CHAPTER THREE

3. 1 Demand for Labor

The labor market analysis becomes complete when the agents that constitute demand side are dealt well. The agents are firms who make decisions of hiring and firing of workers. In order to satisfy the consumers demand for goods and services, firms engage in the production process of those goods and services. The production of such goods and services gives rise to the demand for labor and other factors of production like and, building, capital and machines. The demand for labor is therefore, derived from the consumers' demand for goods and services. Consequently, the firm's labor demand is a **derived demand.**

Unlike the demand for the other factors of production, the demand for labor is given a special consideration in economies. Of the social, political and economic considerations, labor economics emphasizes on the economic policies that are said to facilitate the functioning of the labor market. This unit is organized in such a way that the demand for labor in the short-and long run will be discussed together with how the elasticity coefficients of labor demand and factor substitutions are measured. To simplify the understanding of these concepts, the discussion starts with the explanation and specification of the production function.

3.2. The Production Function

The production function describes the **technological relationships between inputs and outputs.** For the sake of simplicity, the inputs are categorized into two groups: labor and capital. The economic variable labor is measured by the number of hours hired by firms and that of capital includes the other factors of production except labor. Thus the production function can be written as

$$Q = F(L.K) \qquad (3.1)$$

Where Q is the firm's output, L is the amount of employee-hours employed by the employer and K is the physical unit of capital used in the production process. It is important to note first, that L is obtained by multiplying the number of workers hired by the average number of hours worked per person. Second, the workers skill is assumed to be homogeneous so that different workers are aggregated into the single variable labor.

a) Marginal and Average Products

From the production function of which specification is given by equation (3.1) we can produce two important concepts: Marginal Products and Average Products. As the inputs are categorized into two groups, we can identify two marginal products the marginal product of labor and the marginal product of capital. Formally the marginal product of labor (MP) is simply defined as the change in physical output (ΔQ) produced by hiring an additional unit of labor (ΔL) holding capital constant

$$MP_L = \frac{\Delta Q}{\Delta L}(\overline{K}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

Similarly, the marginal product of capital MP_L is defined as the change in output resulting from a one-unit change in the capital stock ΔK , holding labor constant

$$MP_k = \frac{\Delta Q}{\Delta k}(\overline{L}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

Graphically, the marginal product curves are derived from the total product curve as the firm hires more workers. Figure 3.1 (a) illustrates the total product curve, which is upward sloping. Figure 3.1(b) depicts the marginal and average product curves. The marginal product curve is the slope of the total product curve, i.e. the rate of change in output as more workers are hired.

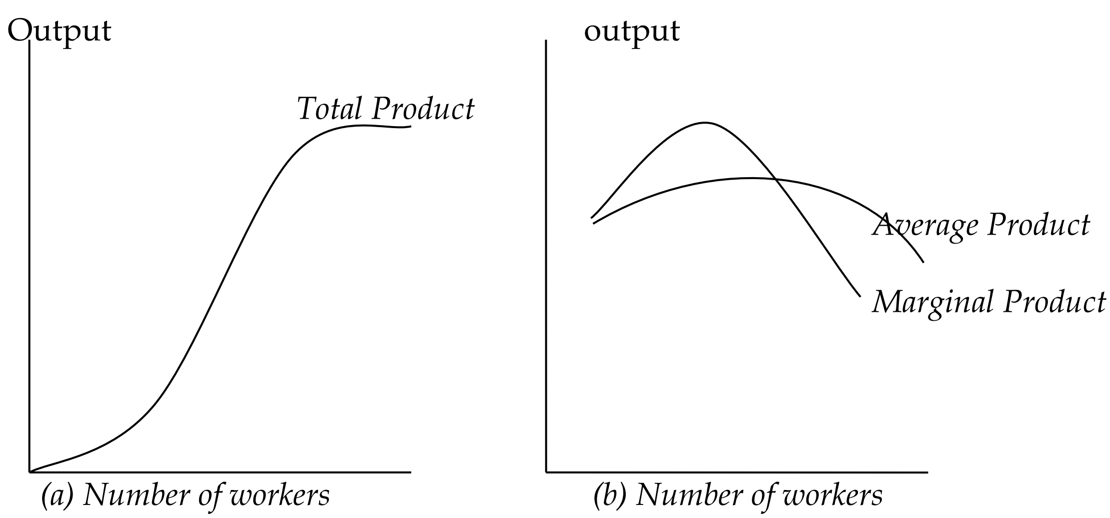


Figure 3.1: The total product, marginal product and average product curves

It rises initially but eventually starts to decrease as more workers are hired. Since the marginal product of labor is measured by holding capital constant the increment on output as more workers employed must be subject to the law of diminishing returns.

The average product of labor (AP_L) is defined as amount of output produced per person.

$$AP_L = \frac{Q}{L} \text{..}(3.4)$$

From figure 4.1(b) we can establish the following relationship: the MP_L curve lies above the MP_L curve when the latter is rising, and the AP_L curve lies below the AP_L curve when the latter is falling. It implies that the MP_L curve intersects the AP_L curve at the point where AP_L curve peaks.

b) Marginal Revenue Product

Usually firms make production decisions by considering what is prevailing in the output market rather than the availability of factors of production. Employment depends on the revenue generated by producing and selling extra output in the market. The more important concept associated with the production decision of firms is that of the marginal Revenue Product or the value of marginal Product. It is defined as the money value generated from hiving an additional worker.

$$MRP_L = MP_L \, x \, MR \text{..}(3.5)$$

Where VMP_L is the value of marginal product of labor and MR is the marginal revenue. The marginal revenue that is generated by an extra output sold depends on the bind of market in which the product is sold. If the market is a perfectly competitive, then the marginal revenue is identical to the product price (P) and equation (3.5) can written as

$$VMP_L = MP_L \, x \, P \text{..}(3.6)$$

Likewise, the value of average product of labor is given by the product of the average product and product price

3.3. The Short-run demand for labor

3.3.1 The perfectly competitive seller

The short-run demand for labor analysis focuses on the firms behavior towards the labor demand over a short period of time during which the capital stock is hold constant. As a result of this, the law of diminishing marginal returns is regarded as the critical assumption that lies behind the derivation of the labor demand curve in the short run. For exposition purpose, the firm works under the perfectly competitive output market and hires labor from a competitive labor market so that both the product price and the market wage rate the firm faces will be constant. Consider the following example, and suppose that the product price is Birr 2 and the market wage rate is Birr 22. For the various level of labor employed the marginal product and the value of marginal product is given as follows:

Table 3.1 the Firm's hiring decision in the short run under perfect market

No. of employees	**Output**	**Marginal product**	**Average product**	**Value of Marginal Product**	**Value of Average product**
0	-	-	-	-	-
1	11	11	11	22	22
2	27	16	13.5	32	27
3	47	20	15.7	40	31.4
4	66	19	16.5	38	33
5	83	17	16.6	34	33.2
6	98	15	16.3	30	32.7
7	111	13	15.9	26	31.7
8	122	11	15.3	22	30.5
9	131	9	14.6	18	29.1

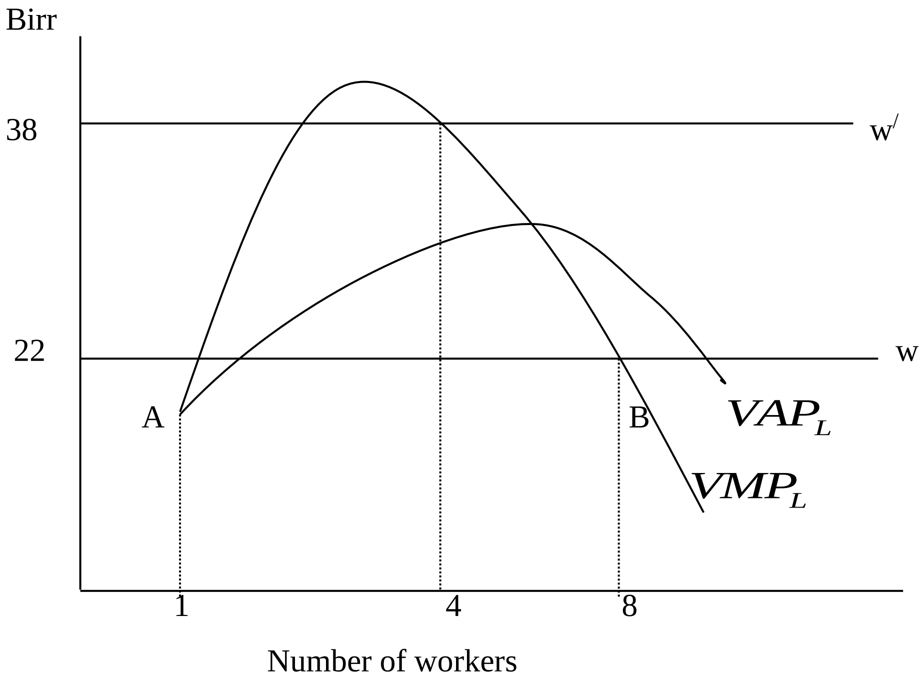


Figure 3.2: The Firm's hiring decision in the short run

As depicted in the above diagram, with a wage rate of Birr 22 and product price of Birr 2, the profit-maximizing firm will choose to hire eight workers. At this level of employment the VMP_L curve satisfies two conditions; first, it is downward sloping, and second, it equals to the wage rate. Note that the wage rate and the value of marginal product of labor equals at point A and point B. At point A, however, the value of marginal product of labor curve is upward-sloping and profit is not maximized because hiring one additional worker would yield extra revenue for the firm. Unless the law of diminishing returns assumption is incorporated, the firm would maximize profits by expanding indefinitely. It implies that the law of diminishing returns is a critical assumption in the short-run labor demand model.

Suppose the firm decides to hire only six workers. If the firm hired the seventh worker, the extra revenue obtained by the firm is Birr 26 while the extra cost of hiring this seventh worker is Birr 22. The positive difference then has an incentive to employ more labor. In contrast, if the firm were to hire more than eight workers, the value of marginal product falls short of the wage rate and the firm will not be motivated to hire additional workers. This implies that a profit-maximizing firm has to continue to hire workers until $VMP_L = w$.

It is important to note that only the level of employment that the firm can adjusts so that $VMP_L = w$. In other words, the firm, being a competitive, do not have any influence on the wage and cannot set the wage to the value of marginal product of labor. If, for instance, the market wage rate is raised to a value of Birr 38, the firm should adjust its level of employment only to four workers, at which $VMP_L = w$. If the firm hired the fourth worker, however, the VAP_L (Birr 33) would be lower than wage rate (Birr 38), and the firm would incur a loss and leave the market. This implies that the hiring decision for the alternative given wage rates will take place only if the VMP_L curve is downward sloping and lies below the intersection point with the VAP_L.

a) The short-run labor demand curve for a firm

This curve indicates how the firm's employment of labor varies as the wage rate changes, holding capital constant. From the preceding discussion, we know that the demand for labor curve is constituted from the portion of the value of marginal product of labor curve that is downward sloping and lies below the point where the VMP_L curve intersect the VAP_L curve.

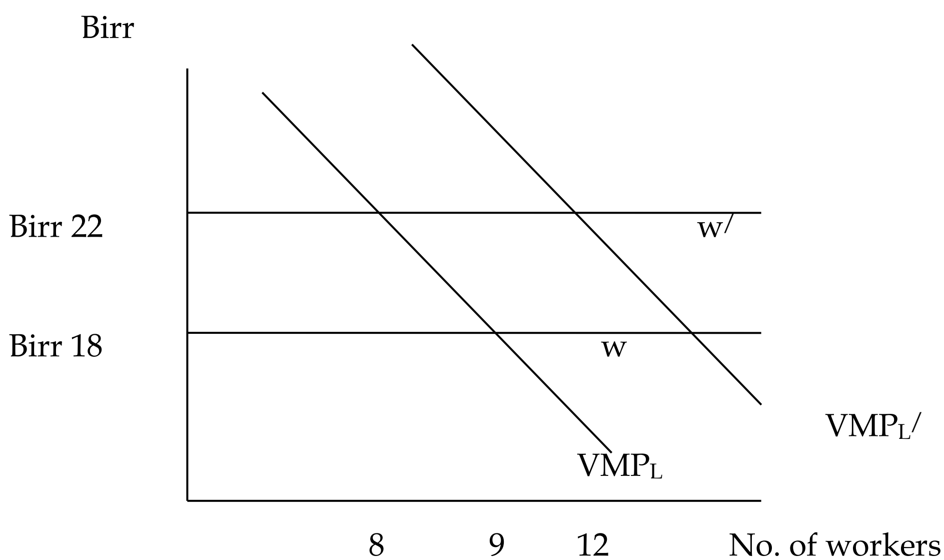


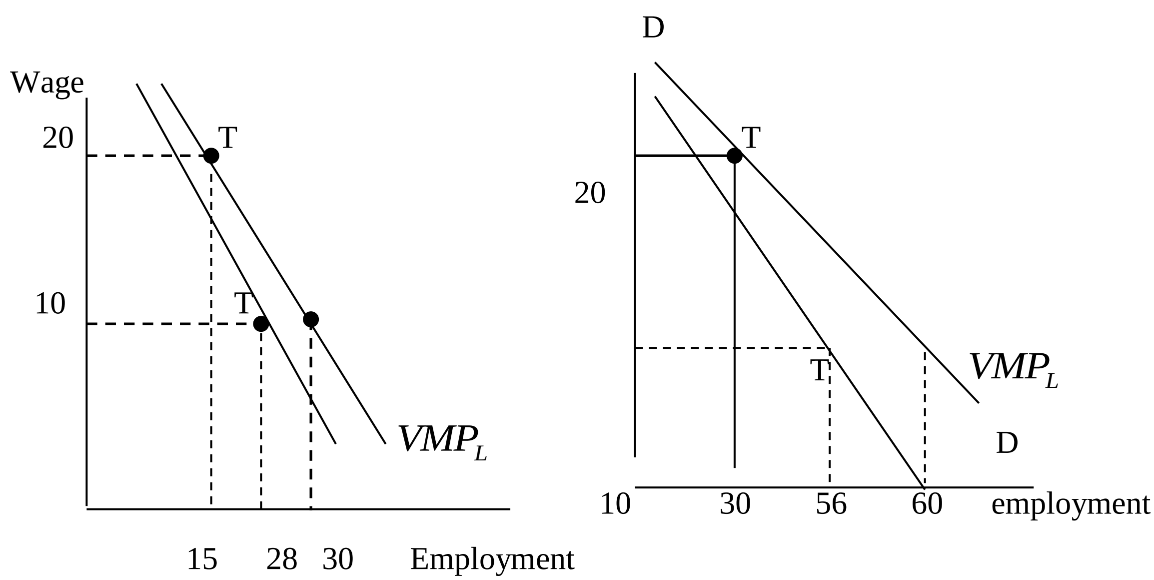
Figure 3.3: The short run demand curve for labor

When the wage rate is Birr 22, the firm hires eight workers, when falls to Birr 18, the form hires nine workers. The short-run demand curve for labor, therefore, is given by the value of marginal product curve. Because the value of marginal product of labor declines as more workers are hired, it must be the case that a fall in the wage increases the demand for labor.

The demand for labor curve is also affected by the change in output price. The short run labor demand curve shifts upward for the given wage rate if the price of output increases. In fig. 4.3 for the given wage of Birr 22, suppose that the output price increases, which shifts the VMP_L outward to VMP_L / . Then the firm's demand for labor will increase from 8 to 12 workers. Therefore, there is a positive relationship between short-run labor demand and product price. In addition to the output price, productive efficiency of workers, which improve the marginal product of labor employed, also affects the demand for labor curves my shifting it upward.

The short-run labor demand curve in the industry

Once the sort-run labor demand curve for a firm is derived, it would apparently seem easy to derive for the industry, by taking the horizontal summation of the individual firm's labor demand curve. Such a derivation of the industry's labor demand curve is misleading because it takes no account of the possible change in the output price of the industry when total output of the industry increases. When the wage rate decreases every firm in the industry will increase its level of employment that will lead to a great deal of output in the industry for the given demand. This excess supply of output eventually causes the output price to fall, and hence the value of marginal product of labor, the product of VP_L and P, to fall. Consequently, at the lower wage rate, the labor demand curve of each firm will shift slightly to the left.



(a) Individual firms ***(b) Industry***

Fig 3.4: The Industry's labor demand curve

Each firm in the industry initially hires 15 workers when the wage rate is Birr 20. Then the total employment in the industry will be 30 if there are only two firms in the industry. But if the wage falls to Birr 10, each firm tends to hire 30 workers. The resulting total employment in the industry would have been 60 had the labor demand in the industry been the horizontal summation of the two firms' demand for labor. And the demand for labor curve in the industry would have been given by the curve DD in Fig 3.4(b).

Following the fall in wage from Birr 20 to Birr 10, however, firms in the industry will expand output thereby reducing the price of output and the value of marginal product. Consequently, the total employment in the industry will be 56 instead of 60, as the labor demand curve for the industry becomes steeper. The 'true' industry labor demand curve is given by TT.

b) The Marginal Approach

The hiring decisions of firms could be alternatively reached by employing the marginal productivity conditions. According to this alternative method the profit-maximization level of employment is identified by equating the marginal cost with the marginal revenue-the additional cost of producing an additional unit of output must be equal to the extra revenue obtained from selling that output.

Formula derivation

i. Short run production function takes the form Q=f (L)

ii. The MP_L is accordingly dQ/dL =f '(L). The profit function is given by ∏ =TR-TC.

iii. If the producer operates in perfectly competitive product and labor markets, then the market price of the output, P_x and the wage rate w, are given.

Therefore TR=P*Q and TC= WL. Implies that ∏ = P*Q- WL.

iv. ∏ is a max when d∏/dL= 0. (Necessary condition)

Therefore d∏/dL= Pf' (L)-W=0 = MRP_L=W

v. The sufficient condition is

$$d^2\prod/d^2L = Pf''(L)<0$$

3.2 .2 The imperfectly competitive seller

Most firms do not sell their product in purely competitive market. Rather they sell under imperfectly competitive conditions. Because of product uniqueness of differentiation, the imperfectly completive seller's product demand curve is dawn ward sloping, rather than perfectly elastic, and this means that the firm must lower its price to sell the output contributed by each successive workers. Hence, the labor demand curve (MRP) for purely competitive seller falls for a single reason: MP_L diminishes while product price is constant. But the MRP of the imperfectly competitive seller declines for two reasons: MP_L falls and product price declines as output increases. As in the case of perfectly competitive seller, application of the MRP= W rule to the MRP curve will yield the conclusion that the MRP curve is firm's labor demand curve.

However, all else being equal, the imperfect seller's labor demand curve is steeper and less elastic than that of purely competitive seller.

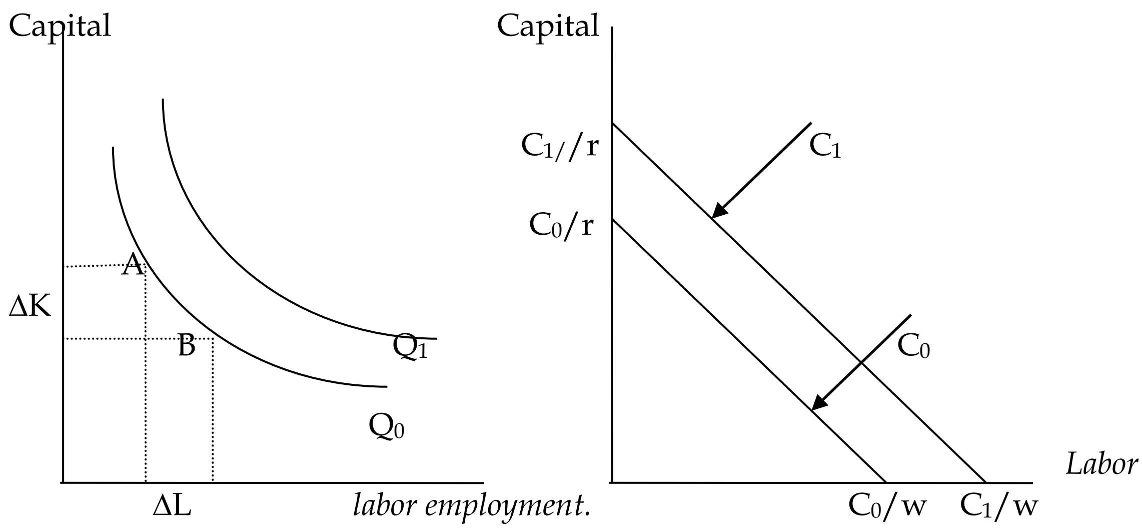
It is not surprising that the firm which possesses monopoly power is less responsive to wage rate change than is the purely competitive seller. The tendency for the imperfectly competitive seller to add few workers as the wage rate declines is merely the labor market reflection of the firm's tendency to restrict output in the product market. Other things being equal, the seller possessing monopoly power will find it profitable to produce less output than would a purely competitive seller. In producing this seller output, it will employ fewer workers.

3.4 The Demand for labor in the Long Run

The short-run labor demand discussion assumes that the time period is so short that the level of capital stock remains fixed. In this section we will see what happens to the demand for labor if the time period is long enough that the level of capital changes- the plant size can expand or contract. Therefore, the long run profit-maximization condition requires making decisions about the number workers to be employed and the amount of plant and equipment to invest in. The explanation of this section starts by emphasizing the basic microeconomic concepts of cost minimization.

Concepts of Cost Minimization

Iso-quants and iso-cost underlie the cost minimization concept. An iso-quant is the possible combinations of capital and labor that produce the same level of Output.



(a) Iso-quant curves (b) Iso-cost curves

Figure3.5: Iso-quants and Iso-cost curves

Properties of iso-quant curves

- Isoquants must be downwards sloping
- Isoquants do not intersect each other
- Higher isoquants, Q_1 , are associated with higher levels of output than lower isoquant, Q_2.
- Isoquants are convex to the origin

The slope of an isoquant is given by the negative of the ratio of marginal products. In Fig 4.5(a), the movement from point A to point B, the firm hires ΔL additional labor, each producing MP_L units of output. Hence the total output gained out of the employment of ΔL units of labor is given by the product $\Delta L x MP_L$. The same movement along the Q_0 curve makes the firm reduce Δk unites of capital, each reducing the total output by MP_K . Hence the total loss in output as a result of this reduction is given by the product $\Delta k \ x \ MP_k$. But the movement from point A to point B leaves total output unaffected so that:

$$(\Delta L \ x \ MP_k) + (\Delta k \ x MP_L) = 0$$

$$\frac{\Delta k}{\Delta L} = -\frac{MP_L}{MP_k} \text{..............................(3.1)}$$

The absolute value of the slope of an isoquant yields the marginal rate or technical substitution. The convexity assumption of an isoquant implies diminishing marginal rate of technical substitution as the firm substitutes more labor for capital.

An isocost is the various combinations of labor and capital that the firm could hire so that the cost outlay is the same. It has the property that the higher isocost line C_1 represents the higher cost of production. The slope of the isocost line is derived from the firm's cost of production function given by

$$C = wL + rK. \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

Where C is the total cost outlay, r is the price of capital. By rearranging terms in equation (3.8)

$$K = \frac{c}{r} - \frac{w}{r}L$$

$$\frac{\Delta k}{\Delta L} = -\frac{w}{r} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.9)$$

Equation (3.9), the slope of the iso-cost line, is the negative of the ratio of input prices; cost-minimization principle dictates that the firm, in order to maximize profit by producing Q_0 level of output, should produce this output at the lowest possible cost. In order to produce Q_0 level of output the firm can use different combinations of labor and capital $\left[(Lo, Ko), (L_1.K_1) or (L_2.K_2)\right]$

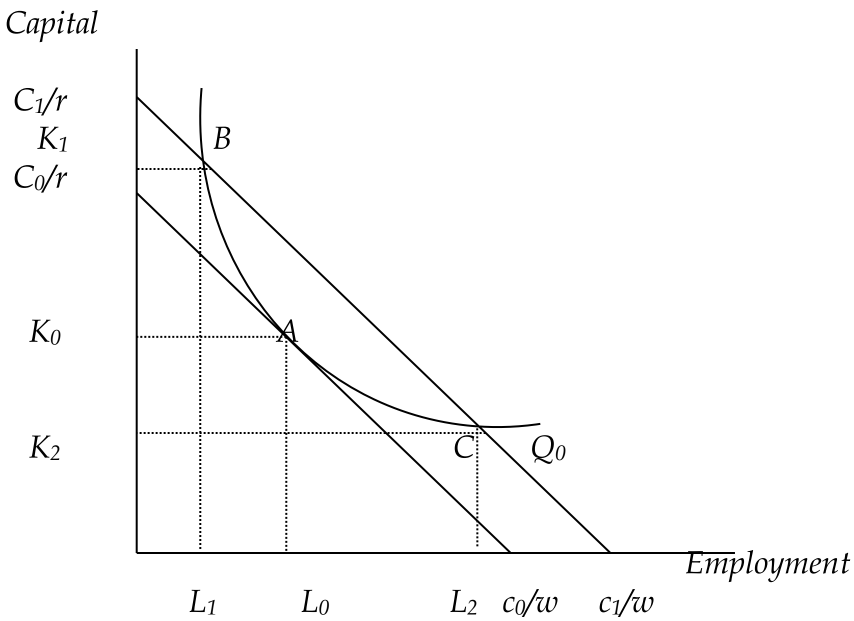


Figure 3.6: the firm's optimal combination of inputs

However the least possible cost of producing Qo is given at point A, where the firm hires Lo and Ko units of inputs. Whereas, capital-labor combinations given by points B and C produce Qo level of output at a higher cost outlay, C_1. The firm minimizes costs when it uses the capital labor combination at which the iso-cost is tangent to the Iso-quants curve, implying that the slope of the iso-cost line $\left(w/r\right)$ equals to the slope of the Iso-quants curve $\left(MP_L/MP_k\right)$. At optimal combination of capital and labor the marginal rate of technical substitution equals the ratio of input prices. Upon rearranging the equality

$$\frac{MP_L}{w} = -\frac{Mp_k}{r} \text{.....................................(3.10)}$$

$\left(MP_L/w\right)$ Gives the output yield of the last Birr spent labor. This is because the ratio of the output produced by the last worker, MP_L, to the cost spent on the last worker, w. Likewise $\left(MP_k/r\right)$ gives the output yield of the last Birr spent on capital. Cost-minimization implies that the last Birr spent on labor yield and that on capital must be equal.

In addition to cost-minimization, we need to consider the profit maximizing behavior of the firm since the two concepts are different. Cost minimization constrains the firm to concentrate on the given level of output, Qo, rather than considering the other options for profit-maximization. Profit-maximization condition, however, enables the form to choose the optimal level of output, by comparing the marginal cost and marginal revenue for different possible set of outputs. Therefore the long –run profit-maximization condition requires that labor and capital are hired until: $W = VMP_L$ and $r = VMP_k$ ....(3.11)

Note that profit maximization implies cost minimization.

$$W = P x\, MP_L \quad and \quad r = P x\, MP_k$$

$$P = \frac{w}{MP_L} \qquad \text{And} \qquad P = \frac{r}{MP_k}$$

$$\frac{w}{MP_L} = \frac{r}{MP_k} \Rightarrow \frac{MP_L}{MP_K} = \frac{w}{r} \text{ ....(3.12)}$$

Equation (3.12) is the condition for cost- minimization. However, cost-minimization need not imply profit-maximization.

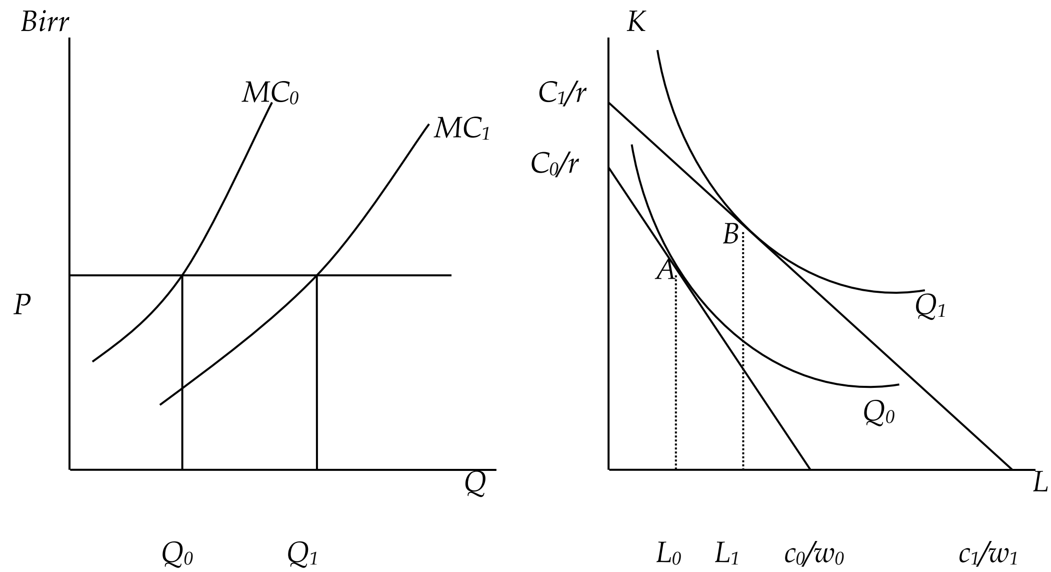
The Long-run Demand Curve for Labor

The long-run Labor demand curve graphs the relationship between the long-run demand for labor and wage rate. To see what the labor demand curve looks like where the wage rate change let us consider that

- The firm is initially producing Qo units of output
- The corresponding input prices are W_0 and r_0
- Qo satisfies both profit-maximizing and cost minimizing conditions
- The optimal cost outlay associated with Qo level of output is given by Co

Suppose the market wage falls from Wo to W1. The slope of the isocost line becomes small and the isocost line becomes flatter than before. Unless the firm’s total outlay, Co remains the same, the new isocost line doesn’t rotate around the original intercept, Co/r. However, the firm’s cost outlay need not be the same before and after the change in wage. Instead of originating from the initial intercept, the new isocost line may start from an intercept, which is located over the previous one. Another important result that follows from the wage cut is the fall in the marginal cost of producing the firm's output. An additional unit of output can be produced when labor becomes cheap. The upward sloping marginal cost curve will shift rightward following this wage cut. At the given output price, which is equal to the marginal revenue for competitive firm, the profit-maximizing level of output, occurs at a higher level of output. After the wage cut the

Marginal cost



(a) Firm's output decision *(b) Firm's hiring decision*

Fig. 3.7 the Impact of wage reduction on output and employment of a profit-maximizing firm

Shifts from MCo to MC_1 and the new MC curve equates with the output with the output price at Q level of output so that profit is maximized after the fall. Then the firm decides to produce Q_1 level of output.

Figure 3-7(b) illustrates that the new iso-quant curve, Q_1 corresponds with the profit maximizing level of output, of the various mix of labor and capital used to produce Q_1 level of output, the cost-minimizing (optimal) one is given by point B, where the new isoquant curve, Q_1, is tangent to the new isocost line, C_1. The new optimal mix is located to the right of the original mix, implying that the firm's demand for labor will always increase as the wage falls. However, the fall in wage does not necessarily increase the use of capital. We can thus conclude that the long-run demand curve for labor is also a downward sloping curve (see figure 3-8 below).

Substitution and Scale Effects

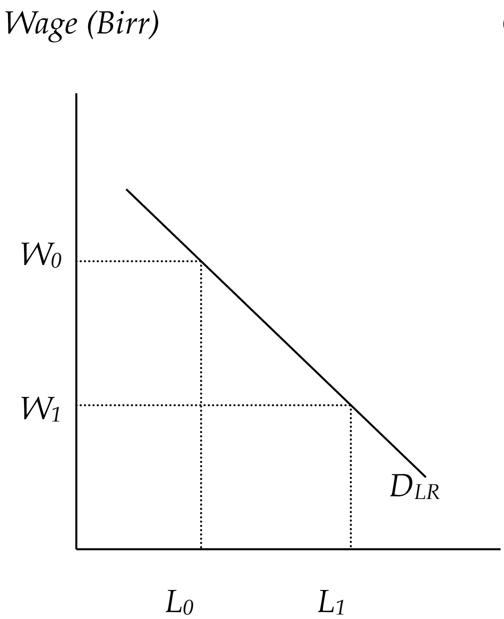


Fig. 3.8: the LR demand for labor

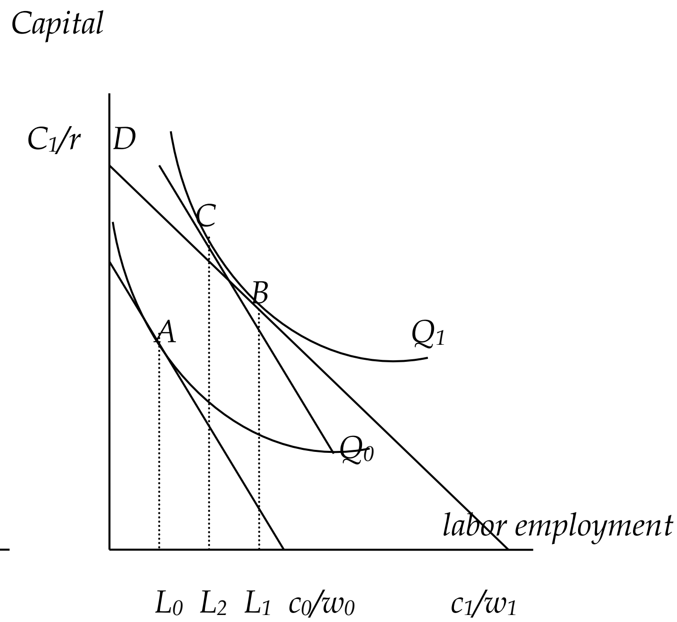


Fig. 3.9: Substitution and scale effect

The movement from point A to point B happens as a result of wage cut. It is possible to decompose such a move into substitution and scale effects. In particular, the wage cut reduces the price of labor relative to that capital. The decline in the wage encourages the firm to readjust its input mix so that it is more labor intensive. In addition the wage cut reduces the marginal cost of production and encourages the firm to expand. On the whole, the demand for labor becomes high as the firm expands and takes advantage of the fall in the wage rate.

Initially the firm is producing Qo level of output and faces W_o wage rate, where it demands Lo units of labor. As the wage falls to W_1, the marginal cost declines and the firm expands its production to a level of Q_2 units, there by employing L_1 units of labor. If we decompose the move in to two stages, firstly the firm takes advantage of the wage cut by expanding production. Since labor and capital are normal inputs, using the same analogy of normal goods the demand for both labor and capital increases following the expansion of production. It is worth noting that the newly introduced isocost line is parallel to and has the same slope as the original isocost line so that the new tangency point C shows the expansion in output as both capital and labor increases proportionately. The move from point A to point C is defined as the scale effect. ***The scale effect thus increases both labor and capital.***

Secondly, the wage cut makes labor cheaper than before. This leads to the rearrangement of input combination towards the labor- intensive techniques of production. The analysis of such an effect, substitution effect, is undertaken by holding output fixed. So the movement along the new isoquant curve, the move from point C to point B, reflects the substitution of labor for capital. Unlike the scale effect, the substitution effect increases the firm's demand for labor but reduces the firm's demand for capital. Whether the firm demands more capital as wage falls depends on which effect outweighs. If the scale effect, which increases the demand for both inputs, exceeds the substitution effect, the wage cut will make firms hire more capital. Otherwise, the firm would use less capital as the wage falls.

3.5 Elasticity of Labor Demand

The responsiveness of labor demand for a change in the wage rates measures the elasticity of labor demand. It is possible to measure both the short-run and long run elasticity.

(i) the short-run elasticity of labor demand (δ_{SR}):- it is defined as the percentage change in the short-run demand for labor (L_{SR}) resulting from a 1 percentage change in wage (w)

$$\delta_{SR} = \frac{\%\ change\ in\ labor\ demand}{\%\ change\ in\ wage\ rate} = \frac{\Delta L_{SR} / L_{SR}}{\Delta w / w}$$

$$= \frac{\Delta L_{SR}}{\Delta w}\frac{w}{L_{SR}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.13)$$

(ii) the long-run elasticity of labor demand (S_{LR}) :- it is defined as the percentage change in the long-run demand for labor (L_{LR}) resulting from a 1 percentage change in the wage (w)

$$\delta_{SR} = \frac{\%\text{change in labor demand}}{\%\ change\ in\ wage\ rate} = \frac{\Delta L_{LR} / L_{LR}}{\Delta w / w} = \frac{\Delta L_{LR}}{\Delta W}\frac{W}{L_{LR}} \ldots\ldots\ldots\ldots\ldots\ldots (3.14)$$

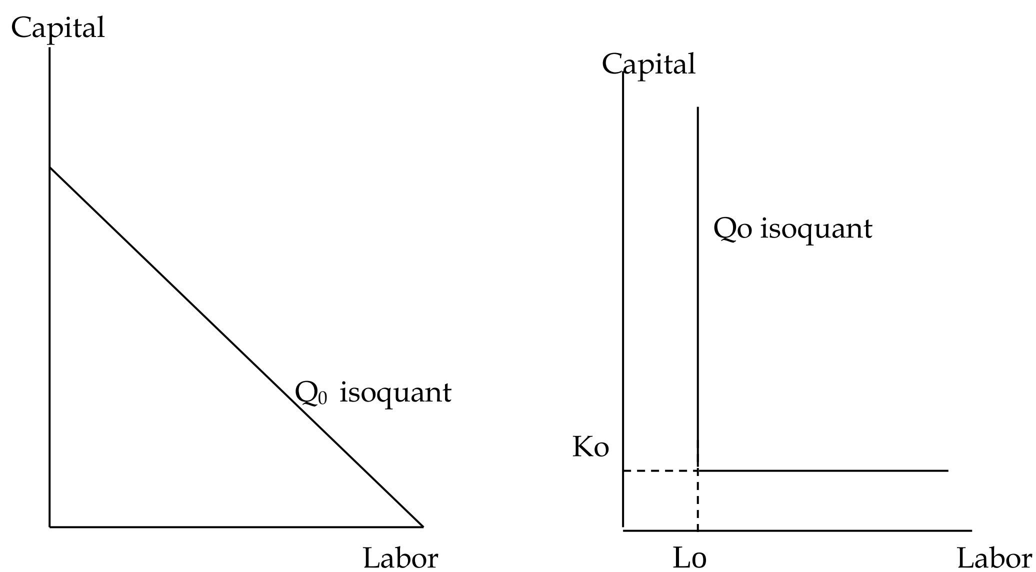
Note that the labor demand curves being downward sloping, the elasticity measures of both the short-run and long run labor demands bear negative sings. The imprison of elasticity between short-run and long run demand for labor indicates that the long-run elasticity of labor demand is greater than the short-run labor demand elasticity. This is because of the fact that in the long run the time period is long enough to adjust capital and labor input combinations in response to changes in the wage rate. But in the short run the time period is too short to adjust its size optimally.

3.6 The Elasticity of Factor substitution

The elasticity of substitution is a summary measure of the shape of the isoquant and thereby, of the ease of substitution between labor and capital. The elasticity of substitution between labor and capital (holding output constant) is given by

$$\text{Elasticity of substitution} = \frac{\text{Percentage change in the ratio of capital to labor}}{\text{Percentage change in the slope of the isoquant}}$$

The elasticity of substitution is used to measure the curvature of the isoquant. Let's consider two extreme cases of the isoquant curve. First, if the isoquant curve is a straight line, the marginal rate of technical substitution (the slope of the isoquant curve) remains constant as we move along the isoquant curve. (See Fig 3.10 (a) below)



(a) Perfect substitutes (b) perfect complements

Fig 3.10: Two extreme curvatures of Isoquants

When labor and capital are substituted at a constant rate irrespective of the initial amount, they are called **perfect substitutes**. The amount by which one input replaced by another is determined by the slope. If, for example, the slope of the isoquant is unity, the two inputs will be exchanged on a one-to-one basis.

The other extreme case appears to happen when the two inputs are perfectly complementary, i.e. the isoquant curve is a right-angled one (see Fig 3.10) (b) above). We can either add more workers by holding capital at some constant value, Ko or add more capital by holding labor constant at a value of Lo; hours, in each case output remains the same. Thus a cost- minimizing firm has only one optimal combination of labor and capital-Ko units of capital and Lo units of labor.

Following this definition of extreme isoquant curvatures, we can measure the elasticity of substitution between the two inputs. When the isoquant curve is a straight line, the firm minimizes by producing at either of the extreme points depending on the cheaper alternative. If the input price changes, the firm will shift to the other extreme position. As a result of this the elasticity of substitution is infinite

Example

Suppose that the substitution between labor and capital is perfectly substitutable. The techniques of production allow one capital to do the work of three workers (the slope of the iso-quant curve, MRTS, is 1/3). The firm wants to produce 100 units of output. Suppose also that the price of capital is Birr 750 per machine per week and that the weekly salary of each worker is Birr 300 What would be the optimal combination? Find the input combination the firm uses if the weekly salary of each worker falls to Birr 225?

The production function

$$Y = aK + bL$$

$$K = y/a - b/a\,L$$

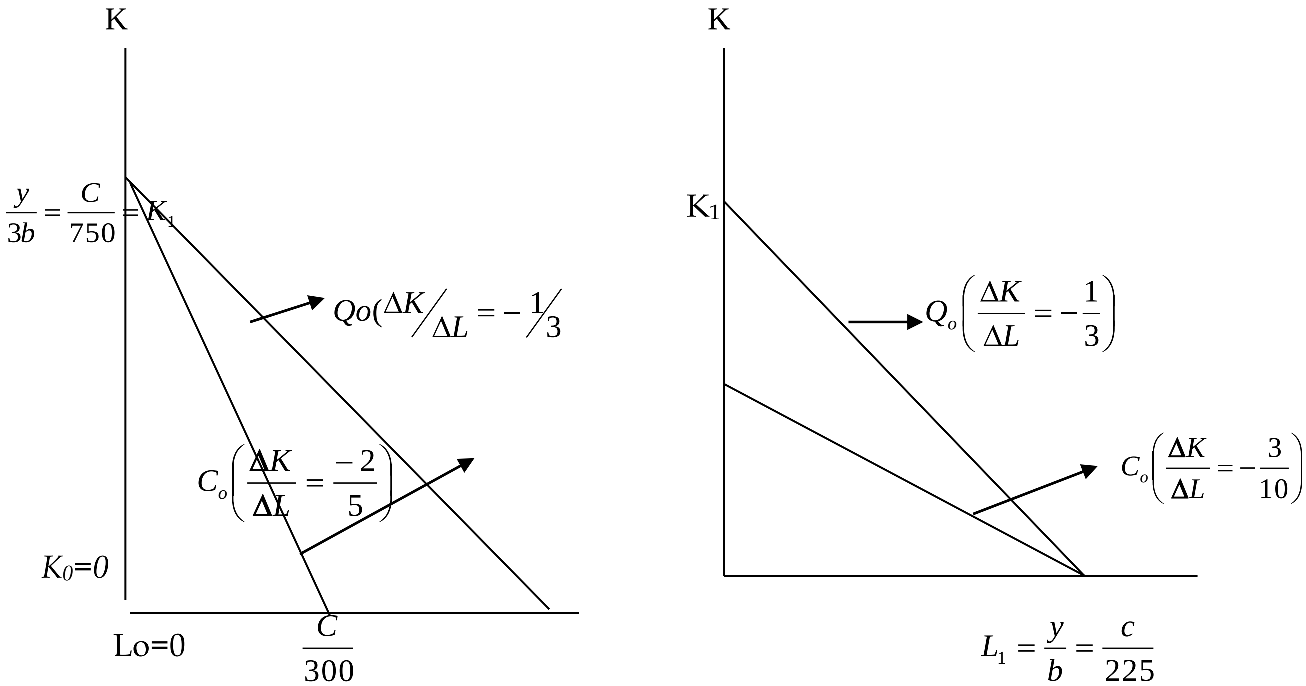
$$\Delta K/\Delta L = -b/a = -1/3$$

the iso-cost line before and after the wage cut

$$C = 300L + 750K \qquad C = 225L + 750K$$

$$K = C/750 - 300/750\,L \qquad K = C/750 - 225/750\,L$$

$$\Delta K/\Delta L = -2/5 \qquad \frac{\Delta K}{\Delta L} = -\frac{3}{10}$$



When the two inputs are perfect complements, there is no substitution to speak of because there is only one optimal mix of inputs regardless of the prices of inputs. Therefore, the elasticity of substitution becomes zero when the isoquant curve is right-angled. However a great number of isoquants lie between these two extreme cases, implying that the more curved the isoquant, the smaller will be the degrees of substitution, the flatter the cover, the larger the size substitution effect. Therefore the elasticity of substitution lies between zero and infinity but it is always non-negative.

3.7 Marshall's Rules of Derived Demand

1. Labor demand is more elastic the greater the elasticity of substitution, the greater the elasticity of substitution, the flatter the iso-quant curve is and the more readily substitutes for one input can be obtained as the two inputs are more similar.
2. Labor demand is more elastic the greater the elasticity of demand for the output. This proposition arose directly from the fact that labor demand is a derived demand, and, therefore the amount of labor demanded depends directly on the volume of output demanded in the product market.

3. Labor demand is more elastic the greater labor's share in total costs. If labor is an important input in the production process, the share of labor from total cost will be large. A small rise in the wage rate leads to a large rise in the marginal cost of production and, hence, a large rise in the output price. Consumers will respond by cutting back their demand for the high price product that results in a substantial fall in employment.
4. The demand for labor is more elastic the greater the supply elasticity of other factors of production, such as capital. If the two inputs are substitutes then a rise in the wage rate will produce a substitution towards capital. If the supply curve of capital is inelastic, the movement away from labor to capital will be reduced. But if the supply of capital is elastic, firms are induced to substitute more capital for labor.