price (figure 5.1). The demand curve of the individual firm is also its average revenue and its marginal revenue curve (see page 156).

Free entry and exit of firms

There is no barrier to entry or exit from the industry. Entry or exit may take time, but firms have freedom of movement in and out of the industry. This assumption is supplementary to the assumption of large numbers. If barriers exist the number of firms in the industry may be reduced so that each one of them may acquire power to affect the price in the market.

Profit maximisation

The goal of all firms is profit maximisation. No other goals are pursued.

No government regulation

There is no government intervention in the market (tariffs, subsidies, rationing of production or demand and so on are ruled out).

The above assumptions are sufficient for the firm to be a price-taker and have an infinitely elastic demand curve. The market structure in which the above assumptions are fulfilled is called *pure competition.* It is different from *perfect competition*, which requires the fulfilment of the following additional assumptions.

Perfect mobility of factors of production

The factors of production are free to move from one firm to another throughout the economy. It is also assumed that workers can move between different jobs, which implies that skills can be learned easily. Finally, raw materials and other factors are not monopolised and labour is not unionised. In short, there is perfect competition in the markets of factors of production.

Perfect knowledge

It is assumed that all sellers and buyers have complete knowledge of the conditions of the market. This knowledge refers not only to the prevailing conditions in the current period but in all future periods as well. Information is free and costless. Under these conditions uncertainty about future developments in the market is ruled out.

Under the above assumptions we will examine the equilibrium of the firm and the industry in the short run and in the long run.

II. SHORT-RUN EQUILIBRIUM

In order to determine the equilibrium of the industry we need to derive the market supply. This requires the determination of the supply of the individual firms, since the market supply is the sum of the supply of all the firms in the industry.

A. EQUILIBRIUM OF THE FIRM IN THE SHORT RUN

The firm is in equilibrium when it maximises its profits (Π), defined as the difference between total cost and total revenue:

$$\Pi = TR - TC$$

Given that the normal rate of profit is included in the cost items of the firm, Π is the profit above the normal rate of return on capital and the remuneration for the risk-bearing function of the entrepreneur. The firm is in equilibrium when it produces the output that maximises the difference between total receipts and total costs. The equilibrium of the firm may be shown graphically in two ways. Either by using the *TR* and *TC* curves, or the *MR* and *MC* curves.

In figure 5.2 we show the total revenue and total cost curves of a firm in a perfectly competitive market. The total-revenue curve is a straight line through the origin, showing that the price is constant at all levels of output. The firm is a price-taker and can sell any amount of output at the going market price, with its *TR* increasing proportionately with its sales. The slope of the *TR* curve is the marginal revenue. It is constant and equal to the prevailing market price, since all units are sold at the same price. Thus in pure competition $MR = AR = P$.

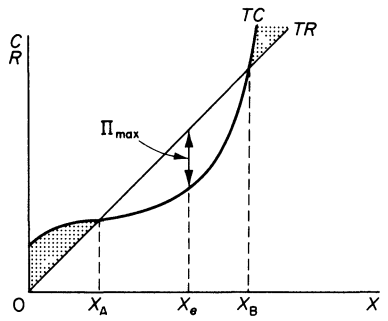

Figure 5.2

The shape of the total-cost curve reflects the U shape of the average-cost curve, that is, the law of variable proportions. The firm maximises its profit at the output X_e, where the distance between the *TR* and *TC* curves is the greatest. At lower and higher levels of output total profit is not maximised: at levels smaller than X_A and larger than X_B the firm has losses.

The total-revenue–total-cost approach is awkward to use when firms are combined together in the study of the industry. The alternative approach, which is based on marginal cost and marginal revenue, uses price as an explicit variable, and shows clearly the behavioural rule that leads to profit maximisation.

In figure 5.3 we show the average- and marginal-cost curves of the firm together with its demand curve. We said that the demand curve is also the average revenue curve and

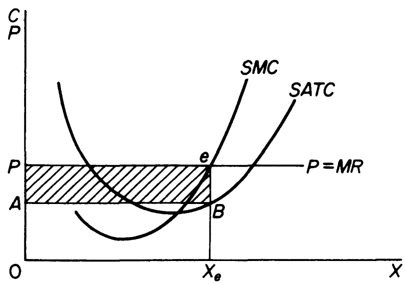

Figure 5.3

the marginal revenue curve of the firm in a perfectly competitive market. The marginal cost cuts the *SATC* at its minimum point. Both curves are U-shaped, reflecting the law of variable proportions which is operative in the short run during which the plant is constant. The firm is in equilibrium (maximises its profit) at the level of output defined by the intersection of the *MC* and the *MR* curves (point *e* in figure 5.3). To the left of *e* profit has not reached its maximum level because each unit of output to the left of X_e brings to the firm a revenue which is greater than its marginal cost. To the right of X_e each additional unit of output costs more than the revenue earned by its sale, so that a loss is made and total profit is reduced. In summary:

(*a*) If $MC < MR$ total profit has not been maximised and it pays the firm to expand its output.

(*b*) If $MC > MR$ the level of total profit is being reduced and it pays the firm to cut its production.

(*c*) If $MC = MR$ short-run profits are maximised.

Thus the first condition for the equilibrium of the firm is that marginal cost be equal to marginal revenue. However, this condition is not sufficient, since it may be fulfilled and yet the firm may not be in equilibrium. In figure 5.4 we observe that the condition

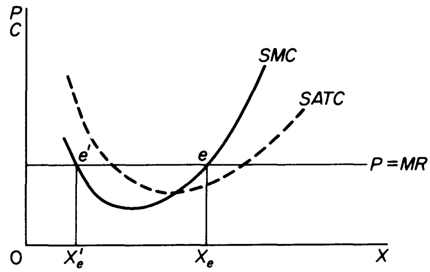

Figure 5.4

$MC = MR$ is satisfied at point *e*′, yet clearly the firm is not in equilibrium, since profit is maximized at $X_e > X_{e'}$. The second condition for equilibrium requires that the *MC* be rising at the point of its intersection with the *MR* curve. This means that the *MC* must cut the *MR* curve from below, i.e. the slope of the *MC* must be steeper than the slope of the *MR* curve. In figure 5.4 the slope of *MC* is positive at *e*, while the slope of the *MR* curve is zero at all levels of output. Thus at *e* both conditions for equilibrium are satisfied

(i) $MC = MR$

and

(ii) (slope of *MC*) > (slope of *MR*).

It should be noted that the *MC* is always positive, because the firm must spend some money in order to produce an additional unit of output. Thus at equilibrium the *MR* is also positive.

The fact that a firm is in (short-run) equilibrium does not necessarily mean that it makes excess profits. Whether the firm makes excess profits or losses depends on the level of the *ATC* at the short-run equilibrium. If the *ATC* is below the price at equilibrium (figure 5.5) the firm earns excess profits (equal to the area *PABe*). If, however, the *ATC* is above the price (figure 5.6) the firm makes a loss (equal to the area *FPeC*). In the latter case the firm will continue to produce only if it covers its variable costs. Otherwise it will close down, since by discontinuing its operations the firm is better off: it mimimises its losses. The point at which the firm covers its variable costs is called 'the closing-down

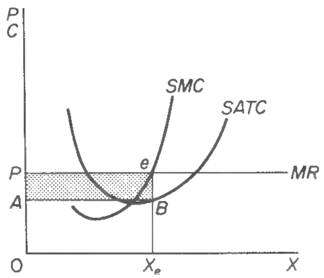

Figure 5.5

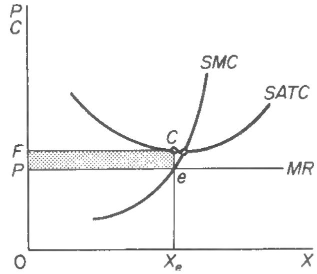

Figure 5.6

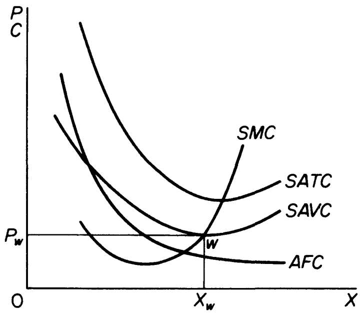

Figure 5.7

point.' In figure 5.7 the closing-down point of the firm is denoted by point w. If price falls below P_w the firm does not cover its variable costs and is better off if it closes down.

Mathematical derivation of the equilibrium of the firm

The firm aims at the maximisation of its profit

$$\Pi = R - C$$

where Π = profit
R = total revenue
C = total cost

Clearly $R = f_1(X)$ and $C = f_2(X)$, given the price P.

(*a*) The first-order condition for the maximisation of a function is that its first derivative (with respect to X in our case) be equal to zero. Differentiating the total-profit function and equating to zero we obtain

$$\frac{\partial \Pi}{\partial X} = \frac{\partial R}{\partial X} - \frac{\partial C}{\partial X} = 0$$

or

$$\frac{\partial R}{\partial X} = \frac{\partial C}{\partial X}$$

The term $\partial R/\partial X$ is the slope of the total revenue curve, that is, the marginal revenue. The term $\partial C/\partial X$ is the slope of the total cost curve, or the marginal cost. Thus the first-order condition for profit maximisation is

$$MR = MC$$