

CHAPTER 6

UNDERSTANDING THE COST OF PRODUCTION

In this section, we wish to look into our break-even price, profitable price, and shut down price. Many times it is the cost per unit of production compared to the price per unit of production that most producers are concerned about. These are the concepts determined by looking into the cost of production.

A. Using Average and Marginal Cost Analysis

Analyzing the cost of production involves using average cost analysis. An average puts the cost on a per unit basis, which makes it easier to compare to the per unit price. This includes averaging the variable, fixed and total cost. Using marginal cost analysis involves understanding the changing of total cost as output rises. We are still analyzing outputs, so we will use the cost information for our soybean example.

Quantity (Q) (Q/acre)	Total Fixed Cost (TFC) (\$/acre)	Total Variable Cost (TVC) (\$/acre)	Total Cost (TFC + TVC) (\$/acre)	Marginal Cost (MC) \$
0	80	0	80	XIX
10	80	43	123	4.30
20	80	55	135	1.20
30	80	65	145	1.00
40	80	85	165	2.00
50	80	120	200	3.50
60	80	169	249	4.90
70	80	270	350	10.10

Averaging these costs involves dividing each by the output or production level. The formula is summarized in the following, and yields the average cost for each category.

$$\text{Average Cost} = \text{Cost} / \text{Output}$$

The average cost is calculated for each cost category, but each has a different meaning so they will be discussed individually.

Average Variable Cost (AVC) is the variable cost for each unit of output produced. Variable costs are considered the direct cost of production, so they **must be covered**. These are cost such as feed, seed, fertilizer, or other cost that change with production, and must be covered for the producer to justify producing. So the average variable cost is the minimum price a producer is willing to receive to continue normal production.

The average variable cost is found by the total variable cost divided by its respective output level. For example, the average variable cost for an output level of 20 bushels is:

$$AVC = (TVC) 55 / 20 (Q = 2.75)$$

(which means \$2.75 is the variable cost per bushel at 20 bushels of output.)

The AVC for 50 bushels is:

$$AVC = 120 / 50 = 2.40$$

(which means \$2.40 is the variable cost per bushel at 50 bushels of output.)

The remainder of the AVC is in the above chart. Notice also that there is a new average variable cost for every level of production, because the cost of increasing 10 bushels changes each different level of output. Consider the 50 bushels per acre of soybeans, with the average variable cost of \$2.40 per bushel. The producer has to receive at least \$2.40 a bushel in revenue to produce soybeans. Any lesser amount will not cover the variable cost, and the producer would have to search for a better price.

However, why would a producer sell at a price that only covers variable cost? Because fixed costs are “sunk costs,” and the producer cannot control them. The lost fixed cost may be recaptured in the following year if the prices improve. So for the short run, the producer will produce at a loss, if he or she can cover their variable cost.

The *average fixed cost* only considers the fixed cost per unit of output. It is found by dividing the total fixed cost by its respective level of output. For example, the average fixed cost for 20 bushels of soybeans is:

$$AFC = (TFC) 80 / 20 (Q) = 4$$

(There is \$4.00 per bushel of output associated with fixed cost.)

The average fixed cost for 50 bushels is:

$$AFC = 80 / 50 = 1.6$$

(There is \$1.60 fixed costs per bushel of soybeans.)

The AFC decreases as output increases because the cost is fixed and is spread out among more and more units of production. These costs are sunk cost that the producer has no control over.

The *average total cost* is the per unit total cost for every unit of output. This total cost per unit includes fixed and variable cost. The average total cost can be calculated two ways.

The first and the easiest is to simply add the average fixed and average variable cost at each output level to come up with the average total cost for each output level. The second way is to take the total cost and divide by its respective level of output, to find the average total cost at each level. This method will come up with a slightly different number depending on how many decimal places your calculator will carry.

We will use the first one because it is the easiest. Now let's consider the ATC for 20 bushels of soybeans:

$$ATC = (AVC) 2.75 + (AFC) 4 = 6.75$$

(There is \$6.75 of total cost per bushel of soybeans at a production level of 20 bushels.)

Consider the 50-bushel of soybeans:

$$ATC = 2.40 + 1.6 = 4.0$$

(At 50 bushels of soybeans there is \$4.00 of total cost per unit.)

These per unit of total cost are used to determine what price is needed to break even or have total revenue equal to total cost. For example, 50 bushels of soybeans produced have an average total cost of \$4.00 per bushel. If a producer is at that level of output, they must have at least an estimated price of \$4.00 per bushel to break even. Another example may be the previously determined maximum profit level of 60 bushels, assuming a price of \$5.00 per bushel.

$$ATC \text{ (for 60 bushels)} = 2.82 + 1.33 = 4.15$$

(In order to break even at the optimal level of production, the price of soybeans cannot fall below \$4.15 per bushel.)

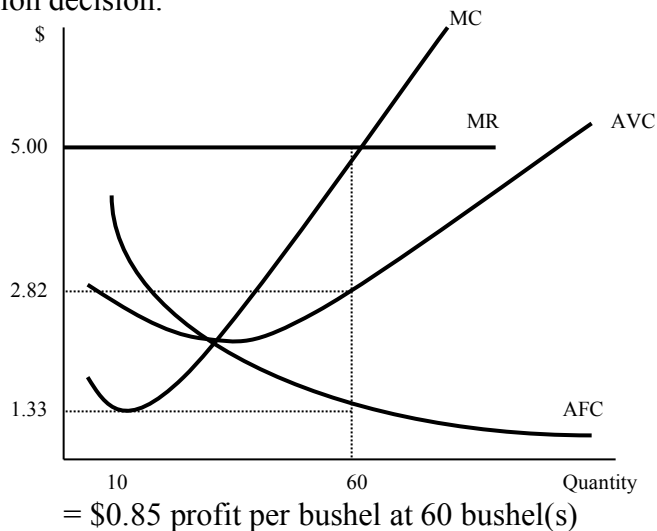
The following table illustrates all the average cost analysis.

Quantity (Q) (Q/acre)	Average Fixed Cost (AFC)	Average Variable Cost (AVC)	Average Total Cost (ATC)	Marginal Cost (MC)
0	0	0	0	XIX
10	8.00	4.30	12.30	4.30
20	4.00	2.75	6.75	1.20
30	2.60	2.16	4.76	1.00
40	2.00	2.12	4.12	2.00
50	1.60	2.40	4.00	3.50
60	1.33	2.82	4.15	4.90
70	1.14	3.86	5.00	11.50

The marginal cost represents the additional cost from changing production levels, and as the previous chapter indicated, you have maximum profit when $MR = MC$.

B. Graphically Analyzing the Cost of Production

The average cost and marginal cost can also be graphed to look at the relationships with price in making a production decision.



Average Cost at 60 bushels:	AVC	2.82
	+AFC	+1.33
	ATC	4.15

This graph illustrates how the cost curves are shaped and how they relate to the previously determined maximum profit level at 60 bushels. In this graph, production will occur at maximum profit, which is at 60 bushels of production. This is labeled on the graph where $MR = MC$. It also illustrates the fixed marginal revenue of \$5, and with a variable cost of \$2.82 and a fixed cost of \$1.33 that gives per bushel profit \$0.85 ($5.00 - 2.82 - 1.33 = 0.85$).

This \$0.85 is profit per bushel of soybeans for producing at a yield of 60 bushels per acre. This \$0.85 multiplied by 60 bushels gives a total profit of \$51 ($60 \times 0.85 = 51$). This is the same maximum profit found in using the total and marginal analysis. However, analyzing cost allows a producer to understand their break-even price and shut down price.

Prices are not always constant, so understanding these important price levels allows a producer to plan for any risk management techniques needed to achieve a certain price level. A new price level will create a new horizontal price line (MR), and create a new $MC = MR$ level, which determines a new profitable output, new cost and new profit level.

In our previous example, the production of 60 bushels is our goal for production as long as the price is \$5.00 per bushel, but what if the price is not \$5.00. As a soybean producer you may already have the crop planted. At 60 bushels our minimum price to sell the crop at is \$2.82 per bushel. If we cannot obtain the \$2.82 or cover our variable cost, would have to *shut down* operation.

A *breakeven* situation would involve obtaining a price equal to all cost, which is \$4.15 per bushel.

Maximizing profits can apply to efficiently using inputs, efficiently selecting outputs, and analyzing the cost of production. Each of these areas address different aspects of maximizing profits and enables a firm to maintain profits, or exist during adverse years.