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# **Marginal Cost & its Variation in Different Economy Scales**

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### Abstract

In economics, marginal cost is the change in the total cost that arises when the quantity produced is incremented by one unit; that is, it is the cost of producing one more unit of a good. Intuitively, marginal cost at each level of production includes the cost of any additional inputs required to produce the next unit. At each level of production and time period being considered, marginal costs include all costs that vary with the level of production, whereas other costs that do not vary with production are fixed and thus have no marginal cost. For example, the marginal cost of producing an automobile will generally include the costs of labor and parts needed for the additional automobile and not the fixed costs of the factory that have already been incurred. In practice, marginal analysis is segregated into short and long-run cases, so that, over the long run, all costs (including fixed costs) become marginal.

Keywords: Marginal Cost; Variations; Cost Functions; Negative and Positive Externalities of Cost.

#### **1. Introduction**

If the cost function { $\display-style C$ } C is differentiable, the marginal cost { $\display-style MC$ } MC is the first derivative of the cost function with respect to the output quantity { $\display-style Q$ }

 $\{ display-style MC (Q) = \{ dC \} \{ dQ \} \}. \} \{ dQ \} \}. \}$ 

The marginal cost can be a function of quantity if the cost function is non-linear. If the cost function is not differentiable, the marginal cost can be expressed as follows:

display-style MC = (Delta C) (Delta Q) (Velta Q) (Velt

Where {\display-style \Delta} \Delta denotes an incremental change of one unit.

#### 2. Cost Functions and Relationship to Average Cost

In the simplest case, the total cost function and its derivative are expressed as follows, where Q represents the production quantity, VC represents variable costs, FC represents fixed costs and TC represents total costs.

Since (by definition) fixed cost does not vary with production quantity, it drops out of the equation when it is differentiated. The important conclusion is that marginal cost is not related to fixed costs. This can be compared with average total cost (ATC), which is the total cost divided by the number of units produced and does include fixed costs, denoted here as C0:

{\display style ATC= {\frac {C\_ {0} +\Delta C} {Q}}.} {\display style ATC= {\frac {C\_ {0} +\Delta C} {Q}}.}

For discrete calculation without calculus, marginal cost equals the change in total (or variable) cost that comes with each additional unit produced.

For instance, suppose the total cost of making 1 shoe is \$30 and the total cost of making 2 shoes is \$40. The marginal cost of producing the second shoe is 40 - 30 = 10.

Marginal cost is not the cost of producing the "next" or "last" unit. The cost of the last unit is the same as the cost of the first unit and every other unit. In the short run, increasing production requires using more of the variable input — conventionally assumed to be labor. Adding more labor to a fixed capital stock reduces the marginal product of labor because of the diminishing marginal returns. This reduction in productivity is not limited to the additional labor needed to produce the marginal unit – the productivity of every unit of labor is reduced. Thus the cost of producing the marginal unit of output has two components: the cost associated with producing the marginal unit and the increase in average costs for all units produced due to the "damage" to the entire productive process. The first component is the per-unit or average cost. The second component is the

small increase in cost due to the law of diminishing marginal returns which increases the costs of all units of sold.

Marginal costs can also be expressed as the cost per unit of labor divided by the marginal product of labor. Denoting variable cost as VC, the constant wage rate as w, and labor usage as L, we have

Here MPL is the ratio of increase in the quantity produced per unit increase in labor: i.e.  $\Delta Q/\Delta L$ , the marginal product of labor. The last equality holds because {\display-style {\frac {\Delta L} {\Delta Q}}} \frac {\Delta L} {\Delta Q}} is the change in quantity of labor that brings about a one-unit change in output. Since the wage rate is assumed constant, marginal cost and marginal product of labor have an inverse relationship—if the marginal product of labor is decreasing (or, increasing), then marginal cost is increasing (decreasing).

# **3. Economies of Scale**

Economies of scale apply to the long run, a span of time in which all inputs can be varied by the firm so that there are no fixed inputs or fixed costs. Production may be subject to economies of scale (or diseconomies of scale). Economies of scale are said to exist if an additional unit of output can be produced for less than the average of all previous units— that is, if long-run marginal cost is below long-run average cost, so the latter is falling. Conversely, there may be levels of production where marginal cost is higher than average cost, and the average cost is an increasing function of output. For this generic case, minimum average cost occurs at the point where average cost and marginal cost are equal.

# 4. Perfectly Competitive Supply Curve

The portion of the marginal cost curve above its intersection with the average variable cost curve is the supply curve for a firm operating in a perfectly competitive market (the portion of the MC curve below its intersection with the AVC curve is not part of the supply curve because a firm would not operate at a price below the shutdown point). This is not true for firms operating in other market structures. For example, while a monopoly has an MC curve, it does not have a supply curve. In a perfectly competitive market, a supply curve shows the quantity a seller is willing and able to supply at each price – for each price, there is a unique quantity that would be supplied.

#### 5. Decisions Taken Based on Marginal Costs

In perfectly competitive markets, firms decide the quantity to be produced based on marginal costs and sale price. If the sale price is higher than the marginal cost, then they produce the unit and supply it. If the marginal cost is higher than the price, it would not be profitable to produce it. So the production will be carried out until the marginal cost is equal to the sale price.

#### 6. Relationship to Fixed Costs

Marginal costs are not affected by the level of fixed cost. Marginal costs can be expressed as  $\Delta C/\Delta Q$ . Since fixed costs do not vary with (depend on) changes in quantity, MC is  $\Delta VC/\Delta Q$ . Thus if fixed cost were to double, the marginal cost MC would not be affected, and consequently, the profit-maximizing quantity and price would not change. This can be illustrated by graphing the short run total cost curve and the short-run variable cost curve. The shapes of the curves are identical. Each curve initially increases at a decreasing rate, reaches an inflection point, and then increases at an increasing rate. The only difference between the curves is that the SRVC curve begins from the origin while the SRTC curve originates on the positive part of the vertical axis. The distance of the beginning point of the SRTC above the origin represents the fixed cost – the vertical distance between the curves. This distance remains constant as the quantity produced, Q, increases. MC is the slope of the SRVC curve. A change in fixed cost would be reflected by a change in the vertical distance between the SRVC curve. Any such change would have no effect on the shape of the SRVC curve and therefore its slope MC at any point.

### 7. Private Versus Social Marginal Cost

Of great importance in the theory of marginal cost is the distinction between the marginal private and social costs. The marginal private cost shows the cost borne by the firm in question. It is the marginal private cost that is used by business decision makers in their profit maximization behavior. Marginal social cost is similar to private cost in that it includes the cost of private enterprise but also any other cost (or offsetting benefit) to parties having no direct association with purchase or sale of the product. It incorporates all negative and positive externalities, of both production and consumption. Examples include a social cost from air pollution affecting third parties and a social benefit from flu shots protecting others from infection.

Externalities are costs (or benefits) that are not borne by the parties to the economic transaction. A producer may, for example, pollute the environment, and others may bear those costs. A consumer may consume a good which produces benefits for society, such as education; because the individual does not receive all of the benefits, he may consume less than efficiency would suggest. Alternatively, an individual may be a smoker or

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alcoholic and impose costs on others. In these cases, production or consumption of the good in question may differ from the optimum level.

# 8. Negative Externalities of Production

Much of the time, private and social costs do not diverge from one another, but at times social costs may be either greater or less than private costs. When the marginal social cost of production is greater than that of the private cost function, there is a negative externality of production. Productive processes that result in pollution are a textbook example of production that creates negative externalities.

Such externalities are a result of firms externalizing their costs onto a third party in order to reduce their own total cost. As a result of externalizing such costs, we see that members of society will be negatively affected by such behavior of the firm. In this case, an increased cost of production in society creates a social cost curve that depicts a greater cost than the private cost curve.

In an equilibrium state, markets creating negative externalities of production will overproduce that good. As a result, the socially optimal production level would be lower than that observed.

# 9. Positive Externalities of Production

When the marginal social cost of production is less than that of the private cost function, there is a positive externality of production. Production of public goods is a textbook example of production that creates positive externalities. An example of such a public good, which creates a divergence in social and private costs, is the production of education. It is often seen that education is a positive for any whole society, as well as a positive for those directly involved in the market.

Such production creates a social cost curve that is below the private cost curve. In an equilibrium state, markets creating positive externalities of production will under-produce their good. As a result, the socially optimal production level would be greater than that observed.

# **10.** Conclusion

Decision making approach in which marginal costs are used as the basis for choosing which product to make or which process to use. Also called incremental costing.

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