PART III

Theory of the Firm and Market Organization

The theory of business operation within an organized but uncontrolled market brings together the topics covered in Parts I and II. Demand, the broad topic of Part I, establishes the *revenue side* of business operation. Product demand determines either the quantity a firm can sell at any price it selects or the price a firm can obtain for any quantity it wishes to market. Market demand also helps to determine the type of industry structure that is likely to emerge in response to market conditions—whether the industry is likely to be competitive, monopolistic, or what have you.

The technical conditions of production and their reflection in business operating costs, the subject of Part II, establish the *cost side* of business operation and the *supply conditions* of the industry. Brought together, revenue and cost for the individual business concern and demand and supply for the entire market determine the market price and output for the firm and the industry. These forces, accordingly, also determine the allocation of resources among industries.

The general purpose of Part III is to discover how the price-output decisions of individual entrepreneurs and the structure of the market jointly determine the allocation of resources. This inquiry inevitably entails an appraisal of the *efficiency* with which resources are allocated.

Given the conditions of demand and supply, or of revenue and cost, analysis is based upon two fundamental assumptions.

Free Market. First, we assume each market is free and operates freely in the sense that no external control of market forces exists. One form of external control is government intervention. The federal government (and upon occasion state and local governments as well) imposes various types of regulations that condition the economic milieu in which firms operate and to which they must ultimately adjust. The regulation of so-called public utilities by both federal and state governments is one example—perhaps the most well-known example, but still only one. Parity-price programs and acreage controls are examples of regulations applied largely to agricultural markets. Tariffs and certain antitrust regulations are examples of controls principally applicable to industrial markets.

A third type of government control, at times more subtle than the explicit regulations mentioned above, is "moral suasion." By "moral suasion" one generally means the more or less effective control of business (and sometimes labor-union) activity by means of appeal to "social consciousness," "social responsibility," or "regard for public welfare." Incidences of moral suasion have run the gamut from President Dwight D. Eisenhower's rather weak appeal to all businessmen to resist price increases to President John F. Kennedy's forceful threat to steel producers.

Irrespective of their nature, all these controls establish artificial market conditions to which business firms must adjust—they help to establish the economic environment in which business decisions are made. So also does another type of external control somewhat more amorphous than government regulation. To set the stage for explanation, let us quote Adam Smith: "People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."[1] Simply, when only a small number of producers are in a certain field there is a strong incentive for them to act collectively to fix a monopoly or near monopoly price.

Such collective behavior imposes an external control upon the market and thereby limits the free exercise of market forces. It is perhaps for this reason that the Sherman Antitrust Act was passed in 1890, declaring it illegal to (a) enter into a contract, combination, or conspiracy in restraint of trade (sect. 1); and (b) to monopolize, attempt to monopolize, or combine or conspire to monopolize trade (sect. 2).

While many markets are not "free" in the sense used here, a vast number are. The objective is to analyze the efficiency of resource

[1] Adam Smith, *Wealth of Nations* (Cannan ed.; London: Methuen, 1904), Vol. 1, p. 130.

allocation in free markets. In case a market is not free, one may draw inferences concerning the relative efficiency of free as against controlled markets.

Profit Maximization. The second fundamental assumption underlying Part III is that entrepreneurs try to maximize profit.[2] Without doubt, not all producers try to maximize profit at all times. Entrepreneurs may indeed be seekers after multiple goals. Nonetheless, a business cannot long remain viable unless profits are earned; and it is a very unusual businessman who treats profits in a cavalier fashion.

Whether profit maximization is a reasonable assumption is a question long debated in economics. Several important criticisms have been brought to bear. However, these criticisms do not overcome the supremely important fact that the assumption of profit maximization is the only one providing a general theory of firms, markets, and resource allocation that is successful both in explaining and predicting business behavior.

[2] For the purpose of *explaining* business behavior it is sufficient to assume that entrepreneurs act *as if* they tried to maximize profit. For the purpose of predicting business behavior the *as if* assumption is the only justifiable one.

Chapter 9 THEORY OF PRICING IN PERFECTLY COMPETITIVE MARKETS

9.1 INTRODUCTION

"Perfect competition" is an exacting concept forming the basis of the most important model of business behavior. The essence of the concept, to be defined more fully below, is that the market is entirely *impersonal.* There is no "rivalry" among suppliers in the market and buyers do not recognize their competitiveness vis-à-vis one another. Thus in a sense perfect competition describes a market in which there is a complete absence of direct competition among economic agents. As a theoretical concept of economics it is diametrically opposite from the businessman's concept of competition.

In ordinary conversation the market for automobiles, say, or for razor blades would be described as highly competitive; each firm competes vigorously with its rivals, who are few in number. The principal area of competition is in advertising. The advertisement of one firm will state that its product is superior to those of its rivals, which it will virtually name. Firms also strive to attract customers by means of style features, method of packaging, claims of durability, and such. More generally, there is active, if sometimes spurious, quality competition. In fact, firms compete in almost every conceivable way except by means of price reduction.

The type of market just described, however, is far from what the economist means when he speaks of perfect competition. When this austere concept is used, no traces of personal rivalry can appear. All relevant economic magnitudes are determined by impersonal market forces.

9.2 PERFECT COMPETITION

Four important conditions define perfect competition. Taken together, these conditions guarantee a free, impersonal market in which the forces of demand and supply—or of revenue and cost—determine the allocation of resources and the distribution of income.

9.2.a—Small Size, Large Numbers

First, perfect competition requires every economic agent in the market to be so small, relative to the market as a whole, that it cannot exert a perceptible influence on price. From the standpoint of buyers this means that each consumer taken individually must be so unimportant he cannot obtain special considerations from the sellers. Perhaps the most familiar special consideration is the rebate, especially in the area of transportation services. But there can be many others, such as special credit terms to large buyers, or rendering free additional services. None of these can prevail if the market is perfectly competitive.

From the seller's standpoint perfect competition requires each producer to be so small that he cannot affect market price by changes in his output. As you have seen in Chapter 5, this provision means that each perfectly competitive producer believes his demand curve is a horizontal line. If all producers act collectively, changes in quantity will definitely affect market price. But if perfect competition prevails each producer is so small that individual changes will be unnoticed.

9.2.b—Homogeneous Product

A closely related provision is that the product of any one seller in a perfectly competitive market must be identical to the product of any other seller. This ensures that buyers are indifferent as to the firm from which they purchase.

In this context the word "product" has a much more detailed meaning than it does in ordinary conversation, where one might regard an automobile or a haircut as a product. For us, this is not adequate to describe a product: every changeable feature of the good must be included. When this is done it is possible to determine whether the market is characterized by a homogeneous, or perfectly standardized, commodity. If it is not, the producer who has a slightly differentiated product has a degree of control over the market and, therefore, over the price of his specific variety; he can thereby affect market price by changes in his output. This condition, as you have seen, is incompatible with perfect competition.[1]

9.2.c—Free Mobility of Resources

A third precondition for perfect competition is that *all* resources are perfectly mobile—that each resource required can move in and out of the market very readily in response to pecuniary signals.

[1] The classification of products and product differentiation is treated in much greater detail in Chapter 11.

The condition of perfect mobility is an exacting one. First, it means that labor must be mobile, not only geographically but among jobs. The latter, in turn, implies that the requisite labor skills are few, simple, and easily learned. Next, free mobility means that the ingredient inputs are not monopolized by an owner or producer. Finally, free mobility means that new firms (or new capital) can enter and leave an industry without extraordinary difficulty. If patents or copyrights are required, entry is not free. Similarly, if vast investment outlays are required, entry certainly is not easy. If average cost declines over an appreciable range of output, established producers will have cost advantages that make entry difficult. In short, free mobility of resources requires free and easy entry and exit of new firms into and out of an industry—a condition very difficult to realize in practice.

9.2.d—Perfect Knowledge

Consumers, producers, and resource owners must possess perfect knowledge if a market is to be perfectly competitive. If consumers are not fully cognizant of prices, they might buy at higher prices when lower ones are available. There will then not be a uniform price in the market. Similarly, if laborers are not aware of the wage rates offered, they may not sell their labor services to the highest bidder. Finally, producers must know their costs as well as price in order to attain the most profitable rate of output.

But this is only the beginning. In its fullest sense, perfect knowledge requires complete knowledge of the future as well as the present. In the absence of this omniscience, perfect competition cannot prevail.

The discussion to this point can be summarized by the following:

Definition: perfect competition is an economic model of a market possessing the following characteristics: each economic agent is so small relative to the market that it can exert no perceptible influence on price; the product is homogeneous; there is free mobility of all resources, including free and easy entry and exit of business firms into and out of an industry; and all economic agents in the market possess complete and perfect knowledge.

9.2.e—Conclusion

Glancing at the four requirements above should immediately convince one that no market has been or can be perfectly competitive. Even in basic agricultural markets, where the first three requirements are frequently satisfied, the fourth is obviated by vagaries of weather conditions. One might therefore reasonably ask why such a palpably unrealistic model should be considered at all.

The answer can be given in as much or as little detail as desired. For our present purposes, it is brief. First, generality can be achieved only by means of abstraction. Hence no theory can be perfectly descriptive of real-world phenomena. Furthermore, the more accurately a theory describes one specific real-world case the less accurately it describes all others. In any area of thought a theoretician does not select his assumptions on the basis of their realism; the conclusions, not the assumptions, are tested against reality.

This leads to a second point of great, if somewhat pragmatic, importance. The conclusions derived from the model of perfect competition have, by and large, permitted accurate explanation and prediction of real-world phenomena. That is, perfect competition frequently *works* as a theoretical model of economic processes. The most persuasive evidence supporting this assertion is the fact that despite the proliferation of more "sophisticated" models of economic behavior, economists today probably use the model of perfect competition in their research more than ever before.

9.3 EQUILIBRIUM IN THE MARKET PERIOD

The short run and the long run were defined in Chapter 6. In the short run, some inputs are fixed—they are not instantaneously augmentable. Changes in the quantity of output per unit of time can be achieved only by changes in the usage of the instantaneously variable inputs. In the long run, on the other hand, all inputs are variable. Changes in the volume of output can be achieved by changes in the usage of any input.

These two "runs" however, do not cover all cases. In certain instances the quantity of a commodity available for sale is absolutely fixed for a short period of time. For example, after the harvest of an agricultural crop the quantity of the commodity cannot be increased until the next harvest. As another example, merchants hold inventories of goods. The quantity available for sale cannot be increased instantly because the order-and-delivery process inevitably entails some delay. Finally, in some cases quantity can be increased virtually instantaneously; but the cost of rapid production is so great as to preclude very quick changes. In all these cases, the short period of time in which supply is absolutely fixed is called the market period.

9.3.a—Industry Equilibrium in the Market Period

Definition: an industry is a collection of firms producing a homogeneous product.

In both the short and long runs each individual firm can adjust its output. Thus one must analyze equilibrium adjustments for the firm as well as industry or market equilibrium. In the market period, however, the individual business concerns cannot adjust at all. By definition, output cannot be changed in the market period. Hence the behavior of individual firms need not be studied—each firm has a fixed supply which it sells for the market-established price.

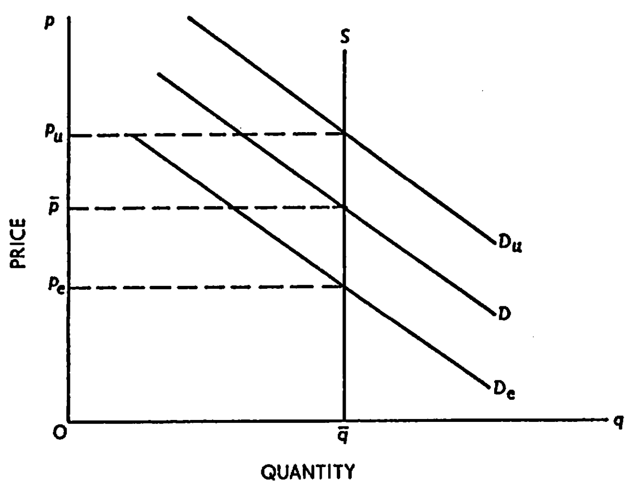


FIGURE 9.3.1

MARKET EQUILIBRIUM IN THE MARKET PERIOD

Since the supply of each firm is absolutely fixed in the market period, the market supply curve is simply the horizontal summation of all individual supply curves. And again, since supply is fixed, the market supply curve is a straight line parallel to the vertical axis, as shown in Figure 9.3.1. The fixed quantity available for sale is $O\bar{q}$, and the market supply curve is the straight line labeled *S*.

Market equilibrium is attained, of course, at that price which exactly clears the market. If market demand is given by the curve labeled *D* in Figure 9.3.1, the market equilibrium price is $O\bar{p}$. If demand were greater, say D_u, the equilibrium price would also be greater, Op_u. But the market equilibrium quantity would be the same as before because supply is absolutely fixed. Similarly, if demand were less, D_e, the equilibrium price would be lower, Op_e. Thus in the market period demand *alone* determines the market equilibrium price, given the fixed supply, while supply *alone* determines the market equilibrium quantity. This result differs markedly from the corresponding result for the short and long runs in which demand and supply *jointly* determine *both* the equilibrium price and quantity.

9.3.b—Price as a Rationing Device

The price a commodity bears may play various roles. It may be a signal to producers to expand or contract their rate of production. It may reflect the marginal social value of the commodity. And, among other things, it is always a rationing device.

In the market period, rationing the existing supply among prospective buyers is the chief function performed by market price. Since supply is not related to the cost of production when the former is fixed, price is exclusively a demand phenomenon. When the market equilibrium price is established, it rations the fixed supply of goods among those individuals who are willing and able to pay a unit price equal to or greater than the market equilibrium price. While this is true of an equilibrium price in any market in any "run," it is dramatically true in the market period.

9.4 SHORT-RUN EQUILIBRIUM OF A FIRM IN A PERFECTLY COMPETITIVE MARKET

In the short run, the rate of output per period of time can be expanded or diminished by increasing or decreasing the rate of use of variable inputs. The individual firm can adjust its rate of output over a wide range subject only to the limitations imposed by its fixed inputs (generally, plant and equipment). Since each firm adjusts until it reaches a profit-maximizing rate of output, the market or industry also adjusts until it reaches a point of short-run equilibrium.

9.4.a—Short-Run Profit Maximization, Total Revenue–Total Cost Approach

As already noted, one assumes each firm adjusts its rate of output so as to maximize the profit obtainable from its business operation. Since profit is the difference between total revenue from sales and total cost of operation, profit is a maximum for that rate of output which maximizes the excess of revenue over cost (or minimizes the excess of cost over revenue).

Consider the example contained in Table 9.4.1 and shown graphically in Figure 9.4.1. The first two columns of the table give the demand curve for the perfectly competitive producer. Market price is $5 per unit; the producer can sell as many units as he chooses at this price.

TABLE 9.4.1

REVENUE, COST, AND PROFIT FOR AN HYPOTHETICAL FIRM

Market Price	*Rate of Output and Sales*	*Total Revenue*	*Total Fixed Cost*	*Total Variable Cost*	*Total Cost*	*Profit*
$5.00......	1	$ 5.00	$15.00	$ 2.00	$17.00	−$12.00
5.00......	2	10.00	15.00	3.50	18.50	− 8.50
5.00......	3	15.00	15.00	4.50	19.50	− 4.50
5.00......	4	20.00	15.00	5.75	20.75	− 0.75
5.00......	5	25.00	15.00	7.25	22.25	+ 2.75
5.00......	6	30.00	15.00	9.25	24.25	+ 5.75
5.00......	7	35.00	15.00	12.50	27.50	+ 7.50
5.00......	8	40.00	15.00	17.50	32.50	+ 7.50
5.00......	9	45.00	15.00	25.50	40.50	+ 4.50
5.00......	10	50.00	15.00	37.50	52.50	− 2.50

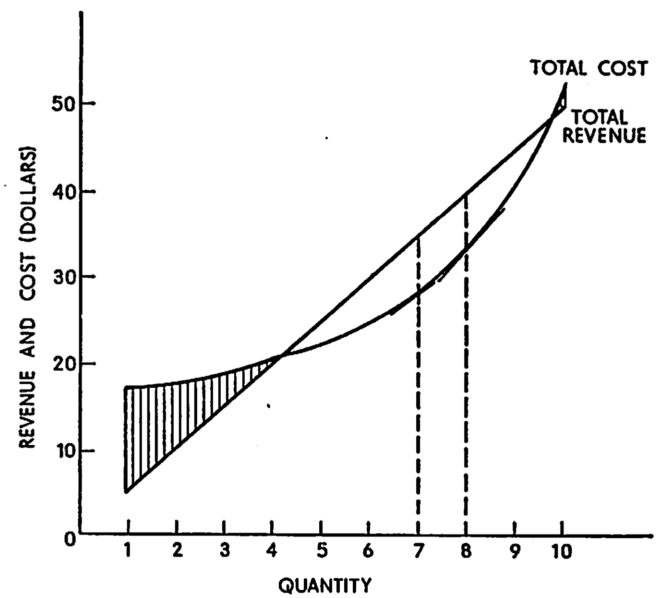


FIGURE 9.4.1

PROFIT MAXIMIZATION BY THE TOTAL REVENUE-TOTAL COST APPROACH

The product of columns one and two gives total revenue, the entries appearing in column three. The straight line in Figure 9.4.1 is a graphical representation. Notice that the total revenue curve is always a straight line in the case of perfect competition because unit price does not change when quantity sold changes.

Columns four, five, and six give total fixed, total variable, and total cost respectively. Total cost is graphed as the curved line in Figure 9.4.1. Profit, the difference between total revenue and total cost, is shown in the last column of Table 9.4.1 and is represented by the positive or negative distance between the total revenue and total cost curves in Figure 9.4.1. Profit is first negative, becomes positive, and is ultimately negative again. In Figure 9.4.1, the shaded areas denote the range of output over which profit is negative (a loss is incurred).

It is clear from either the table or the figure that maximum profit is $7.50, achieved with an output of either seven or eight units. The seeming indeterminancy of the rate of output is attributable to the discrete data used in this hypothetical example. If continuous data were used, it would be obvious that the profit-maximizing output is eight units per period of time. This is because the maximum distance separating the two curves coincides with the output point for which the tangents to the curves have the same slope. From the two tangents constructed in Figure 9.4.1, it is easily seen that the slopes are equal only at the output of eight units per period of time.

The total revenue-total cost approach is a useful one from some standpoints; however, it does not lead to an analytical interpretation of business behavior. To get at this, the familiar marginal approach must be adopted.

9.4.b—Short-Run Profit Maximization, the Marginal Approach

The definitions of marginal revenue and marginal cost are familiar from Chapters 5 and 8 respectively. Similarly, the method of calculating each has been learned. Applying these methods to the data in Table 9.4.1, we obtain the information in Table 9.4.2.

Columns one and two show the demand or marginal revenue curve, identical for the firm in a perfectly competitive market (as explained in Chapter 5). Column three contains the marginal cost figures, while average total or unit cost has been computed from column six, Table 9.4.1, and entered in column four. Unit profit, the difference between price and average total cost, is shown in column five. Finally, total profit, the difference between total revenue and total cost, is contained in column six.

Just as in the previous case, maximum total profit corresponds to either seven or eight units of output and sales per period of time. Unit

TABLE 9.4.2

MARGINAL REVENUE, MARGINAL COST, AND PROFIT

Output and Sales	*Marginal Revenue or Price*	*Marginal Cost*	*Average Total Cost*	*Unit Profit*	*Total Profit*
1.	$5.00	$2.00	$17.00	−$12.00	−$12.00
2.	5.00	1.50	9.25	− 4.25	− 8.50
3.	5.00	1.00	6.50	− 1.50	− 4.50
4.	5.00	1.25	5.19	− 0.19	− 0.75
5.	5.00	1.50	4.45	+ 0.55	+ 2.75
6.	5.00	2.00	4.04	+ 0.96	+ 5.75
7.	5.00	3.25	3.93	+ 1.07	+ 7.50
8.	5.00	5.00	4.06	+ 0.94	+ 7.50
9.	5.00	8.00	4.50	+ 0.50	+ 4.50
10.	5.00	12.00	5.25	− 0.25	− 2.50

profit is a maximum at seven units of output, but this is immaterial inasmuch as the entrepreneur is chiefly concerned with total profit.

The data in Table 9.4.2 are plotted in Figure 9.4.2. The short-run equilibrium of the firm is clearly attained at point *E,* where marginal cost equals marginal revenue. Alternatively stated, since marginal revenue equals price for a perfectly competitive producer, short-run equilibrium occurs at the output point for which marginal cost equals price.

9.4.c—Proof of the Short-Run Equilibrium

To prove the proposition that a firm in perfect competition attains its profit-maximizing equilibrium at the rate of output for which marginal cost equals price, the hypothetical example of Figure 9.4.2 has been converted to the general representation in Figure 9.4.3. The theorem follows immediately from the definitions of marginal revenue and marginal cost.[2]

[2] Let $p = f(q)$ represent the inverse demand function. Hence $qf(q)$ is total revenue. Further, let $C = g(q)$ be the total cost function. Profit (π) is thus $\pi = qf(q) - g(q)$. Profit is a maximum when $d\pi/dq = 0$ and $d^2\pi/dq^2 < 0$. Taking the first derivative and equating with zero,

$$\frac{d\pi}{dq} = f(q) - g'(q) = 0 \tag{9.4.1}$$

or

$$f(q) = g'(q), \tag{9.4.2}$$

because $p = f(q)$ is a given constant. Marginal cost is $g'(q)$, see Chapter 8. Marginal revenue and price are both given by $f(q)$. Hence equation (9.4.2) states that marginal revenue or price must equal marginal cost. This is the necessary condition for profit maximization. From equation (9.4.1) the second-order condition is that $d^2\pi/dq^2 = -g''(q) < 0$ or

$$g''(q) > 0. \tag{9.4.3}$$

Hence stability of equilibrium, by inequality (9.4.3), requires a *positively sloped* marginal cost curve.

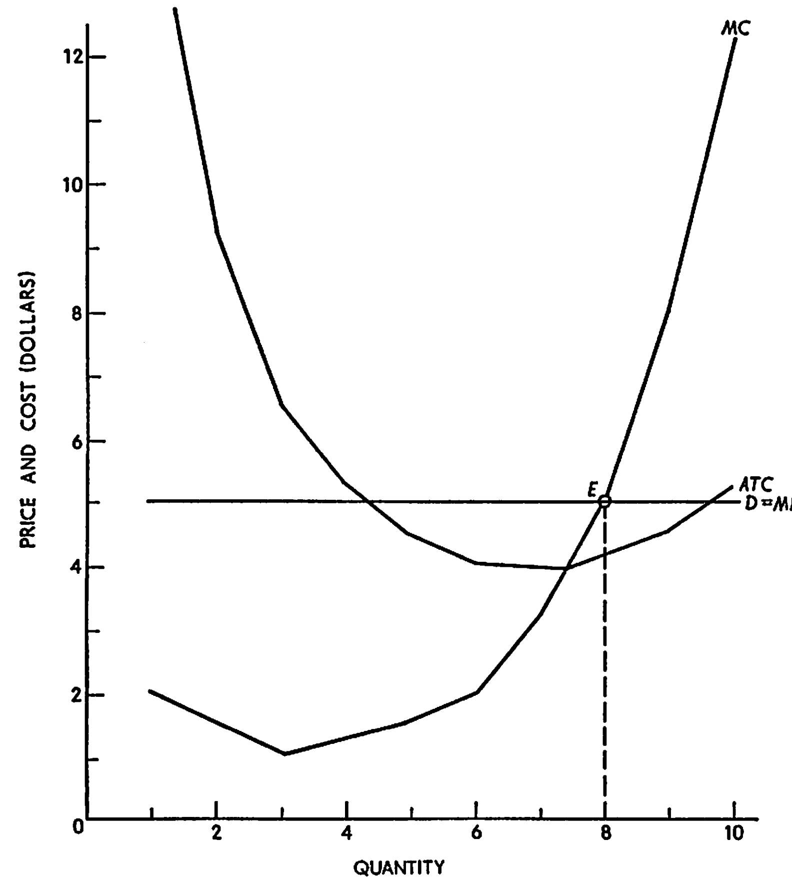


FIGURE 9.4.2

PROFIT MAXIMIZATION BY THE MARGINAL APPROACH

Marginal revenue is the addition to total revenue attributable to the addition of one unit to sales, while marginal cost is the addition to total cost resulting from the addition of one unit to output. Thus it should be evident that profit increases when marginal revenue exceeds marginal cost and diminishes when marginal cost exceeds marginal revenue. Profit must, therefore, attain its maximum when marginal revenue and marginal cost are equal.

Consider Figure 9.4.3. The fundamental proposition is that at market price $O\bar{p}$, the firm attains a profit-maximizing equilibrium at point E, corresponding to the output of $O\bar{q}$ units per period of time. If the rate of output were less than $O\bar{q}$, say Oq_e, marginal revenue q_eB would exceed marginal cost q_eA. Adding a unit to output and sales would increase total revenue by more than total cost. Profit would accordingly increase, and it would continue to increase so long as marginal revenue exceeds marginal cost.

On the other hand, suppose the rate of output exceeded $O\bar{q}$—say Oq_u. At this point, marginal cost q_uF exceeds marginal revenue q_uC. This unit of output causes total cost to increase by more than total revenue, thereby reducing profit (or increasing loss). As is evident

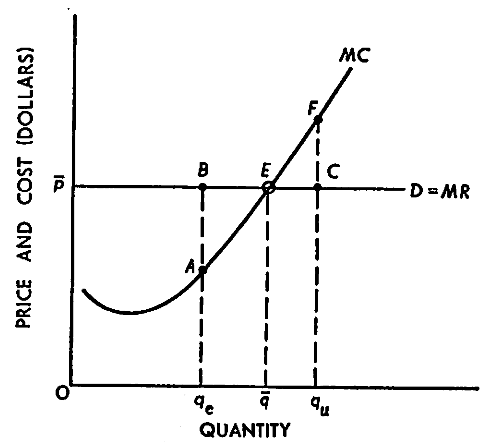


FIGURE 9.4.3

SHORT-RUN EQUILIBRIUM AT POINT WHERE MARGINAL COST EQUALS PRICE

from the graph, profit must be reduced by adding a unit to output and sales whenever marginal cost exceeds marginal revenue.

Therefore, since profit increases when marginal revenue exceeds marginal cost and declines when marginal revenue is less than marginal cost, it must be a maximum when the two are equal. Furthermore, since price equals marginal revenue for a firm in perfect competition, the following theorem has been proved.

Proposition: a firm in a perfectly competitive industry attains its short-run, profit-maximizing equilibrium by producing the rate of output for which marginal cost equals the given, fixed market price of the commodity.

9.4.d—Profit or Loss?

The equality of price and marginal cost guarantees either that profit is a maximum or that loss is a minimum. Whether a profit is

made or a loss incurred can be determined only by comparing price and average total cost corresponding to the equilibrium rate of output. If price exceeds unit cost the entrepreneur will enjoy a profit in the short run. On the other hand, if unit cost exceeds price a loss must be incurred.

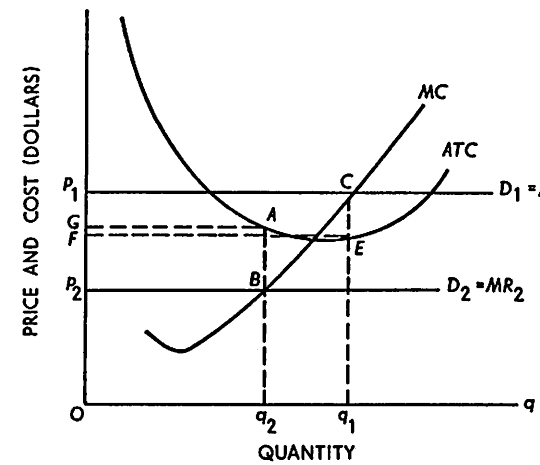


FIGURE 9.4.4.

PROFIT OR LOSS IN THE SHORT RUN

Figure 9.4.4 illustrates this. MC and ATC represent marginal cost and average total cost respectively. First, suppose short-run market equilibrium establishes the price Op_1 per unit. The demand and marginal revenue curves for the firm are, therefore, given by the horizontal line labeled $D_1 = MR_1$. Short-run equilibrium is attained when output is Oq_1 units per period of time. At this rate of output, total revenue (price times quantity) is given by the area of the rectangle Oq_1Cp_1. Similarly, total cost (unit cost times quantity) is the area Oq_1EF. Total revenue exceeds total cost, and profit is represented by the area of the rectangle $FECp_1$.

On the other hand, suppose the market price–quantity equilibrium established the price Op_2. In that case the optimum rate of output would be Oq_2 units per period of time. Total revenue is the area of Oq_2Bp_2, while total cost is Oq_2AG. Since total cost exceeds total revenue, a loss is incurred in the amount represented by the area of p_2BAG.

When demand is $D_2 = MR_2$, there is no method by which the firm can earn a profit. If output were either smaller or greater than Oq_2 units per period of time the loss would simply be greater. One might therefore ask why the firm does not go out of business since a loss is incurred at any rate of output.

9.4.e—Short-Run Supply Curve of a Firm in a Perfectly Competitive Industry

The basic answer to this question is: an entrepreneur incurring a loss in the short run will continue to produce in the short run if, and only if, he loses less by producing than by closing the plant entirely. As you will recall from Chapter 8, there are two types of costs in the short run: fixed costs and variable costs. The fixed costs cannot be changed

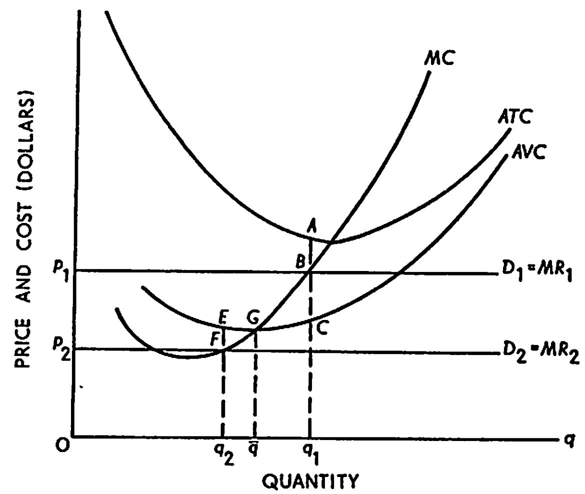


FIGURE 9.4.5

CEASING PRODUCTION IN THE SHORT RUN

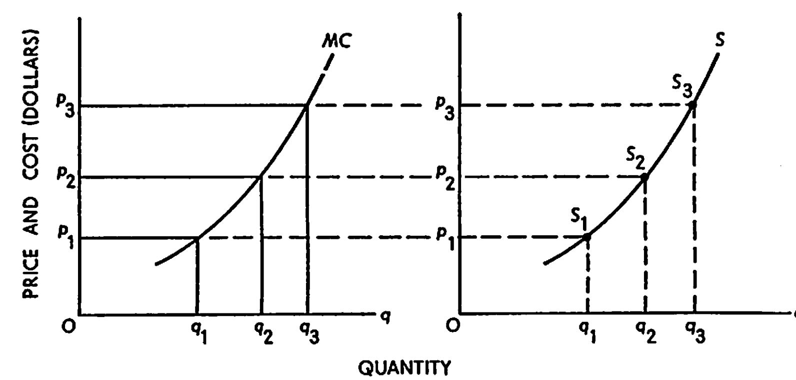
and are incurred whether the plant is operated or not. Fixed costs, that is, are the same at zero output as at any other.

Therefore, so long as total revenue exceeds the total variable costs of producing the equilibrium output, a smaller loss is suffered when production takes place. Figure 9.4.5 is a graphical demonstration of this.

As previously explained, the business decision regarding production in the short run is not affected by fixed costs. Therefore, only the average total cost, average variable cost, and marginal cost curves are shown in Figure 9.4.5. Since our discussion involves only a loss situation, the price lines are constructed so as to lie entirely beneath the average total cost curve. First, suppose market price is Op_1, so the firm's demand-marginal revenue curve is given by $D_1 = MR_1$. Profit maximization (or loss minimization) leads to producing the output for which marginal cost equals price—production occurs at point *B*, or at the rate of Oq_1 units per period of time. At this rate of output the firm loses *AB*

dollars per unit produced. However, at the price Op_1 average variable cost is not only covered but there is an excess of *BC* dollars per unit. The average cost of the variable inputs is q_1C dollars per unit of output. The price obtained per unit is q_1B. The excess of price over average variable cost, *BC*, can be applied to the fixed costs. Thus not all of the fixed costs are lost, as would be the case if production were discontinued. Although a loss is sustained, it is smaller than the loss associated with zero output.

This is not always the case, however. Suppose market price were as low as Op_2, so that demand is given by $D_2 = MR_2$. If the firm produced at all, its equilibrium output would be Oq_2 units per period of time.



PANEL a--POSITIONS OF SHORT-RUN EQUILIBRIA FOR THE FIRM

PANEL b--EQUILIBRIUM QUANTITIES SUPPLIED BY THE FIRM

FIGURE 9.4.6

DERIVATION OF THE SHORT-RUN SUPPLY CURVE OF AN INDIVIDUAL PRODUCER IN PERFECT COMPETITION

Here, however, the average variable cost of production exceeds price. The firm producing at this point would not only lose its fixed costs, it would lose *EF* dollars per unit on its variable costs as well. Thus when price is below average variable cost, the short-run equilibrium output is zero.

As shown in Chapter 8, average variable cost reaches its minimum at the point where marginal cost and average variable cost intersect—point *G* in figure 9.4.5. If price is less than $\bar{q}G$ dollars per unit, equilibrium output is zero. For a price equal to or greater than $\bar{q}G$ dollars per unit, equilibrium output is determined by the intersection of marginal cost and the price line.

Using the proposition just discussed, it is possible to derive the short-run supply curve of an individual firm in a perfectly competitive market. The process is illustrated in Figure 9.4.6. Panel a of the figure shows the marginal cost curve of a firm for rates of output greater than that associated with minimum average variable cost. Suppose market price is Op_1. The corresponding equilibrium rate of output is Oq_1. Now on panel *b*, find the point associated with the coordinates Op_1, Oq_1. Label this point S_1; it represents the quantity supplied at the price Op_1.

Next, suppose price were Op_2. In this case, equilibrium output would be Oq_2. Plot the point associated with the coordinates Op_2, Oq_2 on panel b—it is labeled S_2. Similarly, other equilibrium quantities supplied can be determined by postulating other market prices (for example, price Op_3 leads to output Oq_3 and point S_3 on panel b). Connecting all the *S*-points so generated one obtains the short-run supply curve of the firm, the curve labeled *S* in panel b. But by construction, the *S*-curve is precisely the same as the *MC* curve. The following is thus established:

Proposition: the short-run supply curve of a firm in perfect competition is precisely its marginal cost curve for all rates of output equal to or greater than the rate of output associated with minimum average variable cost. For market prices lower than minimum average variable cost, equilibrium quantity supplied is zero.

9.5 SHORT-RUN EQUILIBRIUM IN A PERFECTLY COMPETITIVE INDUSTRY

In Part I it was shown that market demand is simply the horizontal summation of the individual demand curves of all buyers in the market. Deriving the short-run industry supply curve may not be such an easy matter.

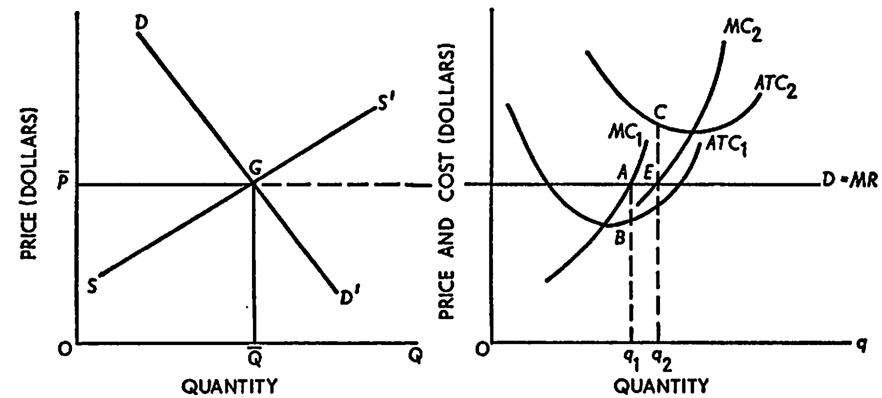
9.5.a—Short-Run Industry Supply Curve

As you will recall from Chapter 8, the short-run marginal cost curve of a firm is derived from its marginal product curve under the assumption that the unit price of the variable input is fixed. For most firms and inputs this is a reasonable assumption because one firm is usually so small, relative to all users of the resource taken together, that variations in its rate of purchase will not affect the market price of the resource. In other words, many resource markets are more or less perfectly competitive, at least on the *buying* side. Thus production and therefore resource use can frequently be expanded in one firm without affecting the market price of the resource.

But when *all* producers in an industry simultaneously expand output there may be a marked effect upon the resource market. As an

example, consider farming as an industry. One single farmer can doubtless double his output, and therefore materially increase his inputs, without affecting the market price of fertilizer, tractors, etc. But if all farmers double output there will inevitably be a marked upward pressure on the prices of these inputs.

As a consequence, the industry supply curve usually cannot be obtained by summing horizontally the marginal cost curves of each producer. As industry output expands, input prices normally increase, thereby shifting each marginal cost curve to the left. A great deal of



PANEL a--MARKET PRICE-QUANTITY EQUILIBRIUM

PANEL b--PROFIT OR LOSS IN SHORT-RUN EQUILIBRIUM

FIGURE 9.5.1

SHORT-RUN MARKET EQUILIBRIUM AND PROFIT OR LOSS IN THE FIRM

information would be required to obtain the exact supply curve. However, one may generally presume that the industry supply curve is somewhat more steeply sloped and somewhat less elastic when input prices increase in response to an increase in output. In this case, the concept of a competitive industry supply curve is less precise. Nonetheless, doubt is not cast upon the basic fact that in the short run, quantity supplied varies directly with price. The latter is all one needs to draw a positively sloped market supply curve.

9.5.b—Short-Run Market Equilibrium, Profit and Loss

Given the market demand and market supply curves, a short-run market price-quantity equilibrium is attained at that price which makes quantity demanded and quantity supplied equal. This proposition is so familiar that a proof is not given here, although the equilibrium is illustrated in panel a, Figure 9.5.1. *DD'* is market demand and *SS'* is market supply. The price-quantity equilibrium is attained at point *G*, with equilibrium price $O\bar{P}$ and equilibrium quantities demanded and supplied $O\bar{Q}$.

The market equilibrium price $O\bar{P}$, which establishes the horizontal demand or marginal revenue curve $D = MR$ for a typical firm in the industry, is shown in panel b. First, suppose the firm has costs represented by ATC_1 and MC_1. It would then attain its profit-maximizing equilibrium at point *A*, producing Oq_1 units per period of time and earning a pure economic profit of *AB* dollars per unit. On the other hand, if costs are given by ATC_2 and MC_2, equilibrium is reached at point *E*. The firm would produce Oq_2 units and incur a pure loss of *CE* dollars per unit.

A perfectly competitive firm is merely a quantity adjuster. Price is given by the market; the firm produces that rate of output which maximizes profit or minimizes loss for its established plant. In the short run, no other alternative is available. In the long run, however, there is.

9.6 LONG-RUN EQUILIBRIUM IN A PERFECTLY COMPETITIVE MARKET

Since all inputs are variable in the long run, an entrepreneur has the option of adjusting his plant size, as well as his output, in order to achieve maximum profit. In the limit, he can liquidate his business entirely and transfer his resources and his command over resources into a more profitable investment alternative. But just as established firms may leave the industry, new firms may enter the industry if profit prospects are brighter than elsewhere. Indeed, adjustment of the number of firms in the industry in response to profit motivation is the key element in establishing long-run equilibrium.

9.6.a—Long-Run Adjustment of an Established Firm

In the long run, an entrepreneur adjusts his plant size, and therefore his rate of output, in order to attain maximum profit. The adjustment process is illustrated in Figure 9.6.1.

Let market price be $O\bar{P}$ and suppose the firm has a plant whose costs are represented by SAC_1 and SMC_1 (short-run average total and marginal cost, respectively). With this plant, short-run equilibrium is reached at point *A*, corresponding to output of Oq_1 units per period of time. At this point the firm sustains a small loss on each unit of output produced and sold.

In looking to the long run, or the planning horizon, the entrepreneur has two options: he can go out of business or he can construct a plant of more suitable size. For example, he could decide upon the plant size represented by SAC_2 and SMC_2. At price $O\bar{P}$, he would produce Oq_2 units per period of time and make a pure profit of *BC* dollars per unit. However, with perfect knowledge, the plant represented by SAC_4 and SMC_4 would be constructed.

With this plant, operated so as to produce Oq_4 units per period of time, the maximum attainable profit is realized. The logical basis of this

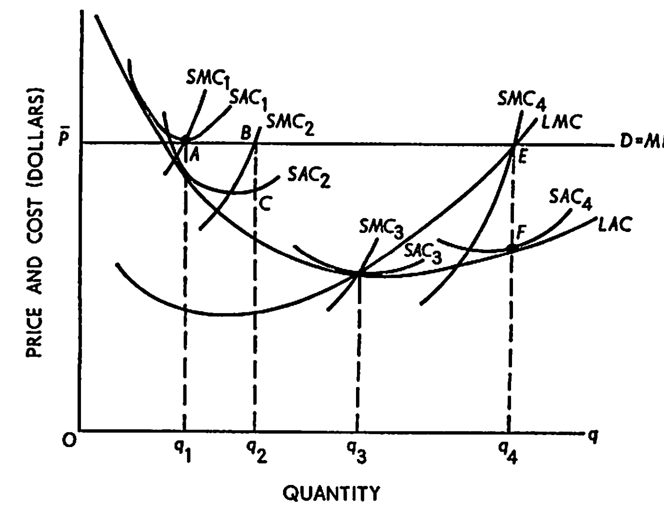


FIGURE 9.6.1

LONG-RUN ADJUSTMENT OF PLANT SIZE

proposition is the same as in the case of short-run profit maximization. Long-run marginal cost shows the addition to total cost attributable to the addition of one unit to output, ***after plant size has been adjusted so as to produce that rate of output at minimum achievable unit cost.*** Marginal revenue, or demand, shows the increase in revenue attributable to the addition of one unit to sales. By the familiar argument, therefore, maximum profit is obtained by producing that rate of output in the plant of such size that long-run marginal cost equals price at the point where the relevant short-run marginal cost equals price.

In Figure 9.6.1, the optimum-size plant is larger than the plant for which unit cost reaches its minimum—the plant given by SAC_3. However, at the optimum rate of output, Oq_4, unit cost is smaller in the plant represented by SAC_4 than in a plant of any other size. So long as price is $O\bar{P}$, long-run equilibrium adjustment dictates building the plant SAC_4 and operating it so as to produce Oq_4 units per period of time.

9.6.b—Long-Run Adjustment of the Industry

If all firms in the industry originally had plants with a size represented by SAC_1, the simultaneous expansion of plant size by all firms would shift the industry supply curve materially to the right. Market price would be reduced, and each firm would then possess a plant that was too large. Further adjustment of plant size by established firms would be necessary before long-run equilibrium could be attained.

On the other hand, if all firms except one originally possessed plants of optimum size, the expansion by one plant would not have a perceptible effect upon market price. All firms would be in a temporarily optimal situation, earning a pure economic profit of EF dollars per unit.

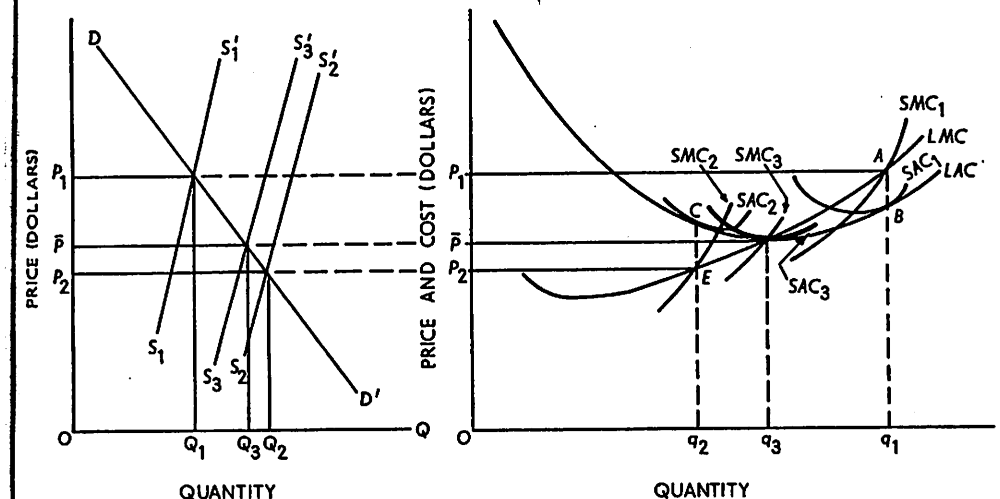
As you will recall from Chapter 8, economic cost and economic profit are somewhat different from the corresponding accounting concepts. In particular, economic cost includes the returns that could be obtained from the most profitable alternative use of the invested resources. Hence a *pure economic profit* represents a return on investment in excess of that obtainable elsewhere. The appearance of such profit naturally attracts new firms into the industry, expanding industry supply and reducing market price. When this occurs, all firms—both old and new—must adjust; and the adjustment process must continue until a position of long-run equilibrium is attained.

The process of long-run equilibrium adjustment is illustrated by Figure 9.6.2. Suppose each firm in the industry is identical. The original size is represented by SAC_1 and SMC_1 in panel b. The market demand curve is given by DD' in panel a, and the market supply is S_1S_1'. Market equilibrium establishes the price of OP_1 dollars per unit and total output and sales of OQ_1 units per period of time. At price OP_1, each firm attains a point of short-run equilibrium where SMC_1 equals price. Each firm produces Oq_1 units per period of time and reaps a pure economic profit of AB dollars per unit. As panel b is constructed, this position could be one of long-run equilibrium inasmuch as LMC equals price at this point.

From the standpoint of the market as a whole, however, the present situation is not stable. Each firm in the industry enjoys a pure

economic profit—a rate of return on invested resources greater than could be earned in any alternative employment. Therefore, in the long run some firms in less profitable industries will switch to the industry in question because a greater profit can be earned there.

The process of new entry might be very slow, or it might be very fast. It depends primarily upon the liquid assets in other industries. In any event, as time elapses new firms will enter the industry, thereby shifting the industry supply curve to the right. Suppose, indeed, the



PANEL a--LONG-RUN MARKET EQUILIBRIUM

PANEL b--LONG-RUN EQUILIBRIUM ADJUSTMENT ADJUSTMENT IN A TYPICAL FIRM

FIGURE 9.6.2

LONG-RUN EQUILIBRIUM ADJUSTMENT IN A PERFECTLY COMPETITIVE INDUSTRY

profit attraction is so strong that a substantial number of new firms enters the industry, shifting the industry supply curve to S_2S_2' in panel a. In this situation equilibrium quantity will expand to OQ_2.

When each firm adjusts optimally to the new market price, however, the output of each will be smaller. The larger number of firms accounts for the overall increase in output. When market price falls some firms will be ready to build new plants, so they can adjust their plant size quite rapidly. Others will have relatively new plants of size represented by SAC_1. These firms will be quite slow in making the optimal size adjustment. But even the firms that quickly adjust to optimal plant size—given by SAC_2 and SMC_2 in panel b—lose money at the rate of *CE* dollars per unit. Those whose size is not quickly adapted lose even more.

As in the previous case, short-run and long-run marginal cost both equal price. Each firm has adjusted as best it can; but the situation is still not consistent with long-run equilibrium. In the present case each firm incurs a pure economic loss, even though it may earn an accounting profit. In any event, profit is less than in alternative investments. Hence firms will tend to leave the industry as their plants and equipment wear out. Investment in some other industry is more attractive because profit promises to be greater.

As a consequence industry supply shifts to the left, raising the market equilibrium price. As shown in the next subsection, industry supply must shift until it is represented by S_3S_3'. With the given demand curve, market price is $O\overline{P}$. Each firm, after adjustment, has a plant represented by SAC_3 and SMC_3. Price is just equal to short-run marginal and average total cost and to long-run marginal and average total cost as well. Neither pure profit nor pure loss is present.

9.6.c—Long-Run Equilibrium in a Perfectly Competitive Firm

The position of long-run equilibrium is inevitable from and is embodied in the assumptions of profit maximization and free entry. Each firm strives to achieve the maximum possible profit. In the short run a firm in perfect competition can do nothing more than adjust its output so that marginal cost equals price. In the long run it can adjust the size of its plant and it can select the industry in which it operates—both with an eye to profit.

The long-run equilibrium position of a firm in a perfectly competitive industry is explained by Figure 9.6.3. If price is above the level $O\overline{P}$, each established firm in the industry earns a pure profit. New firms are attracted into the industry, shifting the market supply curve to the right. Market equilibrium price declines, and the horizontal demand curve confronting each firm falls to a lower level. On the other hand, if price is below $O\overline{P}$, each firm in the industry incurs a pure economic loss. As their plants and equipment depreciate, some firms will leave the industry, thereby causing the market supply curve to shift to the left. Market price and, accordingly, the horizontal individual demand curves rise.

The only conceivable point of long-run equilibrium occurs at point *E* in Figure 9.6.3. Here firms in the industry receive neither pure profit nor pure loss. There is no incentive for further entrance because the rate of return in this industry is the same as in the best alternative.

But for the same reason there is no incentive for a firm to leave the industry. The number of firms stabilizes, each firm with a short-run plant represented by *SAC* and *SMC*.

The position of long-run equilibrium is actually determined by the horizontal demand curve confronting each firm. Since the industry is perfectly competitive by assumption, firms will enter or leave the industry if there is either pure profit or pure loss. Therefore, since the position of long-run equilibrium must be consistent with *zero* profit (and zero loss), it is necessary that price equal average total cost. For a firm to attain its individual equilibrium, price must be equal to marginal

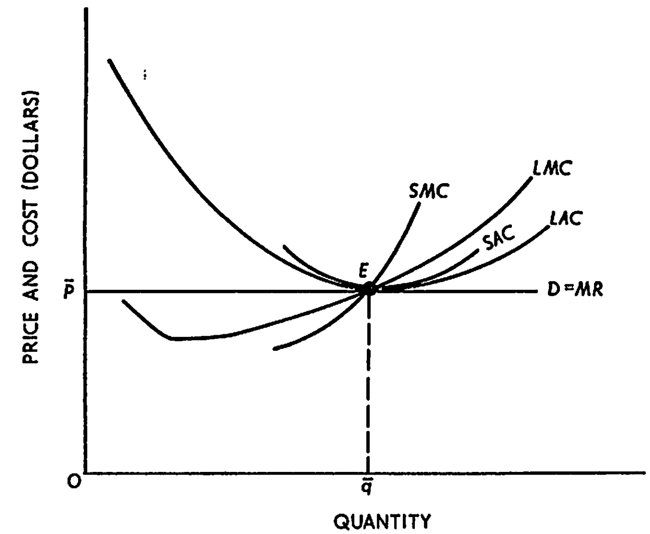


FIGURE 9.6.3

LONG-RUN EQUILIBRIUM OF A FIRM IN A PERFECTLY COMPETITIVE INDUSTRY

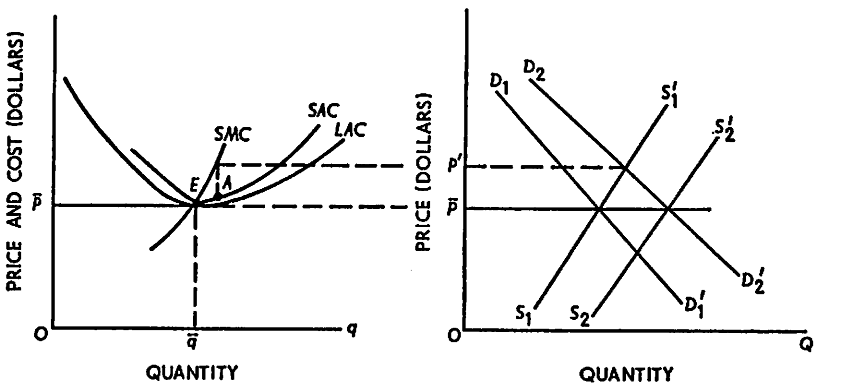
cost. Therefore, price must equal both marginal and average total cost. This can only occur at the point where average total and marginal cost are equal, or at the point of minimum average total cost.

The statement, so far, could conceivably apply to any *SAC* and *SMC*. However, unless it applies *only* to the short-run plant that coincides with minimum long-run average cost, a change in plant size would lead to the appearance of pure profit, and the wheels of adjustment would be set in motion again. These arguments establish the following:

Proposition: long-run equilibrium for a firm in perfect competition occurs at the point where price equals minimum long-run average cost. At this point minimum short-run average total cost equals minimum long-run average total cost, and the short- and long-run marginal costs are equal. The position of long-run equilibrium is characterized by a "no profit" situation—the firms have neither a pure profit nor a pure loss, only an accounting profit equal to the rate of return obtainable in other perfectly competitive industries.

9.6.d—Constant and Increasing Cost Industries

The analysis of subsections 9.6.b and 9.6.c was based upon the tacit assumption of "constant cost," in the sense that expanded resource usage does not entail an increase in resource prices. To carry the analysis further, and to make it more explicit, both constant and increasing cost



PANEL a--LONG RUN EQUILIBRIUM OF THE FIRM

PANEL b--LONG RUN MARKET EQUILIBRIUM

FIGURE 9.6.4

LONG-RUN EQUILIBRIUM AND SUPPLY PRICE IN A PERFECTLY COMPETITIVE INDUSTRY SUBJECT TO CONSTANT COST

industries are examined in this subsection. The phenomenon of decreasing cost is not examined inasmuch as it is not consistent with all the requirements of perfect competition.

Long-run equilibrium and long-run supply price under conditions of constant cost are explained by Figure 9.6.4. Panel a shows the long- and short-run conditions of a typical firm in the industry, while panel b depicts the market as a whole. D_1D_1' and SS_1' are the original market demand and supply curves, establishing a market equilibrium price of $O\bar{P}$ dollars per unit. We assume the industry has attained a position of long-run equilibrium, so the position of each firm in the industry is depicted by panel a—the price line is tangent to the long- and short-run average total cost curves at their minimum points.

Now suppose demand increases to D_2D_2'. Instantaneously, with

the number of firms fixed, the price will rise to OP' and each firm will move to equilibrium at point A. However, at point A each firm earns a pure economic profit, thereby attracting new entrants into the industry and shifting the industry supply curve to the right. In this case we assume all resources used are so general that increased usage in this industry does not affect the market price of resources. As a consequence, the entrance of new firms does not increase the costs of existing firms; the LAC curve of established firms does not shift and new firms can operate with an identical LAC curve. Long-run equilibrium adjustment to the shift in demand is accomplished when the number of firms expands to the point at which S_2S_2' is the industry supply curve.

In other words, since output can be expanded by expanding the number of firms producing $O\bar{q}$ units per period of time at average cost $O\bar{P}$, the industry has a constant long-run supply price equal to $O\bar{P}$ dollars per unit. If price were above this level, firms of size represented by SAC would continue to enter the industry in order to reap the pure profit obtainable. If price were less than $O\bar{P}$, some firms would ultimately leave the industry to avoid the pure economic loss. Hence in the special case in which an expansion of resource usage does not lead to an increase in resource price, the long-run industry supply price is constant. This is precisely the meaning of a "constant-cost" industry.[3]

An increasing cost industry is depicted in Figure 9.6.5. The original situation is the same as in Figure 9.6.4. The industry is in a position of long-run equilibrium. D_1D_1' and S_1S_1' are the market demand and supply curves respectively. Equilibrium price is OP_1. Each firm operates at point E_1, where price equals minimum average cost, both long- and short-run cost. Thus each firm is also in a position of long-run equilibrium.

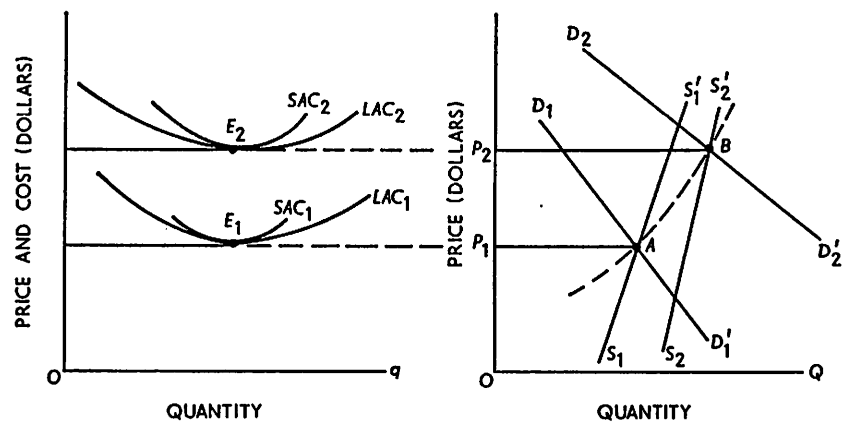
Let demand shift to D_2D_2' so that price instantaneously rises to a much higher level. The higher price is accompanied by pure economic profit; new firms are consequently attracted into the industry. The usage of resources expands and now, we assume, resource price expands with

[3] In Chapters 6 and 7 there was a discussion of "constant returns to scale" and of the type of production function giving rise to this phenomenon. Notice carefully that there is no necessary relationship between "constant returns to scale" and "constant cost." A firm with LAC in Figure 9.6.4 as its long-run average total cost curve may or may not have constant returns to scale. This depends upon its production function. Nonetheless, the industry can expand by expanding the number of firms producing $O\bar{q}$ units at average cost of $O\bar{P}$.

"Constant cost" is another matter entirely. An industry is or is not subject to constant cost according as resource prices remain constant or not as industry output expands. If resource prices increase, as shown below, the industry is subject to increasing cost irrespective of the production function (that is, whether there are constant returns to scale or not).

resource usage. The cost of inputs therefore increases for the established firms as well as for the new entrants. As a result the entire set of cost curves shifts upward, say to a position represented by LAC_2 in panel a.

Naturally, the process of equilibrium adjustment is not instantaneous. The *LAC* curve gradually shifts upward as new entrants gradually join the industry. The marginal cost curve of each firm shifts to the left, thereby tending to shift the industry supply curve to the left. However, more firms are producing and this tends to shift industry supply to the right. The latter tendency must dominate, for otherwise



PANEL a--LONG-RUN EQUILIBRIUM OF THE FIRM

PANEL b--LONG-RUN MARKET EQUILIBRIUM

FIGURE 9.6.5

LONG-RUN EQUILIBRIUM AND SUPPLY PRICE IN A PERFECTLY COMPETITIVE INDUSTRY SUBJECT TO INCREASING COST

new firms would have obtained resources *only* by bidding them away from established firms in the industry. Total output could not expand as dictated by the increase in market price. New resource units must have entered the industry, so the supply curve shifts to the right, though not by as much as it would in a constant-cost industry.

The process of adjustment must continue until a position of full long-run equilibrium is attained. In Figure 9.6.5, this is depicted by the intersection of D_2D_2' and S_2S_2', establishing an equilibrium price of OP_2 dollars per unit. Each firm produces at point E_2, where price equals minimum average total cost. The important point to emphasize is that in constant-cost industries new firms enter until price returns to the unchanged level of minimum, long-run average cost. For industries subject to increasing cost, new firms enter until minimum long-run average cost shifts upward to equal the new price. In both cases, the size

of firms remains unchanged between the old and new equilibrium, although the rate of output changes during the transit between equilibria.

In the transition from one long-run equilibrium to the other, the long-run supply price increases from OP_1 to OP_2. This is precisely what is meant by an "increasing-cost industry." In keeping with this, the long-run industry supply curve is given by a line joining such points as *A* and *B* in panel b. Thus an increasing-cost industry is one with a positively sloped long-run supply curve. Alternatively stated, after all long-run equilibrium adjustments are made, an increasing-cost industry is one in which an increase in output requires an increase in the long-run supply price.[4]

The result of this section can be summarized as follows:

Relationships: constant or increasing cost in an industry depends entirely upon the way in which resource prices respond to expanded resource usage. If resource prices remain constant the industry is subject to constant cost; if resource prices increase the industry is one of increasing cost.

The long-run supply curve for a constant-cost industry is a horizontal line at the level of the constant long-run supply price. The long-run industry supply curve under conditions of increasing cost is positively sloped, and the long-run supply price increases as long-run equilibrium quantity supplied expands.

9.7 CONCLUSION

Up to this point the salient feature of perfect competition is that, in long-run market equilibrium, market price equals minimum average total cost. This means that each unit of output is produced at the lowest possible cost, either from the standpoint of money cost or of resource usage. The product sells for its average (long-run) cost of production; each firm accordingly earns the "going" rate of return in competitive industries, nothing more or less.

But so far we have seen only one side of perfect competition—the operation of firms within a perfectly competitive industry. The pricing of productive services under conditions of perfect competition is also an important feature, as is the question of general economic welfare in a perfectly competitive economy. While all of these studies are based upon a highly stylized set of assumptions and conditions, they ulti-

[4] Notice that in the short run an increase in output will be induced only by an increase in price, regardless of the nature of the industry. In the special case of constant cost an increase in output can be achieved at a constant price after *all* long-run equilibrium adjustments have been made.

mately provide criteria by which to evaluate actual market operation and practice.

PROBLEM

Use the output cost data computed for the problem in Chapter 8.

1. Suppose the price of the commodity is $1.75 per unit.
   a) What would net profit be at each of the following outputs?
   (i) 1314
   (ii) 1384
   (iii) 1444
   (iv) 1494
   (v) 1534
   b) What is the greatest profit output?
   c) Is there any output that will yield a greater profit at any price?
   d) How much more revenue is obtained by selling this number of units than by selling one fewer? What is the relation between marginal revenue and selling price?
   e) If you are given selling price, how can you determine the optimum output by reference to marginal cost?
2. Suppose price is 70 cents.
   a) What would net profit be at each of the following outputs:
   (i) 410
   (ii) 560
   (iii) 700
   (iv) 830
   (v) 945
   (vi) 1234
   (vii) 1444
   b) Is there any output that will earn a net profit at this price?
   c) When price is 70 cents, what is the crucial relationship between price and average variable cost?
   d) Consider any price for which the corresponding marginal cost is equal to or less than 70 cents. At such a price, what is the relationship between marginal cost and average variable cost?
   e) When the relationship in (*d*) exists, what is the relationship between average and marginal product?
   f) What will the producer do if faced with a permanent price of 70 cents?
   g) Why is it not socially desirable to have a producer operating when price is 70 cents?
3. Suppose price is 80 cents.
   a) What will the optimum output be?
   b) Can a profit be made at this price?
   c) Will the producer operate at all at this price?
   d) How long?
4. Determine the supply schedule of this individual producer.

Price	*Quantity Supplied*
$0.60	
0.70	
0.80	
0.90	
1.00	
1.10	
1.20	
1.30	
1.40	
1.50	
1.60	
1.70	
1.80	
1.90	
2.00	

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