INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

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4 Markets for Factors of Production

Markets for factors of production are defined as places, where the supply of factors for production (supply of labour, land, capital, etc.) meets the demand for these factors. Unlike the markets for products and services, where producers offer their products and services and these are demanded by households, the markets for factors of productions involves **individuals** (households) **as the suppliers** and **firms as the demanders**. The markets for factors of production determine the prices of factors of production and enable allocation of resources among particular production segments. **The method of allocation** defines prerequisites for either effective or ineffective production. The relationship between the output and production inputs has been described using the short- and long-run functions of production as $Q = f(K, L)$ in chapter 2.1 on page 41. Functioning of the market for factors of production depends on the ability of market players to transfer the inducements from the market for products and services into requirements on markets for factors of production. The solution provided by the market for factors of production types the level of future compliance between assumptions and requirements of the demand and the actual supply on markets for final production.

Specifics of the market for factors of production are defined mainly:

- ⇒ on the side of demand for factors of production, which is **the demand derived from the demand for final production** made using the factors of production. The demand for factors of production is generated by **firms** motivated by the efforts towards increase of their economic profit. While the principle of exchange remains fully unaffected, i.e. the exchange is to bring certain benefit for the exchanging party, the fact is it does not serve to satisfy the need of the buyer. That is why the motivation of demand cannot be explained using the Marginal Utility theory. Demand is represented by firms purchasing factors of production to use these for production of outputs to be offered and sold at the market for final products and services. The general objective of exchange is to maximise the difference between revenues from sales and costs, whereas costs are the actual link between the market for final production and the market for factors of production.
- ⇒ on the supply side, where **households represent the supply** of factors of production and their behaviour is motivated by maximising of utility.
- ⇒ by the nature of consumption of factors of production, the so called **consumption in production**. When being consumed, the factors of production become the source of production of new goods, while used in various combinations the productiveness is **subject to technologies**. That is why the demand for factors of production is subject to

technologies too.

The functioning principles of markets for factors of production are similar to those on final production markets. Their outcome deals with determination of the optimal quantity of factors of production involved in the production process and determination of prices of factors or production based on the principle of economic profit maximisation pursued by the firm demanding factors of production. Maximisation of profit when hiring factors of production - capital and labour - follows the principles below:

$$\pi(K,L) = TRP(K,L) - TFC(K,L), \tag{4.1}$$

where *TRP* refers to the total revenue product and *TFC* refers to the total factor cost. While the relations can be also expressed as:

$$TRP_K = P_A \cdot TP_K \text{ a } TRP_L = P_A \cdot TP_L, \tag{4.2}$$

$$TFC_K = r \cdot K \text{ a } TFC_L = w \cdot L, \tag{4.3}$$

where TRP_K refers to the total revenue product of capital obtained by multiplication of the final product price P_A and the total product of capital TP_K; analogically TRP_L refers to the total revenue product of labour obtained by multiplication of the final product price P_A and the total product of labour TP_L; TFC_K refers to the total factor cost of capital obtained by multiplication of the capital unit price (interest rate) *r* and the amount of capital used in production *K*; analogically TFC_L refers to the total factor cost of labour obtained by multiplication of the labour unit price (wage rate) *w* and the amount of labour employed in production *L*.

The prerequisite for maximizing of economic profit with respect to capital is:

$$\begin{aligned} &\frac{\partial \pi}{\partial K} = \frac{\partial TRP_K}{\partial K} - \frac{\partial TFC_K}{\partial K} = 0 \\ &\frac{\partial TRP_K}{\partial K} = \frac{\partial TFC_K}{\partial K} \quad \Rightarrow \quad MRP_K = MFC_K \end{aligned} \tag{4.4}$$

The prerequisite for maximizing of profit with respect to labour is:

$$\begin{aligned} &\frac{\partial \pi}{\partial L} = \frac{\partial TRP_L}{\partial L} - \frac{\partial TFC_L}{\partial L} = 0 \\ &\frac{\partial TRP_L}{\partial L} = \frac{\partial TFC_L}{\partial L} \quad \Rightarrow \quad MRP_L = MFC_L \end{aligned} \tag{4.5}$$

The prerequisites sufficient for maximizing of profit comprise negative values of the second partial derivation of the profit function depending on the particular input:

$$\frac{\partial^2 \pi}{\partial K^2} < 0 \text{ and } \frac{\partial^2 \pi}{\partial L^2} < 0 \tag{4.6}$$

The equation (4.2) shows that the **revenues from factors of production** are dependent on the performance of factors of production and final production prices. **The marginal revenue product (*MRP*)** therefore refers to an additional revenue gained by a firm by employing one extra unit of factor of production into the production process, while the remaining inputs remain constant. This is a change to the total revenue achieved by extra production. The marginal revenue product will tend to decrease from a certain point after employment of a factor of production; this is due to the decline of marginal product caused by the effect of decreasing revenue from variable input (see page 43). The price of final product on the market will be:

⇒ decreasing, when employment of any extra units is subject to price decrease within the imperfect competition environment

⇒ constant, if the firm gains every extra unit of production at the same price

The marginal revenue product of capital MRP_K represents the change of the total revenue product of capital generated by the sale of products made using an extra unit of capital, while the amount of other factors of production remains constant:

$$MRP_K = \frac{\partial TRP_K}{\partial K} = \frac{\partial TR}{\partial Q_A} \cdot \frac{\partial Q_A}{\partial K} = MR_A \cdot MP_K \qquad (4.7)$$

where MR_A refers to the marginal revenue of extra product unit A, MP_K is the marginal product of capital.

The marginal revenue product of labour MRP_L represents the change of the total revenue product of labour generated by the sale of products made using an extra unit of labour, while the amount of other factors of production remains constant.

$$MRP_L = \frac{\partial TRP_L}{\partial L} = \frac{\partial TR}{\partial Q_A} \cdot \frac{\partial Q_A}{\partial L} = MR_A \cdot MP_L \qquad (4.8)$$

where MR_A refers to the marginal revenue of extra product unit A, MP_L is the marginal product of labour.

The marginal productivity theory was published in book themed "*The Distribution of Wealth*" (1899) by the American economist **John Bates Clark** (1847-1938). The marginal productivity theory explains behaviour of a firm when hiring factors of production and defines the amount of these factors to be hired by the firm at certain costs. The conclusions achieved can then be used to derive market demands for factors of production, as shown further below.

The marginal factor cost (***MFC***) refers to extra cost incurred by the firm due to purchase of an extra unit of particular factor of production. The marginal factor cost is:

⇒ constant in case the market conditions in perfect competition allow the firm purchase every extra unit of factor of production at the same price

⇒ rising when the firm purchases factors of production on markets for factors of production with imperfect competition

The marginal factor cost of capital MFC_K refers to the extra cost incurred by purchase of an extra unit of capital. That is the increment of the total cost of factor capital when the amount of capital has risen by one unit:

$$MFC_K = \frac{\partial TFC_K}{\partial K} = \frac{\partial (r \cdot K)}{\partial K} = r + K \cdot \frac{\partial r}{\partial K} \tag{4.9}$$

The marginal factor cost of labour MFC_L refers to the extra cost incurred by purchase of an extra unit of capital. That is the increment of the total cost of factor labour when the scope of labour hired has risen by one unit:

$$MFC_L = \frac{\partial TFC_L}{\partial L} = \frac{\partial (w \cdot L)}{\partial L} = w + L \cdot \frac{\partial w}{\partial L} \tag{4.10}$$

The average factor cost refers to the cost of each unit of factor employed in production. **The average factor cost of capital AFC_K** refers to the cost per each unit of capital employed in production. The price capital units is usually represented by the interest rate r.

$$AFC_K = \frac{TFC_K}{K} = \frac{r \cdot K}{K} = r \tag{4.11}$$

The average factor cost of labour AFC_L refers to the cost per each unit of labour used in production. The price of labour units is defined by the wage rate w.

$$AFC_L = \frac{TFC_L}{L} = \frac{w \cdot L}{L} = w \tag{4.12}$$

4.1 Labour Market

The market for labour as a factor of production is the place, where the market demand for labour $\boldsymbol{D_L}$ interacts with the supply of labour $\boldsymbol{S_L}$. Our market analysis will start by deriving the individual demand for labour (demand from a single firm) $\boldsymbol{d_L}$ for further derivation of the market demand for labour D_L. The next part of sub-chapter 4.1 will be primarily dedicated with the individual supply of labour $\boldsymbol{s_L}$ (supply from one employee) for further derivation of the market supply of labour S_L.

4.1.1 Demand for Labour

The demand for labour needs to be distinguished with reference to the competition environment both on

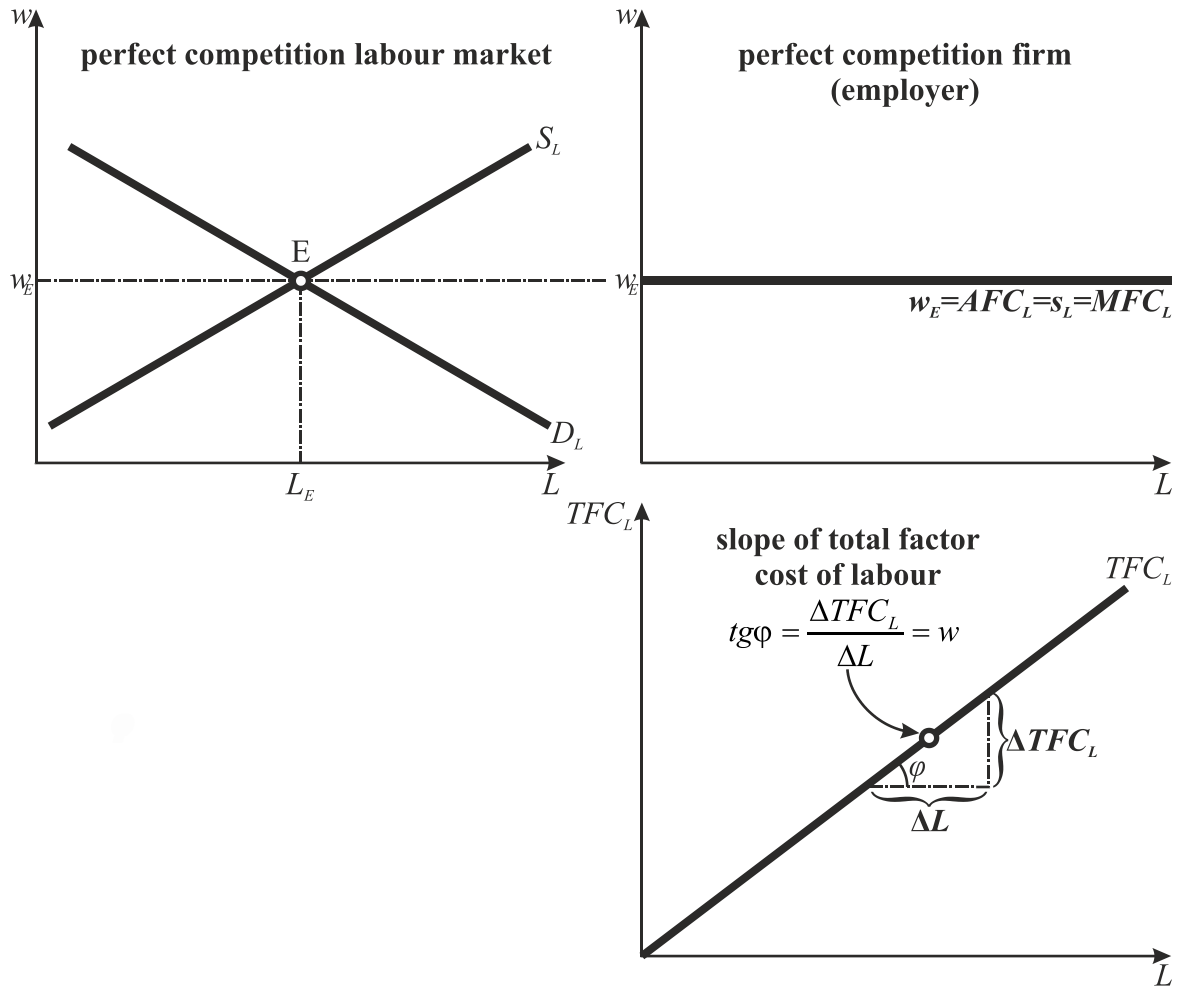
the labour market as well as in connection with competition on the market for final production. One also needs to bear in mind that the decision-making on purchase of factors of production will be different in the short or long period respectively. For schematic classification of the demand for labour see table 4-1.

4-1 Demand for Labour

Type of demand for labour	Competition on the side of demand for labour	Competition on the side of final production supply	Time horizon	Chapter section
individual	perfect competition	perfect competition	short	4.1.1.1
			long	4.1.1.2
		imperfect competition	short	4.1.1.4
			long	4.1.1.5
	imperfect competition			4.1.1.6
market	perfect competition	perfect competition	short	4.1.1.3
			long	4.1.1.3

4.1.1.1 Individual demand for labour in scenario with a firm on a perfectly competitive market for labour and final production in a short period

For a firm operating on **a perfectly competitive market** (perfect competition on the sides of supply of and demand for labour), this means the firm is one of the many firms on the labour market, whereas none of them can influence the labour cost on its own – the wage rate w_E is determined by the market. Each unit of labour is hired at the same wage rate w_E. All the firms are price-takers and every firm may hire any quantity of labour without causing an increase of the labour cost on the market. From the firm's point of view, **the individual supply of labour to one firm is perfectly elastic** and equal to the labour cost: $MFC_L = w_E = AFC_L = s_L$ (compare with the graph 3-1 on page 71).

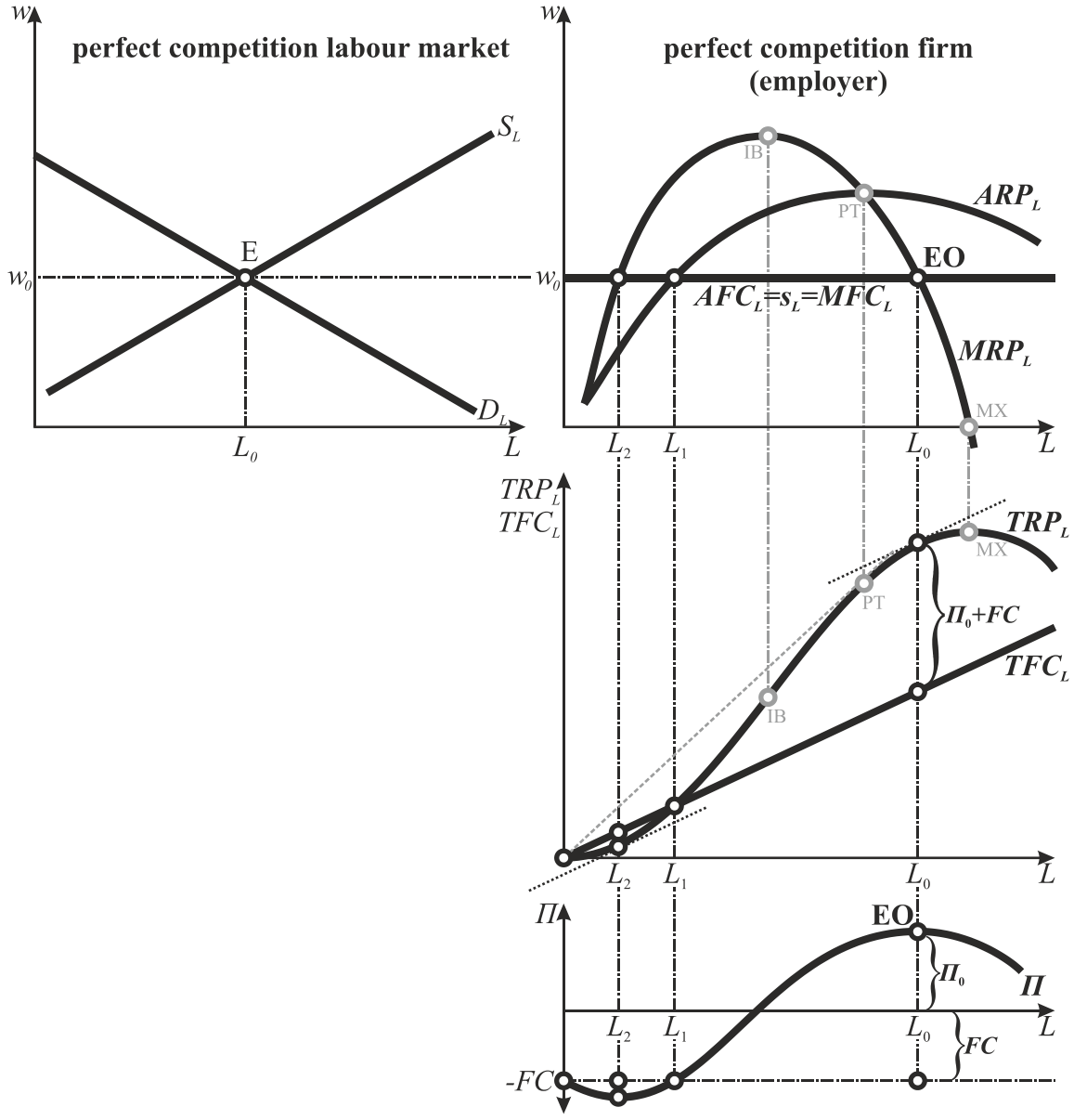


4-1 Perfectly competitive labour market

The characteristics of **a perfectly competitive market for final production** denote that each unit of particular production can be sold at a constant market price (the individual demand for production from one firm is perfectly elastic and it is equal to the marginal revenue, the average revenue and the production price – see the graph 3-1 on page 71).

The firm will be maximizing its revenue at the EO optimal point in **a short run** when hiring such quantity of labour L_0 associated with the wage w_0 equal to the marginal revenue product of labour generated by the last unit employed MRP_L at L_0.

$$\begin{aligned} MRP_L &= MFC_L \\ MR_A \cdot MP_L &= MFC_L \\ P_A \cdot MP_L &= w \end{aligned} \qquad (4.13)$$



4-2 Decision-making of firm on a perfectly competitive labour market over a short period of time

As the **total revenue product of labour** (TRP_L) is obtained by multiplication of the product price (perfectly competitive market for final production) and the volume of finished production, behaviour of the TRP_L function is vitally dependent on the productivity of labour, the behaviour of the short-run function of production respectively. The marginal revenue of product labour is equal to zero at the point MX, where the total revenue of the product of labour is at its maximum.

The total factor cost of labour (TFC_L) is the product of wage rate and the quantity of labour hired ($TFC_L = w \cdot L$). The perfectly competitive labour market will therefore show the rise of TFC_L proportionally to the quantity of labour employed L. The optimal point L_0 indicates the equality of function gradients TRP_L and TFC_L (the dotted line tangent to function TRP_L is parallel with the line

TFC_L in graph 4-2) and this point lies at the greatest vertical distance between these functions. The firm maximizes its economic profit:

$$\frac{\partial TR}{\partial L} = \frac{\partial TC}{\partial L} \quad \Rightarrow \quad MRP_L = MFC_L \tag{4.14}$$

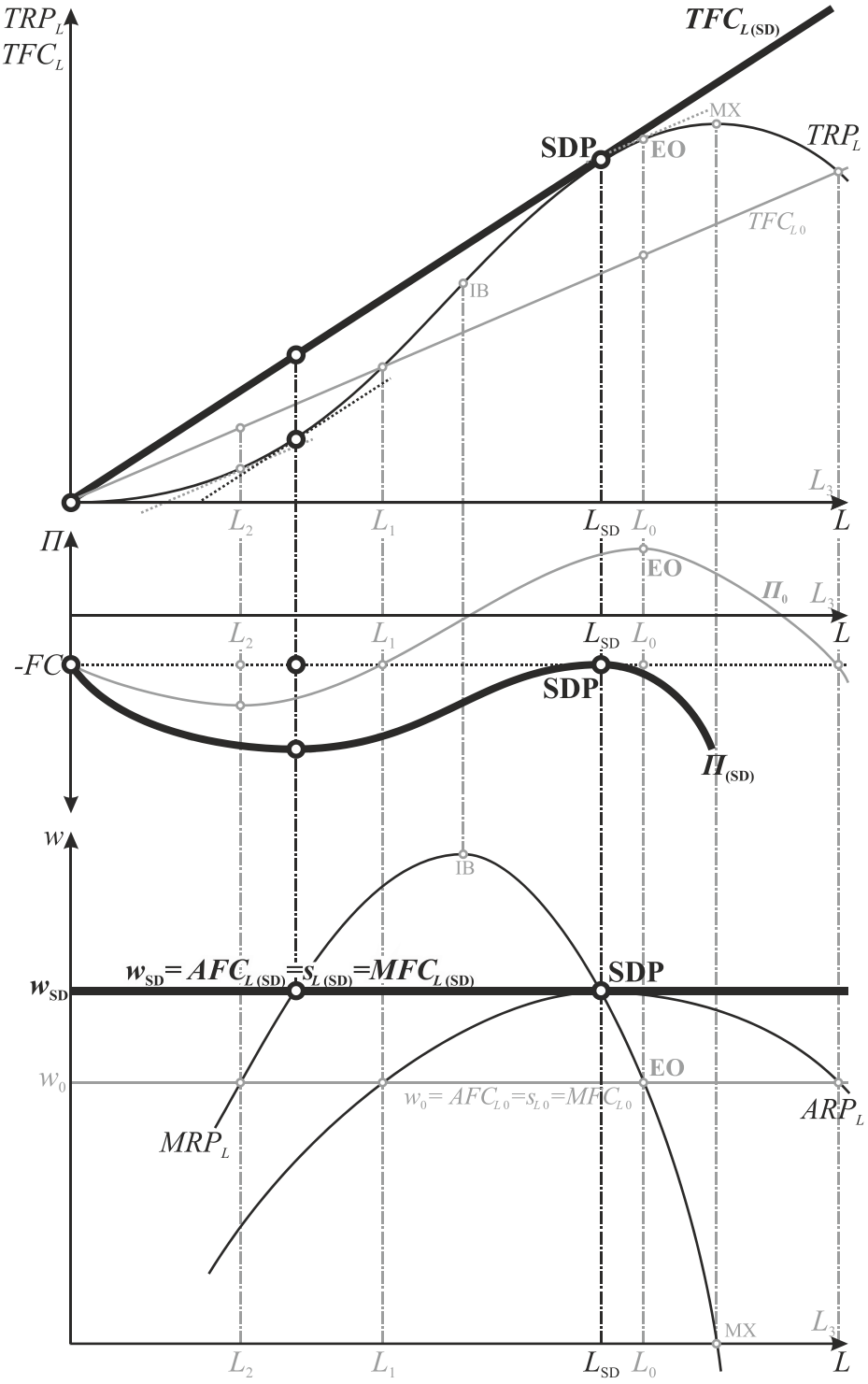
The fact to be naturally borne in mind is that we are still analysing the behaviour of our model firm on the labour market only, whereas the production process involves also further factors that have been considered fixed so far. Hence, the vertical distance between functions TRP_L and TFC_L does not correspond with the amount of economic profit achieved by the firm, as the total labour factor cost does not include the purchase cost of further factors of production (labelled 4-2 *FC* – fixed costs - in the graph).

The short run shutdown point of a firm on perfectly competitive labour market (**SDP**) represents such situation, when the producer operates on a perfectly competitive market for labour and final production and when the firm suffers **a loss equal to the fixed costs** (incurred by purchase of the fixed amount of capital). The figure 4-3 refers to hiring of labour at the quantity of L_{SD}.

The point SDP shows the total revenues TRP_L of firm actually covering the amount of total factor cost of labour TFC_L.

$$\begin{aligned} &TRP_L = TFC_L \\ &ARP_L \cdot L = w \cdot L \quad \Rightarrow \quad ARP_L = w \end{aligned} \tag{4.15}$$

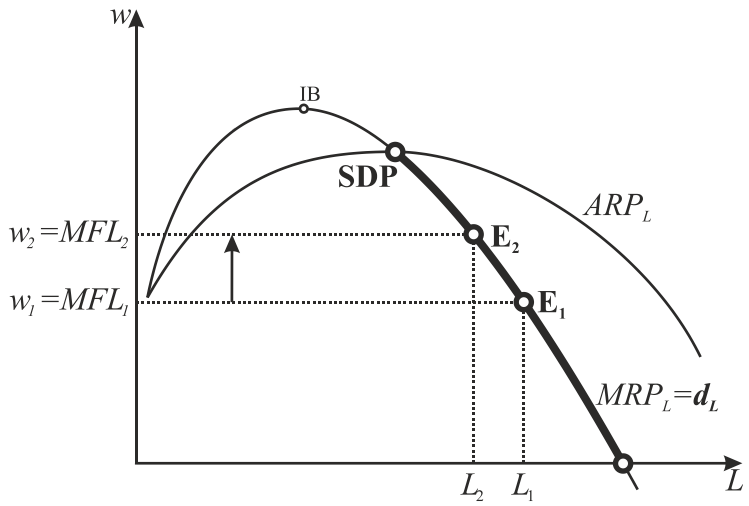
If $ARP_L > w$, the firm will tend to employ more personnel and increase the quantity of labour demanded. When $ARP_L < w$, the firm will not be motivated to hire any more personnel and the quantity of labour demanded by this entity will be zero. The shutdown point of a perfectly competitive firm on the labour market comes at the wage rate w_{SD} equal to corresponding maximum revenue from product of labour ARP_L, i.e. at such point, where the function ARP_L is bisected by the function of revenue from marginal product of labour MRP_L coming from the top.



4-3 The short run shutdown point of a firm on perfectly competitive labour market

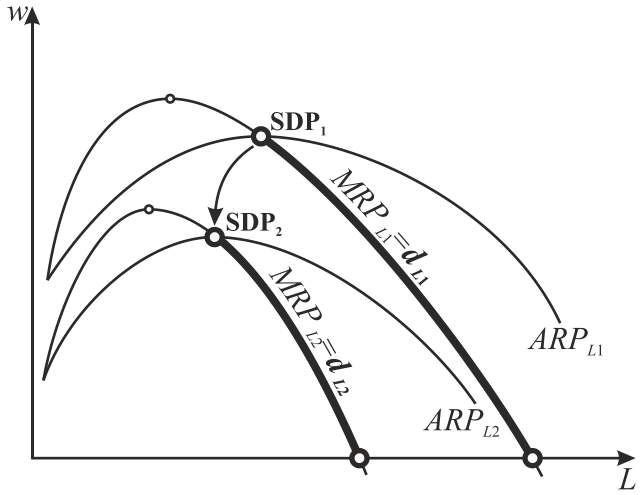
Individual demand for labour d_L of a perfectly competitive firm (if the producer operates on a perfectly competitive market for final production) in a short run is derived upon optimization of the quantity of labour hired at the particular wage rate, i.e. based on the equality of $MRP_L = MFC_L$. The curve showing demand for labour pursued by a perfectly competitive firm in a short run will comprise **the declining part of the marginal revenue product of labour MRP_L** from the shutdown point of the

perfectly competitive firm on the labour market SDP, which matches the point of maximum revenue from the average product of labour.



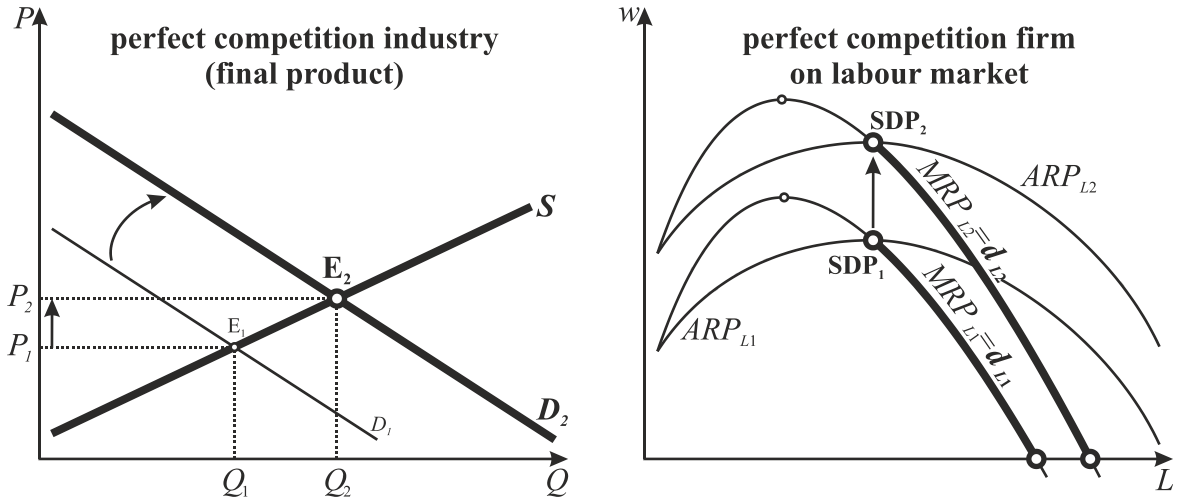
4-4 Individual demand for labour of one firm on a perfectly competitive market for labour and final production in a short period

The course of individual demand for labour d_L pursued by a perfectly competitive firm operating on a perfectly competitive market for final production over a short run depends on the marginal revenues from sale of the final production and the marginal productivity of labour ($MRP_L = MR_A \cdot MP_L = P_A \cdot MP_L$).



4-5 The effect of reduced marginal productivity of labour on the individual demand for labour

Reduction of labour productivity MP_L will induce a decrease of MRP_L to reduce the demand for labour in a short run, as indicated in the graph 4-5.



4-6 The effect of increased price of final production on the individual demand for labour

On the contrary, **an increase of price on a perfectly competitive market for final production** (the increase of price from P_1 to P_2 induced by the increase of market demand from D_1 to D_2, for example – see the graph 4-6) on a perfectly competitive labour market will raise the revenue from the marginal product of labour from MRP_{L1} to MRP_{L2} and cause an increase of the individual demand of labour of one firm from d_{L1} to d_{L2}.

4.1.1.2 Individual demand for labour in scenario with a firm on a perfectly competitive market for labour and final production in a long period

The individual demand for labour of a firm on a perfectly competitive labour market over a long run (the producer operates on a perfectly competitive market for final production) is affected by the possibility to change the quantity of all the factors of production employed, not only labour. The long run prospective offers the options for mutual substitutability of production inputs and changes of prices or even productivity of one production factor reflect into a change of price and volume of another factor of production (see also details on page 58). The rise of wage rate from w_1 to w_2 will trigger the:

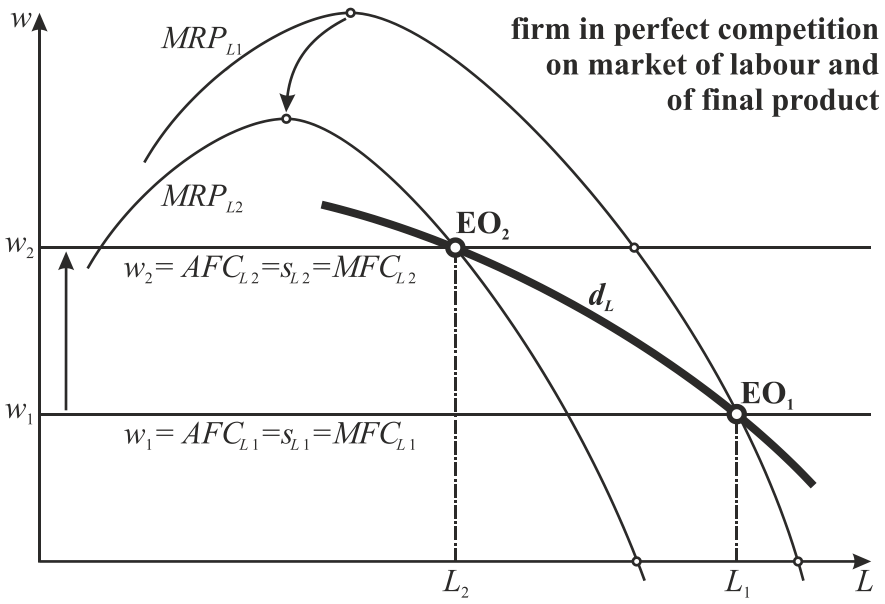
⇒ **Substitution effect**, i.e. the firm will be reducing the quantity of labour hired and replace it with a relatively cheaper capital; a larger amount of capital enhances the productivity of labour in the firm and develops the urge to increase the marginal product of labour, i.e. the shift of MRP_L towards the top left section.

⇒ **Production effect**, i.e. reduction of the finished production volume is a result of reduced volume of both inputs used during production; the decreasing amount of capital reduces the productivity of labour and develops the urge to shift the MRP_L towards the bottom right section.

⇒ **Cost effect** that is associated with the production effect; the growth of wage rate results

in a vertical increase of marginal costs and reduction of the amount of input reflected in the decrease of the demanded quantity of labour and capital.

As the scope of cost and production effects usually exceed the substitution effect, the increase of wage from w_1 to w_2 will induce the reduction of marginal product of labour. As the firm operates on a perfectly competitive market for final production, we should not assume that the change of costs and labour productivity would cause any changes to the final production P_A. The decrease of marginal product of labour will be therefore reflected by evident drop of revenues from the marginal product of labour from MRP_{L1} to MRP_{L2}. The optimal quantity of labour hired will be changed from L_1 to L_2 provided the optimization prerequisite is maintained: $MRP_L = MFC_L$. The curve of long-term demand for labour of a perfectly competitive firm on the market for labour and final production will be **more elastic** than the curve of short-run demand for labour. Higher elasticity of the long-run demand for labour reflects the firm's ability to follow the increase of wage rates and optimize not only the quantity of the labour factor yet also the amount of capital, which enables the firm a more flexible response to rising wages, when compared to the short-run prospective.



4-7 Individual demand for labour of one firm on a perfectly competitive market for labour and final production over a long run

The elasticity of demand will be calculated using **the coefficient of price elasticity of demand for labour e_{DL}**. The coefficient of elasticity of demand for labour represents the relation between the change of the quantity of labour hired and the change of wage rate, both expressed in terms of percentage.

$$e_{DL} = \frac{\frac{\partial L}{L}}{\frac{\partial w}{w}} = \frac{\partial L}{\partial w} \cdot \frac{w}{L} \text{ with the constant output Q} \qquad (4.16)$$

The cross elasticity of demand for labour is defined pursuant to mutual substitutability of production factors. The percentage change of the demanded quantity labour is induced by the percentage change of capital price.

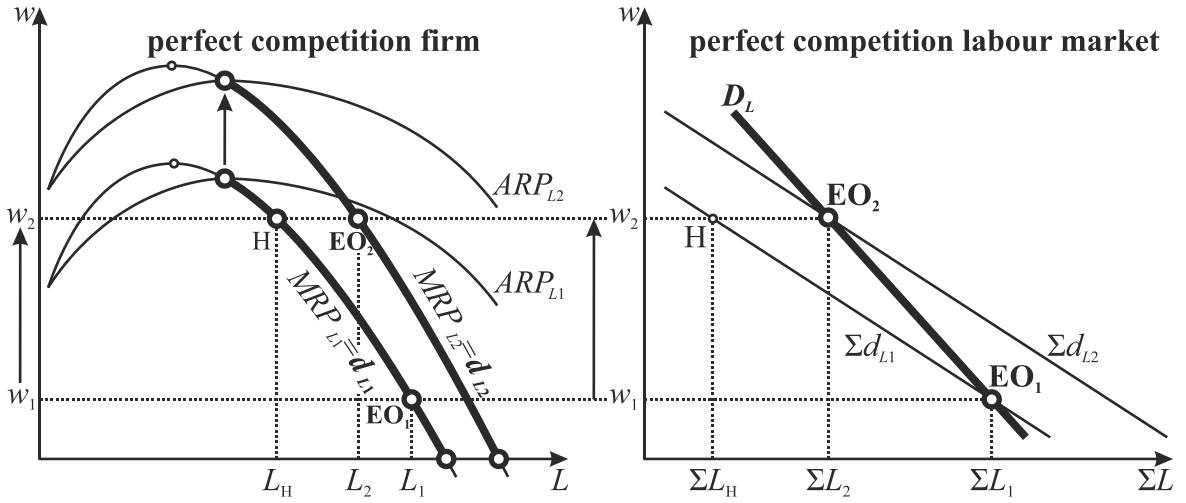
$$e_{CDL} = \frac{\frac{\partial L}{L}}{\frac{\partial r}{r}} = \frac{\partial L}{\partial r} \cdot \frac{r}{L} \text{ with the constant output Q} \qquad (4.17)$$

The elasticity of demand for labour is connected with

- ⇒ the **elasticity of demand for product** being manufactured using the labour employed
- ⇒ the rate of mutual substitutability of labour and capital, that is **the elasticity of input substitution σ –** see the equation (2.19) on page 55
- ⇒ the ratio of labour cost with respect to the total cost incurred by the firm

4.1.1.3 Market demand for labour in scenario with a firm on a perfectly competitive market for labour and final production over a short and long run respectively

The market demand for labour on a perfectly competitive labour market (the demand of all firms operating on a perfectly competitive market for labour and final production) summarizes the volumes of labour demanded by all firms on the market at the particular wage rate *w*. The effect of wage rate growth on a perfectly competitive labour market (when the producer operates on a perfectly competitive market for labour and final production) will be explained by formation of the market demand curve. The increase of wage rate from w_1 to w_2 will raise the production costs **for all the firms** operating on a perfectly competitive labour for final production, which will induce the drop of supply on the perfectly competitive market for final production. The drop of supply (the curve of supply on the market for final production shifts towards the top left section) will be expressed by rising price of the final production (the increase of price from P_1 to P_2) and the relevant increase of revenue from marginal product of labour from MRP_{L1} to MRP_{L2} (see also the graph 4-6 on page 134), which means an increase of the short-run individual demand for labour from d_{L1} to d_{L2} and reduction of the quantity of labour demanded by individual perfectly competitive companies from L_1 to L_2 only. Looking at the perfectly competitive market for labour, this means a shift from the initial point of equilibrium from EO_1 (labour quantity ΣL_1 at the wage rate of w_1) to EO_2 (labour quantity ΣL_2 at the wage rate of w_2). The market demand for labour is D_L.



4-8 Market demand for labour on a perfectly competitive market for labour over a short run

Analogically, the long-run prospective can be also considered with respect to the fact that the market demand for labour D_L on a perfectly competitive market for labour and final production will be steeper than the horizontal sum of individual long-run demands for labour (Σd_L). At the same time, the long-run market demand for labour will be more gradual than the market demand for labour over a short run, because the elasticity of market demand for labour is naturally higher in a long run, thanks to opportunities that individual firms have to optimize not only the quantity of labour hired yet also the quantities of other factors, while the wage rate rises.

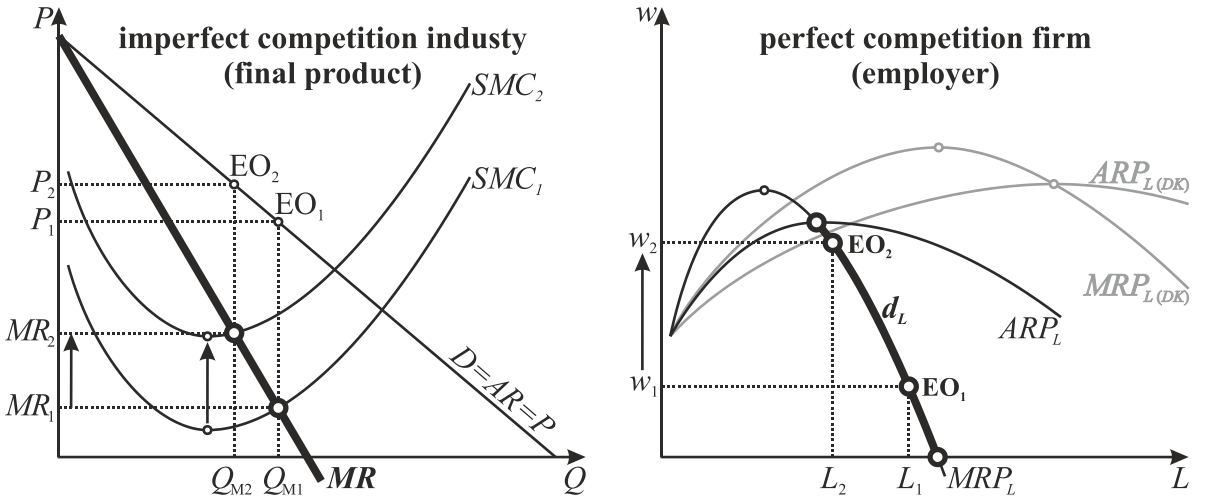
4.1.1.4 Individual demand for labour of a firm on a perfectly competitive market selling its output at a imperfectly competitive market for final production over a short run

The demand for labour by a firm on a perfectly competitive labour market, whereas such firm sells its output at an imperfectly competitive market for final production, is subject to modification by the decreasing demand curve on the market for final production, which implies that "with all the things kept the same" (meaning the price of final production remains the same as well as the course of short-run production function in both firms) the revenue from marginal product of labour of the imperfectly competitive firm will be **lower** than the revenue from marginal product of labour of the perfectly competitive firm, as $MR_A < P_A$. The revenue from marginal product of labour of the imperfectly competitive firm is therefore defined by the decreasing marginal revenue and the initially rising and then dropping marginal product of labour. The right side of the graph 4-9 shows the behaviour of curves MRP_L and ARP_L for a perfectly competitive firm on the labour market that operates on an imperfectly competitive market for final production. To explain the difference between the situation dealing with a perfectly and imperfectly competitive firms on the market for final production, the graph includes (grey) curves of $MRP_{L\,(DK)}$ and $ARP_{L\,(DK)}$ that would be exhibited by the perfectly competitive firm on both

markets - labour and final production. The graph shows two facts clearly:

⇒ the firm operating at the perfectly competitive market for labour and final production shows a more flexible response to the growth of wage rate than the firm operating at the imperfectly competitive market for final production

⇒ the firm on the perfectly competitive market for labour would be demanding larger quantity of labour than the firm operating at the imperfectly competitive market for final production, regardless of the labour cost (provided the behaviour of the short-run function TP_L is identical once again), which is due to the lower price level at the perfectly competitive market for final production compared with the imperfectly competitive market.



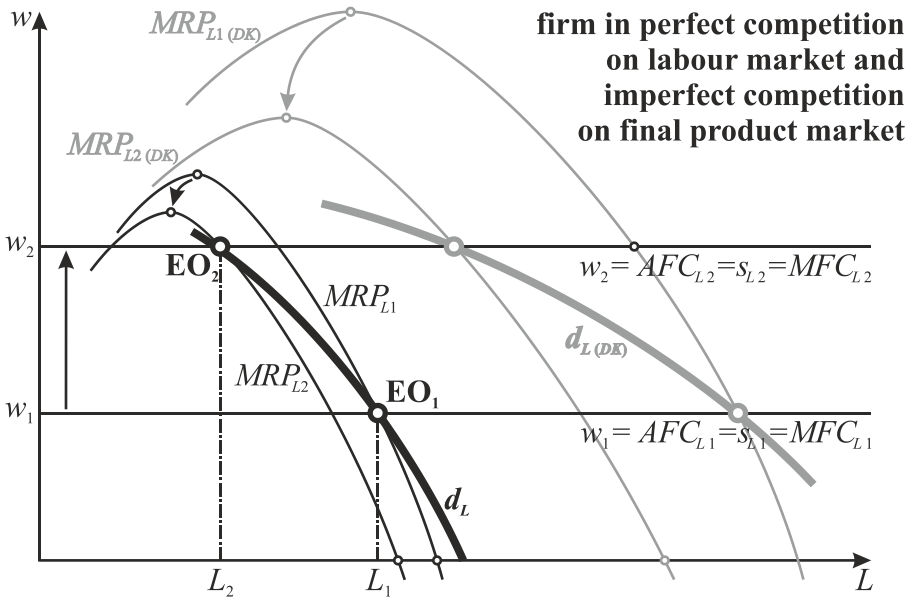
4-9 Individual demand for labour of one firm on a perfectly competitive market for labour and final production

Short-run demand for labour of a firm operating on an imperfectly competitive market for final production is based on optimization of the quantity of labour following the maximization of economic profit. This is actually an analogical procedure to the situation on page 133. However, the rise of market wage rate from w_1 to w_2 means an increase of marginal costs incurred by the imperfectly competitive firm (vertical shift of SMC_1 up to SMC_2 in the graph 4-9) and the firm's output on the market for final production will be lower - Q_{M2}. By contract to the firm on a perfectly competitive market for final production, where the decrease of output (and therefore its marginal revenues) from one firm does not cause any change to the market price, a monopolized market for final production will experience the rise of marginal costs and the drop of production quantities causing the growth of marginal revenues from MR_1 to MR_2. This so called **revenue effect** causes the gradient of curves MRP_L and ARP_L fall steeper compared to the situation with a perfectly competitive firm on the market for final production, as the increase of marginal revenues ensures partial compensation of the growth of marginal costs

incurred by the producer, who will therefore not be forced to reduce the count of its employees as rapidly as a perfectly competitive firm on the market for labour and final production would. The new demand for labour will drop from L_1 to L_2 only. The individual short-run demand for labour $\boldsymbol{d_L}$ of an imperfectly competitive firm on the labour market and an imperfectly competitive producer on the market for final production is steeper that the individual demand of a perfectly competitive firm on the market for labour and final production.

4.1.1.5 Individual demand for labour of a firm on a perfectly competitive market selling its output at a imperfectly competitive market for final production over a long run

The derivation of a long-run individual demand for labour of a firm operating at a perfectly competitive market for labour and selling its output at an imperfectly competitive market for final production is analogical to the derivation made in case of a perfectly competitive market for final production (see page 135). The increase of wage rate from w_1 to w_2 will induce the substitution, production and cost effects resulting in a shift of MRPL towards the bottom left section (see the grey curves in graph 4-10).



4-10 Individual demand for labour of one firm on a perfectly competitive market for labour and final production over a long run

However, a firm on an imperfectly competitive market for final production will be also under the influence of the **revenue effect** (similarly to the short-run situation). The decrease of production volume due to the substitution, production and cost effects will enable the firm operating at an imperfectly competitive market for final production to proceed with a price increase, which will be reflected in higher marginal revenues from the sale of products of services. Thanks to the decreasing demand curve showing demand on the market for final production, the drop of production volume will not be as

substantial as it would be on a perfectly competitive market. The drop of $MRP_{L1\,(DK)}$ to $MRP_{L2\,(DK)}$ that would occur in case of a perfectly competitive market for final production is inhibited by the revenue effect due to monopolization of the final production segment.

The long-run individual demand for labour of a firm operating on a perfectly competitive market and selling its output at an imperfectly competitive market for final production – i.e. he line connecting EO_1 (demanded quantity L_1 at the wage rate w_1) and EO_2 (demanded quantity L_2 at the wage rate w_2) – is therefore:

⇒ more gradual than the short-run individual demand curve showing the firm on a perfectly competitive labour market and an imperfectly competitive market for final production at the same time

⇒ steeper than the long-run individual demand curve showing the firm on a perfectly competitive market for labour and final production (see the bold grey curve in graph 4-10).

4.1.1.6 Individual demand for labour of an imperfectly competitive firm on the labour market

The demand on an imperfectly competitive labour market is characteristic for the limited number of firms using their privileged position on the market to benefit from the advantage of having potential influence on the wage level *w*. We are therefore able to distinguish the following scenarios on the labour market:

⇒ **monopsony**, where the demand for labour comes from a single firm only.

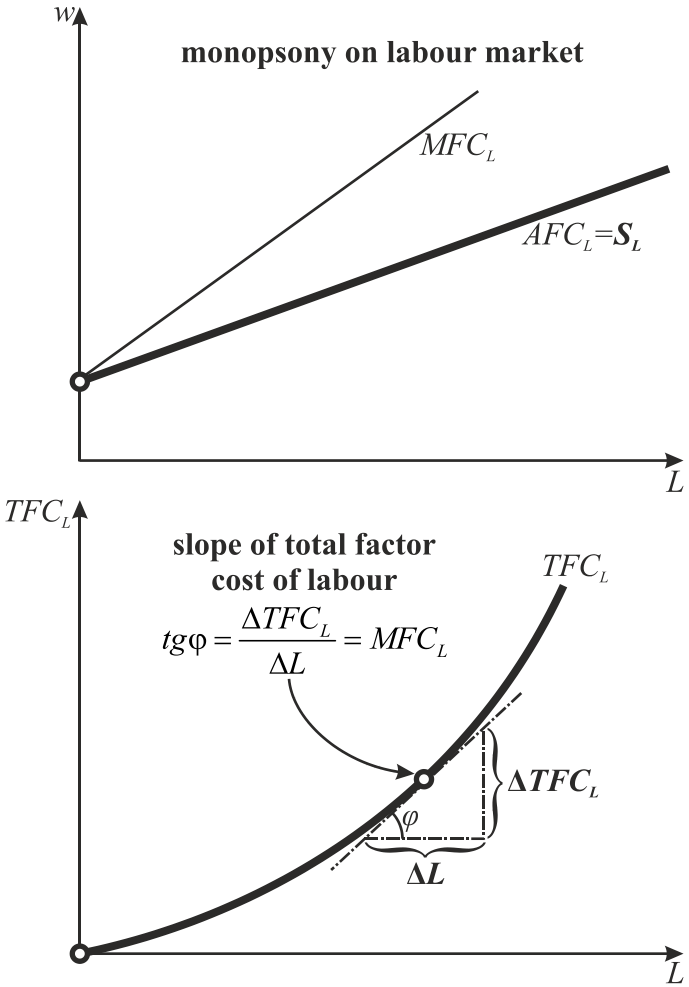
⇒ **oligopsony**, where the demand for labour originates from a few firms only.

⇒ **monopsony competition**, where labour is purchased by many firms, whereas each of them can have a partial influence on the wage rate.

The firm on an imperfectly competitive labour market is in position of a price giver, the essential characteristic of an imperfectly competitive labour market is **the rising individual supply curve**, i.e. every further unit of labour must be hired at a higher wage rate (compare with the graph 3-12 on page 83). Every additional employee hired by the monopsonist will therefore raise his marginal factor cost of labour ($MFC_L > w$), because admission of such additional unit of labour will raise the existing wage rate *w* of the employees hired so far. When the linear supply of labour is rising, the marginal factor costs of labour will grow twice as fast as the average factor cost of labour and the curve of total factor cost of labour will be a convex parabola with its top at the origin, as:

$$AFC_L = a + b \cdot L \Rightarrow TFC_L = L \cdot AFC_L = a \cdot L + b \cdot L^2$$
$$TFC_L = a \cdot L + b \cdot L^2 \Rightarrow MFC_L = \frac{\partial TFC_L}{\partial L} = a + 2b \cdot L \qquad (4.18)$$

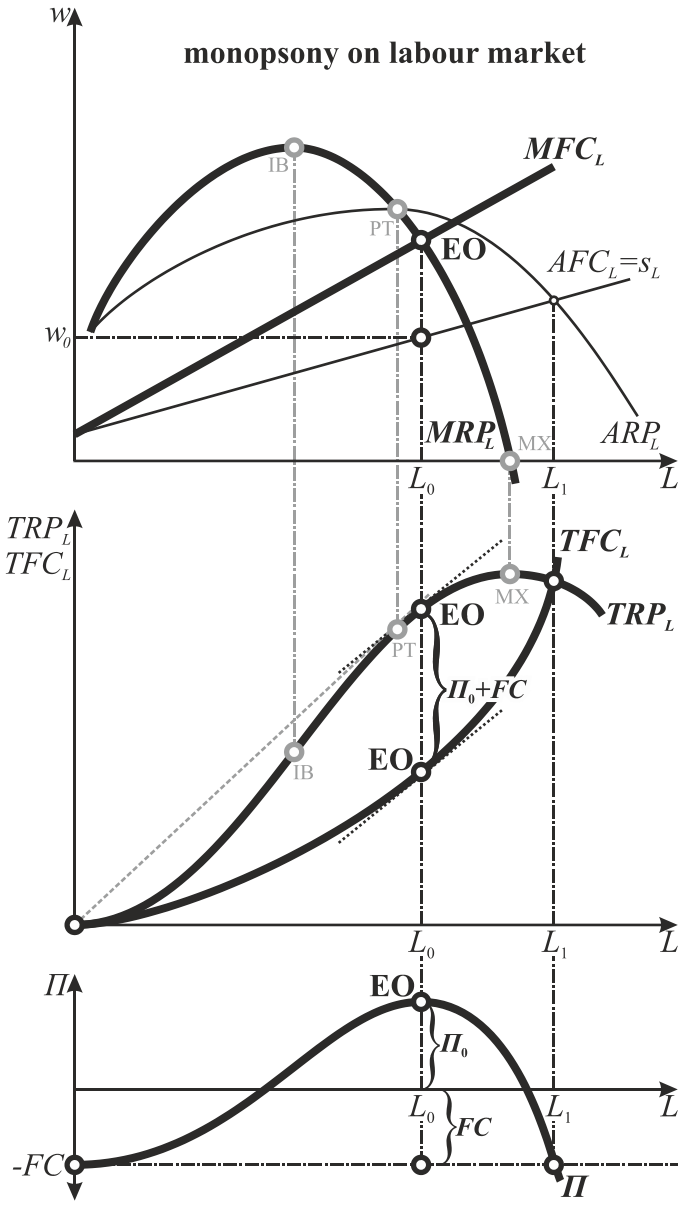
Quantity optimization of labour L_0 hired on an imperfectly competitive market is based on the prerequisite for maximization of the economic profit $MRP_L = MFC_L$. The firm will then exercise its advantage on the imperfectly competitive labour market by setting the wage rate to the level w_0 corresponding with the market supply of labour S_L. Monopsony can therefore use its privileged position on the market and push the hire price of labour below the level of its marginal revenues from the product of labour.



4-11 Imperfect competition on the side of demand for labour (monopsony)

The existence of **monopsony** maximizing its economic profit brings the labour market to a point, where less personnel are employed at a lower wage, as opposed to a perfectly competitive labour market. Similarly to the case, when optimization of quantities and price for a monopoly do not allow drawing a continuous curve to show the supply of such monopoly, there is no continuous curve showing the demand for labour of a monopsony operating on the labour market. The monopsony will set the optimal

quantity of labour L_0 with the corresponding minimum wage rate w_0, at which it is able to hire the quantity of labour L_0 on the labour market.



4-12 Decision-making by an imperfectly competitive firm (monopsony) on the labour market over a short run

Emphasizing the analogy to behaviour of a monopoly of on the market for final production (see page 85), the operation of a monopsony on the labour market is also based on absolutely identical principles, both in the short and long run prospects. It is benefiting from its privileged position on the labour market to gain positive economic profit in a long or short run, as its monopsony power represents an opportunity to keep the wage rate below the marginal revenue from product of labour in a long run.

4.1.2 The supply of labour

The supply of labour (similarly to the supply of other production factors) comprises individuals (households). An individual supply of labour then represents either the supply of labour provided by an individual (as seen by a single party offering) or the supply of labour provided to a single firm (as seen by a single party demanding). The illustration of an individual supply of labour to a single firm on a perfectly competitive labour market has been included in the graph 4-1 on page 129. Its depiction on an imperfectly competitive labour market can be seen in the graph 4-11 on page 141. The only thing left is to derive the individual supply of labour from an individual.

4.1.2.1 Individual supply of labour of one worker

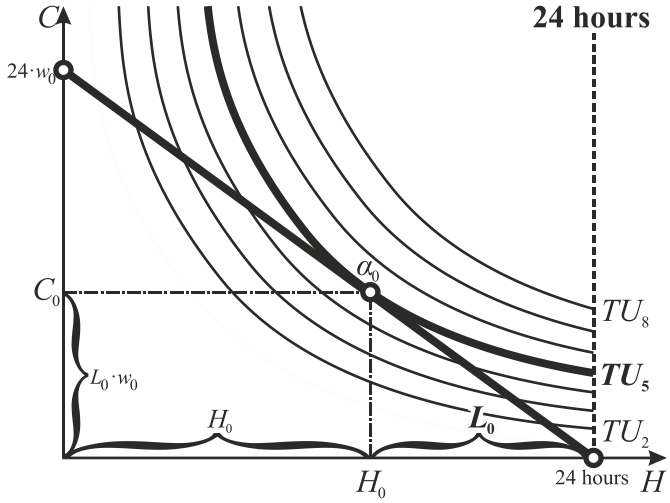
The individual supply of labour by an individual is dependent on the wage rate level, which is associated with the "loss" in form of free time sacrificed (H) in favour of the time dedicated to work (L). The working time remunerated at the wage rate w provides an individual with the opportunity to consume in order to satisfy his needs. The optimal distribution of time (24 hours) among work and free time is based on the efforts towards maximization of utility arising from consumption (C) and free time (H).

$$\begin{aligned} U &= f\left(C, H\right) \\ C &= w \cdot L, \text{ where } L = 24 - H \end{aligned} \tag{4.19}$$

An individual is maximizing his utility with such quantity of labour, at which the marginal rate of substitution of free time with consumption is equal to the wage rate (w).

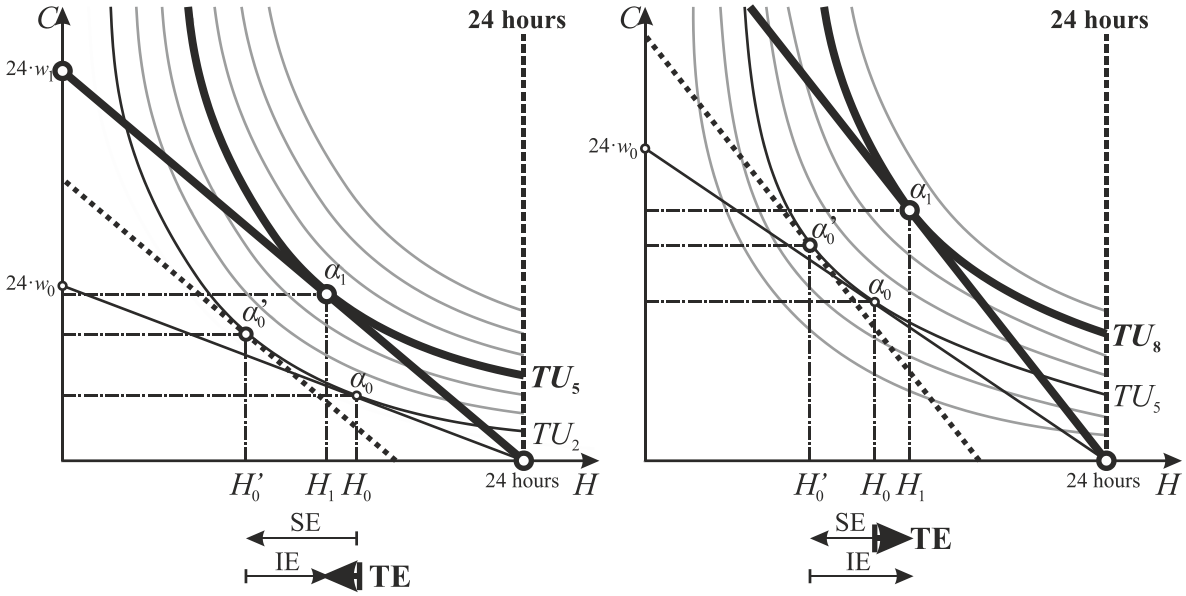
$$w = \frac{\frac{\partial U}{\partial H}}{\frac{\partial U}{\partial C}} = MRS \tag{4.20}$$

While maximizing the utility TU_5 achieved at the point α_0 by means of consumption C_0, the individual will be supplying the quantity of labour L_0 and spending the free time H_0.



4-13 The indifference curve analysis of the consumer decision-making with respect to the optimal quantity of labour

The increase of wage rate from w_0 to w_1 will change the declination of vector $C = 24 \cdot w - w \cdot H$. **The final overall effect** represents the shift from point α_0 to the point α_1 in graph 4-14 and it is determined by the sum of substitution and income effects.



4-14 Substitution and income effects of wage rate growth

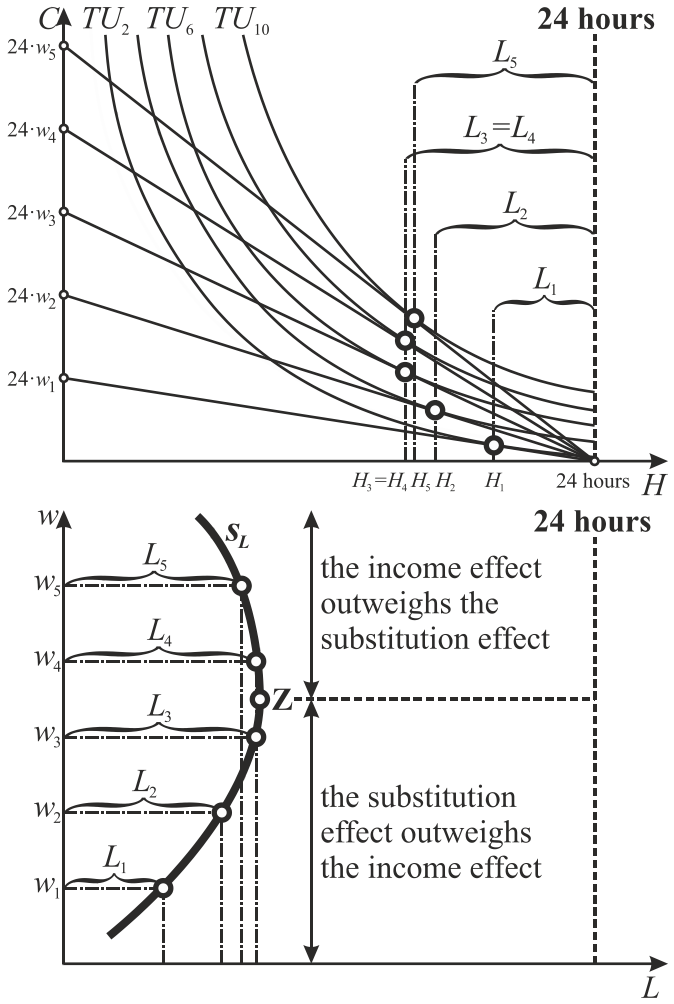
The substitution effect (SE) comprises replacement of free time with work (rising the wage rate will result in motivation towards an increase of time at work at the expense of free time, the substitution effect is negative), **the income effect (IE)** relates to the change of real income caused by the growth of wage rate (rising wage rate will increase the real income and the tendency towards consumption and leisure, the income effect is positive). The total effect brought by increase of the wage rate TE is:

⇒ negative, if the substitution effect prevails over the income effect (increasing wage rate

motivates the individual to increase the extent of labour supplied and decrease the amount of free time spent).

⇒ positive, if the income effect prevails over the substitution effect (increasing wage rate motivates the individual to decrease the extent of labour supplied and increase the amount of free time spent).

The curve showing **individual supply of labour by individuals s_L** as the relation between the amount of labour supplied L depending on the wage level w reflects the decision-making of individuals aimed at the extent of time dedicated to work versus free time.



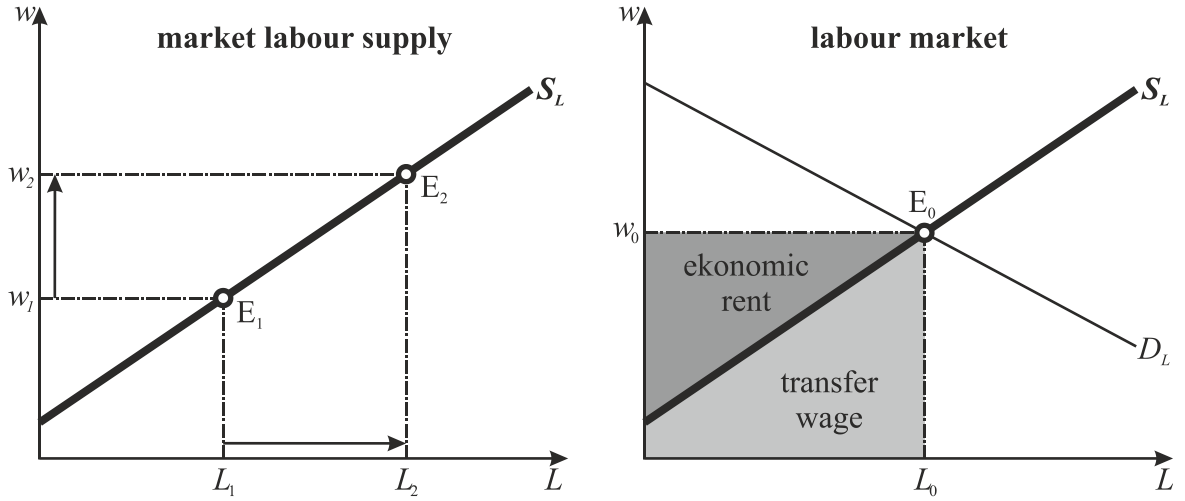
4-15 Derivation of the curve showing individual supply of labour of one worker

The course of this individual supply curve is affected by advancement of the substitution and income effects. The interval below point Z shows prevalence of the substitution effect over the income effect and the increase of wage rate will result in increase of the amount of labour supplied in this case. Looking at the interval above point Z, where the income effects prevails over the substitution one, an increase of the wage rate will induce a reduction of the amount of labour supplied, which will be projected into the regressive curvature of the individual supply curve s_L, as indicated in the graph 4-15. As this is an

individual supply curve of one worker only, derived from the map of his indifference curves, the position of point Z will be surely vary depending on particular preferences of individuals, their attachment to work or free time etc.

4.1.2.2 Perfectly competitive market supply of labour

The market labour supply curve represents the horizontal sum of individual supply curves, i.e. the market supply of labour expresses the dependency between the amount of labour that all the consumers are willing to supply on the market with respect to changes of the wage rate. The market labour supply curve is not regressive due to the so called "overflow effects", where the growth of wage rate will attract new workers coming to the market from other professions, segments or countries.



4-16 Market supply of labour, economic rent and transfer wage

The concurrence of competitive market supply of labour and the market demand for labour is represented by **the labour market** (see graph 4-16). This mutual concurrence results in determination of the level of the equilibrium market wage and the equilibrium market amount of labour. The product obtained by multiplying the equilibrium wage w_0 with the equilibrium amount of labour L_0 is equal to the total amount of wages paid $L_0 \cdot w_0$ comprising the transfer wage and the economic rent:

⇒ **The transfer wage** is the earning that a particular owner of a production factor would gain following its alternate utilisation. This is the minimum level of wage people are willing to work for.

⇒ **The economic rent**, as the difference between the total amount of wages paid and the transfer wage, is the difference between the wage actually paid out and the wage for which any worker is willing to start work at any employment level. As far as its meaning is concerned, this is an analogy to the producer's surplus that actually aims towards the consumers on labour market, i.e. to households.

Optimal functioning of the labour market is hindered by imperfections. Major imperfections of the labour market include **the labour market segmentation** that is the existence of non-competitive groups associated with differences in qualifications, the willingness to commute or even move closer to the workplace etc. Another imperfection is **the wage inelasticity**, especially with respect to reduction of wages. The optimal functioning of labour market is also apparently impaired by the existence of **collective agreements** and **employment legislation**. Other imperfections on the labour market can be seen on the side of labour supply (arising mainly from operation of trade unions) together with market imperfections on the side of demand for labour (see the monopsony issues).

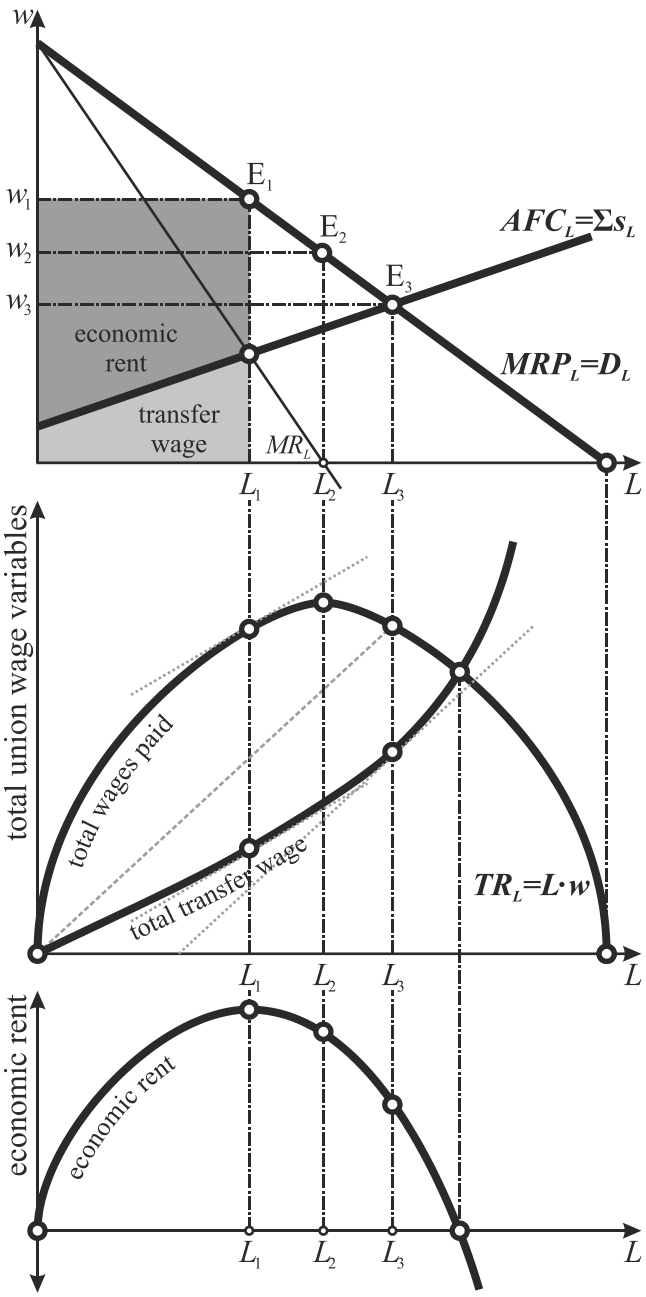
4.1.2.3 Imperfect competition on the labour supply side

Trade unions can be defined as industrial associations of workers involved in collective negotiations concerning conditions on the labour market. Trade unions benefit from the monopolistic advantage on the labour supply side. Assertion of the monopolistic power of trade unions is generally reflected by the efforts to achieve one of the objectives specified below:

- ⇒ maximization of economic rent for trade union members
- ⇒ maximization of the total amount of wages paid out to trade union members
- ⇒ maximization of employment of trade union members

The demand for labour as a production factor in possession of trade unions (their members respectively) is determined by the revenue from the marginal product of labour. Every points of the demand curve refers to the quantity of labour demanded L at the specific wage rate w. The area of rectangle below any point on the curve of demand for labour represents the total amount of wages paid. This **total amount of wages paid** (total wage = $L \cdot w$) can be used for derivation of the **marginal revenue of labour union** ($\boldsymbol{MR_L}$) that represents a change to the total wage caused by the change to employment volume. The marginal revenue of labour union decreases twice as fast as the demand for labour (compare this figure with the marginal revenues in the imperfect competition environment on page 83). Any decrease of wage rate for an extra unit of labour means the drop of wage rate applied to all the units of labour employed:

$$MR_L = \frac{\partial(L \cdot w)}{\partial L} \tag{4.21}$$



4-17 Trade union operations (monopoly on the side of labour supply) on the labour market

As far as **maximization of economic rent** (point E_1 in the graph 4-17) is concerned, trade unions supply the quantity of labour L_1, when the marginal revenue of labour union MR_L is equal to the transfer wage or the alternate factor cost of labour AFC_L. If the marginal revenue of labour union exceeds the transfer wage (the wage rate on particular labour market is higher, when compared to other markets), the trade unions tend towards increasing the quantity of labour supplied and vice versa. Trade unions apply their monopoly advantage when determining the top wage possible at the level w_1. The total economic rent represents the maximum. However, the quantity of labour demanded at the wage rate w_1 is lower than the total market labour supply, the market is not in equilibrium.

If the trade unions **maximized the total amount of wages paid** (point E_2 in the graph 4-17), they would be supply the quantity of labour L_2 at the wage rate w_2, when the marginal wage of the last unit of labour employed is equal to zero and the total amount of wages paid therefore represents the maximum. The amount of maximum wages paid is then equal to $L_2 \cdot w_2$.

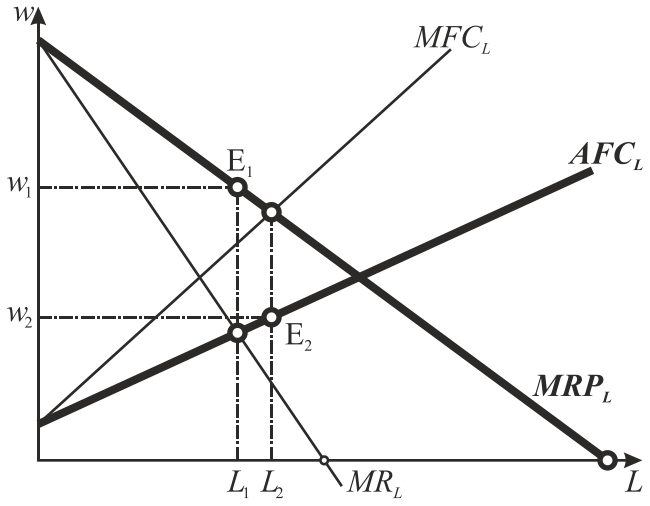
Point E_3 in the graph 4-17 shows the efforts of trade unions striving towards **maximization of the overall employment**. The quantity of labour L_3 supplied at the wage rate w_3 is identical with the quantity of labour demanded and the situation on the labour market is the same as on a perfectly competitive labour market, where the equilibrium is achieved at the meeting point of the perfectly competitive supply of labour and the demand for labour.

The graph 4-17 clearly shows that an imperfectly competitive market structure on the supply side (the supply of labour in this case) **does not enable the draft of a continuous supply curve**, as the monopoly (represented by trade unions in this case) determines the quantity of labour supplied and the wage rate pursuant to its own objectives. There are also certain further specifics of the graph showing monopoly on the labour supply side to be emphasized:

- ⇒ the demand for labour is defined by the course of the marginal revenue of product labour MRP_L. However, the trade unions do not see this value as marginal yet rather average that represents the average level of wage rate paid by the employer to every unit of labour employed (there is a certain analogy to that on the market for final production, where the demand curve follows the marginal utility of consumer, while firms see it as the average revenue from every unit of output sold).
- ⇒ the line AFC_L corresponds with the horizontal sum of individual supply curves for all the members of trade unions and it represents the average wage rate required by each unit of labour employed from the employer's prospective. Yet the trade union consider see this value as marginal figure to express the level of minimum (i.e. transfer) wage rate to make any additional (marginal) employee willing to work an additional unit of labour.
- ⇒ the third objective pursued by trade unions, point E_3 in the graph 4-17, is shown by the point, where function MRP_L, seen by trade unions as the average wage rate derived from the total amount of wages paid $L \cdot w$, bisects the curve of AFC_L, which is the marginal value derived from the course of total transfer wages from the trade union's prospective. The graph with total values therefore shows the maximum rate of employment achieved with such quantity of labour L_3, where the beam run towards the curve representing the total amount of wages paid is parallel with the tangent to the function of total transfer wages. The economic rent is positive.

4.1.3 Bilateral monopoly on the labour market

Bilateral monopoly on the labour market shows the situation with a monopoly on the supply side and a monopsony on the side of demand for labour, i.e. either party can influence the level of wage *w*. The monopsony on supply side will be demanding the quantity of labour L_2 (see graph 4-18) defined by the intersection $MRP_L = MFC_L$, the monopsony power entitles this party to set the wage rate w_2. The monopoly of trade unions on the supply side will strive towards maximization of economic rent for their members and supply the quantity of labour L_1 corresponding with the balance between MR_L and AFC_L, the monopoly power entitles trade unions to request the wage rate w_1. The final wage amount will be ranging within the interval (w_1; w_2) and depending on the negotiating power of both parties involved.



4-18 Bilateral monopoly on the labour market

Please note that the graph 4-18 does not show the demand for labour D_L or the supply of labour S_L. That is due to the reason that monopsony on the side of demand for labour has no continuous curve showing the demand for labour (even though the supply of labour provided by monopsony follows the curve AFC_L), whereas the monopoloy on the side of labour supply has no continuous curve showing the supply of labour (even though the demand for labour by monolopy follows the curve of MRP_L). As far as the intersection of monopolized supply of / demand for labour is concerned, one cannot consider any continuous curves showing the supply / demand for labour.

4.2 Capital market

The only source of wealth to be increased on progressive basis in connection with increase of income and postponement of consumption for future use is **capital**. The capital can be distinguished as follows:

⇒ **physical capital**, which is the stock of goods not used for consumption and utilised for

further production instead, i.e. as a factor of production. In this respect, investment into physical capital will be considered as an investment into business, with the investor seeking revenue in form of return on investment.

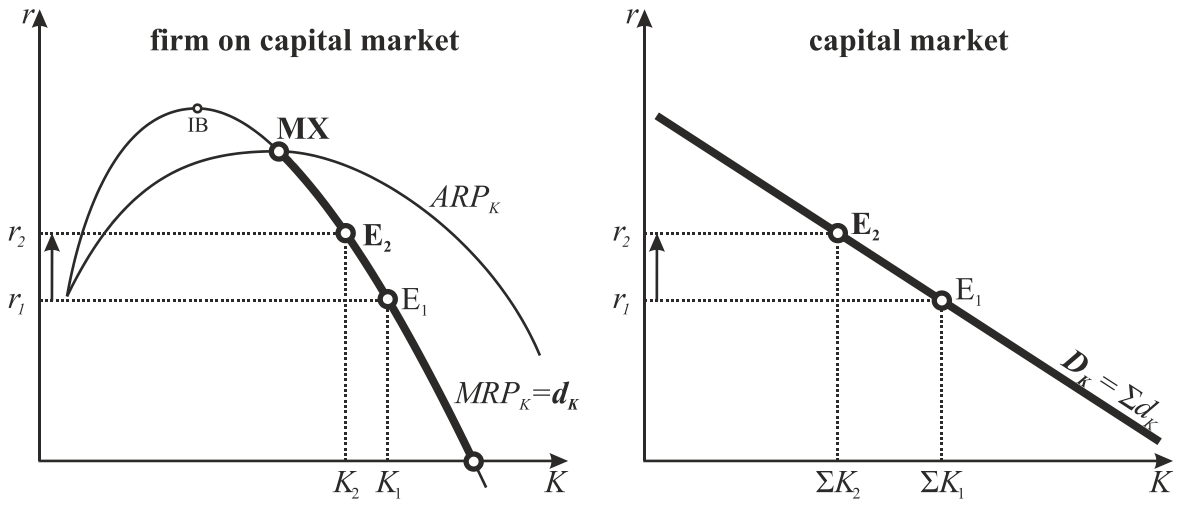
⇒ **financial capital** is money or financial asset of another type (term deposits, shares, securities etc.). Speaking of the investment into financial capital, we assume that the investor enters the financial market and converts his savings into financial capital envisioning his future income in form of interest. (Money capital and financial capital will be considered synonyms in this book.)

⇒ **human capital** represents the stock of technical knowledge and abilities of workers. However, the agenda associated with investments into education of employees reaches beyond the framework of this learning material and we will skip that.

4.2.1 Supply of and demand for capital

The capital market is the place joining economic entities with free financial capital suitable for investing into various forms of capital (these have investment means available) and economic entities able to increase the value of such financial means effectively (these have investment opportunities available). The classic approach to capital market comprises exclusive a market for trading of financial capital, convening households (consumers) on the supply side and producers (firms) on the side of demand for financial capital. To keep the explanations simple, we should assume - analogically to the labour market - that capital is the exclusive possession of households (consumers) offering it for further utilisation by other economic entities against payment.

The demand for capital is derived from same principles used for derivation of the demand for labour. Firms are willing to demand additional units of capital as long as the marginal revenue product of capital MRP_K exceeds the marginal factor cost of capital MFC_K that is equal to the market interest rate r.



4-19 Demand for capital

As the market economy can be hardly seen as background for market monopolization of financial (capital) markets, the derivation of demand for capital will be limited to a perfectly competitive market environment. Under these circumstances, the demand for capital will be illustrated by the declining part of the curve MRP_K below the maximum of ARP_K (see also page 127) and the market demand for capital $\boldsymbol{D_K}$ by horizontal sum of individual demands for capital $\boldsymbol{d_K}$.

Whereas firms enter the capital market as debtors, households acts as creditors there. Households are characterised by their **impatience** causing the situation, where consumers lay their priority on the current consumption C_0 and prefer it to savings and future consumption C_1. That is why households are willing to give up their current consumption only under the condition that their future consumption can improve. Therefore the essential characteristic of capital is **the future return** for the capital owner. Such revenue can be in form of interest, dividend, the difference between purchase and sale price of shares, etc. Yet households are not interested in the absolute amount of this earning, their attention focuses on **the interest rate**, which is the ratio between the net yield credited to the amount of savings per year and such savings themselves. The future value of current savings S_0 can be therefore expressed by:

$$S_1 = (1+r)\cdot S_0, \tag{4.22}$$

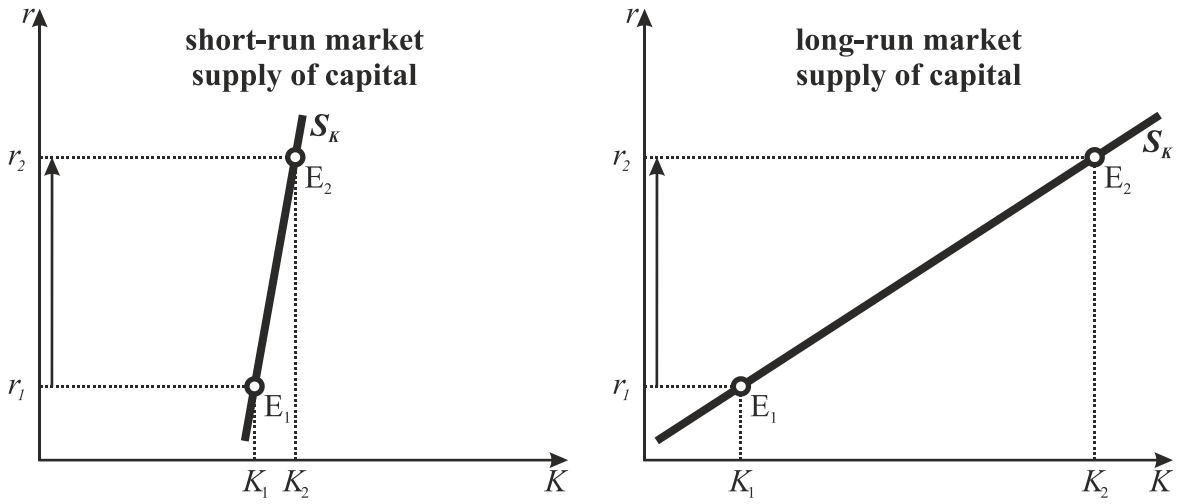
where S_1 is the amount of savings from current consumption S_0 per year and r refers to the annual interest rate.

The amount of S_1 will be naturally increased by interest accumulated on rolling basis every year. Considering the interest rate r constant, we may say that the value of current savings in n years will be equal to:

$$S_n = (1+r)^n \cdot S_0 \tag{4.23}$$

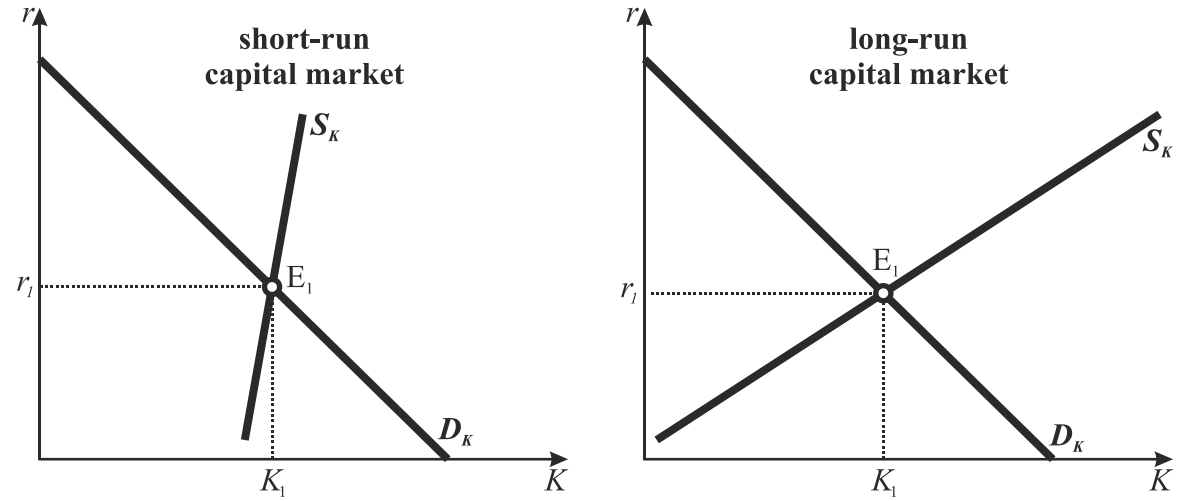
Households actually assess the market interest rate r and use its changes to adjust their current

consumption C_0 together with the existing level of their savings S_0.



4-20 Supply of capital in short- and long-run

However, the projection of changes to the interest rate in the amount of capital supplied will be only evident in a long run only, from the market prospective. The short-run supply of capital is strongly inelastic (see graph 4-20), as the impact of any increase of interest rate on the flow of savings will be negligible in a short run. On the contrary, the growth of interest rate over a long run is supported by the continuous interest accumulation and more intense capitalization of savings to result in greater supply of capital.



4-21 Capital market in short- and long-run

The market interest rate develops upon interaction between the market demand and supply of capital, as shown by the graph 4-21. Market demand for capital depends on the effectiveness of its utilisation in production (the marginal product of capital MP_K), the final product price (P_A), the number of firms entering the capital market and their expectations with respect to future development. The market supply of capital unwinds from the level of income received by households, the expectations of consumers

(concerning especially the future development of prices on markets for final products) as well as the common willingness to postpone the current consumption to the benefit of future earnings.

4.2.2 Investment decision-making by individuals

Decisions made by households are then based on the decision-making to choose between the current consumption and future consumption respectively, with the aim to maximize the utility from the total volume of consumption (current and future). The utility function can be expressed as follows:

$$U = f(C_0, C_1), \tag{4.24}$$

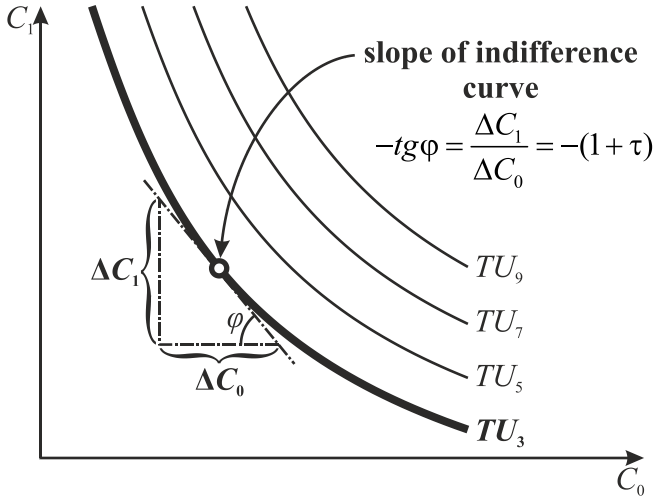
where C_0 refers to the level of current consumption, C_1 is the future consumption level.

The most famous works of American economist **Irwing Fisher** (1867-1947) themed "*The Theory of Interest"* (1930) defined interest as the outcome of concurrence shown by two factors: the willingness to give up the current consumption for future benefits and objective opportunities for investment of current income in order to obtain higher future income.

The analysis of consumer's decision-making to opt for current consumption, investment into the physical capital or investment into the financial capital requires implementation of three elementary instruments:

⇒ **The indifference curve** passing through every point illustrating the combination of current and future consumption that renders the same utility. It has been assumed that, under normal circumstances, the consumer is willing to give up the current consumption to benefit from the future consumption provided the latter is higher than the current consumption would be (by τ units). Of course, if the future consumption granted to such individual were extremely low, one can assume this consumer would be willing to give up a particularly large portion of the current consumption to ensure its greater future improvement (especially in situation, when the current consumption level is extremely high). However, the gradient of indifference curves can be generally expected to exceed 45°. The slope of indifference curve showing the marginal rate of time preference pursued by consumer adopts the following shape:

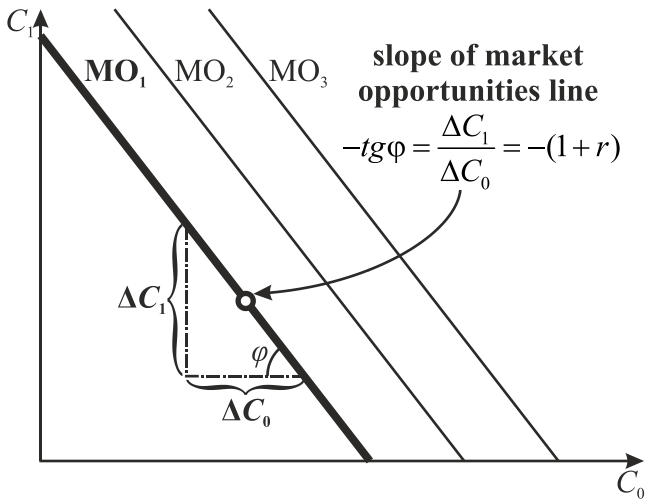
$$\frac{\Delta C_1}{\Delta C_0} = -(1+\tau), \text{ where } \tau \text{ is the marginal rate of time preference.} \tag{4.25}$$



4-22 Indifference curves and marginal rate of time preference of consumer

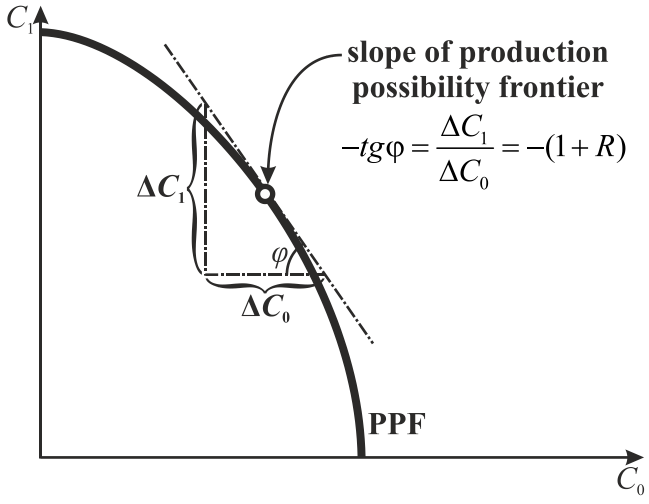
⇒ **The market opportunities line** (**MO**) represents a somewhat specific analogy of budget limitation with respect to intertemporal selection, whereas the volume of current and future consumption is affected by reality **of the capital market**, resp. the opportunity to invest savings into financial capital. Future consumption is determined by the sum of future income and savings on the existing income increased by interest. Current consumption is determined by the sum of current income and loans from the future income reduced (discounted) by interest. The intersection of MO and the horizontal axis represents the point of maximum current consumption, when the consumer has given up his future consumption in full ($C_1 = 0$) and uses the income from both periods for his own current consumption. The intersection with vertical axis means that the consumer has given up his current consumption in full ($C_0 = 0$) in support of maximum future consumption to use the income from both periods for future consumption only. The slope of market opportunities line expressing the marginal rate of substitution in exchange can be defined using the following equation (4.26). Assuming the value of real interest rate remains positive, the slope of market opportunities line will be always greater than 1 (resp. less than – 1). This relation can be defined using the following formula:

$$\frac{\Delta C_1}{\Delta C_0} = -(1+r), \text{ where } r \text{ refers to the real interest rate.} \qquad (4.26)$$



4-23 Market opportunities line and market interest rate

⇒ **The production possibility frontier** (**PPF**) links effective combination of the current and future consumption that can be achieved in both periods using the investment into physical capital (factors of production). The intersection with horizontal axis shows such situation, when the current income is used for current consumption in full. The intersection with vertical axis shows such situation, when the full current income is used for physical capital and its yield will be used in future. The slope of production possibility frontier illustrates the relation between the volume of current consumption that needs to be given up and invested into production and the volume of future consumption increased by the **return on investment**.



4-24 Production possibility frontier and the internal rate of return

⇒ The slope of production possibility frontier shows the increase of future consumption at a particular point of PPF provided the current consumption drops by one unit. As the

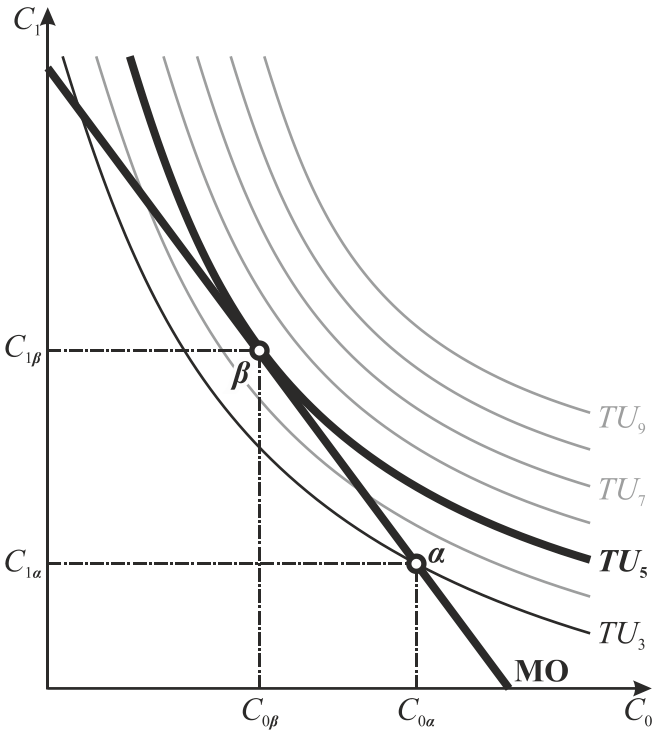
consumer (investor) expects appraisal of the funds invested, the slope of PPF must be greater than one (resp. less than – 1). This fact can be expressed using the following formula:

$$\frac{\Delta C_1}{\Delta C_0} = -(1+R), \text{ where } R \text{ refers to the internal rate of return.} \qquad (4.27)$$

The consumer (investor) optimum represents such decision on the current and future consumption that ensures maximum total utility for consumer. Let us begin with assumption that the consumer is considering an investment into financial capital only. Further examples will deal with optimization of investment into physical capital (business), followed by decision-making on investments based on financial and physical capital investment options.

4.2.2.1 Optimization of investment into financial capital

Let us assume the initial combination α [$C_{0\alpha}$; $C_{1\alpha}$] illustrated by figure 4-25 corresponds with utilisation of the current income for current consumption and the future income for future consumption accordingly, the total utility achieved is TU_3, the consumer is neither saving nor loaning any money, he is not investing into any physical or financial capital.



4-25 Optimization when investing on the capital market

However, point α clearly shows the marginal rate of time preference of consumer τ is less than the interest rate r on financial capital (the slope of indifference curve is lower than for the market opportunity line, the indifference curve at point α is more gradual compared to the market opportunity line). The

consumer is motivated towards savings and investments into financial capital.

If the consumer gives up current consumption (savings $C_{0\alpha} - C_{0\beta}$) in favour of future consumption, he will achieve the combination β [$C_{0\beta}$; $C_{1\beta}$], where the difference ($C_{1\beta} - C_{1\alpha}$) represents revenue gained on the financial capital market and based on the deposit equal to ($C_{0\alpha} - C_{0\beta}$). This optimized distribution of the current and future consumption enables the consumer save and improve his total utility to TU_5. The graph 4-25 clearly shows that the consumption basket β represents the maximum level of utility achievable.

Graphic depiction of the consumer optimum is represented by the point of contact for the market opportunity line and the outmost indifference curve, their slopes also match at this point β:

$$\begin{aligned} -(1+\tau) &= -(1+r) \\ \tau &= r \end{aligned} \tag{4.28}$$

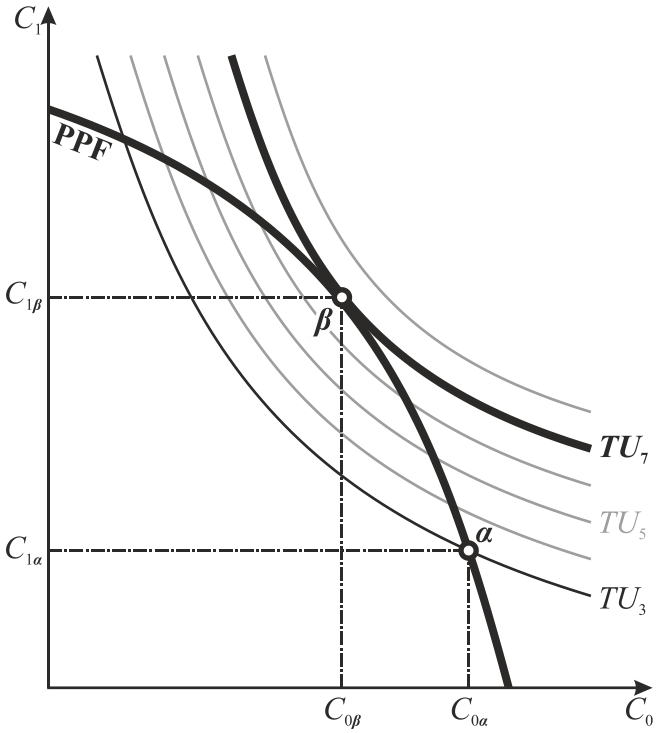
The consumer will maximize his utility from current or future consumption (with support from savings allocated within the financial capital market), if he succeeds in balancing the interest rate with the marginal rate of time preference that is when the market opportunities line becomes a tangent to the top indifference curve available.

4.2.2.2 Optimization of investment into physical capital

When making decisions on the optimal volume of investment into business (i.e. investments into the physical capital, investment into production respectively), the consumer also strives towards maximization of utility from the current and future consumption.

The initial assumption is also based on the default combination α [$C_{0\alpha}$; $C_{1\alpha}$] shown in graph 4-26 corresponding with usage of the current income for current consumption, while the expected future income will be used for the future consumption, the total utility achieved is equal to TU_3, the consumer is neither saving nor loaning any money to cover his current consumption.

Yet the point shows evidently that the marginal rate of time preference of consumer τ is lower than the internal rate of return R on investment into the physical capital (the slope of indifference curve is lower than the slope of production possibility frontier, the point α shows the indifference curve more gradual compared to the production possibility frontier). The consumer is motivated towards savings and investments into physical capital.



4-26 Optimization when investing into business

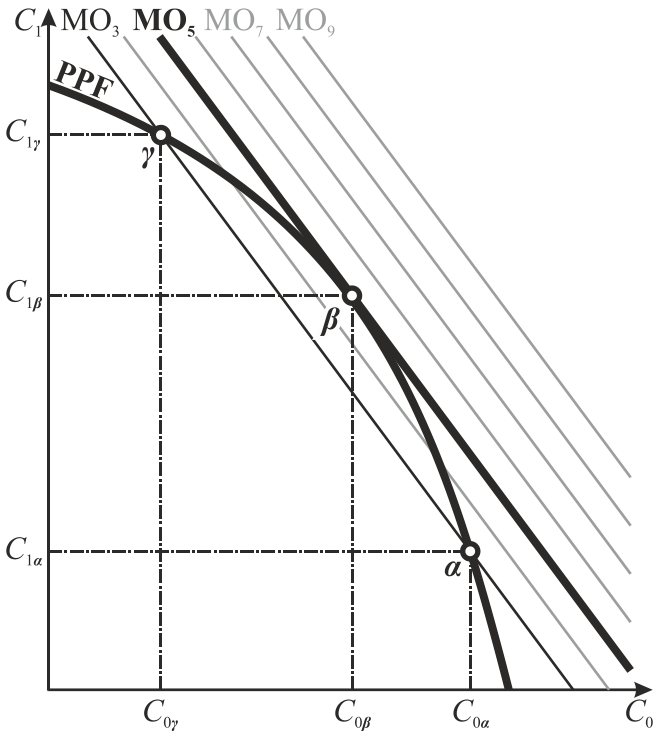
If the consumer gives up a part of his current consumption (investment equal to $C_{0\alpha} - C_{0\beta}$) and this part is then invested into production, his future consumption will be increased by the return on investment ($C_{1\alpha}$ - $C_{1\beta}$). The combination β [$C_{0\beta}$; $C_{1\beta}$] then shows the consumer achieving the maximum utility available TU_7. Graphic depiction of the consumer optimum comprises the point of contact between the production possibility frontier and the outmost indifference curve. Their slopes will be also mutually equal at this point:

$$\begin{aligned} -(1+R) &= -(1+\tau) \\ R &= \tau \end{aligned} \qquad (4.29)$$

The consumer will be maximizing his utility from current and future consumption through investment into production, if he succeeds in balancing the internal rate of return R with the marginal rate of time preference τ, as if he chooses such combination of current and future consumption, where the production possibility frontier touches the top indifference curve available.

4.2.2.3 Optimization of investment into physical and financial capital

Under circumstances, when the consumer may use a certain part of his current consumption for **investment into production while** having access to the **capital market**, he must select such optimal combination of both options to achieve the maximum utility from current and future consumption. Let us begin with the position of market opportunities MO_3 in the graph 4-27:



4-27 Optimization of investment into business

⇒ The consumer will prefer investing an additional unit of current consumption into the physical capital, if the internal rate of return exceeds the interest rate on capital market (the graphics will show slope of PPF grater compared to MO; $R > r$; refer to point α in the graph 4-27).

⇒ If the interest rate on the financial capital market exceeds the internal rate of return on investment into the physical capital, the consumer will prefer allocation of his savings on the financial capital market to investing these funds into the physical production (the graphics will show slope of MO greater compared to PPF; $r > R$; refer to γ in the graph 4-27).

⇒ An optimal combination is therefore achieved upon such allocation of savings among investments into the physical and financial capital, when the consumer (investor) is no longer motivated to change his decisions, that is when the internal rate of return is in equilibrium with the interest rate (slopes of MO and PPF match; $r = R$; refer to point β in the graph 4-27).

⇒ Looking at the graphics, the consumer is seeking for the highest line of market opportunities available along the production possibility frontier (refer to graph 4-27 showing the market opportunities line MO_5), which is also a tangent to the production possibility frontier:

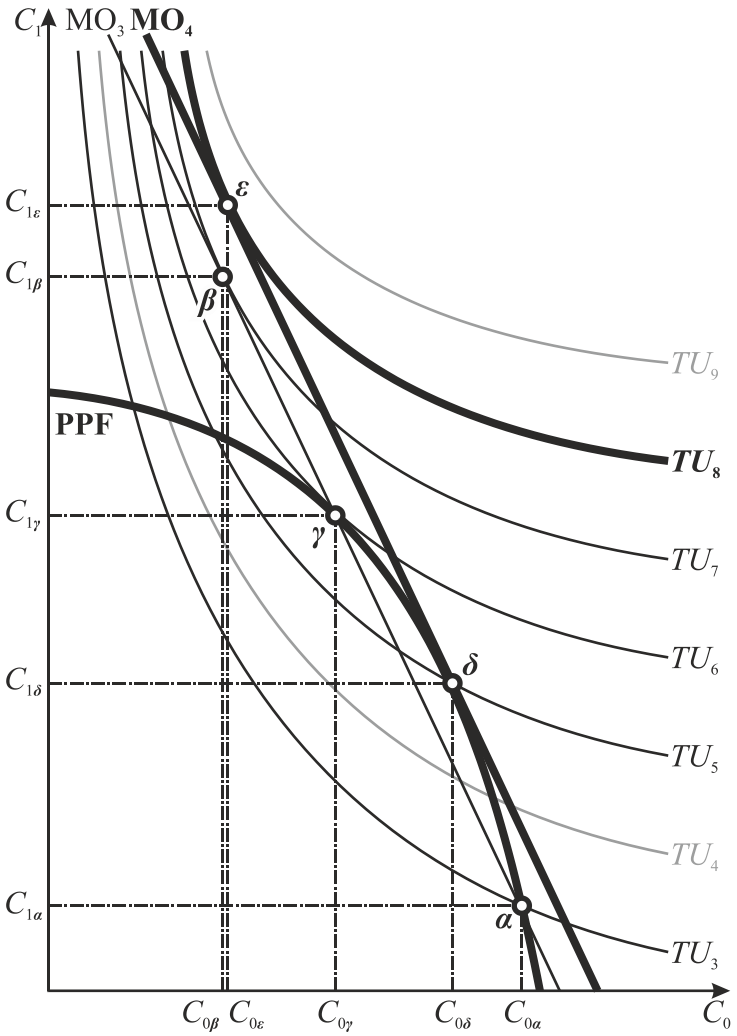
$$-(1+R) = -(1+r)$$
$$R = r \tag{4.30}$$

The optimization in savings allocation between physical and financial capital will be enriched with the criterion of total utility from current and future consumption now:

Let us assume once again that the initial point α in the graph 4-28 shows the consumer with current consumption equal to the level of his current income $C_{0\alpha}$ and the future consumption level is equal to the expected future income volume $C_{1\alpha}$, he is achieving the total utility TU_3, he is neither saving nor in need for loan to cover his current consumption.

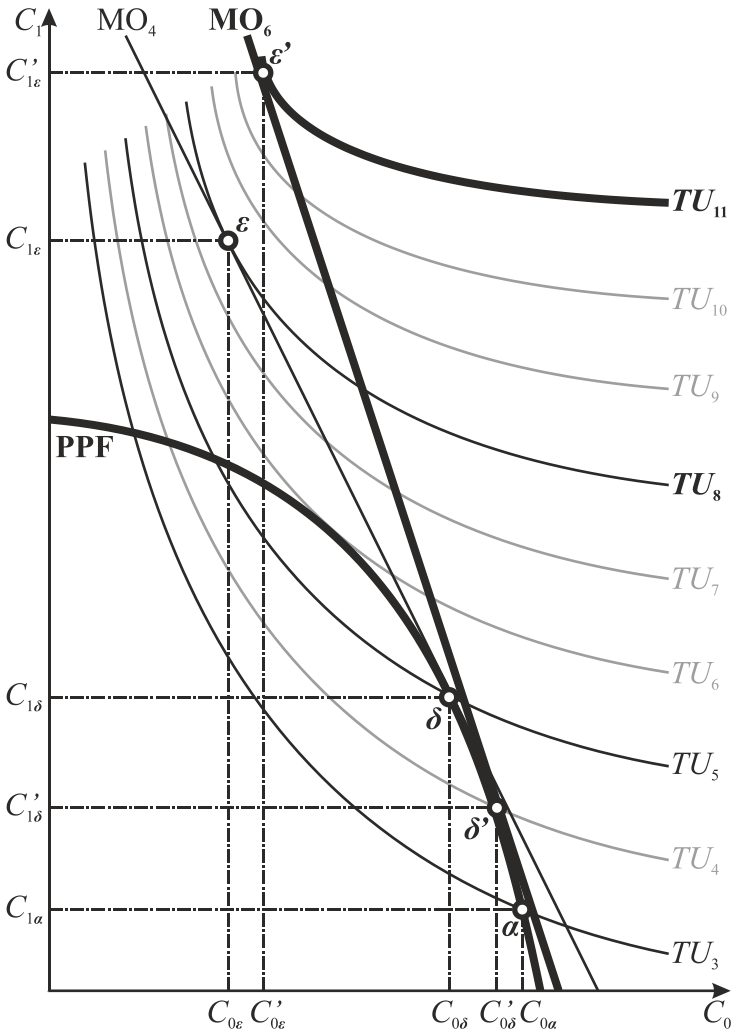
Yet the point α clearly shows that the marginal rate of time preference of consumer τ is fairly low and both the internal rate of return on investment into physical capital and the interest rate applied to financial capital are higher. The consumer is therefore motivated towards savings and investments into physical or financial capital:

- ⇒ Point β shows such situation, when the consumer has saved a certain part of his current consumption ($C_{0\alpha} - C_{0\beta}$) for investment into financial capital. He gains the total return ($C_{1\beta} - C_{1\alpha}$) on the financial capital market, achieving the total utility TU_7 on the market opportunities line MO_3 and his marginal rate of time preference equals the interest rate ($r = \tau$). However, point β is not ideal either, because the market opportunities line is not the top market opportunities line available with respect to investment into physical capital (the production possibility frontier includes higher market possibilities lines as well, e.g. MO_4). The consumer is motivated towards reduction of investment into financial capital in favour of investment into physical capital.
- ⇒ Point γ represents the situation, when the part of consumer's current consumption invested into physical capital equals ($C_{0\alpha} - C_{0\gamma}$). The return gained here means higher future consumption at the amount of ($C_{1\gamma} - C_{1\alpha}$) and his total utility rises to TU_6. Point γ shows the internal rate of return on investment into physical capital equal to the marginal rate of time preference of consumer ($R = \tau$). Yet the point γ is not an optimal decision either, as it does not lie at the highest market opportunities line available (it is actually located on the MO_3 same as the point β by coincidence). The point γ is an obvious proof that the marginal rate of time preference and the internal rate of return on investment into physical capital are lower than the interest rate on the financial capital market. The consumer is motivated towards reduction of investment into physical capital in favour of investment into financial capital.



4-28 Optimization of consumer decision-making on investments into financial or physical capital

The decision seen as optimal at this stage would be to make an investment into production, i.e. the physical capital, made of a portion of the initial current consumption $C_{0\alpha}$ equal to the amount of $(C_{0\alpha} - C_{0\delta})$. The consumer will gain the return investment of $(C_{1\delta} - C_{1\alpha})$. The investment into financial capital will comprise the current savings at the amount of $(C_{0\delta} - C_{0\varepsilon})$ to obtain the return of $(C_{1\varepsilon} - C_{1\delta})$. Point δ shows the balance of the internal rate of return and the interest rate (slopes of PPF and MO are the same; $R = r$) and the consumer achieves total utility TU_8 at point ε, where the interest rate corresponds with the marginal rate of time preference (slopes of MO and TU_8 are identical; $r = \tau$).



4-29 The effect of market interest rate growth on consumer's decision-making about investments into financial and physical capital

In case **the interest rate on capital market has grown**, the slope of market opportunities line MO will increase and the consumer will be forced to review his conclusions regarding investments on the capital market in favour of savings and to the detriment of investment into production (see the graph 4-29). The internal rate of return will match the interest rate at point δ' (the consumer reduces his investment into production), the interest rate is levelled with the marginal rate of time preference at point ε' and the consumer achieves the maximum total utility with the current and future consumption equal to TU_{11}.

The detail worth noticing in figure 4-29 is the fact that higher interest rate enables the consumer gain higher returns in future and higher total utility even with the smaller amount of current consumption he has given up. Whereas the amount left out of the initial current consumption $C_{0\alpha}$ was $C_{0\varepsilon}$ only, the higher interest rate will increase the current (non-invested) consumption to $C_{0\varepsilon}$'. The graph 4-29 also provides a good illustration of the higher interest rate reducing the consumer's willingness to loan money at financial market to cover his current consumption. Please notice that the intersection of MO_6 with the horizontal axis is closer to the origin than the intersection of initial MO_4.

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