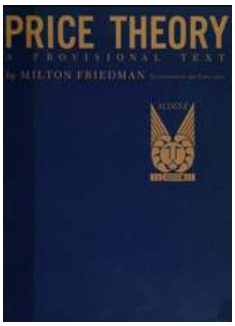

The Theory of Marginal Productivity and the Demand for Factors of Production

in Milton Friedman, *Price Theory,* 1976

The case just considered—of fixed proportions among the factors of production in each industry separately—is a special case of the general theory of marginal productivity. In that special case, an increase in the supply and consequent reduction in price of a particular factor increases the quantity of the factor demanded solely through substitution in consumption: the lowered price of this factor makes the products in whose production it is relatively important cheaper relative to other products, and this leads consumers to substitute them for the other products. More generally, substitution will also take place in production. For each product separately, producers will have an incentive to substitute the relatively cheaper factor for others, and in general it is possible to do so, at least to some extent.

The "theory of marginal productivity" is sometimes described as the "theory of distribution." This statement is misleading. The theory of marginal productivity at most analyzes the factors affecting the demand for a factor of production. The price of the factor depends also on conditions of supply. The tendency to speak of a "marginal productivity theory of distribution" arises because in many problems and contexts it is useful to think of the supply of factors of production as given quantities, as perfectly inelastic. This is particularly relevant if the problem concerns both market and nonmarket uses of factors of production. In such cases, there is a sense in which supply conditions determine only the quantity of the

factors, while demand conditions (summarized in the phrase *marginal productivity*) determine price. But note that even in this case a change in supply—in the fixed amount of a factor—will change the price of the factor, unless demand is perfectly elastic. So it will be better in all cases to regard the theory of marginal productivity as a theory solely of the demand for factors of production. A complete theory requires a theory of both the demand for and the supply of factors of production.

In the main, the marginal productivity theory is a way of organizing the considerations that are relevant to the demand for a factor of production. It has some, but not very much, substantive content. This is reflected in our ability to speak of an abstract factor of production—factors A or B, etc.—without having to specify it any further. To say that wages are equal to the value of the marginal product, for example, says relatively little in and of itself. Its function is rather to suggest what to look for in further analysis. The value of the marginal product is not a single number determined by forces outside the control of individuals or society; it is rather a schedule or function of many variables. It will depend on the quality and quantity of workers, the quantity of capital they have to work with, the quality of the management organizing their activities, the institutional structure of the markets in which they are hired and the product sold, etc. In concrete applications, the basic substantive issue is likely to be what determines the marginal productivity and how the changes under consideration will affect it.

The analysis of the demand for factors of production is closely related to the analysis of the supply of products, and, indeed, is really only another way of looking at or organizing the same material. In analyzing the supply curve of a product, we are interested in tracing the effect of changes in the demand for it under given conditions on the factor markets. In consequence, we direct attention to the output of the firm or industry and take for granted the changes in the quantity of the various factors of production employed and in their prices as demand for the product and with it output of the product change. In distribution theory, our interest centers in the factor markets, and so we concentrate attention on a different facet of the same adjustment by the firm. To put it differently, the statement that a firm seeks to equate marginal factor cost to marginal value product is another way of saying that it seeks to equate marginal revenue to marginal cost rather than an additional condition on the equilibrium of the firm.

As in the theory of supply of products, there are several different levels of analysis, and the demand curve will change as we shift our point of view from the reactions of the firm to the reactions of an industry. And in this case, there is also a third level that is significant, the economy as a whole, since many different industries may employ what for any particular problem it is useful to regard as a single factor of production.

The demand curve for a factor of production by a particular group of

demanders (which may as a special case be a single firm) shows the maximum quantity of the factor that will be purchased by the group per unit of time at each price of the factor, for given conditions. As in previous problems, there is some uncertainty how it is best to specify the "given conditions." They clearly include (1) technical knowledge—the "state of the arts" or the production functions of actual and potential firms; and (2) the conditions of demand for the final producst. The uncertainty attaches primarily to the handling of other factors of production. One procedure is to take as given (3) the supply curves of other factors of production to the group of demanders considered. The problem with item 3 is that at least for the economy as a whole, constant supply curves for other factors may mean an increase in the total resources of the community as we move along the demand curve for this factor in response to an increase in its supply. The alternative is to take the "total resources" of the community, appropriately defined, as fixed, and thus to regard changes in the supply of this factor as changes in its supply relative to other factors but not in the total resources of the community. We shall for the most part beg this question, since most of our discussion wold be unaffected by its resolution.

It should be noted that the precise meaning of items 2 and 3 as stated above depends on the particular group of demanders considered. To a firm selling its product on a competitive market, item 2 is equivalent to holding the price of the product constant; to an industry producing a single product, it is equivalent to holding the demand function for the product constant. To a firm, item 3 is equivalent to holding constant the *price* of factors that it buys on competitive markets, and the *supply curves* of other factors. In particular, it is equivalent to holding constant the amount of "fixed" factors. To an industry, item 3 may still be equivalent to holding constant the price of some factors, namely those of which the industry as a whole buys only a small part of the total, so that the supply curve of the factor to the industry is effectively horizontal. To the economy as a whole, especially if this is regarded as including the nonmarket as well as the market sector, item 3 may be equivalent to holding the quantities of other factors constant (though this obviously depends critically on how the uncertainty about item 3 is resolved).

Note also that the difference between short- and long-run demand curves is in the precise content of items 2 and 3.

Finally, the list of "other things" is not exhaustive for all problems. For many problems, for example, it will be desirable to give special consideration to closely related factors of production.

The Individual Firm

In analyzing the demand for factors of production by the individual firm, we may again start with the fundamental equations defining its equilibrium position:

$$(1) \qquad \frac{1}{MR} = \frac{MPP_a}{MFC_a} = \frac{MPP_b}{MFC_b} = \frac{MPP_c}{MFC_c} = \ldots = \frac{1}{MC}$$

$$(2) \qquad x = f(a, b, c, \ldots)$$

If there is competition on the product market, MR will, of course, be equal to the price of the product or p_x; if a factor is purchased on a competitive market, its marginal factor cost will, of course, be equal to its price. For the time being, we may suppose that any factors are either purchased competitively, so that we can replace their marginal factor costs by their prices, or are "fixed" to the firm, so that we can regard the quantity (or maximum quantity) available as given. The shorter the run, the larger the number of factors the available quantity of which are to be regarded as given, and conversely. Indeed, as we saw in the discussion of supply, this is essentially the definition of length of run.

From a purely formal point of view, the demand curve for a factor of production by an individual firm can be derived immediately and directly from equations 1 and 2. Let the firm be selling on a competitive market, let factors A, B, . . . be purchased competitively, and A′, B′, . . . be the factors whose quantities are fixed to the firm for the run considered. Then the demand curve for, say, factor A, will be given by

$$(3) \qquad a = h(p_a; p_x; p_b, \ldots; \bar{a}', \bar{b}', \ldots),$$

where $\bar{a}'$, $\bar{b}'$, . . . stand for the fixed quantities of these factors available to the firm. Now this equation is simply a rearrangement of equations 1 and 2. For any given set of values of the independent variables in equation 3, equations 1 and 2 can be solved to give the quantities of the various factors employed and the quantity of product produced. This can therefore be done for every set, and the quantity of A employed can be expressed as a function of these variables, as in equation 3.

If the product market is not competitive, p_x in equation 3 is replaced by the demand curve for X; if the factor market for B is not competitive, p_b is replaced by the supply curve of B to the firm, etc.

We shall, however, gain insight if we proceed more slowly and less formally to this final result. It is helpful to rewrite equation 1 in the following form:

$$(4) \qquad \begin{aligned} MR \cdot MPP_a &= MFC_a, \\ MR \cdot MPP_b &= MFC_b, \\ &\ldots\ldots\ldots\ldots\ldots \end{aligned}$$

If we have competition on both factor and product markets, these reduce to

$$(5) \qquad \begin{aligned} p_x \cdot MPP_a &= p_a, \\ p_x \cdot MPP_b &= p_b, \\ &\ldots\ldots\ldots\ldots, \end{aligned}$$

or the familiar equations that marginal value product of a factor equal its marginal factor cost, in the general case, or value of the marginal product of a factor equal the price of the factor, in the competitive case.

Consider the first of equations 5. This shows a relation between the price of A and its quantity: for each price of A, it shows the quantity of A that would have a marginal product whose value would be equal to that price of A. It is tempting to interpret this as the demand curve of the firm for A, and, indeed, the demand curve for A is often loosely described as given by the value of marginal product curve for A. But this is strictly correct only in one special case: that in which the firm is not free to vary the quantity of any factor other than A, i.e., all other factors are "fixed." In that case, the only adjustment the firm can make to a change in the price of A is to change the quantity of A employed; all equations other than the first in 5 become irrelevant and are replaced by equations of the form: $b' = \bar{b}'$. The firm will move along the marginal product curve for A until the value of the marginal product is equal to the new price of A and this curve will be its demand curve.

Suppose, however, that not all other factors are fixed, that, for example, B can be varied and is purchased competitively. Hypothetically, suppose the price of A to fall and the firm to make its first adjustment along the marginal product curve for A, so that it increases the employment of A until the marginal product falls enough to satisfy the first of the equations 5. The remaining equations are now no longer satisfied, despite the fact that they initially were and that the quantity of other factors is, by assumption, the same as initially. The reason, of course, is that the marginal product of the other factors depends on the amount of A employed. Some other factors will be close substitutes for A; the marginal product of these will be reduced by the increased employment of A. Other factors will tend to have their marginal product increased by increased employment of A, since in effect there is less of them per unit of A. In general, we may expect the latter effect to dominate, as should be clear from our earlier discussion of the law of variable proportions. The firm will therefore want to change the amount of other factors employed, reducing the employment of those whose marginal product is now less than initially and increasing the employment of the others. But these adjustments will in turn change the marginal productivity of A, tending to increase it for each quantity of A; both the reduction in quantity of competitive factors and the increase in quantity of others operate in general in this direction. The final position will be one at which the equations 5 are satisfied. At this final position, the price of A is equal to the value of its marginal product, yet this point is not on the initial value of marginal product curve. The essential point is that the marginal product curve is drawn for fixed quantities of other factors; the demand curve, in our special case, for fixed prices of variable factors.

Figure 9.1 summarizes the situation. The solid lines are value of mar-

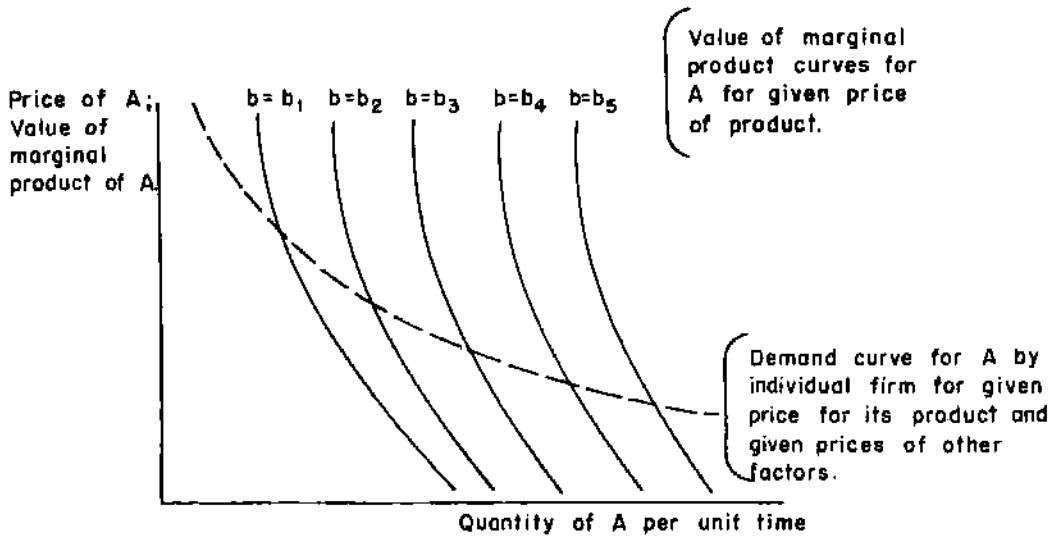

FIGURE 9.1

ginal product curves for different amount of B (used here to stand for all other factors). The dashed line is a demand curve for A by the individual firm. Since competition is assumed on both product and factor markets, the price of the final product and of other variable factors of production is the same at all points on it. But, as seen, the quantity of B is not; it varies in such a way as to keep equations 5 satisfied. Accordingly, the demand curve cuts through the value of marginal product curves, in general going through successively higher curves as the price of A falls.

If demand for the product is not competitive, given demand conditions imply different prices as the output varies. Marginal value product diverges from value of marginal product and is the quantity relevant to the individual firm. With this change in nomenclature, Figure 9.1 can summarize the situation, except that there is no longer any presumption that the quantities of other factors in general will increase as the price of A falls or that the demand curve will pass through marginal value product curves for successively higher quantities of b. The reason is that while an increase in the quantity of A employed in response to a decline in its price would in general raise the marginal physical product of given quantities of the other factors, it will also mean an increase in output, a decline in the price of the product, and perhaps also a decline in marginal revenue. This may offset or more than offset the rise in the marginal physical product of the other factors and so lead to a decline in the quantity of those employed. We shall meet an analogous effect again when we combine competitive firms and examine the demand curve of an industry.

If the market for factor A is not competitive, so that the firm is a monopsonistic purchaser of A, how much the firm would employ at various prices is no longer a meaningful or relevant question, since the firm affects the price by its action and determines the price and quantity simultaneously.

The corresponding question is then the reaction of the firm to changes in the supply of the factor, and these changes cannot be summarized by the single parameter, price of the factor, as they can when the market for A is competitive. What would otherwise be the "demand curve" for factor A still retains significance. It shows the quantity that would be purchased at various marginal factor costs. However, in so interpreting it, it must be kept in mind that a single supply curve will in general have different marginal factor costs for different quantities supplied, and that many different supply curves can have the same marginal factor cost for the same quantity supplied. (This case is discussed more fully in the following pages.)

In the above analysis we have taken as our (hypothetical) first approximation the change in quantity of A with fixed quantities of other factors. This, of course, implies that even in the first reaction, the firm changes its output. There is then an additional change in output when the quantities of other factors are adjusted and the quantity of this one readjusted. Another way of breaking down the reaction of the firm is to take as the first approximation the change in the purchase of A that would occur if the firm kept its output the same. This is, as it were, the pure substitution in production effect. If the price of A falls and output is kept constant, A will be substituted for other factors, implying in general a movement from the initial marginal productivity curve for A to a lower one. At this point, all the equalities in equation 1 except the first are satisfied: the firm is producing this output in the optimum manner, given the new price of A. The reduction in the price of A has, however, increased the common value of the ratios of marginal physical products to marginal factor costs; it has increased the number of units of output attainable by spending an additional dollar, that is, it has reduced marginal cost. Marginal cost is therefore now lower than marginal revenue, which means that output is less than the optimum. An expansion effect is therefore added to the substitution effect. In expanding, the firm will employ more of all factors, in general. This increase in employment of A adds to the increase due to the substitution effect. For other factors, it offsets the initial decrease. As before—since the final position is the same—the final position will tend to involve the employment of more of the other factors in general but may involve the employment of less of close substitutes for A.

Figure 9.2 shows the three curves we have been talking about. P is the initial point of equilibrium, and so all three pass through it. The steepest (at P) shows the amount of A that the firm would purchase if it kept output constant; the next steepest shows the amount of A it would purchase at given product prices if it kept the amount of other factors employed constant; the flattest shows the amount of A it would purchase at given product price and given prices for other factors.

You will find it instructive to check and prove statements made about the order of these curves; to show that monopoly on the product market

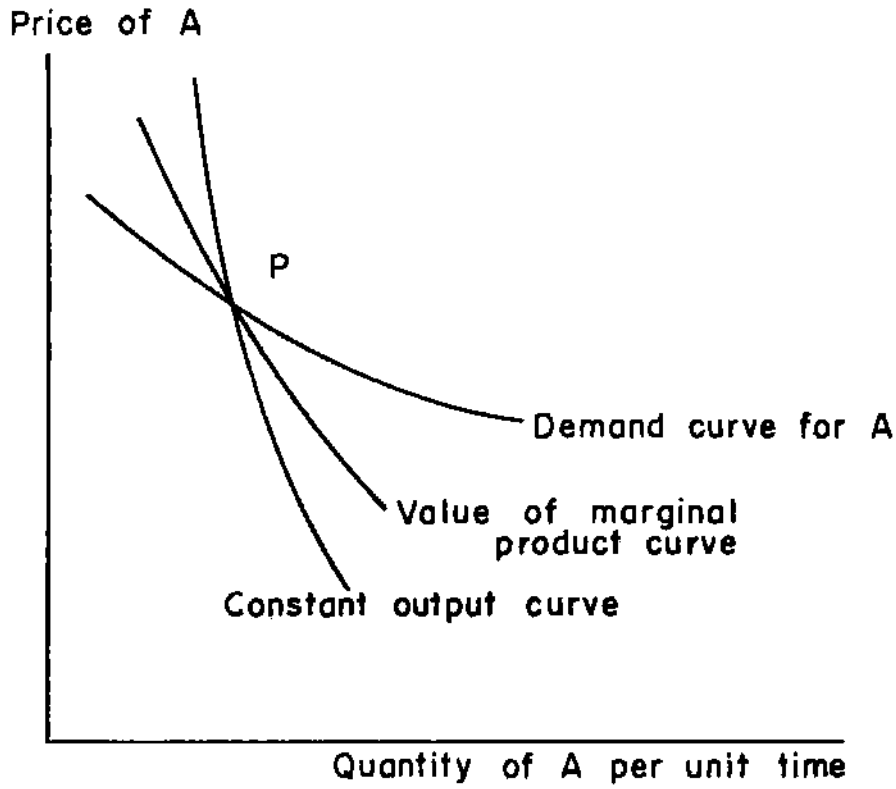

FIGURE 9.2

can change the order of these curves; and to translate the above in terms of production indifference curves.

The Competitive Industry

In reacting to conditions on the product and factor markets as they see them, individual firms obviously change those conditions: they impose external effects on themselves and other firms in their own industry, and the combined reactions of all firms in a single industry impose external effects on other industries.

Let us first confine our attention to a single industry. In response to a decline in the price of A, each individual firm seeks to move along its demand curve for A, which will involve expanding its output. But all individual firms obviously cannot do so without changing the conditions for which those demand curves are drawn. For one thing, the increased output by all firms will lower the price of the product, and this will shift the demand curve for A of each individual firm downward, since each of these is drawn for a fixed price of the product. This would be the only external effect to be considered at this stage if the industry uses no specialized (variable) factors, i.e., if it employs only a small part of the total available supply of all other (variable) factors, so that their supply curves to the industry can be taken as essentially horizontal. The final increase in the amount of

A purchased by all firms in response to a reduction in the price of A (to this industry alone) will be less than that shown by the sum of the demand curves for the individual firms in the industry, as shown in Figure 9.3. The flattest curve through P is the sum of the demand curves for A of the individual firms in the industry; the next steepest curve is the demand curve for A of the industry as a whole. Through each point of the demand curve of the industry there passes such a sum of demand curves of the individual firms, showing the sum of the amounts the individual firms would want to employ if the price of the product were not altered as a consequence of their increased production. The more elastic the demand for the product of the industry, the less will tend to be the divergence between these two curves.

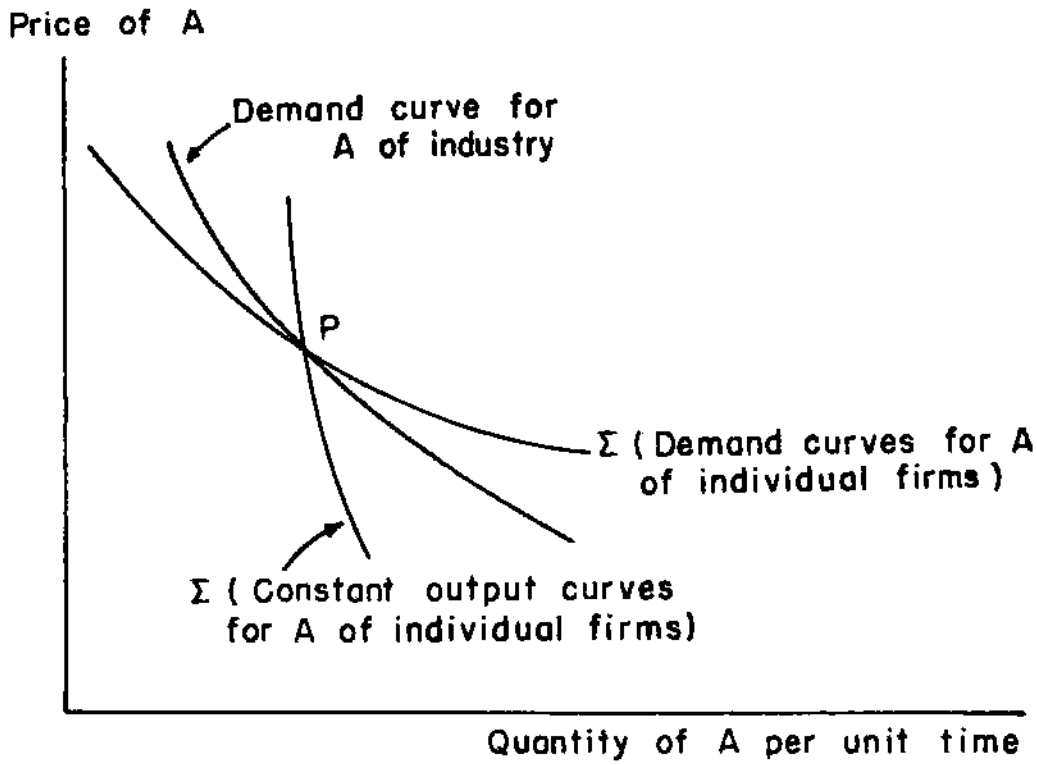

FIGURE 9.3

The changes in the price of the product will affect not only the amount of A employed but also the amount of all other factors. As noted earlier, with a constant price for the product, there is a presumption that the demand for other factors will on the average rise with a decline in the price of A. There is no longer any such presumption, once account is taken of the effect of the expansion of output on the price of the product. This can be readily seen by taking the extreme example in which demand for the product is perfectly inelastic. In this case, the price of the product will fall to whatever extent is necessary to keep total output unchanged, and the demand curve for A of the industry will be approximately the same (in this special case of given other factor prices to the industry) as the sum of the constant output curves for the individual firms drawn earlier. The quali-

fication "approximately the same" is necessary because all firms in the industry need not have the same production functions, and the decline in the price of A may affect different firms differently. In consequence, the unchanged total output of the industry may conceal decreases in output by some firms, balanced by increases by other firms. But as we saw before, these curves imply the substitution of A for all other factors as a group (though not for every single one, since there may be some highly complementary with A), and so reduced employment of other factors on the average. As this example implies, the demand curve for A of the industry will, as shown on the figure, tend to be between the sum of the constant output curves and the sum of the demand curves of the individual firms, its exact position depending on the elasticity of the demand for the product.

If the industry uses some specialized resources, a further effect will be produced on the prices of these resources. The remarks in the preceding paragraph show that we cannot specify the direction of effect on the average. The demand for specialized resources that are highly competitive with A will tend to fall with a reduction of the price of A under almost any circumstances, and so their prices will tend to fall. Taken by itself, the reduction of the price of highly competitive factors reduces the incentive to substitute A for them, but also reduces marginal cost and so increases the incentive to expand output. There is perhaps a presumption that the combined effect is likely to be a smaller increase in the employment of A than if the price of these highly competitive factors had remained unchanged. The demand for specialized resources that are highly complementary with A will tend to rise with a reduction in the price of A under almost any circumstances, and so their prices will tend to rise. This tends clearly to make for a smaller increase in the employment of A than if the price of these highly complementary factors had remained unchanged, both by reducing the advantage in substituting A for other factors and by raising marginal cost. The demand for the remaining resources may move in either direction. The more elastic the demand for the product, the more likely is the demand for, and price of, these other resources to rise, in which case the aggregate effect of the changes in prices of specialized resources will be to make for a smaller increase in the employment of A than if all resource prices other than that of A had remained unchanged. On the other hand, the more inelastic the demand for the product, the more likely is the demand for, and price of, these other resources to fall, and they may fall enough to lead to a greater increase in the employment of A than if all resource prices other than that of A had remained unchanged.

In addition to these external pecuniary effects of the changed pattern of production stimulated by the fall in the price of A, there may, of course, also be external technical effects of the kinds considered in the discussion of supply curves. These may operate in either direction on the employment of A.

So long as we restrict ourselves to the effects of the reactions within a single industry to the decline in the price of A, the net result will be an increased purchase of A and an increased output of the product. The effects external to the individual firm but internal to the industry may make these increases smaller or larger than they would have been without the external effects, but they cannot—aside perhaps from pathological special cases—convert them into decreases. It is precisely the increase in output that makes the price of the product decline and so makes expansion seem less attractive to the individual firm than it would at the initial price; and the prices of other resources cannot on the average rise except as a result of a generally increased demand for them, which also means an increase in output. But while this is true for the industry as a whole, it need not be true for every single firm. The different firms may be using different techniques of production and combinations of factors. Some, for example, may be using techniques that involve particularly heavy use of a factor that rises in price as a result of external effects, and for such firms this rise in price may be enough to produce a decline in output. Some may be specially affected by external technical effects, and so on.

The Economy as a Whole

Much of the preceding discussion applies equally in passing from each industry considered separately to the economy as a whole. Each industry in reacting to the change in the price of A imposes external effects on itself and other industries.

Resources highly competitive with A will obviously tend to fall in price, and resources highly complementary to A to rise in price, almost no matter how (i.e., relative to what) their price is measured and what their conditions of supply are. There is little to add to our previous discussion about such resources. What, however, about all resources other than A, in general? Obviously, the fall in price of A *is* a rise in the price of other resources relative to A, and hence relative to the average price of all resources, and we are talking throughout only about relative prices. The effect on the average price of all resources (including A) relative to the average price of final goods and services depends to some extent on our initial assumptions about the source of the increase in the supply of A that produces the decline in its price (i.e., about the meaning of given conditions of supply of resources). If the increase in supply of A is taken to be solely an increase in relative supply compensated by a decrease in the supply of all other factors sufficient to keep total resources available unchanged in an appropriate sense, then in that same sense aggregate output will be unchanged, and hence the average price of all resources will remain unchanged relative to the average price of goods and services. This, however, means that the average price of resources other than A rises relative to the

average price of final goods and services. If the increase in supply of A is supposed to be a net addition to the total resources of the community, with the supply of other resources unchanged, then it obviously permits a greater aggregate output. It is not clear what effect this will have on the average price of all resources relative to the price of final goods and services; it is clear, however, that the average price of all resources other than A will rise relative to the average price of final goods and services, as in the preceding case.[1] The important thing throughout is to recognize that we cannot speak about changes in "price" for the economy as a whole without defining the base relative to which price is measured.

As just noted, according to at least one possible interpretation of "given conditions of supply of factors of production," total output must in one sense remain the same despite the reduction in the relative price of A. Yet we saw in the preceding section that, if we took account only of the reactions within a single industry, the decline in the price of A would lead to an increase in output in each industry separately. Obviously there must be some external effects that reverse this result for some or many industries. External effects via the prices of particular resources highly competitive with or complementary to A may do so. More generally, however, the external effect that is important in this connection is on the relative prices of final goods and services and the associated substitution in consumption—the effect that we saw working in pure form in the case of fixed proportions. In the preceding section, we took account of the changes in resource prices that each industry produced by its own reactions. But these changes impose external effects on other industries. As we saw in the previous paragraph, a decline in the price of A means that the price of other resources in general rises relative to the price of A and also relative to the average price of all resources and to the average price of final goods and services. For products produced predominantly with these other factors, this rise in their price will more than offset the fall in the price of A. The cost of producing such products will therefore rise and their supply curves shift to the left. This occurs for these industries as a result not of their own reactions to the reduced price of A but because of external effects imposed on them by the reactions of other industries. The output of such industries will tend to decline, though their employment of A may not, for, like other industries, they have an incentive to substitute A for other factors. But the decline in output may be enough to produce also a decline in employment of A. Thus, while the demand curve for A by every industry separately is negatively sloped, a curve showing the amount of A finally employed by an industry at various prices (account being taken of all internal and external

1. Here as elsewhere in this section we are begging index number problems involved in measuring "average" price. These are of the same kind as those considered in the section on consumer demand.

effects) need not be negatively sloped. A particular industry may employ less A at a lower price for A. Of course, such cases will, for the usual reasons, be exceptions.

Essentially, these same comments apply if the increased supply of A is taken to be a net addition to the total resources of the community. In this case, total output can increase so it is not impossible for every industry to increase output. In general, however, if the output of those products produced with relatively little A does not decrease, it will tend to increase less than the output of products produced with relatively much A. This is about the only change in our exposition required.

If the increase in the supply of A is taken to be a net addition to the total resources of the community, and if we suppose the supply curves of other factors to be perfectly inelastic, competition to reign throughout, and external technical effects to be absent, then the demand curve for A for the economy as a whole is a value of marginal product curve for the economy as a whole. (You will find it instructive to see why each of these qualifications is necessary.) But it is not the sum of the value of marginal product curves for each firm separately. The curves for the individual firms not only are for given prices of products, they are also for given quantities of other resources employed by each firm separately. The curve for the economy, on the other hand, takes account of shifts of resources between firms and industries—it is for given quantities of other resources to the economy as a whole. It shows the value of the addition to the total product attainable by adding one unit of A to an unchanged quantity of all other resources, when the allocation of all resources between firms and industries is rearranged in the optimum fashion. The rearrangements that are possible depend, of course, on the assumed conditions and in particular on the adjustment time permitted, so they will be more extensive in the long than in the short run. For any run, the marginal product curve for the economy will tend to be more elastic than the sum of the marginal product curves for the firms, because some rearrangement is possible. And the longer the run, the more elastic the marginal product curve will be, because the wider will be the range of possible rearrangements.

Whichever assumption is made about the source of the increased supply of A, the demand curve for A for the economy as a whole will tend to be between the sum of the demand curves for A of all individual firms and the sum of the constant output curves for A of individual firms, so Figure 9.3 applies for the economy as a whole as well as for an individual industry.

Summary for Competitive Factor Markets

The demand curve for a factor of production for the economy as a whole reflects the effect of substitution in both production and consumption. If prices of products and other factors were unchanged, an increase

in the supply of a factor and consequent decline in price would give each firm an incentive to substitute that factor for other factors in producing its initial output and to expand its output. The attempt by many firms to make these adjustments will, however, raise the prices of other factors relative to product prices. This will raise costs of products produced with relatively little of the now cheaper factor relative to the costs of products produced with relatively much of the now cheaper factor, leading to corresponding changes in the supply of these products and thereby in their prices. This adds substitution in consumption between industries to substitution in production within firms and industries. These general effects will be complicated by special effects arising through special relations between factors in production and products in consumption. Factors that are close substitutes to the now cheaper factor in production will tend to fall relatively in price; factors that are highly complementary will tend to rise in price, with further secondary effects on prices of products in the production of which these factors are specially important. Similarly, products that are close substitutes in consumption for the products produced with relatively much of the now cheaper factor will tend to fall in price and products that are close complements to rise in price, and so on.

For each firm in the economy separately, equilibrium requires that marginal factor cost of the quantity of a factor employed be equal to the marginal value product of that quantity of the factor. For a competitive factor market, this means that at each point on the economy's demand curve for a factor, the price of the factor is equal to the marginal value product of the factor to each firm in the economy separately. This is the central proposition in the marginal productivity theory of the demand for factors of production. But as we have seen, it is a much more complex proposition than may at first appear. Different points on the demand curve involve not only different amounts of the factor in question but extensive readjustments in the organization and use of other factors, the scope of the adjustments depending on the length of run considered. The individual firm seeks equality between marginal value product and price of the factor. It achieves this equality by changing methods of production and output, and so marginal value product, not by changing the price of the factor, over which it has no direct control.

Monopsony

It may be worth considering in somewhat more detail the case in which the factor market is not competitive. Let us suppose that there is perfect competition among the sellers of a particular factor service, so that a supply curve for the factor is meaningful, but that a particular firm is the sole purchaser of the factor service in question: the case of monopsony. As noted above, in this case the question of how much the firm would

employ at various prices is no longer a meaningful question, since the firm determines the price and quantity simultaneously.

This case is depicted in Figure 9.4. The curve VV (labelled the *hypothetical demand curve*) is precisely what the demand curve for this factor would be if the firm were a competitive purchaser of the factor and is to be derived precisely as the demand curve for a factor was derived above. As will be seen from that derivation, it shows, for each quantity of A, the (maximum) amount that the firm can add to its revenue per unit increase in the amount of A employed. If the quantities of all other factors available to the firm were fixed, it would be a marginal value product curve for A. If the quantities of all other factors available to the firm are not fixed, the firm will vary the amount of these other factors employed as it uses more or less A in such a way as to keep their marginal value products equal to their marginal factor costs, so the curve VV is no longer a marginal value product curve, since the quantities of other factors are not the same for all points on it.

Curve SS is the supply curve of the factor A to the firm. It shows the maximum amount of the factor the firm could purchase at various prices. The ordinate of any point on SS is therefore the average cost per unit of A to the firm if it buys the amount given by the abscissa of that point. The ordinate of the curve marginal to SS (curve MM) gives, therefore, the amount that the firm would add to its costs per unit increase in the amount of A employed, or the marginal factor cost for various amounts of A. It obviously pays the firm to hire more A so long as the amount it thereby adds to its receipts (the ordinate of VV) exceeds the amount it adds to its costs (the ordinate of MM). The intersection of these two curves therefore gives

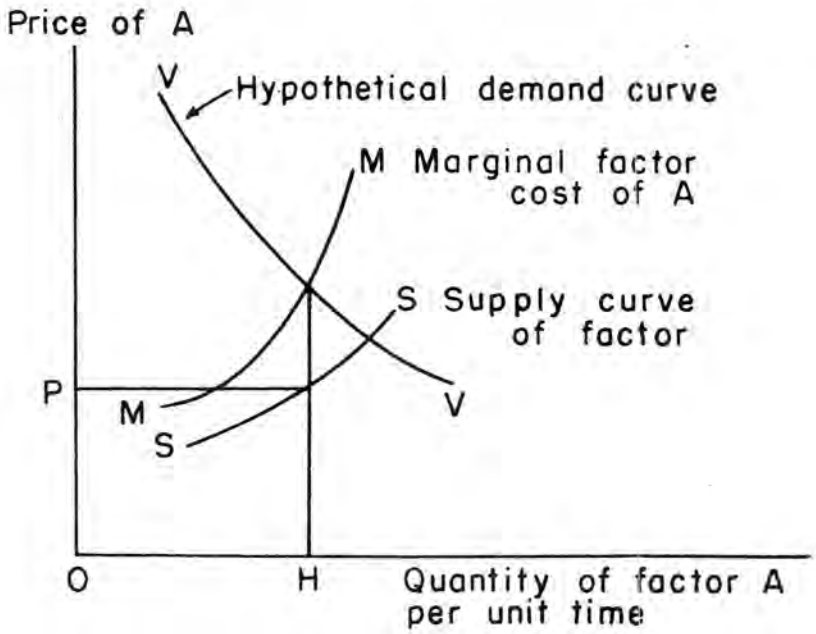

FIGURE 9.4

the optimum amount of A to employ, in this example, OH. The price paid per unit is then the ordinate of the supply curve at H, or OP.

Note that many different prices of the factor are consistent with the same VV curve and the same amount of A employed, since different supply curves can have the same marginal factor costs at a particular quantity of the factor. One example is depicted in Figure 9.5.

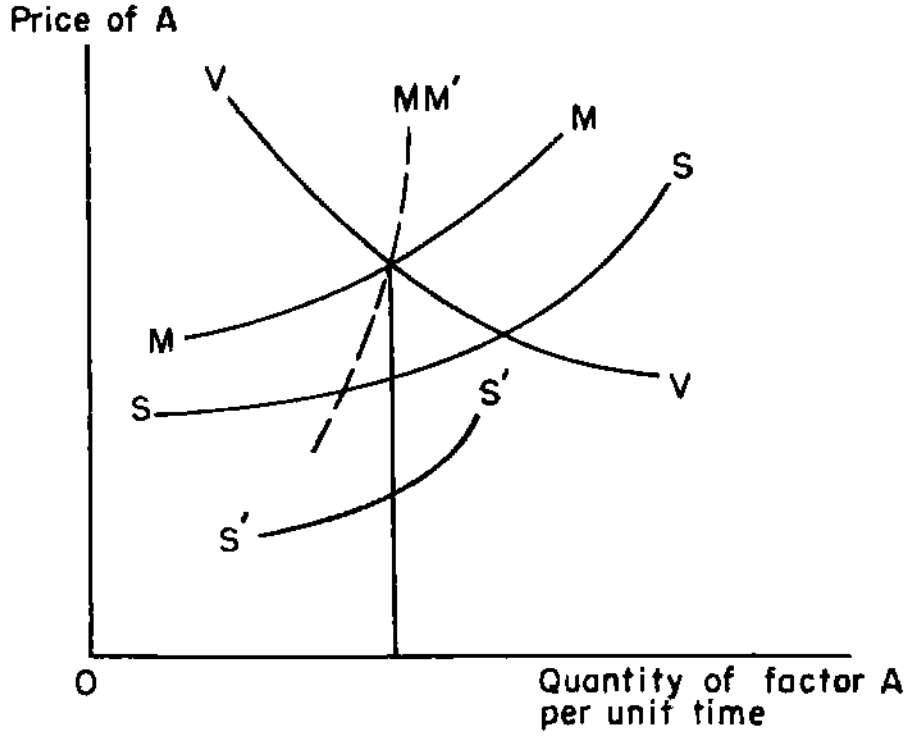

FIGURE 9.5

The factor market may fail to be competitive not because the firm is the sole purchaser of the factor but because there is a single seller. This case is essentially the same as monopoly in the sale of a product. The seller of the factor services is faced by a negatively sloped demand curve, and he will seek to equate marginal revenue with whatever he may regard as his marginal cost.

If a monopsonistic purchaser of a factor faces a monopolistic seller, we have a case of bilateral monopoly. The maximum return for the two monopolists together is given by the intersection of the marginal cost curve of the monopolistic seller and the VV curve of the preceding figures for the monopsonist buyer; this is the amount of the factor that would be used if the two monopolies combined. If the bargaining between the two monopolists does not lead to the use of this amount of the factor, the position is unstable, in the sense that there is a further gain that could be gotten by merging: that is, either monopolist can afford to offer the other a larger sum to buy his monopoly position than the value of that monopoly position to the latter, so there is a further deal by which both can gain. This

argument suggests that there is a uniquely determined quantity under such a bilateral monopoly, at least if merger is not ruled out by some non-economic obstacle; but it does not provide any means of determining how the monopoly returns will be divided between the two monopolists, and in this respect the solution must be regarded as largely indeterminate.

One interesting special application of this monopsony analysis has been to demonstrate the possibility that the imposition of a legal minimum wage higher than the prevailing wage can raise the amount of labor employed. This is illustrated in Figure 9.6. The solid curves apply in the absence of the minimum wage, so OA is the equilibrium amount of labor employed at a wage of OW_1. Suppose a legal minimum wage of OW_2 is imposed and effectively enforced. The supply curve to the firm is no longer SS, but now becomes OW_2 CS, since at a wage below OW_2 the firm cannot hire any labor. The marginal factor cost is then no longer MM but OW_2CDM, which intersects the VV curve at E. Therefore the equilibrium employment is OB, larger than previously, despite a rise in the wage rate

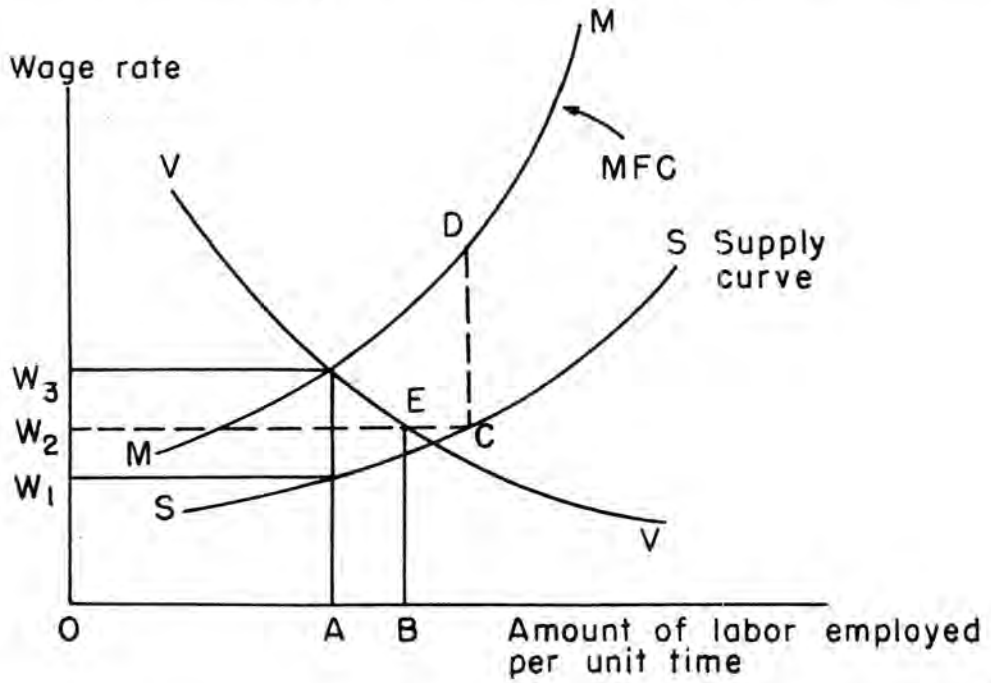

FIGURE 9.6

from OW_1 to OW_2. In order for this effect to occur, it is obvious that the minimum wage must be between W_1 and W_3. If it is above W_3, it will have the usual effect of diminishing employment.[2]

2. An instructive example of the subtleties embodied in such an apparently simple analysis and of how easy it is to go wrong is provided by a series of comments in the *American Economist,* which were triggered by Frank Falero, Jr.'s criticism of this analysis, "A Note on Monopsony, Minimum Wages, and Employment," *American Economist,* 10 (Fall 1966): 39–42. There have since been six further items: Richard C.

It is perhaps worth noting explicitly that this case is little more than a theoretical curiosum and cannot be regarded as of any great practical importance. This is partly because significant degrees of monopsony are particularly unlikely to occur for factors of the kind affected by minimum wage rates, partly because even in such cases there is no presumption the minimum wage rate will fall in the interval analogous to OW_1 to OW_3.

Yates and Benjamin J. Taylor, "A Note on Monopsony, Minimum Wages, and Employment: Comment," ibid., 11 (Fall 1967): 56–61; Frank Falero, Jr., "A Note on Monopsony, Minimum Wages, and Employment: A Reply," ibid., 12 (Spring 1968): 52; William P. Gramm and Robert B. Ekelund, Jr., "Monopsony, Minimum Wages, and Employment: A Reconsideration," ibid.: pp. 52–54; Ralph Gray and John E. Morrill, "A Note on Monopsony, Minimum Wages, and Employment: Extended," ibid.: pp. 55–64; William P. Gramm and Robert B. Ekelund, Jr., "Monopsony in a Muddle," ibid.: 12 (Fall 1968): 79–80; and Houston H. Stokes, "Monopsony, Minimum Wages, and Employment: A Further Comment," ibid.: 14 (Fall 1970): 79–81. For a comprehensive correct analysis, it is necessary to combine the final three items.