

Profit Maximization Goal of the Firm

A firm is said to be in equilibrium when it maximizes its profit. It means the firm will maximize profit when it attains equilibrium. The firm's main objective is to maximize profit. Once if a firm attains equilibrium it has then no tendency to change its behavior tends to persist. This goal is forwarded by classical economists and according to them, profit maximization is the most important objective of a business firm. There are two approaches to analyze the firm's equilibrium or profit maximization goal of the firms.

1. Total Revenue and Total Cost Approach (TR-TC Approach)
2. Marginal Revenue and Marginal Cost Approach (MR-MC Approach)

Total Revenue and Total Cost Approach (TR-TC Approach)

Under the TR-TC approach, a firm attains an equilibrium position at that level of output at which the difference between total revenue and the total cost is maximum. Every rational firm aims to maximize profit. Total profit (π) is defined as the excess of total revenue (TR) over total cost (TC). That is Profit (π) = TR - TC

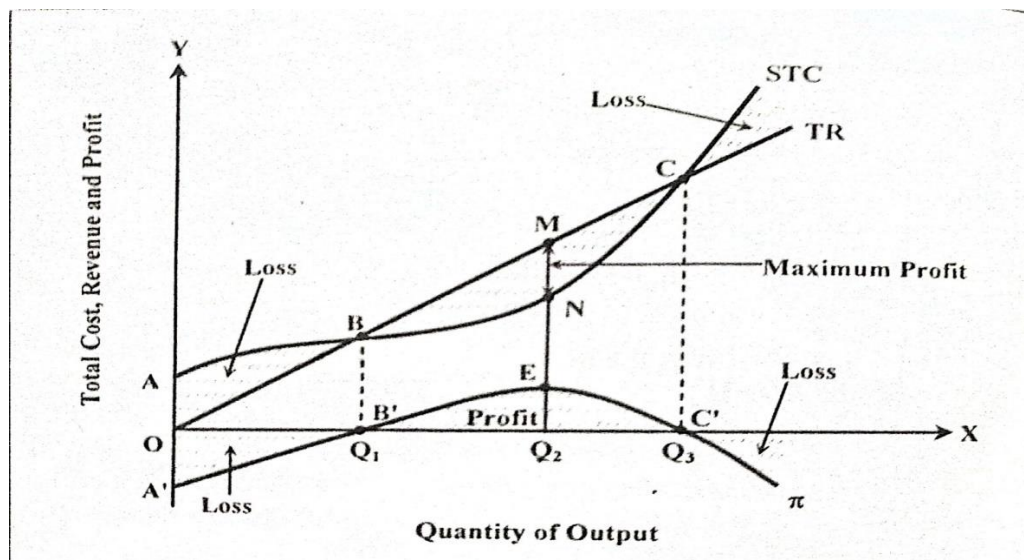
Hence, the firm can maximize its profit at that point where the difference between total revenue and total cost (TR-TC) is maximum. The equilibrium of the firm under perfect competition and monopoly market under the TR-TC approach can be explained below.

Short-run Equilibrium of a Firm Under Perfect Competition Market by Using TR-TC Approach

Under a perfect competition market, the price of the product is determined by the interaction between market demand and market supply and firms sell their output at the given fixed price. Due to such reason total revenue curve is upward sloping straight line through the origin with a constant slope equal to price.

In the short-run, the firm can vary its output by changing the units of variable factors as fixed factors remain constant. So, the total cost of the firm in the short run varies at varying levels of output. The short-run total cost of the firm is inverse s-shaped.

A perfectly competitive firm attains equilibrium or maximizes profit in the short run at that level of output at which the positive gap between total revenue and the total cost is maximum. This can be further explained with help of the following diagram.



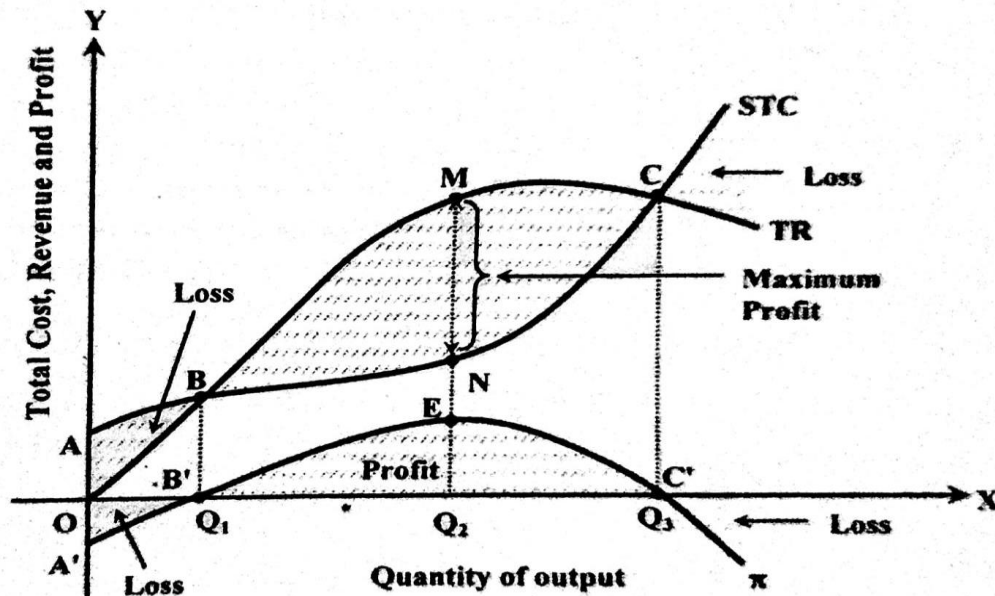
In the above diagram, TR is upward sloping straight line total revenue curve, STC curve shows short-run total cost curve ensures minimum total cost at a different level of output. Intercept OA shows the total fixed cost born by the firm for the fixed factors even at zero levels of output. The horizontal axis shows the quantity sold by the firm. Profit is derived by the vertical gap between the TR curve and the TC curve at every level of output or sales quantity.

When the firm produces zero output, TR is also zero that is no output sold, no revenue but short-run total cost equal to short-run fixed cost even at zero output. OA is short-run total cost which is equal to short-run total fixed cost which is a loss or negative profit shown by the negative intercept of the profit curve, i.e. OA', at zero output. When a firm produces and sells OQ₁ and OQ₃ output, TR is equal to TC and the firm earns zero profit as shown by points B and C/ B' and C'. If the firm continues to produce beyond OQ₁, the vertical gap between total revenue and the total cost curve is increasing. This is increasing up to output OQ₂ and thereafter it is declining. This means output smaller and greater than OQ₂, total profit is lesser as compared to the total profit generated by output OQ₂. The output below OQ₁ and OQ₃, STC is greater than TR so there is negative profit as shown by the portion of the total profit curve below the x-axis. This implies that the firm attains equilibrium when it produces OQ₂ output where there is a maximum gap between TR and STC as shown by MN or EQ₂.

Short-run Equilibrium of a Firm Under Monopoly Market by Using TR-TC Approach

A monopoly market is a market where there is a single seller of a product that has no close substitutes. The firm itself is an industry and monopolists face a downward-sloping demand curve. Given the demand curve, a monopolist firm must choose either price to be charged or quantity to be sold, but it cannot choose both at a time. Hence, the downward sloping demand curve of a monopoly firm indicates that the firm can sell more output only by lowering its price and vice versa. Thus, the total revenue curve under monopoly is inverse U-shaped. TR curve under monopoly can be derived using

its price function given the demand function. The TR curve shows different revenue at a different level of output and price and starts from origin indicating no revenue with no sell. The diagram below shows the profit maximization of a firm under a monopoly by using the TR-TC approach.



In the above diagram, STC represents the short-run total cost curve, TR represents the total revenue curve and π represents profit. The total profit curve is derived based on the vertical distance between the TR curve and the STC curve at each level of output. At zero level of output, total revenue is equal to zero but there is total cost equal to total fixed cost OA, so the monopolist bears the loss equal to OA. At OQ_1 and OQ_3 level of output, TR curve and STC curve gives points B and C as breakeven points. If the firm increases production from OQ_1 , the vertical gap between TR and STC increases and keeps continues until output reaches OQ_2 . At the output less and more than OQ_2 , total profit is less than profit at output OQ_2 because the vertical distance between revenue and cost is maximum at OQ_2 . Hence the equilibrium of the firm is ensured at the OQ_2 level of output with MN profit.

Marginal Revenue and Marginal Cost Approach (MR-MC Approach)

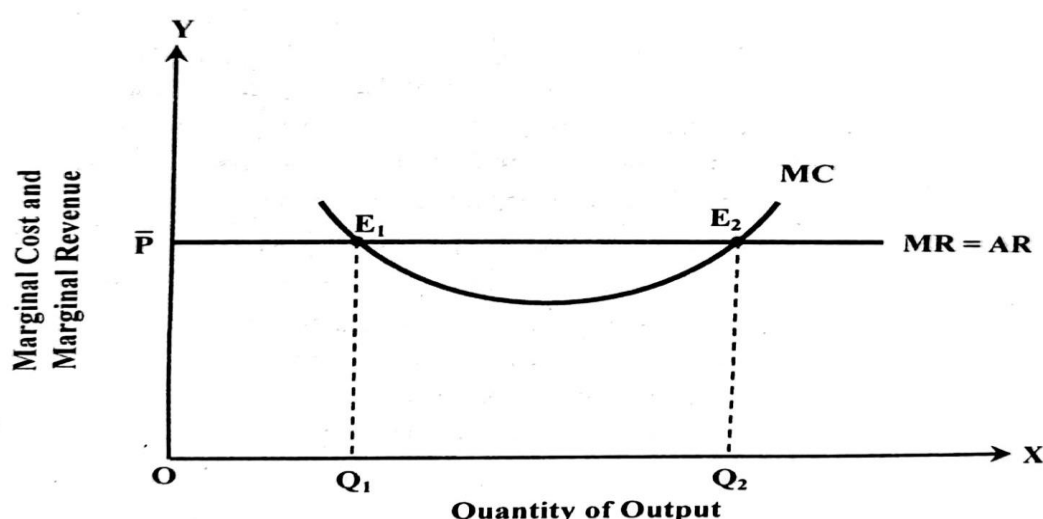
Under the MR-MC approach, a firm will determine output and price based on marginal revenue and the marginal cost of the production. According to this approach, a firm keeps its production continues until its marginal cost will become equal to marginal revenue. At the output, if the marginal cost goes higher than marginal revenue, the firm cuts the output to reduce possible losses. Thus, a firm is in equilibrium at that level of output where marginal cost is exactly equal to marginal revenue and the slope of marginal cost is greater than that of marginal revenue. Thus, the profit-maximizing firm needs to satisfy the following two conditions to earn maximum profit.

1. Marginal revenue must be equal to marginal cost ($MR=MC$)

2. The marginal cost (MC) curve intersects the marginal revenue curve from below. It means the slope of MC should be greater than the slope of the MR curve. This is also known as MC must be increasing at the point where $MR=MC$.

Short-run Equilibrium of a Firm Under Perfect Competition Market by Using MR-MC Approach

In the case of a perfect competition market, the price of the product is determined by the industry, and the firm under the industry has to sell its product at the given price or the price determined by the industry. Due to such reason, the firm under perfect competition market can produce and sell any quantity of the output at the fixed or constant price. Thus, the firm faces a horizontal straight-line demand curve or average revenue curve. Under a perfect competition market, marginal revenue and price are equal that is $P=AR=MR$, therefore the marginal revenue curve coincides with the average revenue curve. The marginal cost curve of the firm is roughly U-shaped. The determination of equilibrium of the firm under perfect competition by using the MR-MC approach is shown in the following graph.

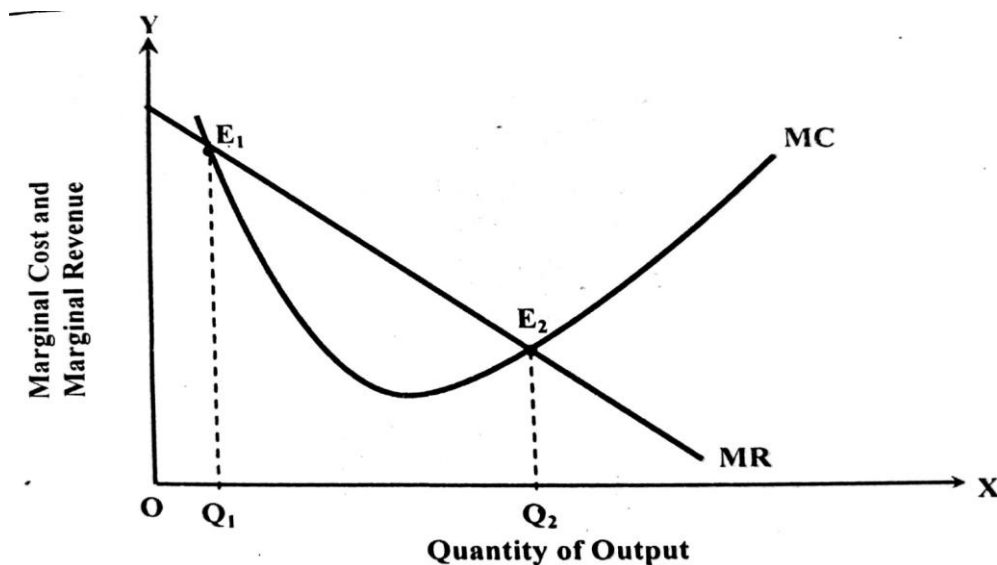


In the above graph, MR and MC represent the marginal revenue and marginal cost curve of the firm under a perfect competition market. MR and MC curve are intersected to each other at point E_1 and E_2 ensuring the fulfillment of the first-order condition of equilibrium. The second-order condition required for the firm's equilibrium is fulfilled at point E_2 only. So, point E_1 is not the equilibrium point but E_2 is the equilibrium point of the firm. At equilibrium point E_2 , where both conditions of equilibrium are satisfied, so the firm attains maximum profit with a definite unit of output (Q_2).

Short-run Equilibrium of a Firm Under Monopoly Market by Using MR-MC Approach

In the case of a monopoly market, a firm or industry is a price maker of a unique product that has no close substitutes. A monopoly firm faces a downward-sloping demand curve or average revenue curve thus monopoly firm must decrease price to sell more units of output. The marginal revenue curve of the monopoly firm also slopes downward but it

passes from below the average revenue curve. The marginal cost curve of the firm is roughly U-shaped. The following figure shows the determination of equilibrium of the monopolist firm under the MR-MC approach in the short run.



In the above diagram, MR and MC are equal that is the implementation of the first-order condition is seen at points E₁ and E₂. Point E₁ is not the equilibrium point because at this point only the first-order condition is fulfilled but the second condition is not. The point E₂ thus is the equilibrium point of the firm ensuring the completion of both required conditions of equilibrium of the firm. Therefore, a monopolist firm maximizes its profit by producing a Q₂ unit of output.

Mathematical Derivation of the Equilibrium of the Firm

The firm aims to maximize profit and profit can be defined as

$$\pi = TR - TC$$

Where π is profit; TR is total revenue, and TC is the total cost

The First Order Condition

This condition requires the first-order derivative of profit function should be equal to zero. So, differentiating the total profit function and equalling it with zero gives us

$$\frac{d\pi}{dQ} = \frac{d(TR)}{dQ} - \frac{d(TC)}{dQ} = 0$$

$$\text{Or } \frac{d(TR)}{dQ} - \frac{d(TC)}{dQ} = 0$$

$$\text{Or } \frac{d(TR)}{dQ} = \frac{d(TC)}{dQ}$$

Here the term $\frac{d(TR)}{dQ}$ is the slope of the total revenue curve that is marginal revenue (MR) and the term $\frac{d(TC)}{dQ}$ is the slope of the total cost curve that is the marginal cost (MC).

Thus, the first-order condition for profit maximization is $MR=MC$. In the case of perfect competition, $MR=P$, so the first-order condition also be written as the $MC=P$.

The Second Order Condition

The second-order condition for equilibrium requires that the second derivative of the profit function must be negative implies that after reaching the highest point the curve turns downwards. The second derivative of the profit function can be given as

$$\frac{d^2\pi}{dQ^2} = \frac{d^2(TR)}{dQ^2} - \frac{d^2(TC)}{dQ^2} < 0$$

$$\text{Or } \frac{d^2(TR)}{dQ^2} < \frac{d^2(TC)}{dQ^2}$$

Here the term $\frac{d^2(TR)}{dQ^2}$ is the slope of the MR curve and $\frac{d^2(TC)}{dQ^2}$ is the slope of the MC curve. Hence the second-order condition can also be expressed as

The slope of $MC > \text{Slope of MR}$

Therefore, the slope of MC should be greater than the slope of MR or the MC must intersect MR from below.

References and Suggested Readings

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