CHAPTER NINE

Measuring the costs of production

Measuring the Costs of Production

We can note that profit will result when the total revenues of a firm exceed the total costs of production. Profit = total revenue - total cost. In symbols this would be $\pi = pq - \varnothing(q) - b$.

This equation suggests that Total Cost in economics consists of two parts. In general we can say that total cost consist of both explicit and implicit costs.

Explicit Costs = money paid to purchase the services of productive resources.

Implicit Costs = the opportunity costs associated with a firm’s use of resources it owns. These costs do not involve a direct money payment.

We can further identify two types of explicit cost. This observation is based on the fact that explicit costs can be subdivided because they: some vary with the level of output, and some do not vary with the level of output.

Costs that vary with the level of output are called Variable Costs (VC). Materials, labor, fuel are all examples of these. Adding up all such costs we come up with a total. Total what? Total Variable Costs (TVC). In our total cost equation $\varnothing(q)$ represents TVC. TVC = $\varnothing(q)$.

Costs which do not vary with the level of output are called Fixed Costs. Rental payments, interest payments, and, property taxes are all examples. Adding up the value we come-up with a total called Total Fixed Costs (TFC). In our equation TFC are represented by “b”.

We are now able to calculate the total cost of production. If we can control these costs to allow our total revenues to exceed them then we know that profit will result. Now profit in the accounting sense is calculated by deducting TC from TR. In the economic use, however, we also include implicit costs and therefore we see profit differently. In fact, in lieu of implicit costs, we say that two types of profit can be realized. Normal Profit and Economic Profit.

Normal Profit = the minimum return to the factors of production that a firm uses in order to keep-up a certain level of production. In other words all costs, including implicit costs, have to be covered by a firm’s revenue in order for normal profits to be earned.
**Economic Profit** = the amount of revenue earned over and above its normal profits.

Therefore, if we go back to the equation that states 
\[ p = pq - \phi(q) - b \] 
we must ask ourselves whether or not we are enjoying a normal or economic profit. For the moment let’s conclude that we are earning a normal profit. Is this our most desirable situation? No. We want more profits.

Well given this we have a choice, we can either go out of business and seek some other (more profitable) pursuit or we can try to change our profit picture. Since we have invested a lot of time and money in this venture lets just see if we can improve our situation.

One obvious way to accomplish this is by trying to cut costs. We have already determined the TC of production, perhaps if we look closer at these costs we can better understand what is happening to our firm.

Total costs are useful to calculate profit but to a producer they are not that helpful because they do not indicate how much it costs to produce each unit. To help this producer we could calculate how much on an average it costs to produce our product.

Well right away we know that we must be able to calculate three types of average costs:

1. **Average Variable Cost (AVC)**
   \[ AVC = \frac{TVC}{Q} \text{ or } \frac{\phi(q)}{q} \]

2. **Average Fixed Cost (AFC)**
   \[ AFC = \frac{TFC}{Q} \text{ or } \frac{b}{q} \]

3. **Average Total Cost (ATC)**
   \[ ATC = \frac{TC}{Q} \text{ or } AFC + AVC \]
   \[ ATC = \frac{\phi(q) + b}{q} \]

Now average costs are more helpful to the producer than TC because he can now compare the average cost of each unit to the revenue it earns and thus determine whether or not he has benefited from producing that unit. But, if you think about this measurement for a moment you will realize that it does have its limitations.

The major problem with average costs is that they imply that each unit we produce, has the same costs. Is this necessarily true? If Burger King produces 100 Whoppers/day would the TC be the same as if they produced 1000/day? Of course not!
The costs of production can and do change with output! This is what economists call a marginal cost.

**Marginal Cost** = the change in total cost as a result of producing one more unit.

\[
MC = \frac{\text{change in TC}}{\text{change Q}} = \frac{\Delta TC}{\Delta q} = \varphi'(q)
\]

Given the following information complete the table:

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Now if you have correctly calculated your costs the chart should look like this:

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Graphing each of these cost columns yields the following:
To fully understand these curves we should ask ourselves some questions:

1. Why is the TFC perfectly horizontal?
2. Why does the TVC have such a peculiar shape?
3. Why does the TC lie where it does on the graph?

To answer these questions simply note the following:

1. TFC is perfectly horizontal because it is a cost that does not vary with the level of production. It is constant.
2. The peculiar shape of TVC shows that in the bottom half of the curve costs are increasing at a decreasing rate and after it crosses the TFC costs increase at an increasing rate. Decreasing rate means that the variable cost per unit declines as more is produced. If the variable cost is $14 for one unit then $12 and $10 for successive units, this is showing decreasing costs. Increasing cost, on the other hand, means that variable costs per unit rise faster as more is produced. For example if one unit’s variable costs were $14, $17 and $23 would indicate increasing costs.

   Costs begin to increase at increasing rates due to the Law of Diminishing Returns. This law states that when one input is given successive increments, all other inputs being held constant, then a point will be reached beyond which the increments in output will diminish.

3. The TC curve lies where it does on the curve because it is the sum of TFC and TVC. Therefore, it must lie above them.
We can apply the same type of reasoning to the average and marginal curves. The AFC curve declines throughout its range because as you divide a fixed cost by more and more units of output the average has to get smaller. The AVC curve declines and then begins to rise because first efficiency in the production process forces costs to rise at decreasing rates until the law of diminishing returns sets in forcing costs to rise at increasing rates.

You will note three average-marginal relationships when you study these curves.
1. when an average curve is rising its corresponding marginal curve is above it.
2. when an average curve is falling its corresponding marginal curve is below it.
3. when an average curve is neither falling or rising its corresponding marginal curve intersects it.

There are also two total-marginal relationships we should acknowledge:
1. when a total curve is increasing at an increasing rate its marginal curve is rising;
2. when a total curve is increasing at a decreasing rate its corresponding marginal curve is falling.

Now these curves that we have constructed represent short-run cost curves. What is the difference between the long-run and short-run?
Short-run is a time period so short that a firm is unable to vary some of its factors of production.
Long-run is a time period of sufficient length to enable the firm the opportunity to vary all factors of production.

For producers there is a genuine concern for monitoring costs because in the long-run they will ultimately affect the survival of the firm. Although the present or short-run
costs of production are of immediate concern to businesses they must also anticipate the future. Businessmen then, continually attempt to plan the future costs of production by projecting forward today’s market conditions.

For example if we plot the ATC of production for our firm, the curve will look as follows:

![ATC curve diagram]

We can say that this curve represents the costs that a similar firm of the same size would incur because an ATC includes consideration of the fixed costs of production. These fixed costs refer to the machinery and buildings necessary for production.

Given the above what is your goal and how can it be accomplished? Our primary goal is to generate profits, however to accomplish this higher levels of production may be necessary. Higher levels of output may require a larger plant size. Therefore producers must consider the long run expansion of their firms and the conditions necessary for that expansion. This long run planning can be illustrated with the following:

![Long run ATC expansion diagram]

ATC1 represents the average total costs associated with the original firm. This proprietor can produce Q1 levels of output at an average cost of P5 and under utilize plant size or he produce Q2 levels at price P4 and produce with efficiency. When the consumer demands more of this product our proprietor can over utilize his plant and raise output levels, but, in the process average costs also rise. If this increase in quantity demanded is perceived as being short lived the proprietor may very well decide to over
utilize current plant size to satisfy current market conditions. If, however, greater levels of output will be required for the long run then plant expansion should be considered.

Producers will be quick to expand their plants if that expansion will lower the average costs of production. Notice as you move from ATC1 to ATC2 that it is possible to lower ATC and increase output levels to Q3. Again as market conditions change the firm will have to consider whether to under or over utilize their current plant.

Connecting the troughs of each ATC curve on the above graph yields the Planning Curve for the firm.

This Planning Curve is also known as the long run average cost curve. The curve shows that firms can realize some economies of scale through expansion which lead to lower production costs. However, these economies cannot be realized forever, eventually the Law of Diminishing Returns will contribute to rising costs and the planning curve turns upward.