4. Labour demand

- ✓ **Aim** = Explain the quantity of labour that companies want (number of hours and number of employees used in the production processes according to their characteristics).

- ✓ In Western countries: 80% of the labour force is salaried and wages account for around 2/3 of the VA.

  - ➯ The demand for labour determines the employment opportunities for a large proportion of the labour force.

  - ➯ The demand for labour is an important factor in explaining unemployment (which is often caused by insufficient demand).

✓A brief reminder:

- The demand for demand comes from companies.

– Companies demand labour in order to produce goods and services that they sell to make profits.

– It is in a company's interest to hire a worker as long as the revenue he generates is higher than his cost.

4.1. Static labour demand theory

No dynamic adjustments, no expectations and no adjustment costs for the production factors.

Production factors: capital (K) and labour (L) $\Rightarrow$ production.

4.1.1. Production functions

The relationship between inputs (K and L) and output is represented by a production function.

A production function associates to each combination of K and L a level of production:

$$Q = f(K, L)$$

Examples :

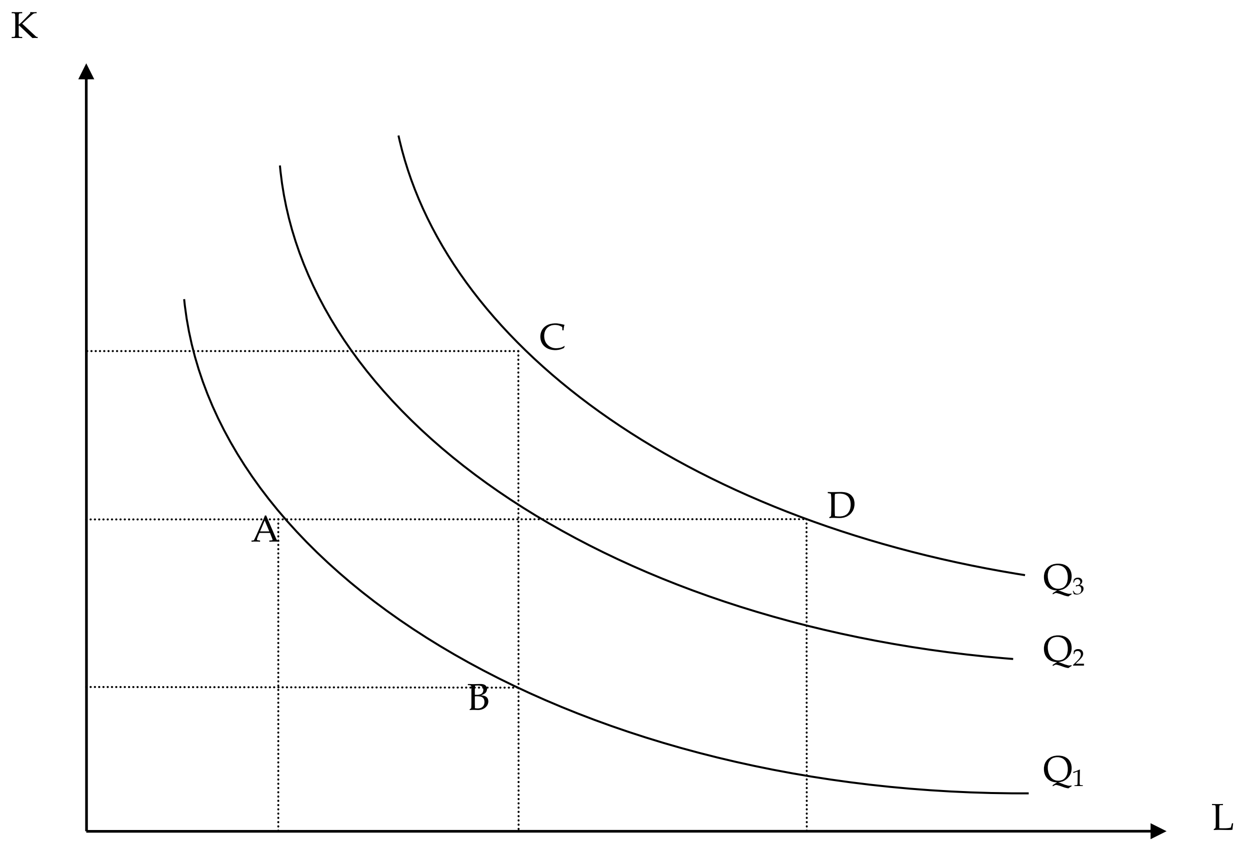
$$\begin{cases} Q = 2.L + 1.K & \text{if K=1 et L=1} \Rightarrow Q = 3 \\ Q = \min(K, L) & \text{if K=1 et L=1} \Rightarrow Q = 1 \end{cases}$$

a) Isoquants

Graphically, production functions are represented by “isoquants”.

Isoquant = locus of the different combinations of inputs (K, L) that enable to produce the same level of output.

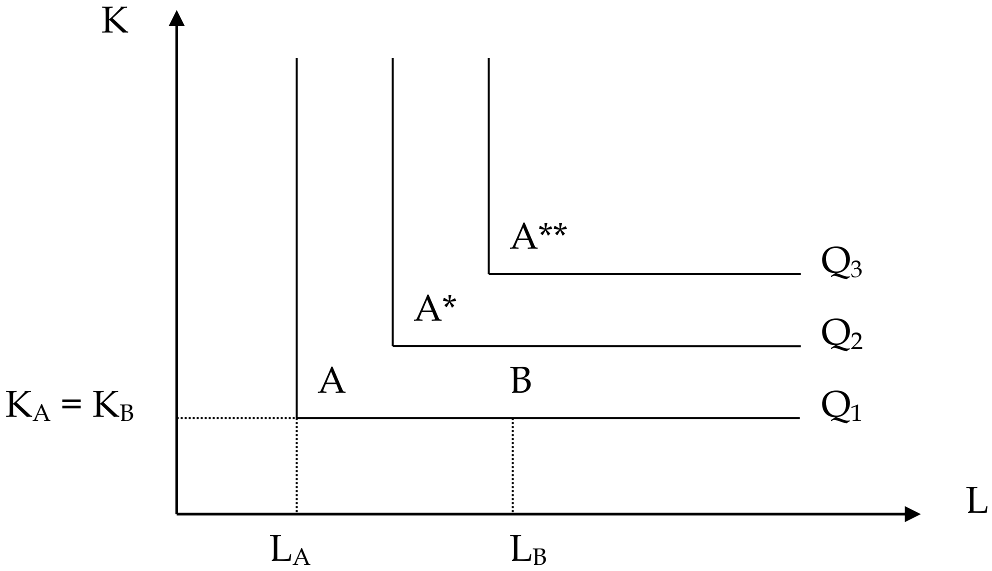
Isoquant curves



b) The shape of isoquants

i) Fixed proportions :

Leontief production function: $f(K,L) = \min\{K,L\}$



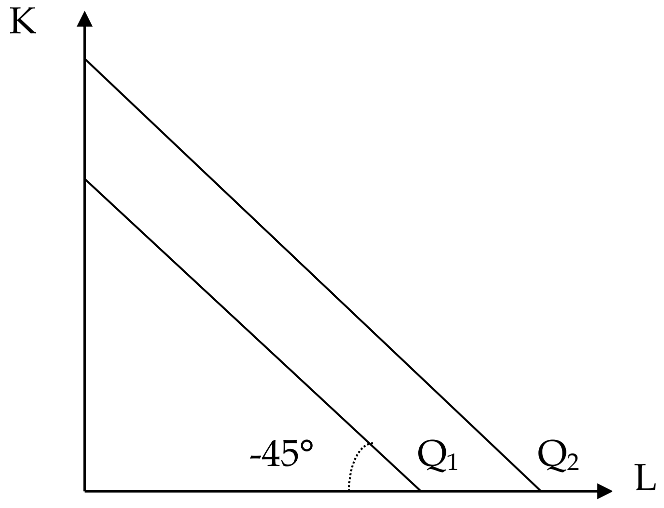
Company produces only at points A, A* et A**.

Example : digging holes with men and excavators.

holles =min (excavators, men), 5 = min (5,6) = min (5,25)

ii) Perfect substitutes :

$$f(K,L) = K + L$$



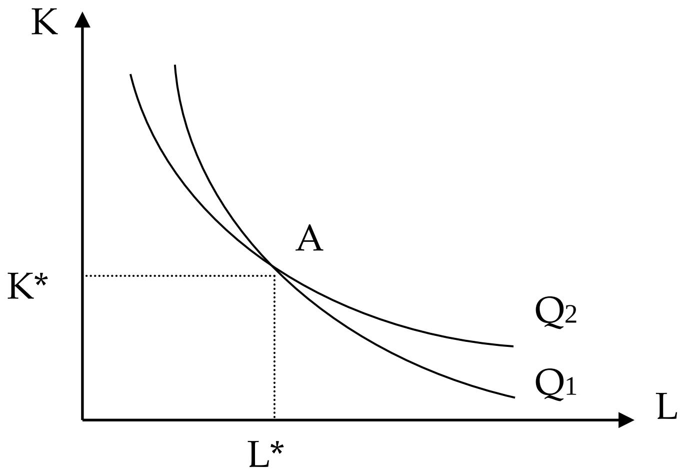
iii) Cobb-Douglas production function:

$$f(K,L) = A\ K^{a}\ L^{b}$$

c) Properties of isoquants

i) Convex with respect to the origin (*cf.* MRTS)

ii) Non-secant



iii) Ordered

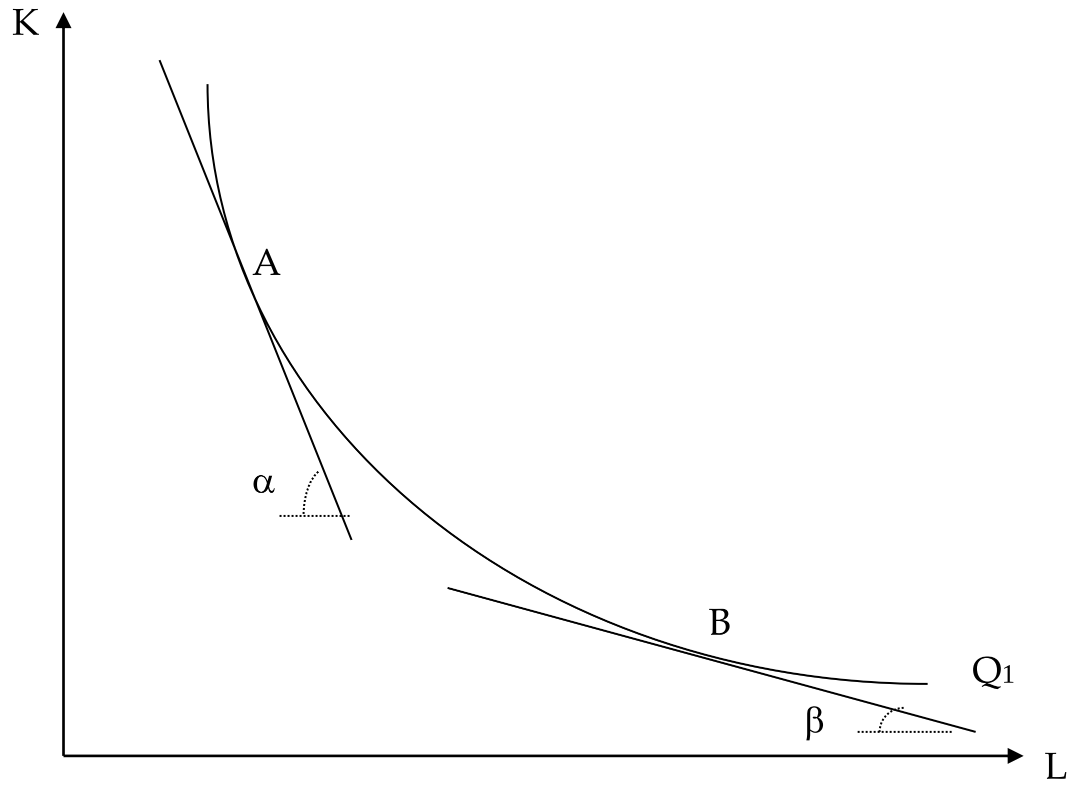
d) The marginal rate of technical substitution (MRTS)

Type of production function $\Rightarrow$ shape of the isoquant $\Rightarrow$ degree of substitutability between the inputs.

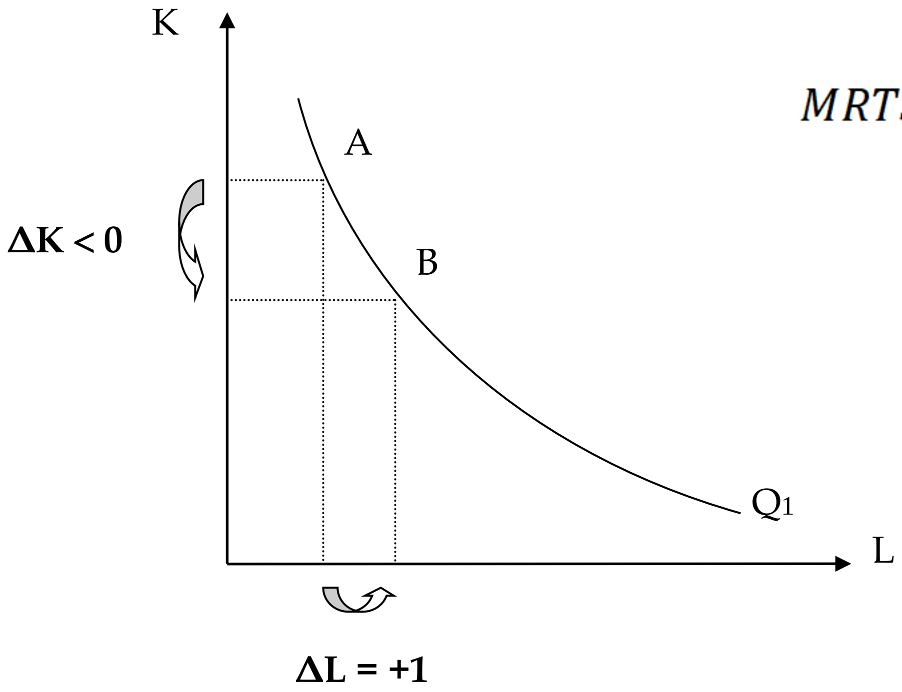
Degree of substitutability measured by the MRTS.

Mathematically: MRTS = derivative at one point of the isoquant.

Graphically : MRTS = slope of the tangent at one point of the isoquant.



Economically : MRTS = indicates by how much capital must be reduced if we want to produce the same quantity with one additional unit of labour.



$$MRTS_{K,L} = \left.\frac{\Delta K}{\Delta L}\right|_{Q=cst}$$

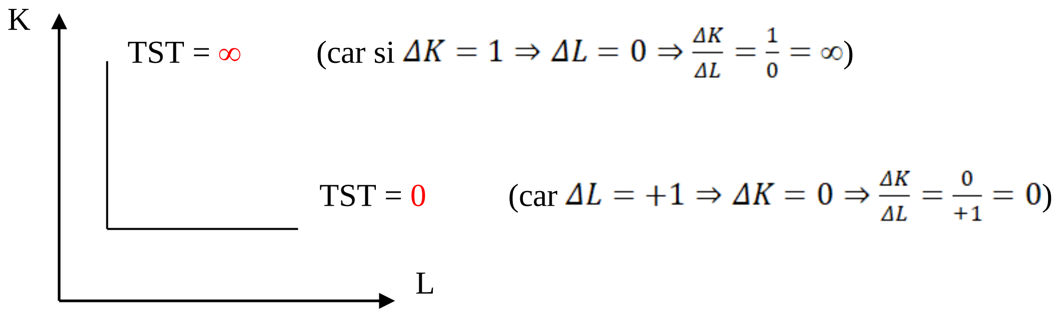
e) Properties of the MRTS

i) Varies along the isoquant… except if it is a straight line.

If straight line ⇒ at constant output, an additional unit of labour will be offset by a fixed reduction in capital ⇒ MRTS will take a constant value.

If straight line at -45 degrees ⇒ inputs will be perfectly substitutable ⇒ MRTS = -1.

if Leontief production function ⇒ inputs will be perfectly complementary ⇒ TST take two values: 0 and ∞.

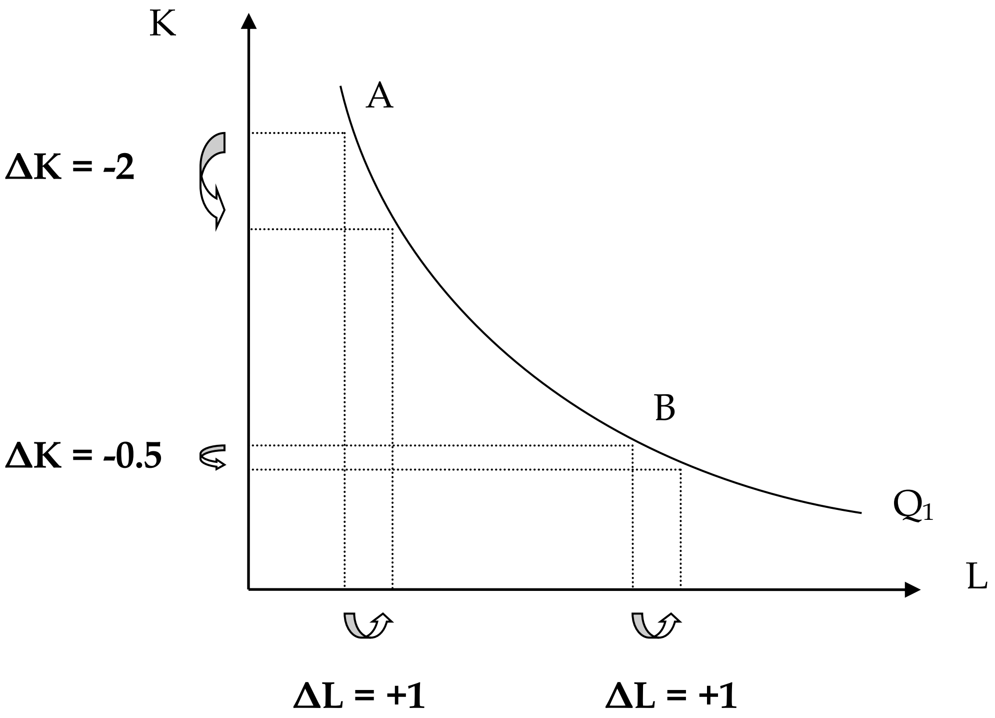


ii) MRTS (generally) decreasing along the isoquant

Intuition:

The more you have of one factor of production (K), the more you are willing to exchange a large part of it for the other factor of production (L).

If you want to maintain production at a constant level and increase the quantity of L by one unit, you will be willing to exchange more K if you have a lot of it.



$$|MRTS_A| = \left|\frac{\Delta K}{\Delta L}\right| = \left|\frac{-2}{+1}\right| = 2\ , \ |MRTS_B| = \left|\frac{\Delta K}{\Delta L}\right| = \left|\frac{-0.5}{+1}\right| = 0.5$$

$\Rightarrow$ **$MRTS_{K,L}$ ↓ (in absolute value) when L ↑**

Why ?

Usual assumption: **decreasing marginal productivity (MaP)**.

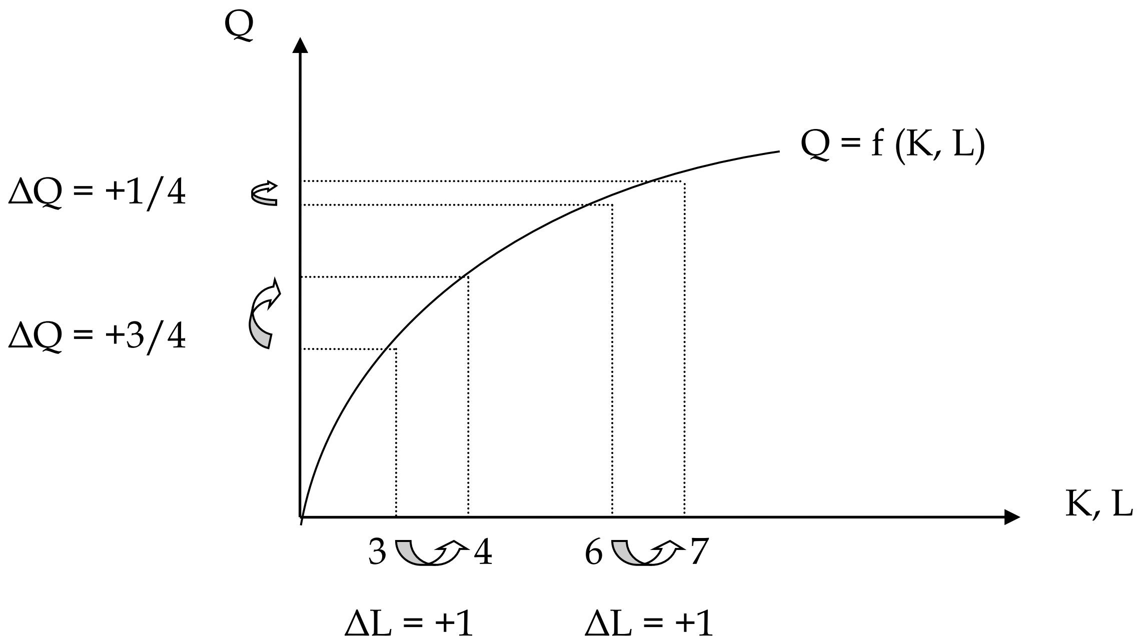
MaP = additional output generated by the use of an additional unit of a given input, all other inputs held constant.

Decreasing MaP = MaP of a given input ↓ when the quantity used of this input ↑.

Mathematically:

$$\frac{\partial F(L,K)}{\partial L} \succ 0 \text{ but… } \frac{\partial^2 F(L,K)}{\partial^2 L} \prec 0 \text{ (idem for K)}$$

Graphically:



⇒ If L (K) = 3 and ΔL (ΔK) = +1 → ΔQ = +3/4.

If L (K) = 6 et ΔL (ΔK) = +1 → ΔQ = +1/4.

Example : A farm

1 man (L), 1 hectare of land (T) → 100 kg of corn (Q).

2 man (L), 1 hectare of land (T) → 250 kg of corn. (Q)

MaP when L increases from de : a) 0 to 1 = 100 ; b) 1 to 2 = 150 ; etc.

When L↑ (ceteris paribus) → Q↑ but…

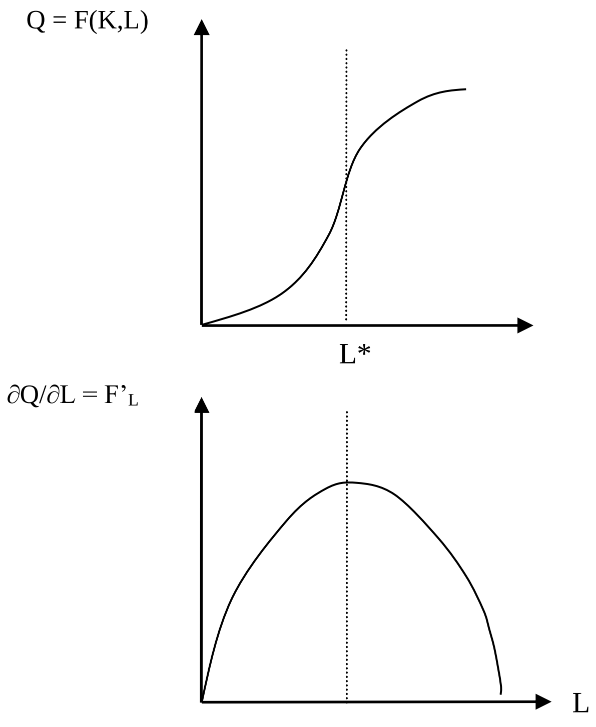
ΔQ (i.e. MaP) culminates at 200 and decreases afterwards.

L	1	2	3	4	5	6	7
Q	100	250	450	600	700	750	…
MPa	100	150	200	150	100	50	…

Rem : ΔK = 0, ΔT = 0.

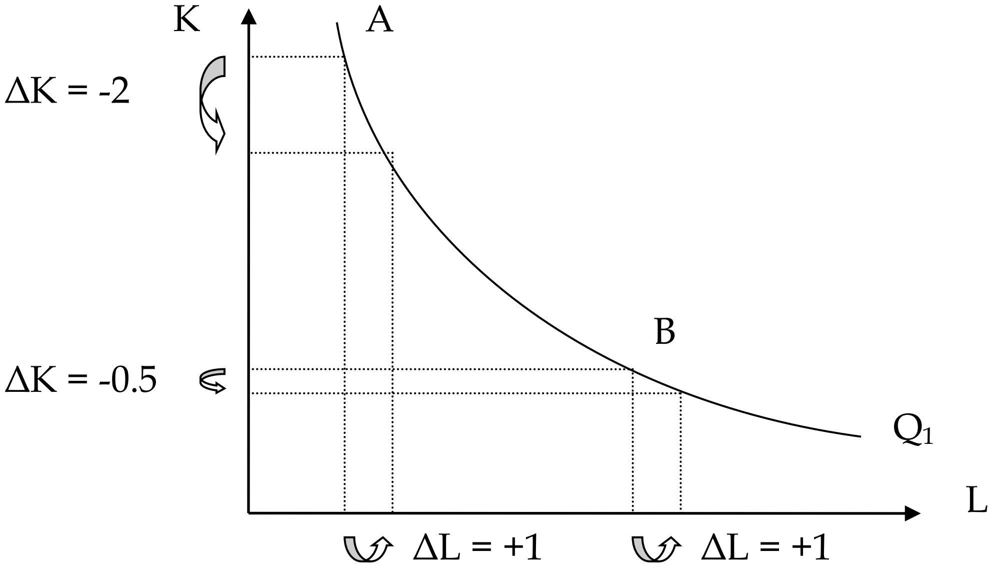
Marginal productivity

First increasing, then decreasing



$F'_L > 0$	$F'_L > 0$
$F''_L > 0$	$F''_L < 0$

Why is $MRTS_A > MRTS_B$ (in absolute value) ?



At point A : K abundant, L rare → MaP_K small, MaP_L big.

At point B : K rare, L abundant → MaP_K big, PMa_L small.

How to measure MRTS ?

Variation of output, which is null along the isoquant, can be decomposed as follows :

$$\Delta Q = MaP_K.\Delta K + MaP_L.\Delta L = 0 \Rightarrow MaP_K.\Delta K = -MaP_L.\Delta L$$

$$\Rightarrow \; -\frac{MPa_L}{MPa_K} = \frac{\Delta K}{\Delta L}$$

But, we know that : $\left.\frac{\Delta K}{\Delta L}\right|_{Q=cst} = MRTS_{K,L}$

$$\Rightarrow \; MRTS_{K,L} = \frac{\Delta K}{\Delta L} = -\frac{MaP_L}{MaP_K}$$

$$\Rightarrow \; |MRTS_A| = 2 \qquad |MRTS_B| = 0.5$$

4.1.2. Labour demand in the short run

a) Individual labour demand

In the short run, asymmetry of inputs (L : skilled and unskilled labour, K : machinery and infrastructure) in the production function.

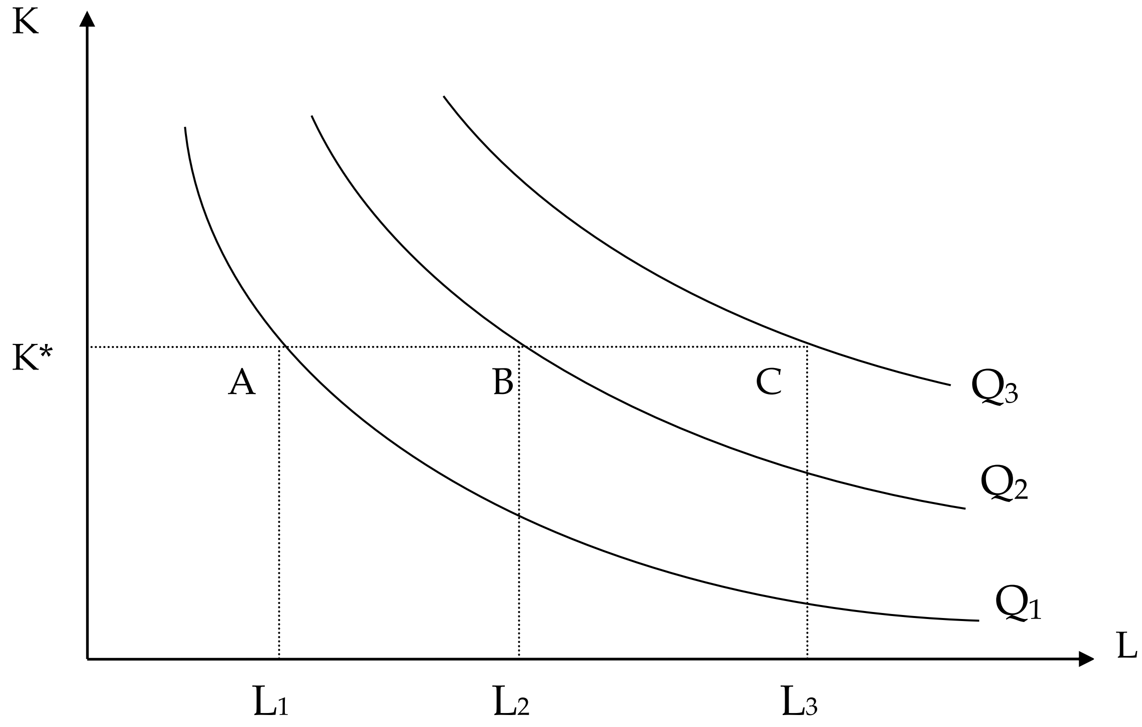
⇒ L is much more mobile and adjustable in the short run.

K is not likely to be adjusted in the short run because of:
- installation time, and
- installation or replacement costs.

⇒ Distinction between labour demand in the short (SR) and long run (LR).

Example : farmer who produces corn, in the short run the amount of land and capital is fixed.

The short-term labour demand of a firm



Capital stock = K*, firm produces Q_1, Q_2 or Q_3 by choosing L_1, L_2 or L_3.

Given K*, what quantity of L and Q does the firm choose?

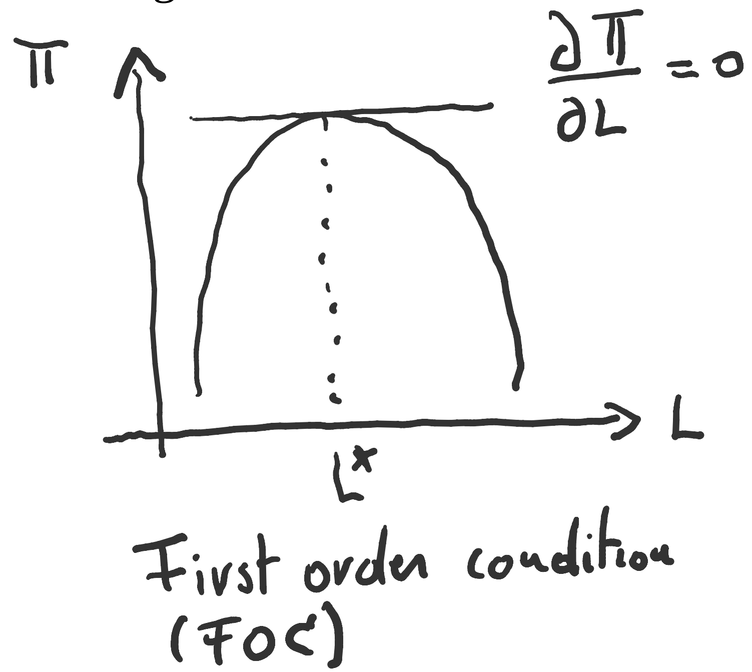
Hypothesis: firm's objective is to maximise its profit.

A firm will only hire an additional unit of labour if the cost of that unit is less than what it generates in terms of production value.

Cost of an additional unit (marginal cost) of L is equal to the wage → firm hires additional workers as long as their marginal product value (MaPV = MaP multiplied by the price of the product sold) is greater than or equal to the wage.

Decision rule :

i)	if MaPV > W ⇒ ΔL > 0.
ii)	if MPaV = W ⇒ ΔL = 0.
iii)	if MaPV < W ⇒ ΔL < 0.



Decreasing MaP_L hypothesis : $\frac{\partial Q}{\partial L} \succ 0$ et $\frac{\partial^2 Q}{\partial^2 L} \prec 0$!

Mathematically

Max $\Pi = RT - CT$

Subject to $Q = F\left(K^*, L\right)$

$$\underset{L}{Max}\ \Pi \equiv \underset{L}{Max}\ \left(RT - CT\right) \equiv \underset{L}{Max}\ \left(P\,Q - W\,L - r\,K\right)$$

$$\equiv \underset{L}{Max}\ \left(P\,F(K^*, L) - W\,L - r\,K\right)$$

$$\frac{\partial \Pi}{\partial L} = 0 \quad \Rightarrow \quad P\,\frac{\partial\, F\left(K^*, L\right)}{\partial\, L} = W \qquad (1)$$

$$\Rightarrow \quad F_L^{'}\left(K^*, L\right) = \frac{W}{P} \qquad (2)$$

At equilibrium:

(1) **MaPV of labour is equal to the wage**,

(2) MaP of labour is equal to the real wage (i.e. the wage divided by the price).

Graphically:

Hyp. : i) Perfect competition $\Rightarrow$ the wage and price are given to the firm (price taker)

ii) Capital stock is fixed in the short term (K= K*)

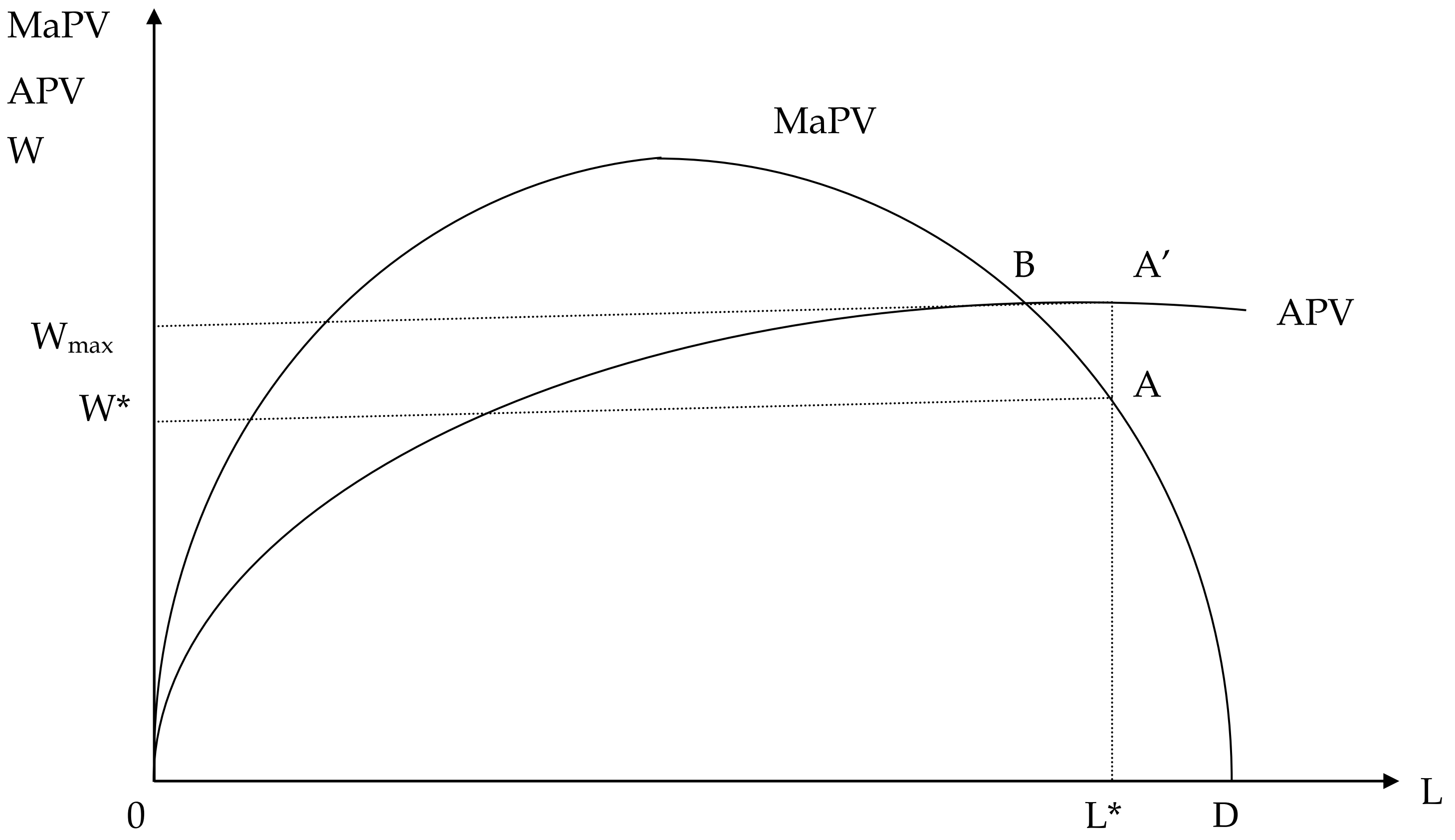
Def. : i) Average product value:

$$APV = P\left(\frac{F(K*, L)}{L}\right) = P\,\frac{Q}{L}$$

ii) Marginal product value:

$$MaPV = P\left(\frac{\partial F(K*, L)}{\partial L}\right) = P\,\frac{\partial Q}{\partial L}$$

The labour demand of a firm in the short term



BAD segment = individual short-term labour demand curve.
In perfect competition, perfectly elastic labour supply (W = APV = MaPV) ⇒ $W=W_{max}$ and equilibrium at point B.

At equilibrium, MaPV = W $\Rightarrow$ labour demand curve is a segment of the MaPV curve.

Which segment ?

i) <u>If W > APV</u> $\Rightarrow \prod < 0 \Rightarrow$ <u>L = 0</u>

Proof :

If W > APV than W > $\frac{Q}{L}P$.

W is for instance equal to: $\frac{Q}{L}P + x$ avec x <<<, x > 0.

But,

$$\Pi = P.Q - W\,L$$
$$= P\,Q - \left(\frac{Q}{L}P + x\right)L$$
$$= P\,Q - P\,Q - x\,L$$
$$= -x.L \prec 0$$

$\Rightarrow$ APV $\geq$ W otherwise L = 0

(on graph : if $W>W_{max} \Rightarrow \forall L$, W>APV $\Rightarrow$ L=0 ; for L>0, we need $W \leq W_{max}$)

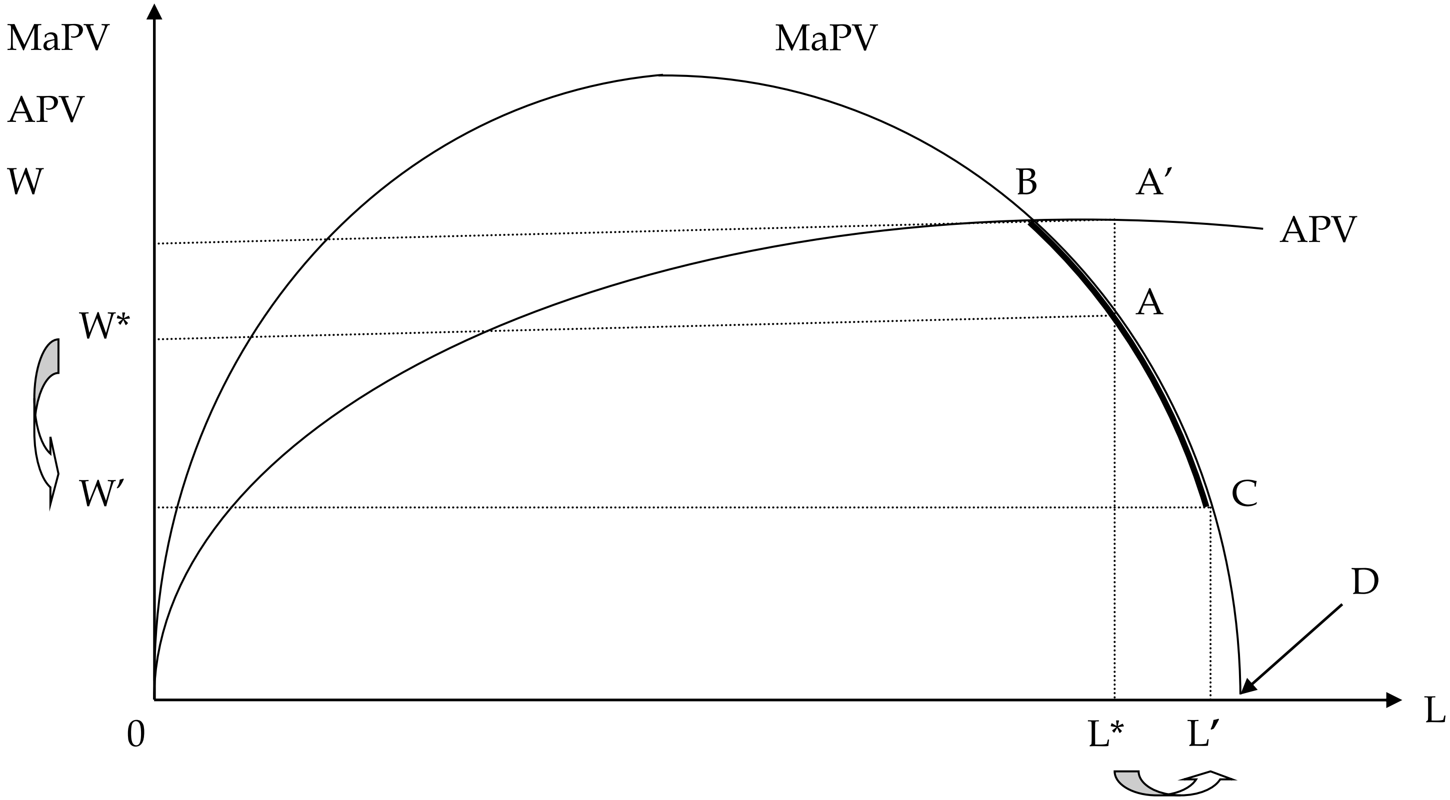
ii) <u>If W < APV</u> $\Rightarrow$ firm hires as long as MaPV $\geq$ W because $\frac{\partial \Pi}{\partial L} \geq 0$

Intuition:

As long as MaPV > W, firm has an incentive to hire additional workers as $\Pi \uparrow$. Since it is assumed that $MaP_L \downarrow$ when L $\uparrow$, MaPV converges to W when L $\uparrow$. When MaPV = W, firm no longer hires ($\Delta L = 0$).

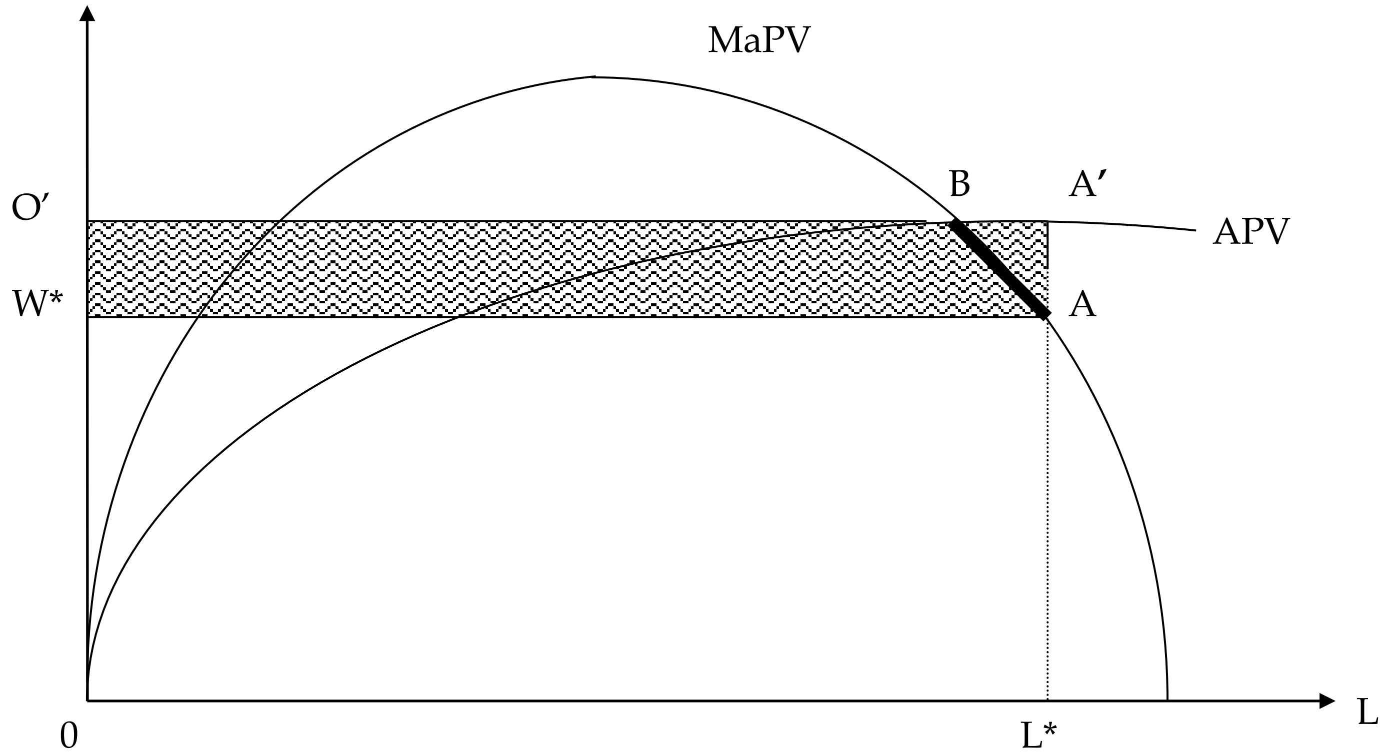
What if the wage falls from W* to W' ?

MaPV(L*) > W' ⇒ ΔL > 0 ⇒ MaPV(L') = W' (avec L' > L*).



BACD segment = individual labour demand curve in the short run.

What about the firm's profit?



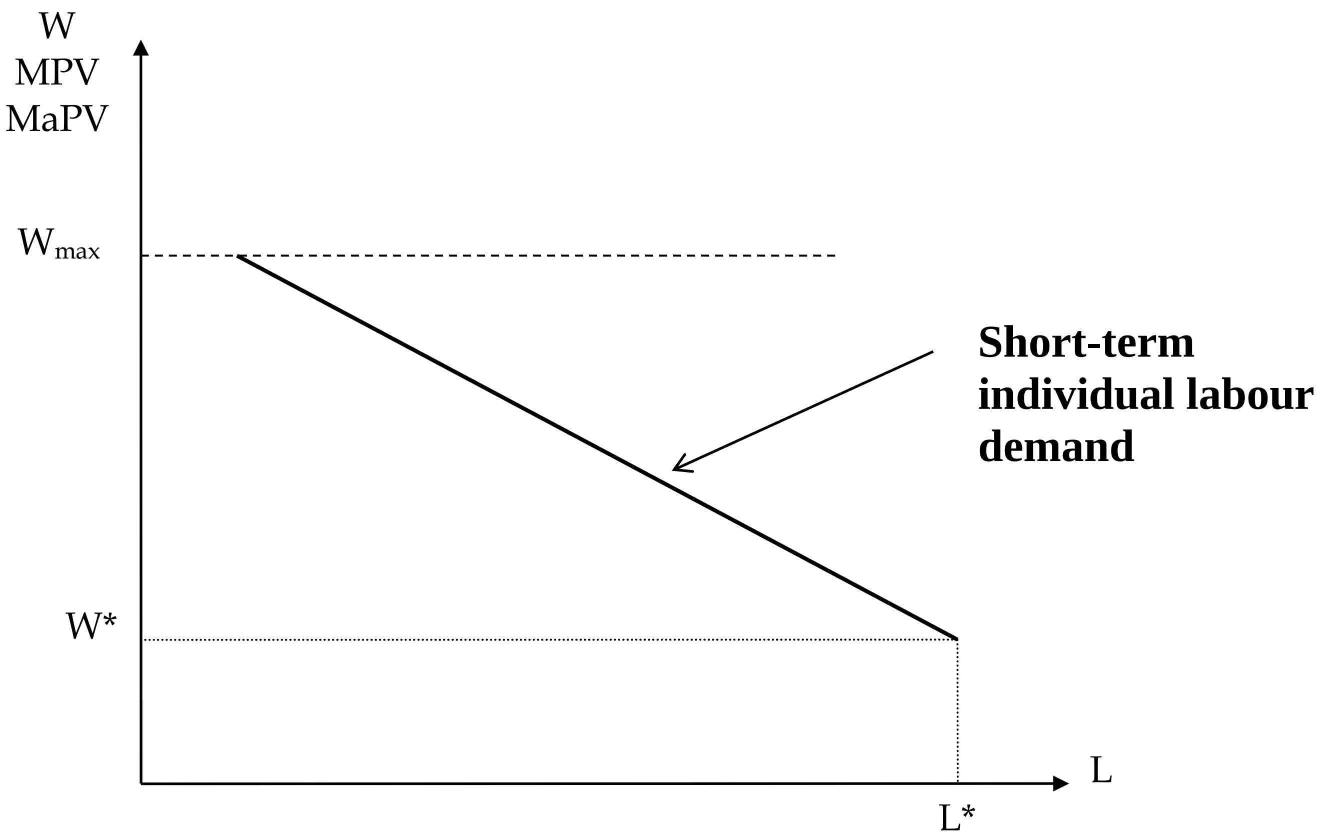
Π = total revenue (TR) – total cost (TC) = (P.Q) – (W.L)

TR = surface 0O'A'L* since MPV times employment = ((Q/L*) P) L* = P Q = RT

TC = surface 0W*AL* since wage times employment = w.L*

$\Rightarrow$ Π = surface WO'A'A $\Rightarrow$ (In perfect competition, profits are null).

Alternatively :



b) Aggregate labour demand

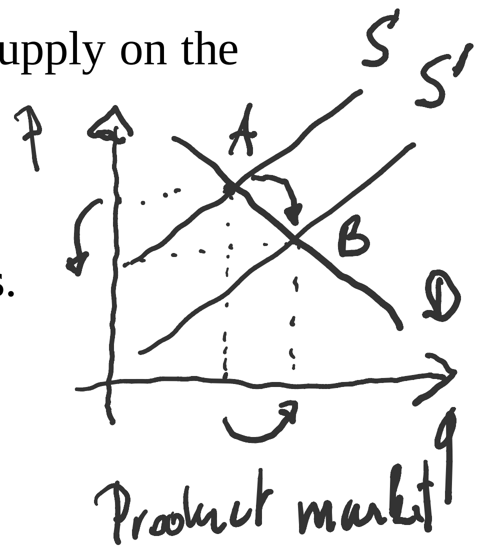
So far, focus on the short-term labour demand of an individual firm, given its production function, its capital stock and the wage it faces.

What about the short-term demand for labour of *all* the firms in a given sector, i.e. of all firms serving the same market?

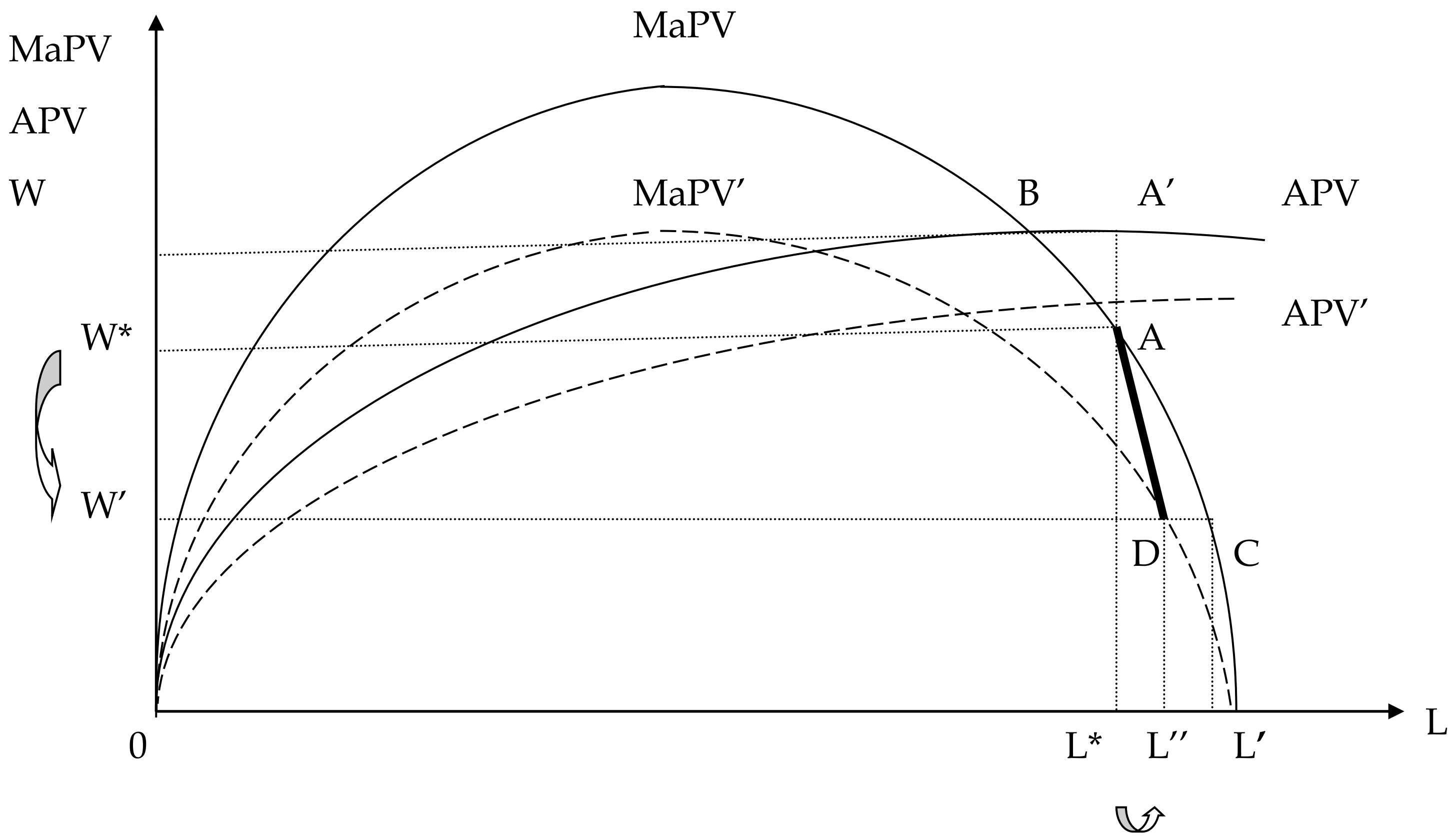
At the sector level, we can no longer assume that output ↑, following a ↓ of W, has no effect on the product price.

If W ↓ and that all firms ↑ their labour demand ⇒ output ↑ (additional supply on the product market) ⇒ product price ↓
⇒ MaPV ↓ and APV ↓.

In short, if W↓ ⇒ Q↑ ⇒ P↓ ⇒ MaPV and APV curves move downwards.



Aggregate labour demand in the short run



AD segment = *aggregate* labour demand curve in the short run.
AC segment = *individual* labour demand curve in the short run.

To sum up:

The slope of aggregate labour demand is steeper than that of individual labour demand.

$\Rightarrow$ The sensitivity of employment to changes in wages is greater for an individual firm than for a sector of activity.

$\Rightarrow$ The elasticity of aggregate labour demand with respect to wages is smaller (in absolute value) that that of individual labour demand.

The elasticity of labour demand with respect to wages (labour cost) measures the % change in labour demand following a 1% change in wages.

$$\eta_d = \frac{\Delta L_d / L_d}{\Delta W / W} \prec 0$$

Example : $|\eta_d| = 0.5$ $\Rightarrow$ if wages ↑ by 1%, labour demand ↓ by 0,5%.

4.1.3. Labour demand in the long run

In the long run, possibility to adjust both the quantity of L <u>and</u> K.

Labour demand depends on the relative cost of inputs and the production function, as it determines the MRTS (i.e. the degree of substitutability between inputs).

A firm maximises its profit subject to its production function :

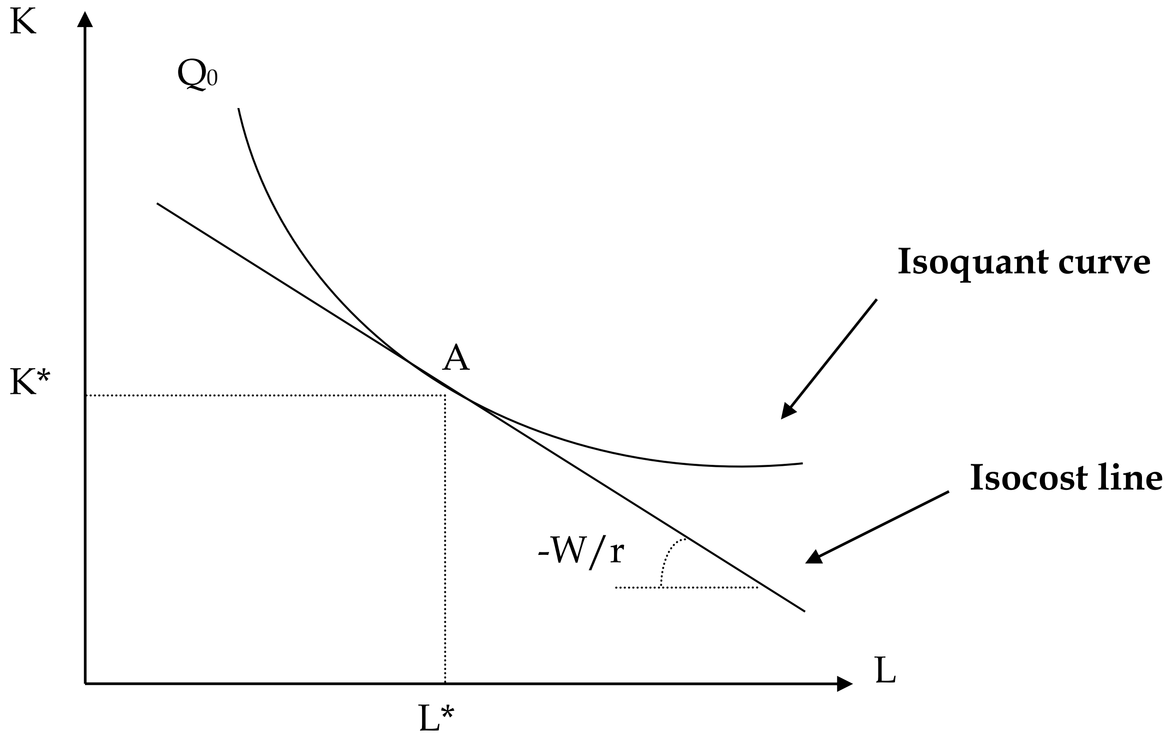
$$\underset{K,L}{Max}\ \Pi \equiv \underset{K,L}{Max}\ P\,F(K,L) - W\,L - r\,K \quad \Leftarrow \quad \begin{array}{l} \underset{K,L}{Max}\ P\,Q - W\,L - r\,K \\ sc\ \ Q = F(K,L) \end{array}$$

$$(1)\ \ \frac{\partial \Pi}{\partial K} = 0 \ \Rightarrow\ P\,F_K^{'}(K,L) = r$$

$$(2)\ \ \frac{\partial \Pi}{\partial L} = 0 \ \Rightarrow\ P\,F_L^{'}(K,L) = W \qquad \Rightarrow \boxed{\frac{F_L^{'}(K,L)}{F_K^{'}(K,L)} = \frac{W}{r}}$$

$\Rightarrow\ |MRTS|$= relative cost of inputs

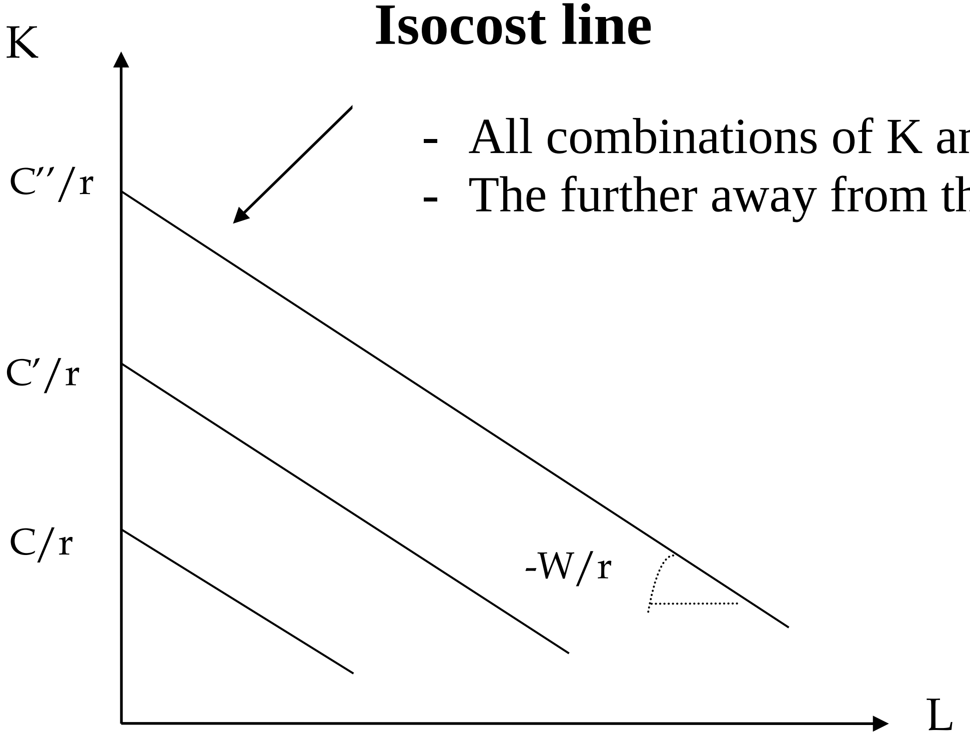
Maximising profits (subject to a production function) is equivalent to minimising costs, subject to a certain level of output (Q_0)



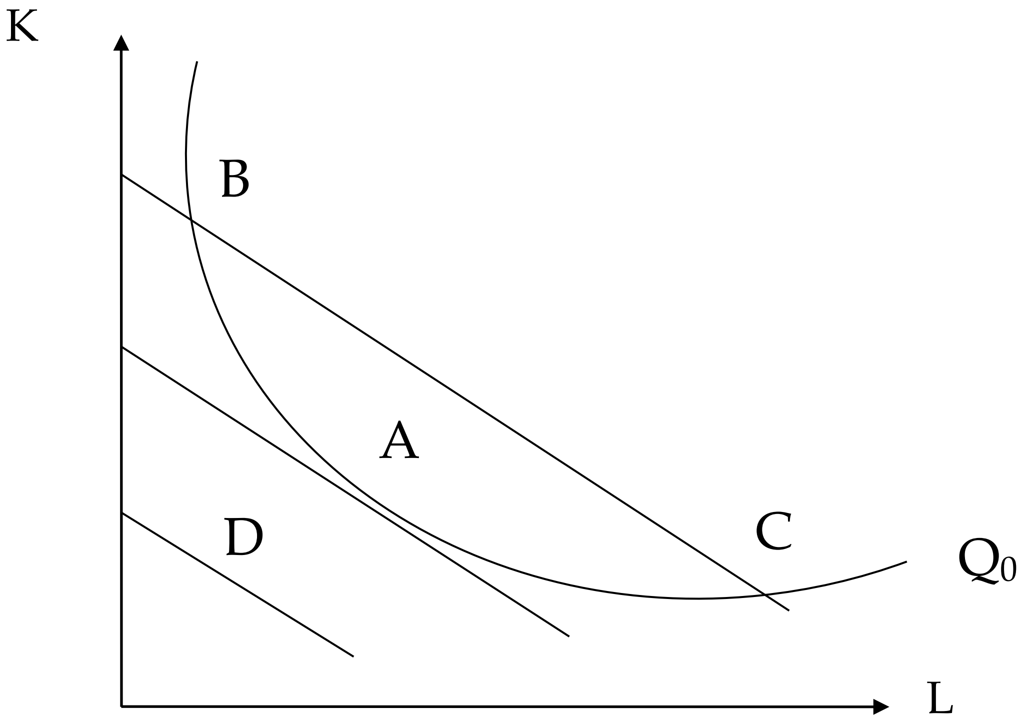
Firm's cost function : C = r K+ W L $\Rightarrow$ K = C/r – (W/r) L

At equilibrium, K* and L* will be chosen, so that $|MRTS_{K,L}|$ = W/r.

Isocost line



- All combinations of K and L generating the same cost.
- The further away from the origin, the higher the cost.

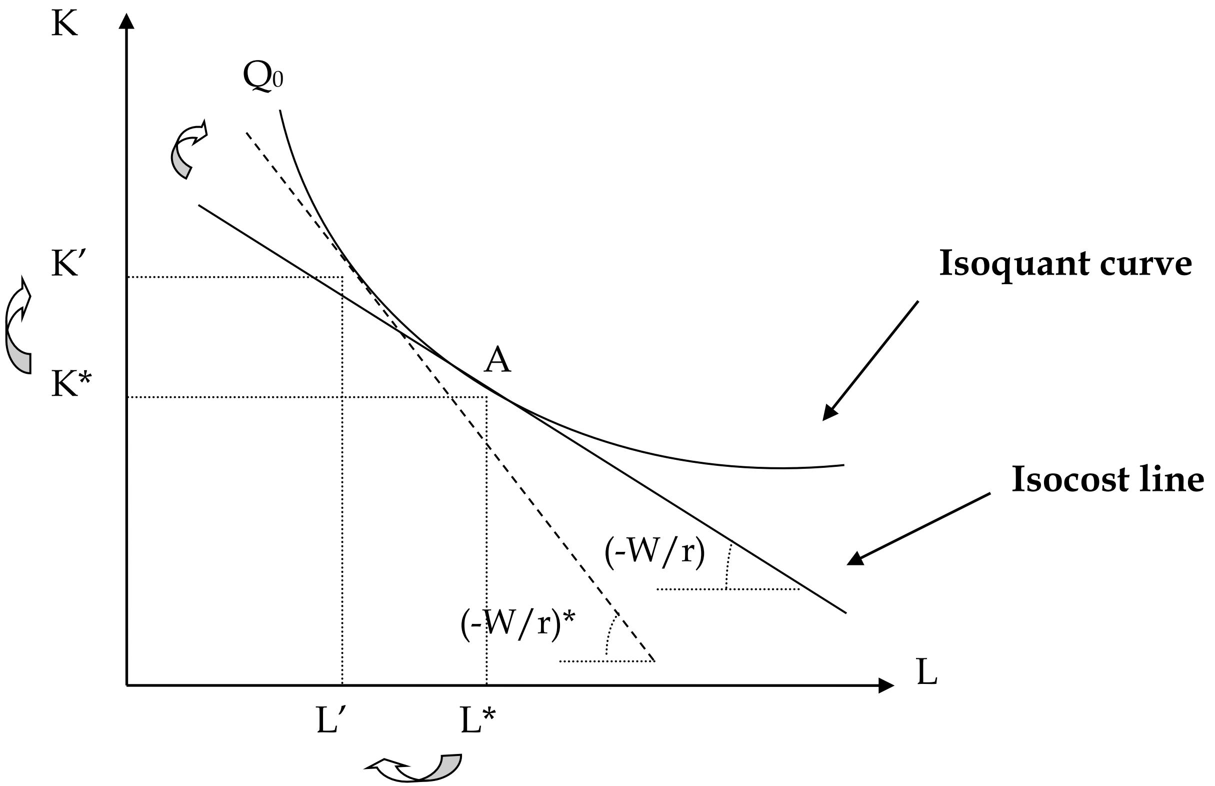


A: optimum.

D: production < Q_0.

B & C: Q_0 reached but cost higher than at A.

What if the relative cost of input changes ? Example (W/r) ↑.



4.1.4. Elasticities

a) Elasticity of substitution

The elasticity of substitution measures the percentage change in the capital-labour ratio when the relative price of labour to capital increases by 1%.

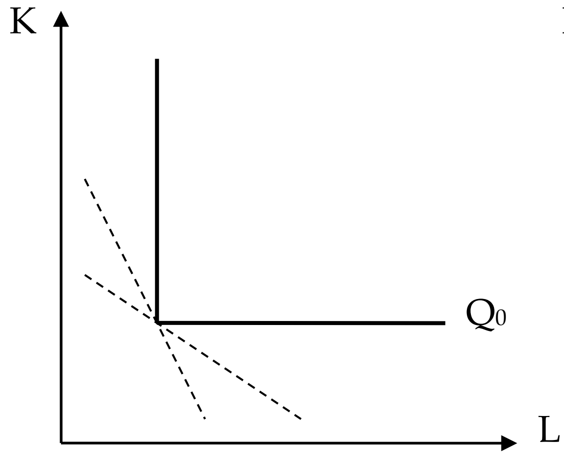
$$\sigma = \frac{\Delta(K/L)/(K/L)}{\Delta(W/r)/(W/r)} = \frac{d\ln(K/L)}{d\ln(w/r)}$$

If $\sigma = 3 \Rightarrow$ if (W/r) ↑ by 1%, (K/L) ↑ by 3%.

Value of σ depends on the shape of the production function.

i) Leontief function

$Q = \min(K, L)$

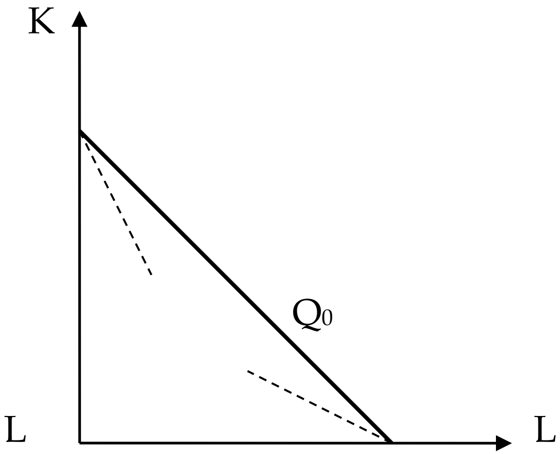


σ = 0 (perfect compl.)

∀ (W/r) ⇒ K*, L*

ii) Perfectly subst. inputs

$Q = aK + bL$



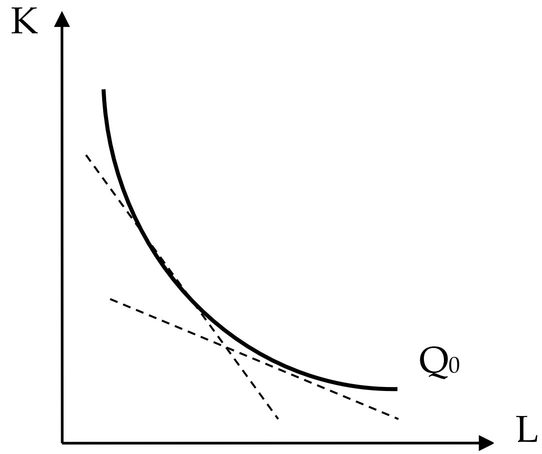
σ = ∞

if (W/r)=MRTS ⇒ sol. indét.

if (W/r)>MRTS ⇒ K>0, L=0

if (W/r)<MRTS ⇒ K=0, L>0.

iii) Intermediate cases



σ = 1 if CD (*)

σ = cst if CES (**)

(*) Cobb-Douglas : $F(K,L) = AL^aK^b$, (**) CES. : $Y = \left[(\alpha L)^{\frac{\sigma-1}{\sigma}} + (\beta K)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\theta\sigma}{\sigma-1}}$

b)Elasticity of labour demand in the long run

Impact on employment of:

	Substitution effect (i.e. at constant output)	**Total effect** = **substitution** + **scale** effects
(i) Δ W **Direct (own-price)** elasticity of labour demand	$-(1-s)\sigma < 0$	$-(1-s)\sigma - s\|\eta\| < 0$
(ii) Δ r **Indirect (cross-price)** elasticity of labour demand	$(1-s)\sigma > 0$	$(1-s)(\sigma - \|\eta\|) >< 0$

The **direct (own-price) elasticity** of labour demand measures how much the demand for labour changes when the wage changes by 1% (all else being equal):

$$\eta(L,L) = \frac{\Delta L / L}{\Delta W / W} \prec 0$$

The **indirect (cross-price) elasticity** of labour demand measures how much labour demand changes when the price of capital changes by 1% (all else being equal):

$$\eta(L,L) = \frac{\Delta L / L}{\Delta r / r} > \prec 0$$

In both cases, the **total effect** on labour demand is equal to the sum of the **substitution** and **scale** effects.

i) The substitution effect

✓ Direct elasticity of labour demand

Tells us by how much the demand for labour changes (in %) when the price of labour increases (or decreases) by 1%, at given level of production (along the isoquant).

$$\eta(L,L) = -(1-s)\sigma \prec 0 \qquad (1)$$

where : $\begin{cases} \sigma \text{ the elasticity of substitution,} \\ s = \dfrac{(wL)}{Y} \text{ (the wage share in total costs),} \end{cases}$

Size of substitution effect depends on value of σ (i.e. the elasticity of substitution or the degree of substitution between capital and labour in the production function).

The greater the value of σ (i.e. the more easily capital and labour can be substituted in the production function), the greater the substitution effect will be (in absolute terms).

s is a normalisation factor. If *s* increases, the elasticity decreases (in absolute value), see below.

✓ Indirect elasticity of labour demand

Tells us by how much the demand for labour changes (in %) when the price of capital increases (or decreases) by 1%, at given level of production (along the isoquant).

$$\eta(L,K) = (1 - s)\sigma \succ 0 \quad (2)$$

where : $\begin{cases} \sigma \text{ the elasticity of substitution,} \\ s = \dfrac{(wL)}{Y} \text{ (the wage share in total costs).} \end{cases}$

Size of substitution effect depends on value of σ (i.e. the elasticity of substitution or the degree of substitution between capital and labour in the production function).

The greater the value of σ (i.e. the more easily capital and labour can be substituted in the production function), the greater the substitution effect will be.

s is a normalisation factor. If *s* increases, the elasticity decreases. Intuition : the greater the quantity of labour (i.e. the wage share, *s*), the smaller the variation in the quantity of labour expressed as a percentage (i.e. in relative terms). See below.

ii) The scale effect

✓ **Direct & indirect elasticities of labour demand**

When the price of labour (or capital) falls, the company sees its production costs falling. It will pass on at least part of this reduction in its selling price.

If the selling price falls, consumer demand will increase and the company will have to adjust its production upwards to meet this growing demand. To do this, the company will need more labour and capital.

The scale effect is therefore the increase in the demand for labour that results from a greater volume of production. And this effect of scale will have a positive impact on the demand for labour, regardless of whether the fall in production costs comes from a fall in wages or a fall in the cost of capital.

The size of the scale effect will depend on the sensitivity of consumers to a variation in the price. In other words, the size of the scale effect depends on the price elasticity of demand for the product, i.e. the size of the parameter $|\eta|$.

If consumers are very sensitive to a variation in the price (of the product manufactured by the company), then the scale effect will be large.

In contrast, if consumer demand is not very sensitive to a variation in the price, then the scale effect will be small.

iii) **The total effect** (substitution + scale effects)

✓**Direct elasticity of labour demand**

$$\eta * (L, L) = -(1 - s)\sigma - s|\eta| \prec 0 \qquad (1')$$

Both the substitution and the scale effects generate an increase in labour demand if W↓

If W↓ and r = constant ⇒ in all cases, demand for labour ↑ (and vice versa) ⇒ direct elasticity of labour demand is always negative.

Recall: $\sigma > 0$; $\eta < 0$ and $s \in [0, 1]$.

✓Indirect elasticity of labour demand

$$\eta^*(L,K) = (1-s)\sigma - (1-s)|\eta| = (1-s)\ (\sigma - |\eta|)\ \succ \prec 0 \qquad (2')$$

If r ↓ and W = constant ⇒ <u>ambiguous effect</u> on labour demand:

1. if σ > |η| (substitution effect domines) ⇒ following a decrease in r, the firm will produce more, with less labour since :
   $$\eta^*(L,K) = \underset{(+)}{(1-s)}\ \underset{(+)}{(\sigma - |\eta|)} \succ 0$$

2. if σ < |η| (scale effect dominates) ⇒ following a decrease in r, the firm will use more labour. However, the K/L ratio will have increased too.
   $$\eta^*(L,K) = \underset{(+)}{(1-s)}\ \underset{(-)}{(\sigma - |\eta|)} \prec 0$$

Recall: σ > 0; η < 0 and *s* ∈ [0, 1].

Overall, it is generally assumed that capital and labour are substitutable in the production function, so that the indirect elasticity is expected to be positive (i.e. the substitution effects is expected to dominate the scale effect).

The increase in labour demand as a result of a higher cost of capital will outweigh the fall in labour demand as a result of a lower volume of production.

However, outcome varies with qualification of the workforce:

- For low-skilled workers (or highly repetitive tasks), the indirect elasticity should be positive. In other words, following a fall in the price of capital, the demand for labour should decrease ($\sigma > |\eta|$).
- For high-skilled workers (or non-repetitive tasks), the indirect elasticity should be negative. In other words, following a fall in the price of capital, the demand for labour should increase ($\sigma < |\eta|$).

In passing, *s* represents the share of wages in the firm's total costs.

Roughly speaking, it indicates whether the firm initially employs a large number of workers or not.

It is a "normalization" factor.

If *s* is large, mechanically the relative variation in employment (and therefore the elasticity of labour demand) will be small, and vice versa.

Example:

$\Delta L = +10$ (as W or r decreases by 1%) $\Rightarrow$ % change in employment (i.e. $\Delta L/L$) will be greater if there are initially few people employed in the company (i.e. if the *s* is small).

If initial L = 10 $\Rightarrow$ % change in L (i.e. $\Delta L/L$) = +100%.

If initial L= 100 $\Rightarrow$ % change in L (i.e. $\Delta L/L$) = +10%.

Key results

- Differents types of elasticities : short run (K constant) vs. long run (L and K can be adjusted), individual vs. aggregate, direct [(ΔLd/Ld)/ΔW/W)] vs. indirect [(ΔLd/Ld)/Δr/r)].

- Direct (i.e. own-price) elasticity of labour demand is negative and generally higher (in absolute value) in the long run.

- Individual (i.e. firm-level) labour demand elasticities are generally bigger (in absolute value) than aggregate (i.e. sector-level) labour demand elasticities.

- An increase (decrease) in the price of capital generally leads to an increase (decrease) in the demand for labour, since capital and labour are generally substitutes in the production function ⇒ η^* (L, K) > 0 (since we generally assume that : $\sigma \succ |\eta|$).

✓ Estimations

- For Western countries (aggregate elasticities) :

Hamermesh (2006) : $\eta^*(L,L)$ comprised between -0,75 et -0,15.
$\eta^*(L,L)$ on average equal to -0,3.

- For Belgium :

Sector-level elasticities (Bureau du Plan) : - 0,17 in the short run,
- 0,33 after 4 years,
- 0,5 after 8 years.

Fim-level elasticities (Konings et Roodhoofd, 1997) : - 0,64 in the short run,
- 1,2 in the long run.

✓ Estimations (cont.)

Tab. : Direct and indirect elasticities.

	Skilled labour, Q	Unskilled labour, NQ	Capital, K
Skilled labour, Q	$\eta(Q,Q) < 0$	$\eta(Q,NQ) > 0$	$\eta(Q,K) < 0$
Unskilled labour, NQ	$\eta(NQ,Q) > 0$	$\eta(NQ,NQ) < 0$	$\eta(NQ,K) > 0$
Capital, K	$\eta(K,Q) < 0$	$\eta(K,NQ) > 0$	$\eta(K,K) < 0$

Results :

Direct elasticities are negative : $\eta(Q,Q) < 0$, $\eta(NQ,NQ) < 0$, $\eta(K,K) < 0$.

Skilled labour and capital are complementary inputs : $\eta(Q,K) < 0$.

Skilled labour and capital are substitutable inputs : $\eta(NQ,K) > 0$.

Skilled and unskilled labour are substitutable inputs : $\eta(NQ,Q) > 0$.

4.2. Labour as a quasi-fixed factor

- Until now, it has been assumed that the cost of labour to the employer was equal to the hourly wage received by the employee.

  Corollary: firms are indifferent between adjusting the number of hours worked or the number of jobs when the business cycle fluctuates.

- In practice, there are adjustment costs associated with the labour factor ⇒ adjusting the workforce involves costs that are not (necessarily) related to the firm's day-to-day business.

  The magnitude of these costs is not negligible⇒ they influence hiring and firing decisions.

  Cyclical variations in working hours are (generally) greater than those in the number of people employed.

  Oi (1962) : labour is a quasi-fixed factor.

a) There are two main types of labour-related adjustment costs :

- Hiring costs (e.g. publication of the vacancy, selection, briefing et training).
- Separation costs (e.g. redundancy payments, costs associated with the disruption of the production process).

b) Adjustment costs are not (necessarily) proportional to the amount of labour actually used by the firm$\Rightarrow$ they are similar to fixed costs.

c) This cost analysis incorporates elements of:

- Human capital theory (e.g. training, briefing).
- Job search theory (e.g. recruitment costs).
- Organisational nature (e.g. drop in production or productivity resulting from the arrival or departure of staff,).

What's the impact of adjustement costs on labour demand ?

The firm's hiring decision is based on the entire period during which an additional worker will be employed.

In its hiring decision, the firm compares the discounted sum (present value) of a worker's cost with the discounted sum (present value) of his marginal product value (MaPV) for the entire period during which the worker will be employed by the firm.

Hypotheses : Adjustment costs include only direct hiring and training costs.
They are paid as a lump sum at the time of hiring.

Present value of the costs:

$$\sum_{\tau=0}^{j} \left(\frac{1}{1+r}\right)^{\tau} W_{t+\tau} + H_t + K_t$$

where:

j = the expected length of time a worker will be employed in the company,

r = the discount rate (i.e. nominal interest rate),

W = the wage at time $t + \tau$,

H= direct hiring costs, and

K = training costs.

What is the value today (i.e. the present value) of 1 EUR paid in *n* years ?

If 1 EUR today can be invested and yield (1+r) EUR in 1 year (where r is the interest rate associated with the investment), then (1+r) EUR is the future value of EUR 1 today.

In other words, (1+r) EUR paid in 1 years' time is worth (1+r)/(1+r) EUR today, i.e. 1 EUR today.

Or, 1 EUR paid in 1 year is worth 1/(1+r) EUR today. Because if we invest 1/(1+r) EUR today, after one year we get [1/(1+r) *(1+r)] EUR, or 1 EUR.

Generally speaking, the value today (i.e. the present value) of 1 EUR paid in n years is therefore equal to $1/(1+r)^n$ EUR. Because, if we invest today $1/(1+r)^n$ EUR, after n years we obtain $[1/(1+r)^n *(1+r)^n]$ EUR, that is 1 EUR.

Present value of the marginal product values (MaPVs):

$$\sum_{\tau=0}^{j} \left(\frac{1}{1+r}\right)^{\tau} MaPV_{t+\tau}$$

where:

j = the expected length of time a worker will be employed in the company,

r = the discount rate (i.e. nominal interest rate),

MaPV = a worker’s marginal product value at the time $t + \tau$.

In the absence of adjustment costs, the company hires additional workers as long as the marginal product value of labour is higher than the wage.

In the presence of adjustment costs, the company hires as long as the discounted sum (i.e. present value) of the marginal product value of an additional worker is greater than the discounted sum (i.e. present value) of the cost generated by this additional worker.

At equilibrium, we have that :

$$\sum_{\tau=0}^{j}\left(\frac{1}{1+r}\right)^{\tau} MaPV_{t+\tau} = \sum_{\tau=0}^{j}\left(\frac{1}{1+r}\right)^{\tau} W_{t+\tau} + H_t + K_t$$

Consequences :

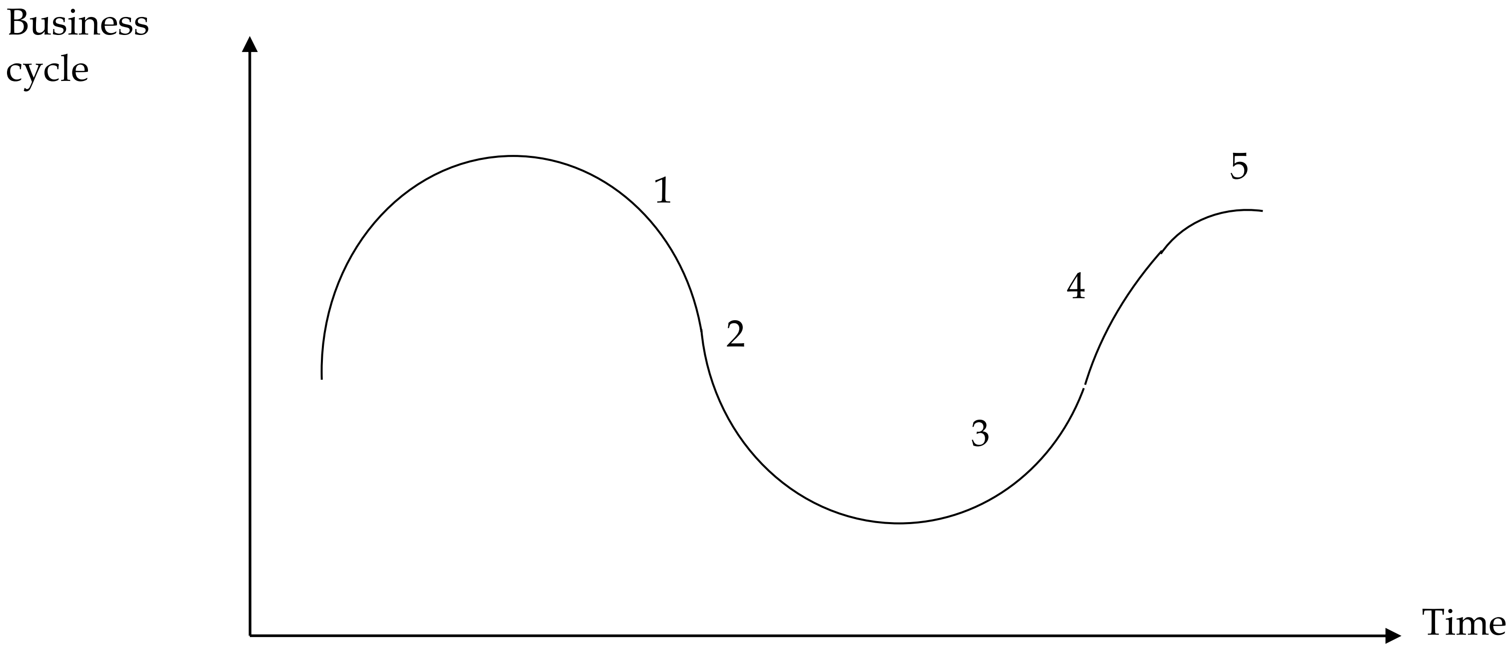
- The worker is no longer paid at his instantaneous marginal product value.
- The present value of wages is less than the discounted sum (i.e. present value) of marginal product values.
- Employment in equilibrium decreases with the size of adjustments costs.

Compared with the base model, which advocates hiring in the event of a work overload, we are seeing the emergence of all sorts of other alternatives, such as resorting to overtime, the use of temporary workers or vocational training.

In particular, it may be optimal for a company not to recruit when additional work is needed, and not to lay off in the opposite case.

The question of timing becomes key. If movements in business activity are perceived by the company as transitory fluctuations, it will seek to neutralise them through short-term adjustments. In the opposite case, the company will adjust the number of employees.

Graph : The adjustment of work to fluctuations in economic activity



Illustrates to important economic phenomena :

- Theory of selective entry into unemployment.
- The « productivity cycle ».

How important are the adjustment costs associated with labour?

i) Evaluating job surpluses

Difference between the optimal employment level that the company would choose in the absence of adjustment costs and the observed employment level.

Example :

Fay and Medoff (1985), manufacturing industry in the USA $\Rightarrow$ labour surplus of around 4% during the 1980 recession.

ii) Evaluating hiring and separation costs

US data, Hamermesh (1993) :

- Adjustment costs are non negligeable.

  Example: in 1965-66, hiring costs in the NY region of around 900 USD (at 1990 prices)

- Hiring costs ↑ with the qualification of the labour force.

  Example: Hamermesh and Rees (1993), hiring costs for managers are 12 times higher than for unskilled staff.

- Hiring costs are significantly higher than redundancy costs.

  Example : in1980, hiring and firing costs amounted to 1,780 and 370 USD respectively (at 1990 prices).

French data :

- Bresson et al. (1996), panel of 187 firme, period 1978-88 :
  Adjustment costs are higher for high-skilled workers.
  Marginal adjustment costs for skilled and unskilled labour amount respectively to 66 and 15% of their annual costs.

- Abowd and Kramarz (2000) :
  Hiring costs significantly lower than redundancy costs.
  The average cost of a redundancy represents 56% of the annual labour cost, whereas hiring (excluding training costs) represents only 3.3% of the annual labour cost.

Belgian data, Dhyne (2002) and Dhyne and Mahy (2002) :

- Slightly higher redundancy costs than hiring costs.

- Redundancy costs are higher for older workers and skilled workers.

In sum :

- In the United States, hiring costs are significant and higher than redundancy costs.

  In France and Belgium, the opposite situation appears to prevail.

- **Adjustment costs associated with labour generally increase with workers' wages.**

iii) Employment protection legislation

The purpose of employment protection legislation, i.e. all the rules governing the hiring and firing of employees, is generally to strengthen job security for workers.

However, it also results in higher labour adjustment costs for the employer and could therefore create a barrier to recruitment.

The public authorities are therefore faced with a fundamental problem: reconciling employers' need for flexibility in hiring and firing with the job security to which workers aspire.

Indicators developed by the OECD (2019) measuring the stringency of employment protection, namely:

1. Protection of workers on open-ended contracts against individual dismissal.
2. Regulation of temporary employment.
3. Special procedures for collective redundancies.

Indicator 1 :

The protection of regular or permanent workers against individual dismissal is measured using three criteria:

a) The difficulty encountered in dismissal, i.e. the constraints imposed by the legislative provisions which lay down the conditions under which a dismissal is "justified" or "fair".
b) Difficulties caused by the procedures that the employer must follow when initiating the redundancy process.
c) Provisions relating to notice periods and redundancy payments.

Indicator 2 :

Regulatory provisions concerning fixed-term contracts and the use of temporary employment agencies.

This indicator reflects:

- The restrictions imposed on companies in terms of the reasons or types of work for which the use of temporary contracts is authorised.
- Limitations on the duration of temporary contracts.

Indicator 3 :

Special provisions concerning collective redundancies.

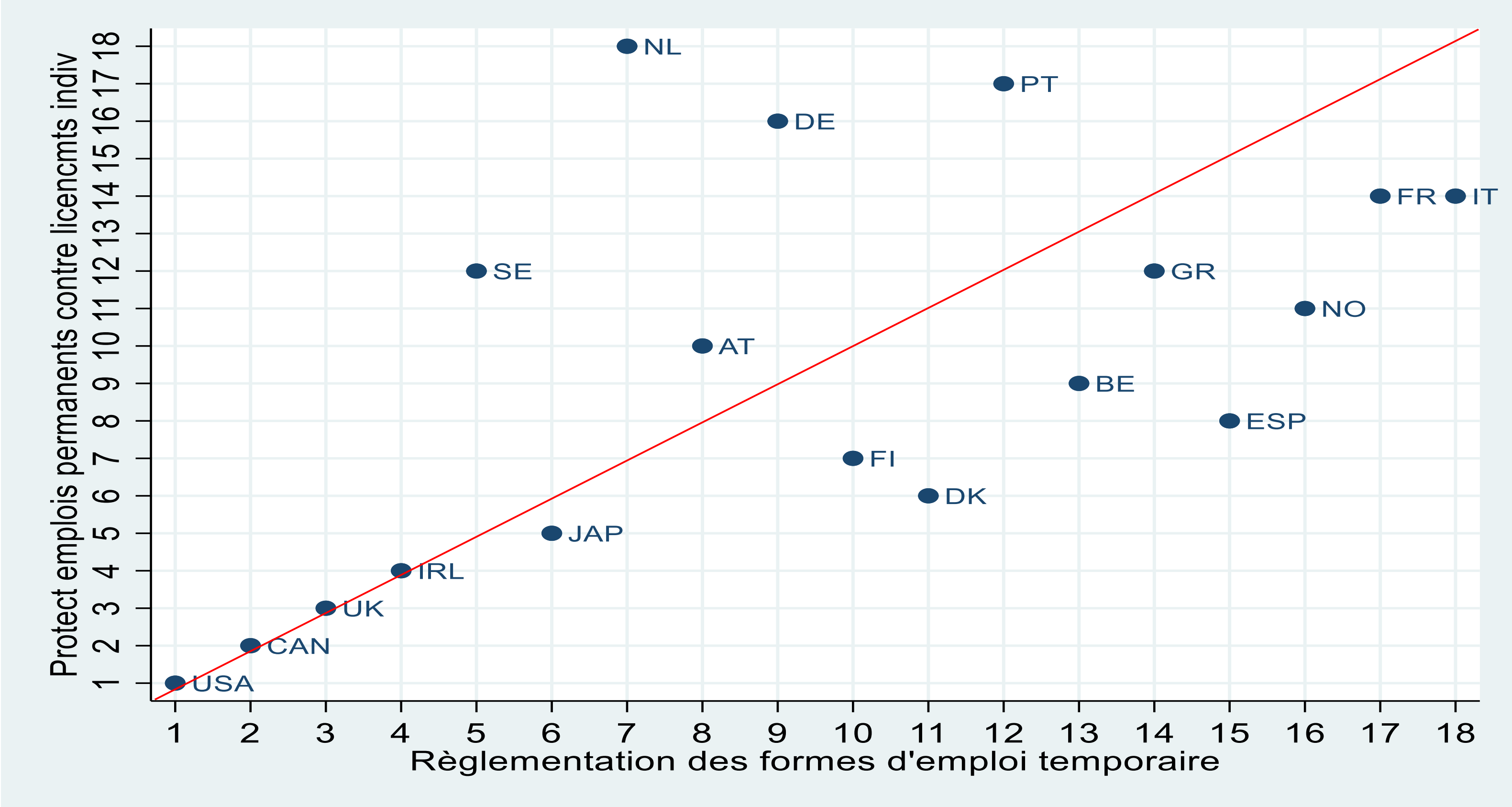
The stringency of these provisions is assessed by considering the definition of a collective redundancy, additional notification requirements, additional time limits, and other special costs falling on employers.

Tab. The stringency of employment protection, 2019

Country	Protection of permanent workers against dismissal (individual)	Regulation of temporary employment	Special provisions concerning collective redundancies
US	0.09 (1)	0.25(1)	2.12 (3)
Canada	0.59 (2)	0.25 (2)	3.13 (11)
UK	1.35 (3)	0.38 (3)	2.13 (4)
Ireland	1.23(4)	0.63 (4)	3.50 (16)
Japan	1.37 (5)	1.00 (6)	3.25 (14)
Denmark	1.53 (6)	1.63 (11)	2.88 (6)
Finland	2.00 (7)	1.56 (10)	1.63 (1)
Spain	2.05 (8)	2.47 (15)	3.00 (8)
Belgium	**2.07 (9)**	**2.06 (13)**	**4.88 (18)**
Autria	2.29 (10)	1.31 (8)	3.25 (14)
Norway	2.33 (11)	2.63 (16)	2.50 (5)
Sweden	2.45 (12)	0.81 (5)	3.00 (8)
Greece	2.45 (12)	2.25 (14)	2.88 (6)
France	2.56 (14)	3.00 (17)	3.13 (11)
Italy	2.56 (14)	3.13 (18)	3.00 (8)
Germany	2.60 (16)	1.38 (9)	3.63 (17)
Portugal	3.14 (17)	1.94 (12)	1.88 (2)
Netherlands	3.61 (18)	1.19 (7)	3.19 (13)
OECD average	**2.11**	**1.69**	**2.84**

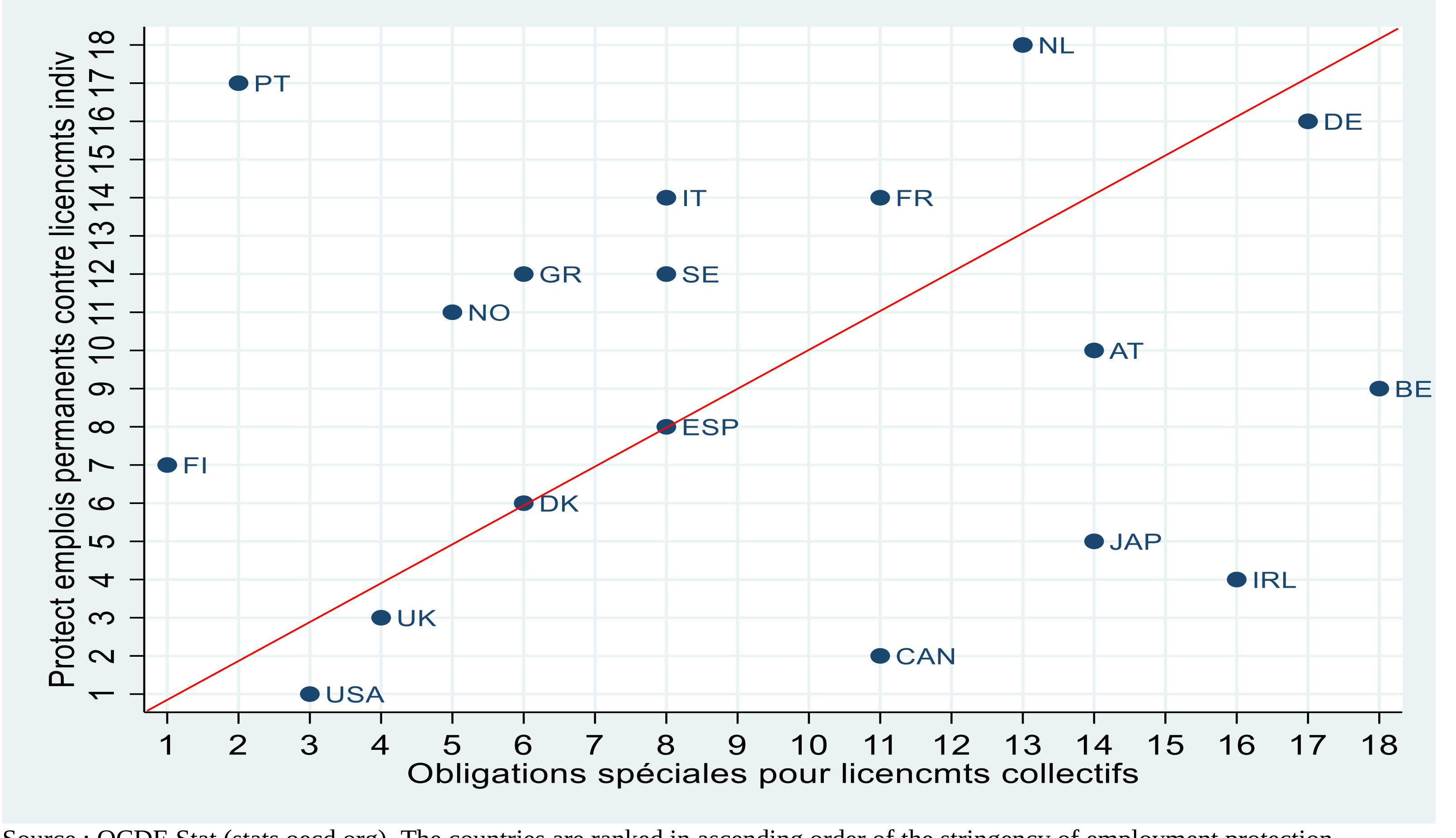
Source : OCDE.Stat. Remark : the countries are ranked in in ascending order of the extent to which permanent workers Are protected against individual dismissal. The rank of each country is shown in brackets.

Fig. : Comparison of country rankings for "Protection of permanent workers against (individual) dismissal" and "Regulation of temporary employment" in 2019. Rank correlation coefficient (Spearman) = 0.58*** (p=0.01)



Source : OCDE.Stat. The countries are ranked in ascending order of the stringency of employment protection.

Fig. : Comparison of the ranking of countries according to "Protection of permanent workers against (individual) dismissal" and "Special obligations applicable to collective redundancies" in 2019. Rank correlation coefficient (Spearman) = 0.10 (p=0.69)



Source : OCDE.Stat (stats.oecd.org). The countries are ranked in ascending order of the stringency of employment protection.

Tab. Changes in the stringency of employment protection: 1985/1998 - 2019

Country	Changes in protection of permanent workers against dismissal (individual)			Changes in the regulation of temporary employment			Changes in the legislation regarding collective dismissals		
	1985-2008	2008-2019	**1985-2019**	1985-2008	2008-2019	**1985-2019**	*1998-*2008	2008-2019	**1998-2019**
US	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Canada	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
UK	0,17	-0,17	0,00	0,13	0,00	**0,13**	0,00	-0,25	**-0,25**
Japan	-0,33	0,00	**-0,33**	-0,81	0,13	**-0,69**	0,00	0,00	0,00
Irlande	-0,17	0,13	**-0,04**	0,38	0,00	**0,38**	0,75	0,00	**0,75**
Belgium	0,05	0,38	**0,43**	-2,25	-0,19	**-2,44**	0,00	0,00	**0,00**
Spain	-1,19	-0,31	**-1,50**	-0,75	-0,53	**-1,28**	0,00	-0,38	**-0,38**
Greece	-0,05	-0,68	**-0,73**	-2,00	-0,50	**-2,50**	0,00	0,00	0,00
Finland	-0,62	-0,08	**-0,70**	0,31	0,00	**0,31**	-0,25	0,00	**-0,25**
Denmark	-0,05	0,06	**0,02**	-1,75	0,25	**-1,50**	-0,75	0,00	**-0,75**
Norway	0,00	0,00	0,00	-0,13	-0,38	**-0,50**	0,00	0,00	0,00
Autria	-0,38	0,00	**-0,38**	0,00	0,00	0,00	0,00	0,00	0,00
France	-0,19	-0,02	**-0,21**	0,56	-0,13	**0,44**	0,00	0,00	0,00
Italy	0,00	-0,46	**-0,46**	-3,25	1,13	**-2,13**	0,00	-1,13	**-1,13**
Sweden	-0,19	0,00	**-0,19**	-3,27	0,00	**-3,27**	0,00	0,00	0,00
Netherlands	-0,18	0,31	**0,13**	-0,44	0,25	**-0,19**	0,00	0,19	**0,19**
Germany	0,10	0,00	**0,10**	-4,00	0,38	**-3,63**	0,00	0,00	0,00
Portugal	-0,58	-1,28	**-1,86**	-1,44	0,00	**-1,44**	-1,00	0,00	**-1,00**

Rem : the countries are ranked in in ascending order of the extent to which permanent workers are protected against individual dismissal in 2019. Source : OCDE.Stat.

Changes in the stringency of employment protection: 1985/1998 – 2019 :

a) Convergence towards countries with lower levels of employment protection.

b) Fairly stable country rankings.

Rank correlations (Spearman) between country rankings with regard to:

a) Protection of permanent workers against individual dismissal in 1985 and 2019 = 0.79***
b) Regulation of temporary employment in 1985 and 2019 = 0.70***
c) Special obligations applicable to collective redundancies in 1998 et 2019 = 0.64***

What is the size of employment adjustments?

Most international comparisons show that employment is adjusting faster in North America than in Europe and Japan.

The causes of these differences are not yet fully understood. However, employment proception legislation (and more generally adjustment costs) is a highly significant variable. Union density, on the other hand, plays a more ambiguous role.

4.3. Example of an economic policy: labour taxes & employment

Belgium's social security system is largely financed by social security contributions.

Employer and personal contributions amount to 25% and 13.07% respectively of gross pay.

Progressive personal income taxes, with a marginal tax rate of 50%.

Example : gross salary of 3,000 EUR/month.

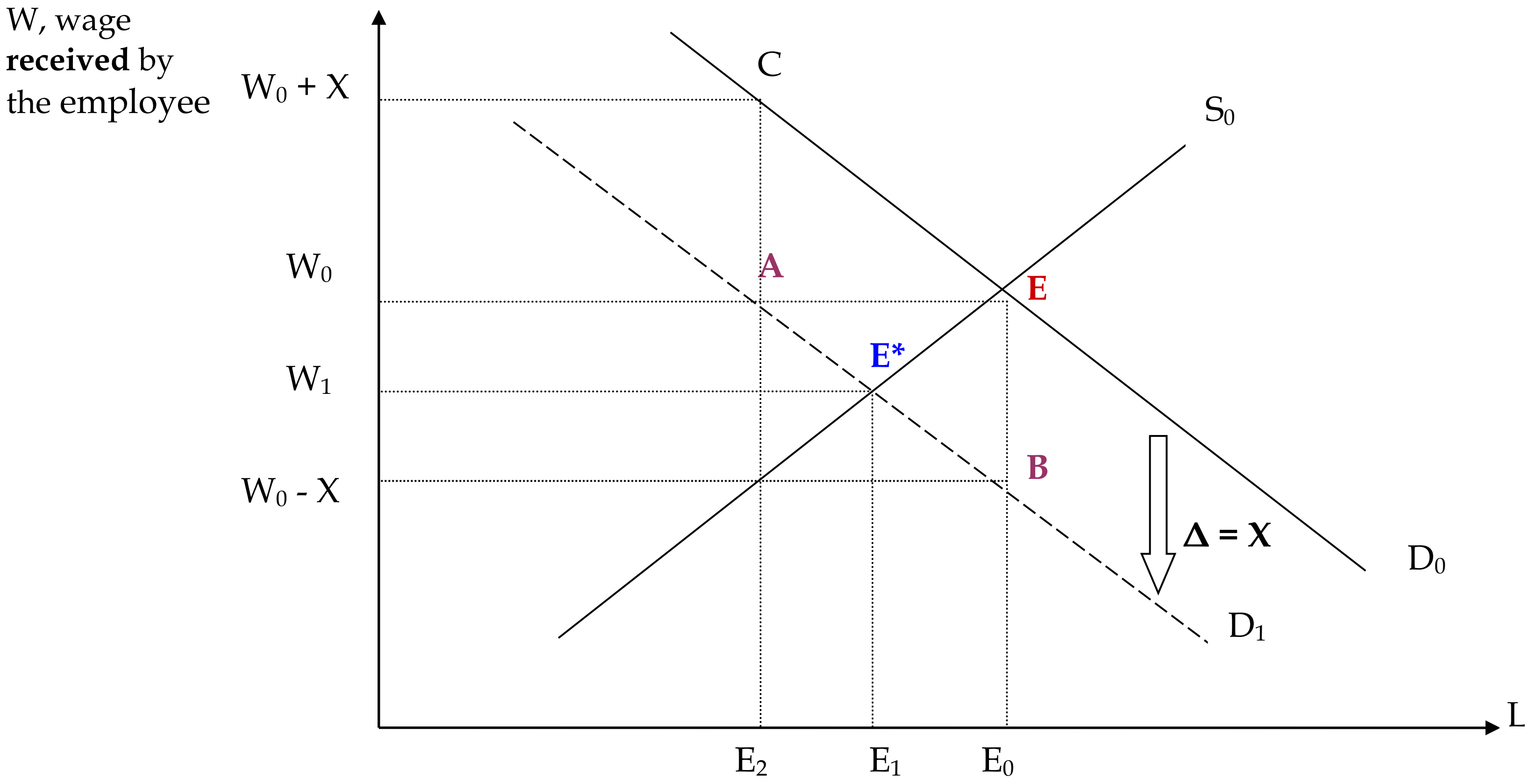
Employer’s labour cost : 3.750 EUR (3.000 EUR + 25% employer contribution)

Employee’s net salary : after personal contribution (13,07%) 2607,90 EUR & after personal income taxes (if average rate of 40%) : 1.564,74 EUR

Tax wedge : 2.185,26 EUR or 58,3% of employer’s labour cost.

What are the consequences of labour taxes ?

Suppose employers have to pay a fixed amount (X) per employee. employee.



How much does the labour demand curve shift downwards?

1. Employers are guided by the price actually paid, i.e. the wage including taxes. When the wage received by employees is equal to W_0, the quantities of labour demanded (after the introduction of the tax) are equivalent to those that would have been demanded if the wage received by employees had been equal to W_0+X and there had been no tax to pay (**Point A on the graph**).

2. To encourage employers to hire an unchanged quantity of workers (i.e. E_0 workers), after the introduction of the tax, the wage received by employees would have to be equal to W_0-X (**Point B on the graph**).

In short, the employer's contribution shifts the labour demand curve downwards by an amount exactly equal to the tax X.

a) What is the demand for labour if the wage received by workers is equal to W_0 and that a tax equal to X has to be paid for each worker?

Wage received by worker	**Amount of tax**	**Wage cost to the employer**	**Labour demand**
W0	0	W_0	E_0
$W_0 + X$	0	$W_0 + X$	E_2
W_0	X	$W_0 + X$	E_2

Yellow lines in table = equivalent situations from the employer's perspective

⇒ First point of new labour demand curve: **A**, with coordinates (W_0, E_2):

b) What must workers be paid to ensure that the demand for labour is always equal to E0 after the introduction of tax X?

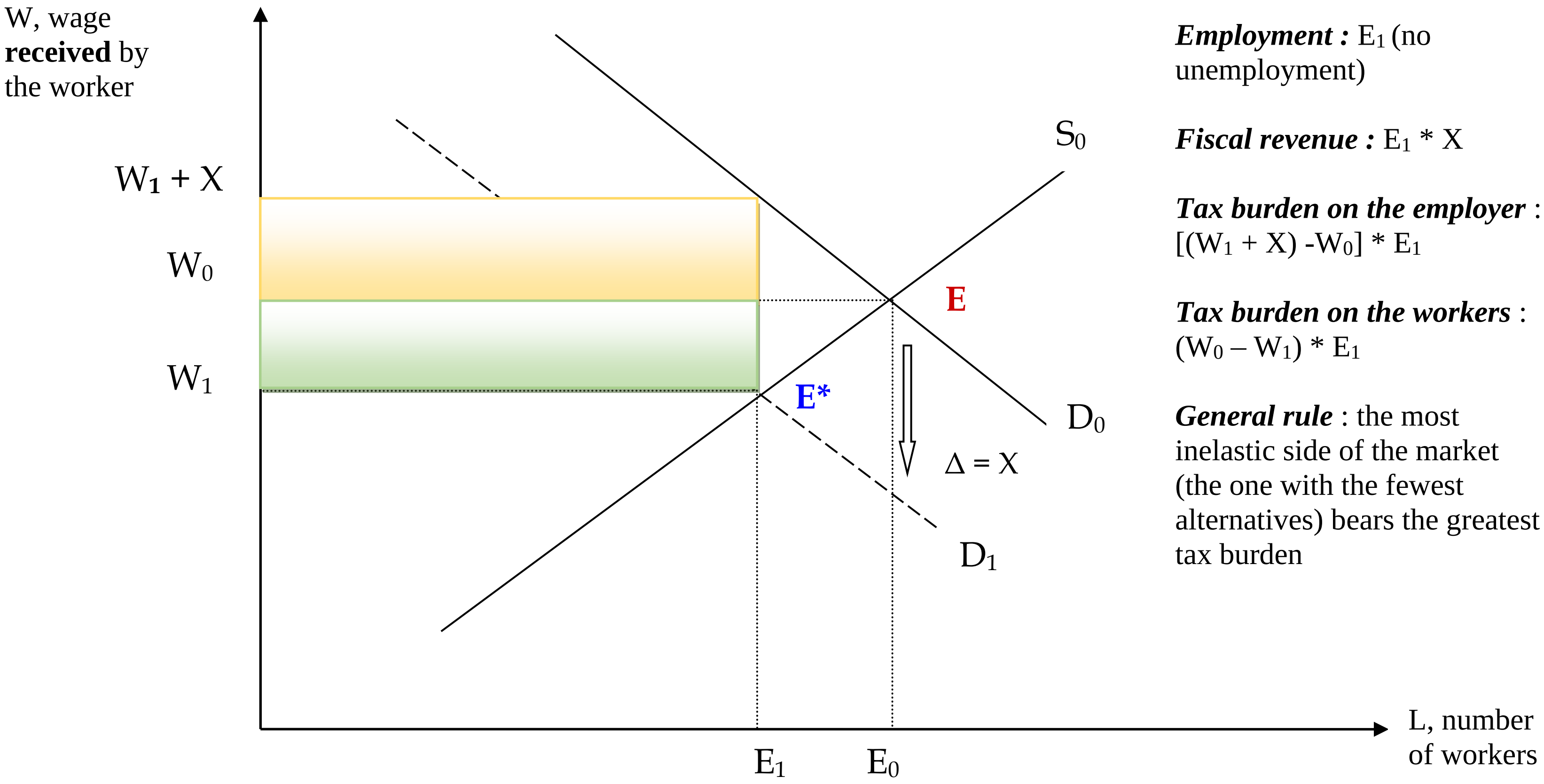
Wage received by worker	Amount of tax	Wage cost to the employer	Labour demand
W0	0	W_0	E_0
W_0 - X	X	W_0	E_0

Yellow lines in table = equivalent situations from the employer's perspective

⇒ Second point of new labour demand curve: **B**, with coordinates (W_0 - X, E_2).

Who ultimately bears – has the economic burden of – the tax (tax incidence)?

If the wage is flexible downwards…



Employment : E_1 (no unemployment)

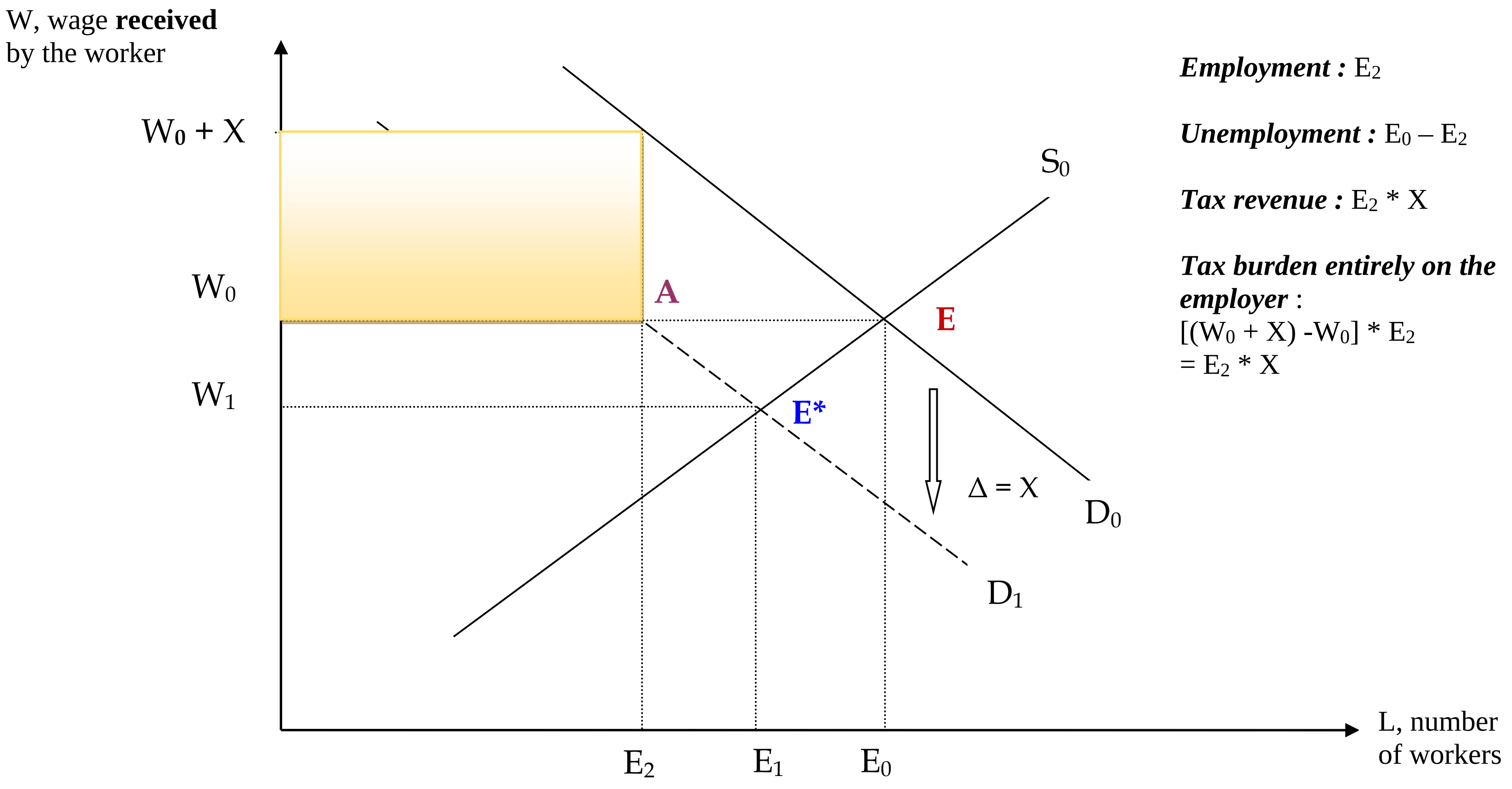
Fiscal revenue : $E_1 * X$

Tax burden on the employer : $[(W_1 + X) - W_0] * E_1$

Tax burden on the workers : $(W_0 - W_1) * E_1$

General rule : the most inelastic side of the market (the one with the fewest alternatives) bears the greatest tax burden

If the wage is NOT flexible downwards…



Employment : E_2

Unemployment : $E_0 - E_2$

Tax revenue : $E_2 * X$

Tax burden entirely on the employer :
$[(W_0 + X) - W_0] * E_2$
$= E_2 * X$

Among the various policies implemented to combat unemployment in the European Union, and more specifically in Belgium, the reduction in employers' social security contributions occupies a central place.

The various measures to reduce social security contributions have cost the Belgian State around EUR 5.1 billion in 2019, or around 1.1% of GDP (EUR 473.1 billion in 2019) and 10.26% of social security contributions (Source: FPS Employment, NRP and OECD).

The aim is to bring labour costs down to the average of our main economic partners. In return, the social partners have agreed to make additional efforts in the areas of lifelong learning and employment.

What about job creation ?

The results in terms of employment depend notably on the budgetary scale of the policy, the method of implementation (linear or targeted at certain groups of workers such as the 'low-paid') and the type of alternative financing.

Alternative financing

- Increase in VAT.
- Increased taxation on capital.
- Introduction of a generalised social contribution (CSG, ‘Cotisation Sociale Généralisée’).
- Green taxes (e.g. taxation of polluting emissions, particularly CO_2, and energy consumption).

Main results

↳ Implementation :

- Target the reduction of social security contributions at low-wage earners.
- Apply without 'timidity' over a sufficient long period.

↳ Alternative financing :

- The CO_2/energy tax and the CSG are the most appropriate.
- An increase in VAT is not recommended.
- The maximum self-financing rate is 70%.

↳ Impact on employment according to macro-econometric estimates:

- Significant (cf. Service vouchers) but no miracle should be expected.

Results of four simulations carried out by the Belgian Federal Planning Bureau using the Hermès model. These different variants are based on a reduction in SSC of 0.74 billion EUR (0.35% of GDP in 1996). The table shows the situation in t + 7.

Tab. : Impact of a 0.74 billion EUR cut in SSC in t+7

Differences in % compared with the basic simulation Situation in t+7	Linear reduction and ...		Reduction targeted at "low-paid workers" and ...	
	CO_2 / energy tax	CSG	CO_2 / energy tax	CSG
GDP	0.07	0.06	0.01	0.01
Employment (in thousands)	**9.7**	**10.2**	**27.6**	**27.8**
Price of private consumption	0.18	- 0.17	0.22	- 0.14
Ex-post balance of public finances (in billions)	4.1	7.8	18.2	17.9

Source : F. Bossier (1996).

Tab. : Long-term effects on employment (in thousands) of SSC reductions of EUR 0.5 billion (0.2% of GDP in 2000). according to the type of wages on which they are targeted

	Targeted at low-wage earners	Targeted at high-wage earners	Not targeted (all employees)
Sneessens & Shadman (2000)	+23.2		
Stockman (2000)	+9.5 / +16.2	+4.4 / +6.2	+2.2 / 7.4
Burggraeve & Du Caju (2003)			+6.2 / +9.2
Hendricks *et al.* (2003)			+8.0 / +11.3
Coût par emploi créé :	Entre 22.000 et 53.000 EUR		Entre 44.000 et 230.000 EUR

Source : Cockx *et al.* (2005).

Caution is required :

- Numerous assumptions, particularly concerning the direct and indirect elasticity of labour demand.

- "Windfall" and "substitution" effects

The « substitution » effect occurs when an employer hires a worker who is entitled to a reduction in employers' social security contributions, whereas in the absence of this measure he would have hired another worker.

The « windfall » effect occurs when a company hires a worker who would have been hired without the policy.