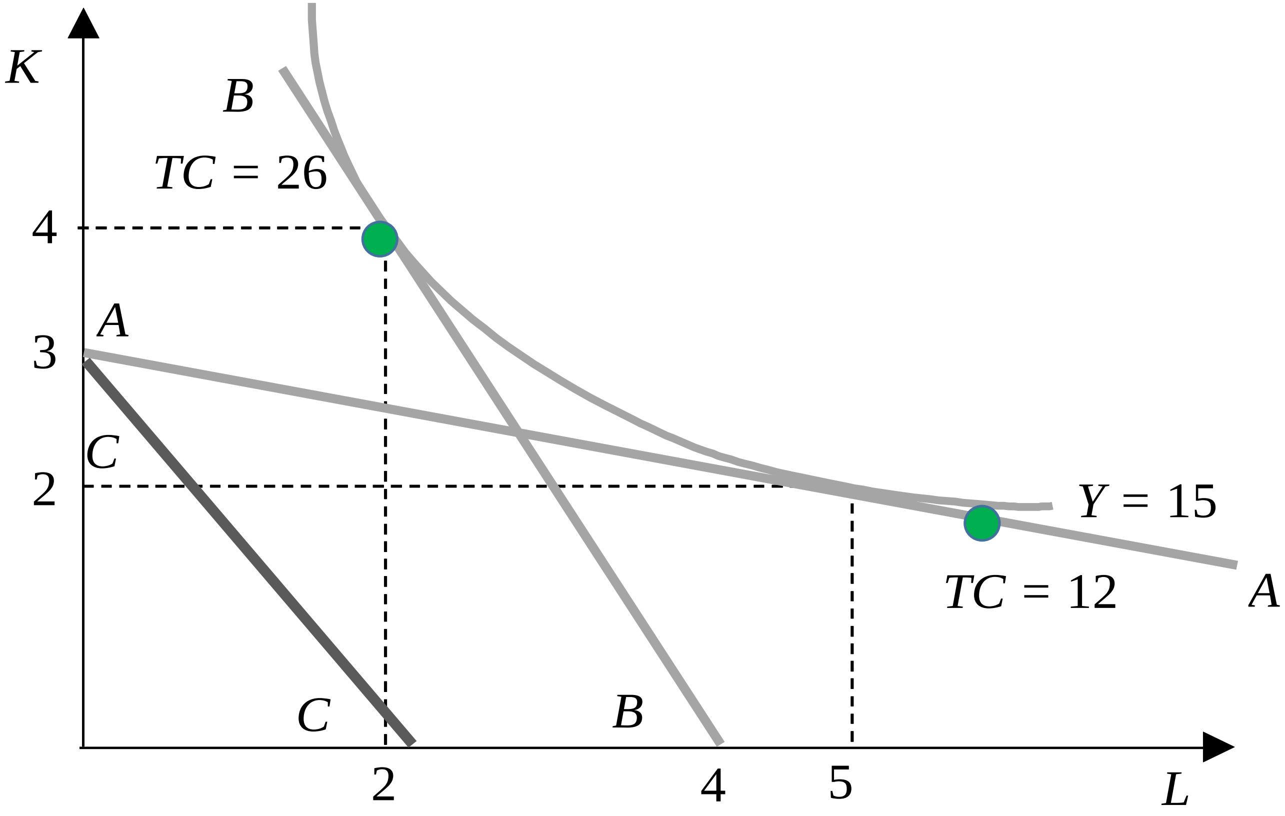
To BB:

w' = 5€

r° = 4€

**Substituting toward the cheaper factor of production**

# ST, variable cost or LT: case B, one unitary cost goes up

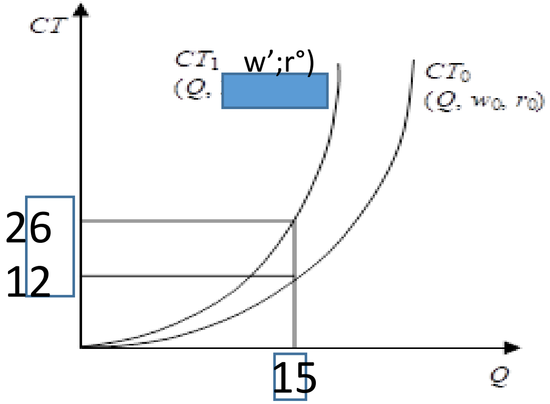



From w° = (4/5) €

r° = 4€

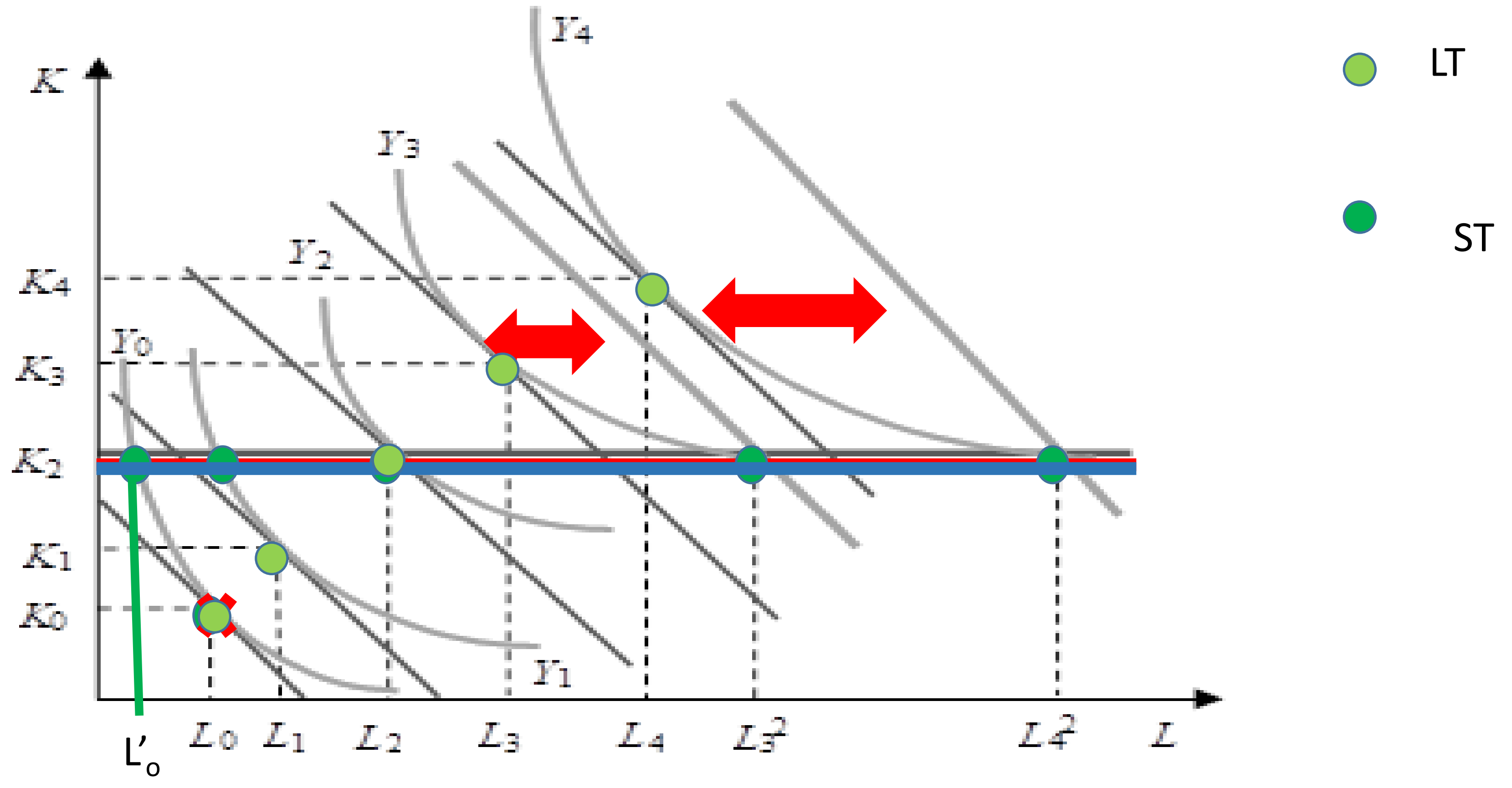
To w’ = 5€

r° = 4€




The cost function goes north-west.

# Short term and Long term cost functions



# Relationship between ST and LT cost functions

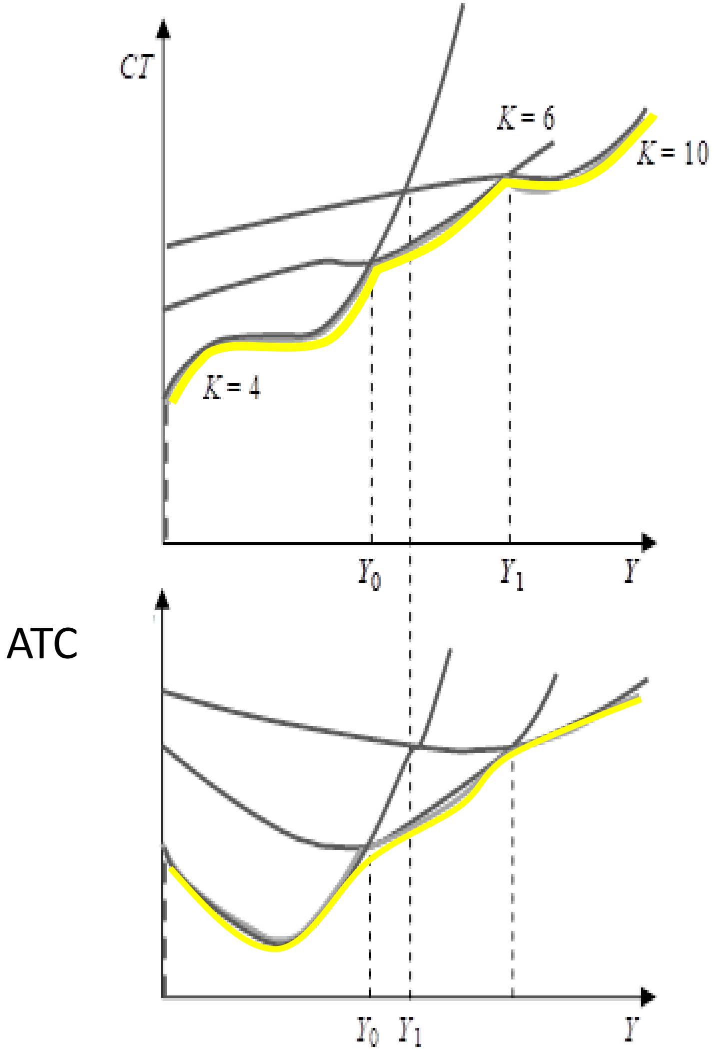
Today (K=warehouse sq. mt.)
FC (K) = 10.000 € for Q = 10 BIKES
Tomorrow?

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

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

K = 4
K= 6
K = 10

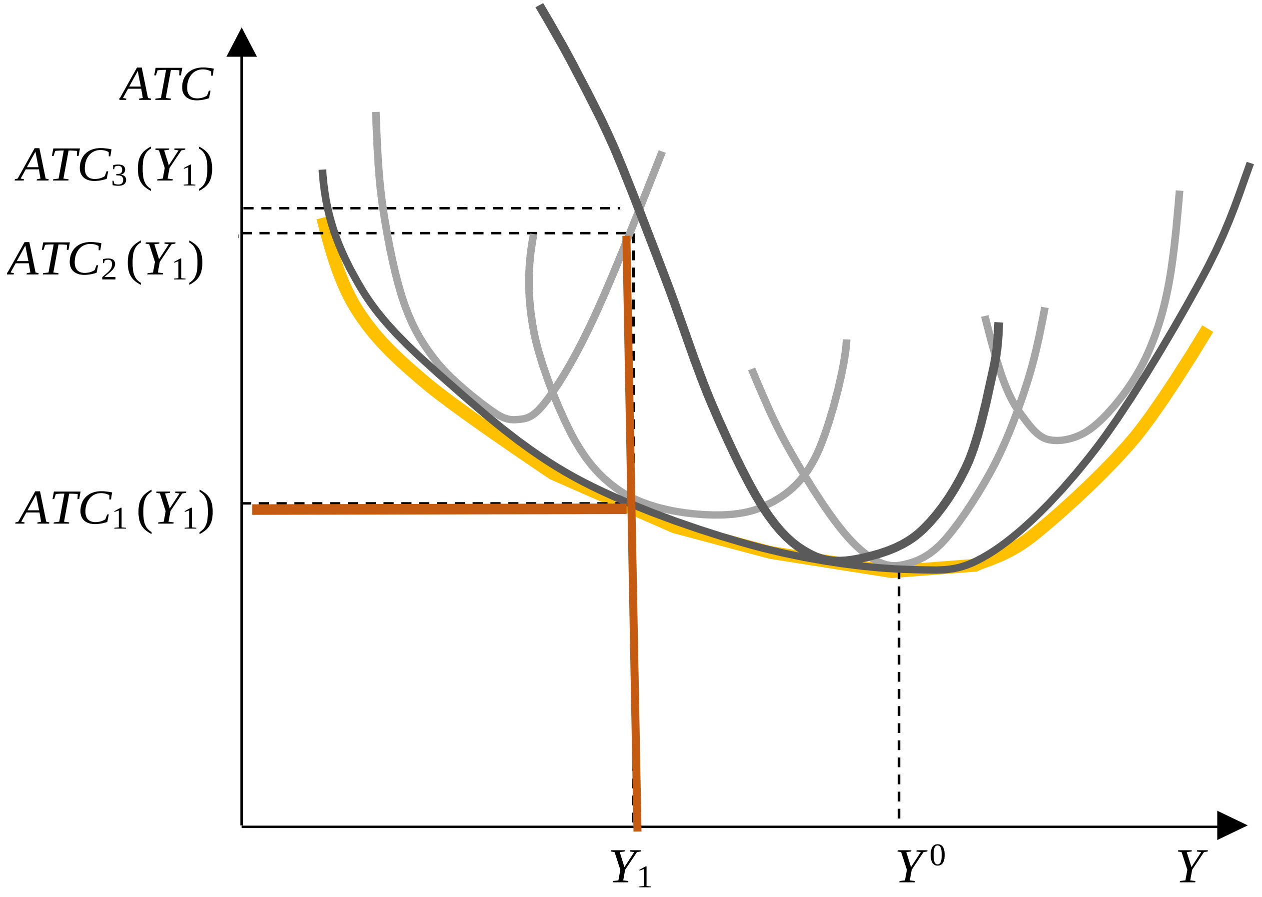
ST: Fixed costs?
ST: Variable costs?
LT: ?



# Relationship between ST and LT cost functions

Y° : minimum efficient scale of the firm, minimum of minima, best of the best

$TC^{LT}$ (Y) = min $TC^{ST}$ (Y)



# Which Isoquant will be chosen? Short-Term

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

s.t. $P = {}_iP^d(Q)$ → P = P° (PRICE-TAKER, perfect competition)

s.t. $Q = f^i\ (K, L)$

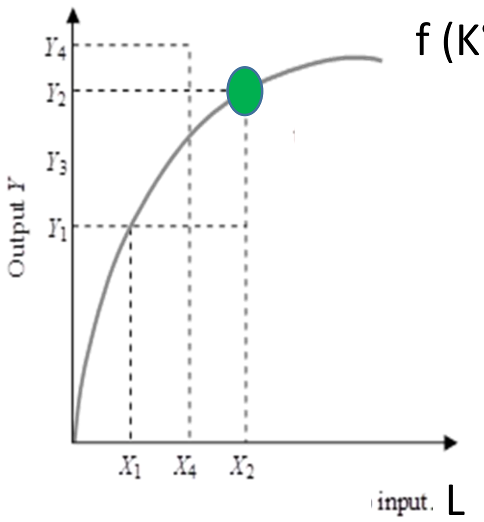
s.t. K = K° (or better K≤K°?) **SHORT TERM PERIOD!**

s.t. $TC^i\ (Q, w°, r°) = w°\ L\ (Q, K) + r°\ K$ NOT ANY L!

PS: which profits?

# Maximization of profit, ST

K=K°




f (K°, **L**)

L

Q* such than:

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°**

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

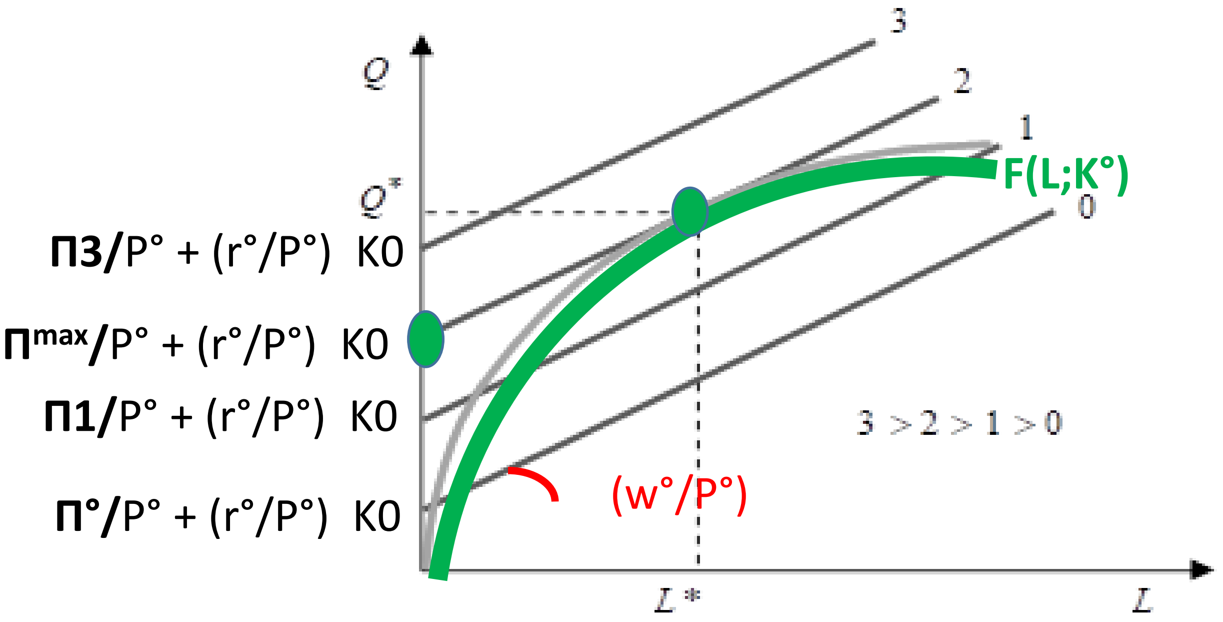

PS: r°K°?

# Isoprofits and Maximization of profits, ST

$$\Pi° = P°\,Q - w°\,L - r°\,K°$$

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

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




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

**Π1 ? Π°**

**Π1 > Π°**

# Isoprofits and Maximization of profits, ST

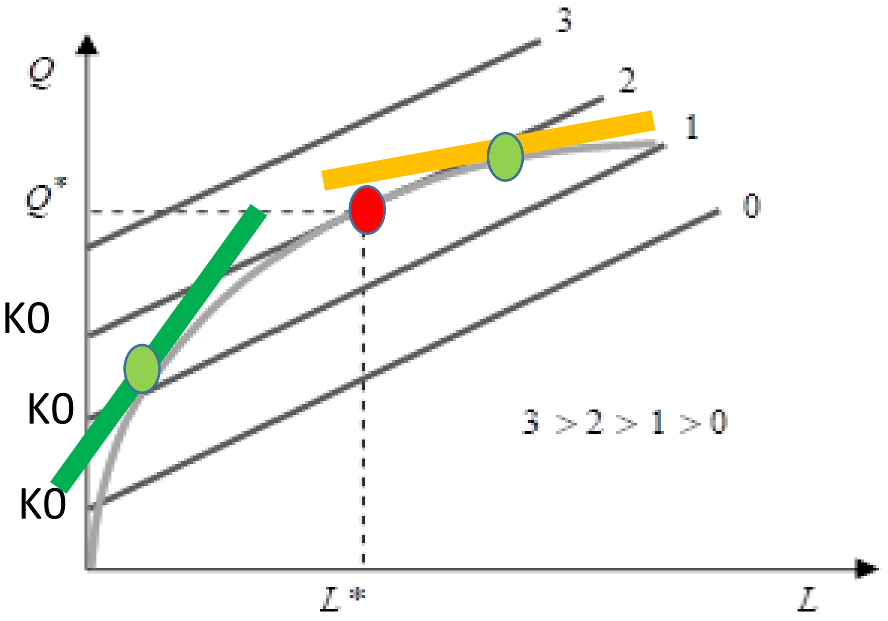
$$\Pi° = P° Q - w° L - r° \ K0$$

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?)**




**$\Pi/P° + (r°/P°)$ K0**

**$\Pi 1/P° + (r°/P°)$ K0**

**$\Pi°/P° + (r°/P°)$ K0**

**What if w declines?**

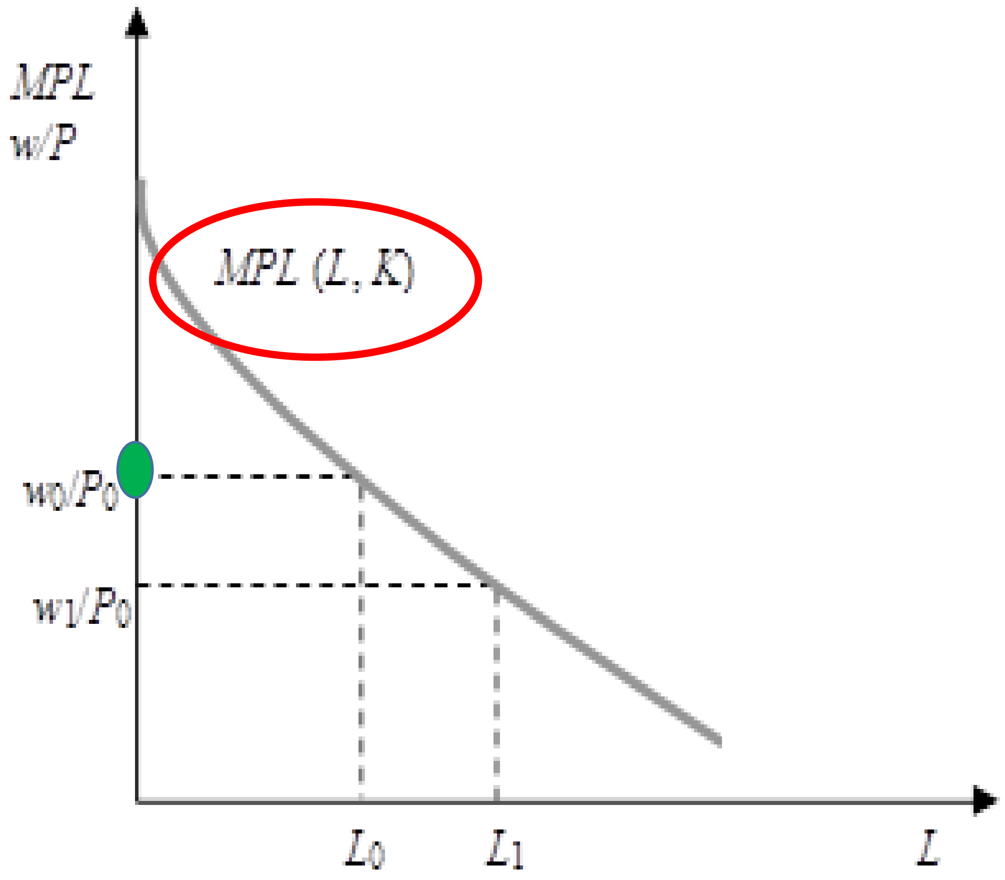
What iF r°K° grows?

# The labor demand curve of the firm?

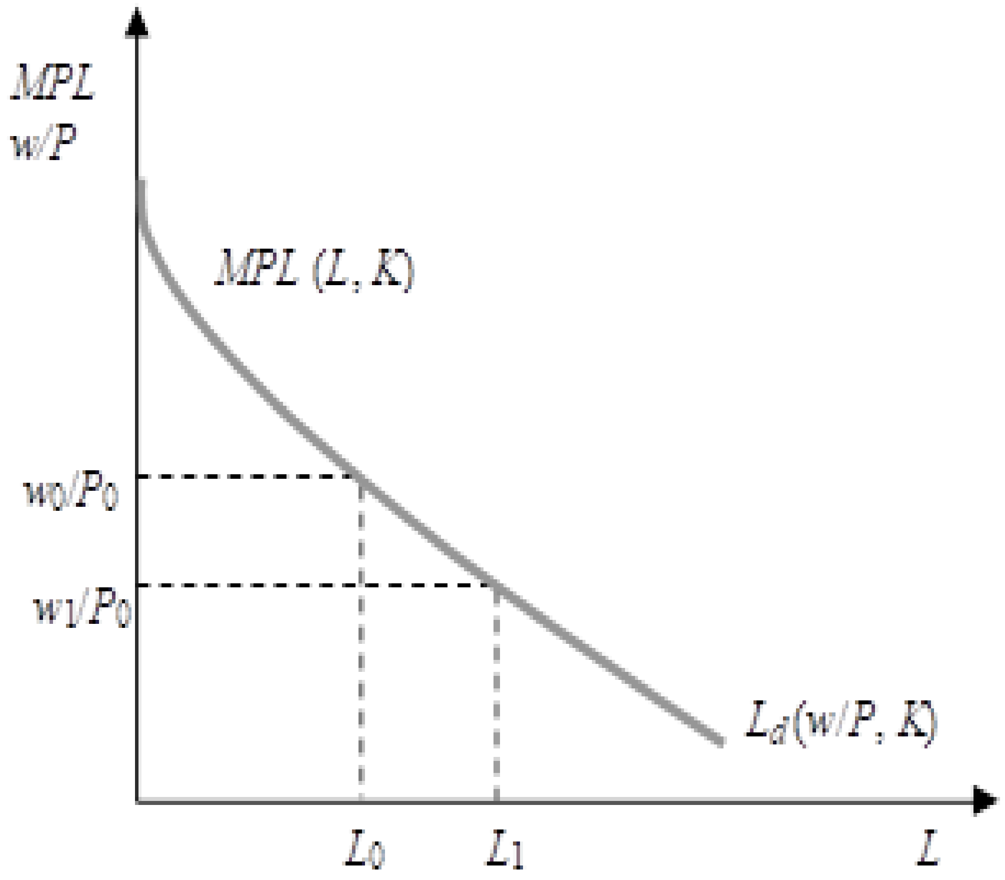
What is the productivity of the $L_o$th worker?

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

And at the wage w1/P°?



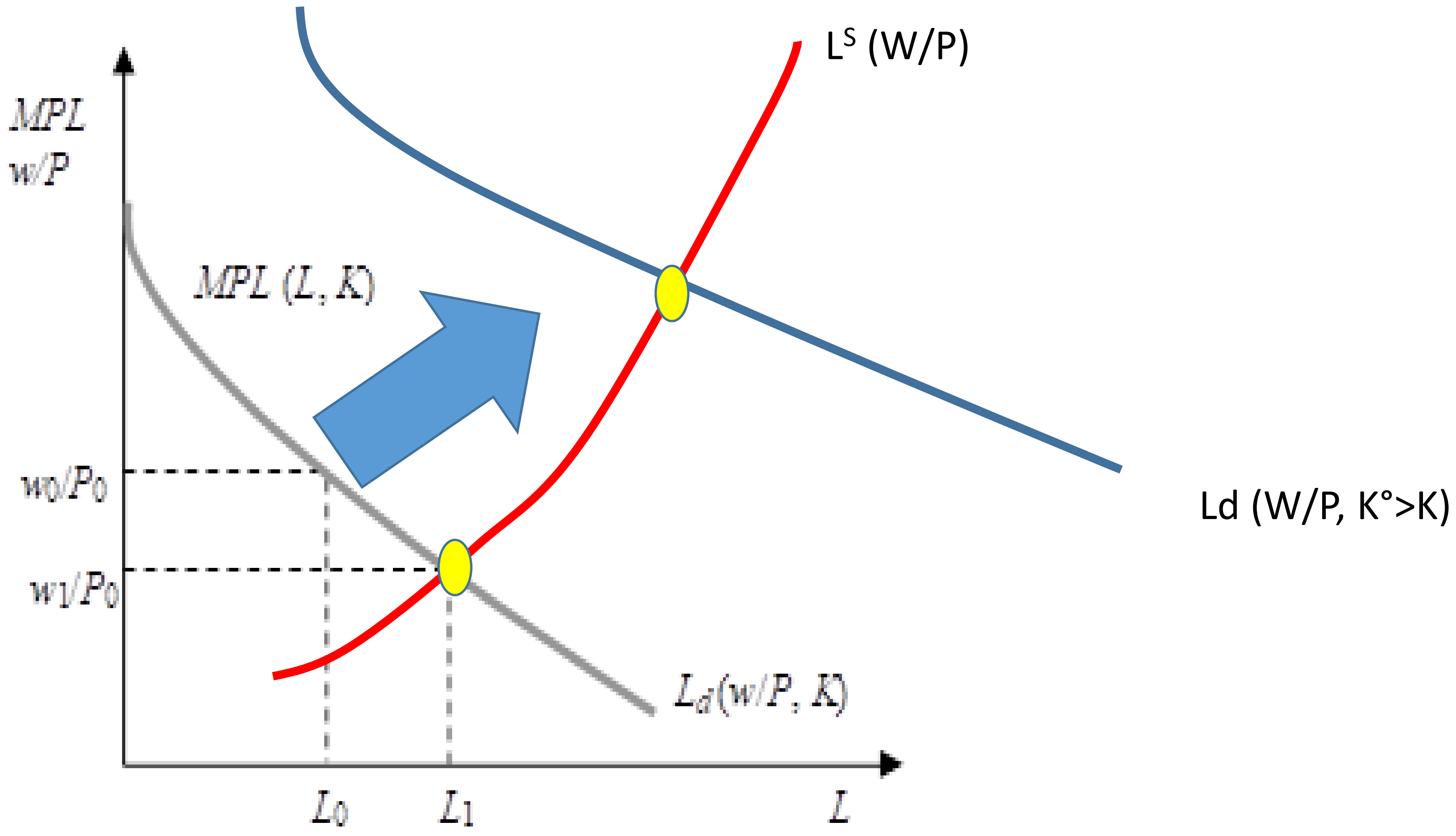
# The labor demand curve of the firm!




!!!!!!
They
coincide!

# 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*

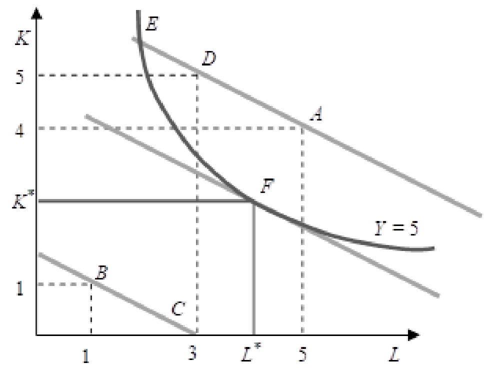
$$\text{Max}_{K,L}\ \Pi\,(K, L) = P°\, f\,(K, L) - w°\, L - r°\, K$$

$$P°\ MPL\,(K^*, L^*) = w°$$

**and**

$$P°\ MPK\,(K^*, L^*) = r°$$

Notice anything?




Maximizing profits requires minimizing costs (not necessarily viceversa)!

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