

With optimal input combinations (i.e., at the points of tangency of isoquants and isocost lines), the (absolute) slope of the isoquant or marginal rate of technical substitution of labor for capital is equal to the (absolute) slope of the isocost line or ratio of input prices. That is,

$$MRTS = \frac{w}{r} \quad [6-12]$$

Since the $MRTS = MP_L/MP_K$, we can rewrite the condition for the optimal combination of inputs as

$$\frac{MP_L}{MP_K} = \frac{w}{r} \quad [6-13]$$

Cross-multiplying, we get

$$\frac{MP_L}{w} = \frac{MP_K}{r} \quad [6-14]$$

Equation 6-14 indicates that to minimize production costs (or to maximize output for a given cost outlay), the extra output or marginal product per dollar spent on labor must be equal to the marginal product per dollar spent on capital. If $MP_L = 5$, $MP_K = 4$, and $w = r$, the firm would not be maximizing output or minimizing costs since it is getting more extra output for a dollar spent on labor than on capital. To maximize output or minimize costs, the firm would have to hire more labor and rent less capital. As the firm does this, the MP_L declines and the MP_K increases (since the firm is in stage II of production for L and K). The process would have to continue until condition 6-14 holds. If w were higher than r , the MP_L would have to be proportionately higher than the MP_K for condition 6-14 to hold. The same general condition for the optimal input combination would have to hold regardless of the number of inputs. That is, the MP per dollar spent on each input would have to be the same for all inputs.

Profit Maximization

In order to maximize profits, a firm should employ each input until the marginal revenue product of the input equals the marginal resource cost of hiring the input. With constant input prices, this means that the firm should hire each input until the marginal revenue product of the input equals the input price. This is a simple extension of the profit maximization condition discussed in Section 6-3 for the case of a single variable input. With labor and capital as the variable inputs, the firm will maximize profits by hiring labor and capital until the marginal revenue product of labor (MRP_L) equals the wage rate (w) and until the marginal revenue product of capital (MRP_K) equals the rental price of capital (r). That is, in order to maximize profits, a firm should hire labor and capital until

$$MRP_L = w \quad [6-15]$$

$$MRP_K = r \quad [6-16]$$

Hiring labor and capital so that Equations 6-15 and 6-16 hold implies that condition 6-14 for optimal input combination will also be satisfied. To see this, remember from Section 6-3