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MICROECONOMICS

3rd Edition

Pearson

MICROECONOMICS

If we set y in [A.12] equal to y^* in [A.13]:

$$y = y^*(p_1, p_2) \qquad \text{[A.14]}$$

then, since profit maximization implies cost minimization, it must be true that

$$z_1^* = D_1(p_1, p_2) = \hat{z}_1 = h_1(p_1, p_2, y^*(p_1, p_2)) \qquad \text{[A.15]}$$

Now let p_1 vary but ensure that y in $h_1(p_1, p_2, y)$ varies to maintain the equalities in [A.14] and [A.15]. Hence h_1 will vary, first because with y constant a new cost-minimizing input combination is chosen and second because varying p_1 will change y^* and therefore y via [A.14]. Differentiating [A.15] with respect to p_1 gives

$$\frac{\partial D_1}{\partial p_1} = \frac{\partial h_1}{\partial p_1} + \frac{\partial h_1}{\partial y}\frac{\partial y}{\partial y^*}\frac{\partial y^*}{\partial p_1} \qquad \text{[A.16]}$$

where the first term on the right-hand side of [A.16] shows how z_1 varies with p_1 when y is constant and so is the substitution effect. The second term is the rate at which z_1 varies indirectly with p_1 because of the effect of changes in p_1 on the optimal output level. This is the output effect. From section 6B we know that

$$\frac{\partial h_1}{\partial p_1} < 0$$

so let us consider the output effect. $\partial h_1/\partial y$ is the rate at which z_1 varies with y along the cost-minimizing expansion path and $\partial h_1/\partial y$ may be positive (z_1 is normal) or negative (z_1 is an inferior input). From [A.14], $\partial y/\partial y^* = 1$. The last part of the second term is $\partial y^*/\partial p_1$: the rate at which the profit-maximizing output varies with the price of input 1. Now, recalling equation [A.4] above, y^* is determined by the equality of marginal revenue with marginal cost. If a rise in p_1 shifts the marginal cost curve upwards then output must fall and, conversely, if the marginal cost curve falls as p_1 rises output will rise. Hence $\partial y^*/\partial p_1$ is positive or negative as MC falls or rises with p_1, i.e. as $\partial MC/\partial p_1$ is negative or positive. But from section 8B, $\partial MC/\partial p_1$ is negative or positive as z_1 is inferior or normal. Hence

$$\frac{\partial h_1}{\partial y} \gtrless 0 \Leftrightarrow \frac{\partial MC}{\partial p_1} \gtrless 0 \Leftrightarrow \frac{\partial y^*}{\partial p_1} \lessgtr 0$$

and therefore

$$\frac{\partial h_1}{\partial y}\frac{\partial y}{\partial y^*}\frac{\partial y^*}{\partial p_1} = \frac{\partial h_1}{\partial y}\frac{\partial y^*}{\partial p_1} < 0 \qquad \text{[A.17]}$$

The output effect of a rise in p_1 always reduces the demand for z_1, so reinforcing the substitution effect. We have therefore established by another route that

$$\frac{\partial D_1}{\partial p_1} = \frac{\partial h_1}{\partial p_1} + \frac{\partial h_1}{\partial y}\frac{\partial y^*}{\partial p_1} < 0 \qquad \text{[A.18]}$$

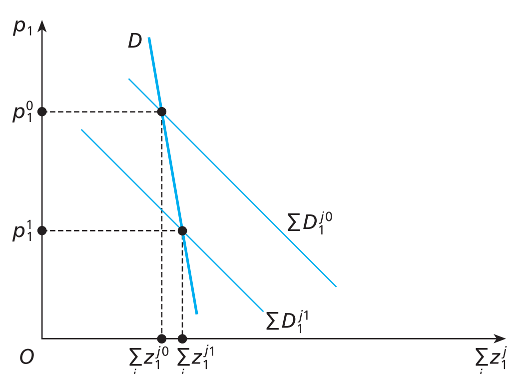
i.e. the input demand curve is negatively sloped, irrespective of whether the firm sells its output in a monopolized or competitive market.

From [A.18] we see that the slope of the firm's input demand curve depends on the magnitude of the substitution and output effects. The substitution effect in turn depends on the curvature of the firm's isoquants and, if the elasticity of substitution (section 6B) is taken as the measure of curvature, the substitution effect is larger the larger is the elasticity of substitution. The output effect is the product of two terms and is larger the greater is the response of the cost-minimizing level of z_1 to changes in output and the greater is the response of output to the change in input price. This latter influence depends on how much marginal cost varies with the price of the input: the bigger the shift in the marginal cost curve the bigger the change in the profit-maximizing output. If the firm is a monopolist in the output market the change in y also depends on the slope of the marginal revenue curve: the steeper this is the smaller will be the change in y as the marginal cost curve shifts. (Draw a diagram to show this.)

The market input demand curve

The market demand curve for a consumer good is derived by horizontally summing the individual demand curves. If an input is used only by firms which are monopolists in their respective output markets and these are unrelated in demand then the input market demand curve can be derived in the same way by horizontal summation of the individual firms' demand curves (see Question 4, Exercise 10A). Apart from this somewhat unlikely case the input market demand curve is *not* the horizontal sum of individual firms' demand curves. The reason can be seen if we examine an input used only in production of one type of good which is sold on a competitive market by the many firms producing it. Consider Fig. 10.2, in which the curve $\sum D_1^{j0}$ is the horizontal sum of the individual firms' demand curves for input 1 and, at the initial price p_1^0, $\sum z_1^{j0}$ is demanded. Each individual demand curve is like the dashed line D_1 in Fig. 10.1, which shows how each firm's *ceteris paribus* demand varies with p_1. It is assumed in drawing D_1 that the firm regards the price of output as unalterable by its actions, so that the D_1^{j0} curve of each firm is derived with the price of output held fixed. Hence the $\sum D_1^{j0}$ curve is also based on the assumption that the price of output is constant. But when the input price p_1 falls to p_1^1 all firms' average and marginal cost curves alter. In the long run, when the number of firms and the size of firms' plants can be varied, the change in total output is determined by the change in the firms' average cost curves (see Chapter 8). Average cost curves shift down when the price of the input falls (section 6B) and the long-run supply of the industry increases. The price of output will therefore fall, shifting the MRP_1, D_1^j

Figure 10.2



and $\sum D_1^j$ curves to the left. This is shown in Fig. 10.2, where $\sum D_1^{j1}$ is the new horizontal sum of the new individual D_1^{j1} curves and the amount of input demanded at p_1^1 is $\sum z_1^j$. We see that the market input demand curve is D, which is steeper than the $\sum_i D_1^j$ curves. (Compare the derivation of the market supply curves in Chapter 8.)

The market input demand curve is therefore determined by the demand conditions in the market for the output produced by the input, the change in firms' cost curves caused by the change in the input price and by the elasticity of substitution among the inputs.

EXERCISE 10A

1. The D curve in Fig. 10.2 is the long-run market demand curve for the input since it shows how demand varies when all inputs and the number of firms are freely variable. Construct the short-run market demand curve showing how demand varies with the price of the input when the other input is fixed and the number of firms does not alter. Would you expect this curve to be more or less elastic than that in Fig. 10.2?
2. Suppose that the fall in p_1 leads to a shift in the market demand curve for z_2. Under what circumstances will this change the price of z_2? What effect will this have on the market demand curve for z_1?
3. Explain why, when the buyers of an input are monopolists in markets unrelated to each other in demand, the input market demand curve can be obtained by horizontal summation of the individual firms' demand curves.
4. *Substitutes and complements*. Input i is a substitute (complement) for input k if an increase in p_k increases (reduces) the firm's profit-maximizing demand for input i. If i is a substitute for k does this imply that k must be a substitute for i? (Compare the definition of Marshallian substitutes and complements for the utility-maximizing consumer.)

B. Monopsony

Monopsony is defined as a market in which there is a single buyer of a commodity who confronts many sellers. Each of the sellers treats the market price of the good as a parameter and so there is a market supply curve for the good which is derived in the usual way from the supply curves of the individual suppliers. The single buyer of the good faces a market supply function relating total supply to the price he pays. This can be expressed (in the inverse form) as

$$p_1 = p_1(z_1) \qquad p_1' > 0 \tag{B.1}$$

where [B.1] shows the price of the commodity which must be paid to generate a particular supply. Note that the buyer is assumed to face an upward-sloping supply curve; the price required is an increasing function of the amount supplied.

The market price of the monopsonized input is determined, given the supply function [B.1], by the buyer's demand for z_1. We assume that the monopsonist is a profit-maximizing firm, in which case the demand for z_1, and hence its price, is determined by the firm's profit-maximizing decision. In the two-input, single-output case the firm's problem is

$$\max_{z_1, z_2} R[f(z_1, z_2)] - p_1(z_1)z_1 - p_2 z_2 \tag{B.2}$$

This is very similar to problem [A.1] except that p_1 depends on z_1 because of [B.1]. Input 2 is assumed to be bought on a market in which the firm treats p_2 as a parameter. The firm's output may be sold in a competitive or a monopolized market: monopsony need not imply monopoly. The firm may, for example, be the only employer of labour in a particular area but be selling its output in a market where it competes with many other firms, and labour may be relatively immobile.

Necessary conditions for a maximum of [B.2] are (when both z_1 and z_2 are positive at the optimum)

$$R'f_1 - (p_1 + p_1'z_1) = 0 \qquad [B.3]$$

$$R'f_2 - p_2 = 0 \qquad [B.4]$$

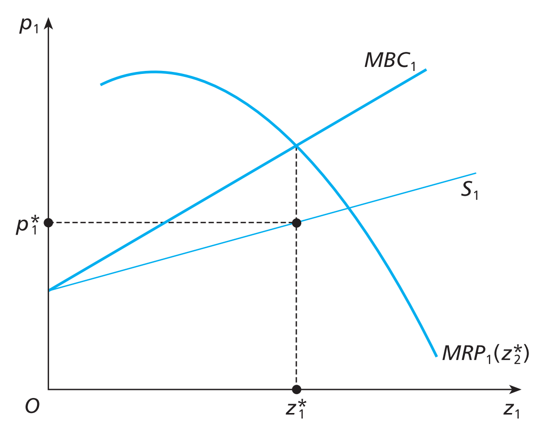
[B.4] is identical with [A.2], but [B.3] is not, because of the $p_1'z_1$ term. The firm will adjust its use of an input up to the point at which the additional revenue from a unit of the input equals the extra cost incurred. When the price of the input is independent of the number of units bought the cost of an extra unit is its price. But when the firm faces an upward sloping supply curve for the input it must pay a higher price for *all* units bought to ensure supply for an extra unit. This means that the cost of an extra unit of z_1 is the price paid for that unit *plus* the increased cost of the units already bought, which is the rise in p_1 times the amounts of z_1 bought: $p_1'z_1$. Hence writing MRP_i for the marginal revenue product of input i and MBC_i for the marginal cost of z_1 to the buyer (marginal buyer cost) the firm maximizes profits by setting

$$MRP_1 = MBC_1 > p_1 \qquad [B.5]$$

$$MRP_2 = MBC_2 = p_2 \qquad [B.6]$$

This equilibrium is illustrated for the monopsonized input in Fig. 10.3. S_1 is the supply curve of z_1 and MBC_1 plots the marginal buyer cost $(p_1 + p_1'z_1)$ of the single buyer. $MRP_1(z_2^*)$ is the marginal revenue product curve for the input given the optimal level of z_2. The firm maximizes profit with respect to z_1 by equating MRP_1

Figure 10.3



to MBC_1 at z_1^*. To generate this supply of z_1 the firm will set the monopsony price $p_1^* = p_1(z_1^*)$.

The analysis of the single buyer confronting many competitive sellers is rather similar to the analysis in Chapter 9 of the single seller confronting many competing buyers. In each case the firm realizes that it faces a curve relating price to quantity which summarizes the response of the competitive side of the market and the firm sets the quantity or price in the light of this interdependence of price and quantity. In each case the market price overstates the *marginal* profit contribution of the quantity and in each case this overstatement depends on the responsiveness of quantity to changes in price. Under monopoly the firm equates $MR = p[1 + (1/e)]$ to the marginal cost of output, and the less elastic is demand the greater is the difference between price and marginal cost. [B.5] can be rewritten in a similar way. Defining the elasticity of supply of z_1 with respect to price as

$$e_1^s = \frac{dz_1}{dp_1} \cdot \frac{p_1}{z_1} \qquad [B.7]$$

we see that

$$MBC_1 = p_1 + \frac{dp_1}{dz_1} \cdot z_1 = p_1\left(1 + \frac{1}{e_1^s}\right) \qquad [B.8]$$

and so [B.5] becomes

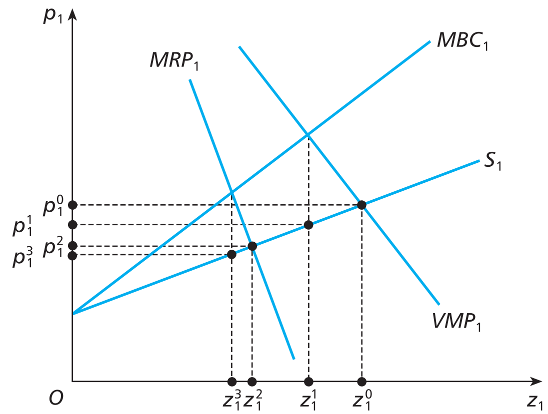
$$MRP_1 = p_1\left(1 + \frac{1}{e_1^s}\right) \qquad [B.9]$$

The less elastic is supply with respect to price the greater will be the difference between MRP_1 and the price of the input. In other words, the less responsive to price the input supply is, the greater the excess of the value of the marginal unit of the input over the price it receives. This could be regarded as a measure of the degree of 'monopsonistic exploitation'.

The effect of monopsony and output monopoly on the input market

When the output is produced from two or more inputs the analysis of the effect of both monopsony and output monopoly on the price of one of the inputs is complicated, because the use of the other input is likely to change as well, thus shifting the MRP_1 curve. If the output is produced by a single input this complication does not arise, and it is possible to show the implications of monopsony and output monopoly in a single simple diagram such as Fig. 10.4. Since there is a single input z_1 its marginal product depends only on z_1 and so the marginal revenue product MRP_1 and the value of the marginal product VMP_1 curves in Fig. 10.4 are fixed. S_1 and MBC_1 are supply and marginal buyer cost curves. There are four possible equilibria in this input market, where suppliers treat the price of z_1 as a parameter. If the firm also treats p_1 as given, i.e. if it acts as if it has no monopsony power and if it also treats output price as a parameter then VMP_1 is its demand curve for z_1 and the market price is p_1^0. If the firm uses its monopsony power but continues to treat output price as a parameter it will equate VMP_1 to MBC_1 and set the price p_1^1. If the firm monopolizes its output market but regards p_1 as a parameter its demand curve for z_1 is MRP_1 and the price of z_1 is p_1^2. Finally, if the firm exercises both monopoly and

Figure 10.4



monopsony power it equates MRP_1 and MBC_1 and sets a price p_1^3. We see therefore that the price in an input market is reduced below the competitive level p_1^0 by both monopsony and monopoly power. The less elastic are the demand for output and the supply of input functions, the lower will be the price paid to suppliers of the input.

EXERCISE 10B

1. Under monopoly there is no supply curve for the monopolized output in the sense of a one to one correspondence between market price and quantity produced. Show that under monopsony there is no market demand curve for the monopsonized input.
2. Analyse the monopsonist's cost-minimization problem and the monopsonist's cost curves. (*Hint*: what does [B.1] imply about the isocost curves?) Show that at the monopsony equilibrium the input price ratio is not in general equal to the ratio of marginal products.
3. What is the effect of minimum wage legislation on the level of employment in (a) a competitive labour market, (b) a monopsonized labour market?
4. *Discriminating monopsony*. Suppose that a monopsony employer can segment its workers into two groups (men and women) and pay the two groups different wages. Show that it will pay a lower wage to the group with the less elastic supply function. What would be the effect on employment and wages of legislation which made it illegal to discriminate in this way?
5. Show that in the multi-input case, where the firm uses n inputs to produce its output and has monopsony power only in the market for input 1, that it is possible to use indifference curves in (p_1, z_1) space to analyze its behaviour in the markets for input 1. (*Hint*: maximize profit for given (p_1, z_1) and then use the envelope theorem.)
6. Show the welfare loss due to monopsony, and compare it with the welfare loss due to monopoly.