

UNIVERSITY OF WISCONSIN

Economics 101 – Spring 2007

Professor Brown

Problem Set 8 – Answer Keys

Cost Curves

- 1) Recall that our wheat farmer has total production costs given by the equation $TC=600+2Q$, where Q is output, measured in bushels of wheat.
- a. The farmer's marginal cost (MC) of production is the increase in costs associated with producing one more bushel of wheat. Thus,

$$MC = \Delta TC / \Delta Q = \text{slope of the total cost function} = 2$$

Notice that marginal cost is always the slope of the total cost function. In most cases (but not here) total cost is non-linear. This means that to find marginal cost, one would need to find the first derivative (using calculus) of the total cost function. Since this class does not require calculus, we'll just tell you the marginal cost if total cost is not linear. We believe that in most cases, total cost is non-linear, and that even marginal cost is non-linear.

- b. The fixed cost is the component of total cost that *does not* change when quantity produced changes. Looking at the equation for total cost, we see that any component of TC without a Q in it is a fixed cost. Thus fixed cost is just the vertical intercept of TC , that is $FC = 600$. Some examples of fixed costs for a wheat farmer might include land, the farmhouse, a barn, tractor(s), and property taxes.
- c. Variable cost is the component of total cost that *does* change when quantity produced changes. Looking at the equation for total cost, we see that any

component of TC with a Q (or function of Q; e.g. Q^2 , \sqrt{Q} , etc.) in it is a variable cost. Here, then, we have $VC = 2Q$. Notice that $TC = FC + VC$.

- d. Average costs may be thought of as average *per-unit* costs. To translate any cost into a per-unit cost, just divide by quantity. Thus,

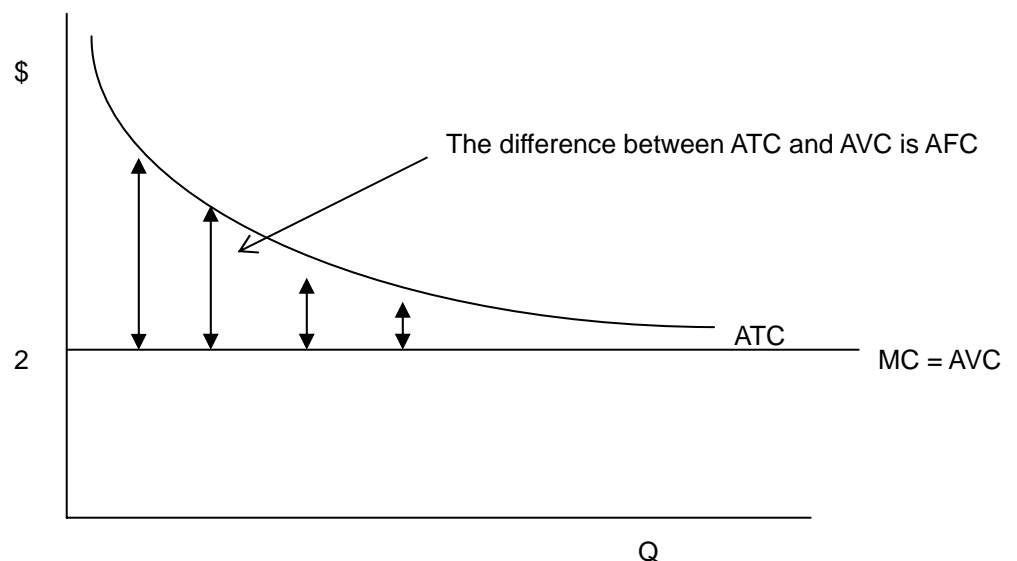
$$ATC = TC/Q = (600 + 2Q)/Q = 600/Q + 2$$

$$AVC = VC/Q = 2Q/Q = 2$$

$$AFC = FC/Q = 600/Q$$

Notice that $ATC = AFC + AVC$. This is not surprising, since $TC = FC + VC$. Dividing both sides by Q shows that $ATC = AFC + AVC$. This is another identity helpful to have on hand.

- e. Notice in the graph below that as Q increases AFC (the difference between ATC and AVC) decreases. Finally, notice that these cost functions do not look like what we typically study in lecture or the textbook. These costs are a special case – one that we usually think of as representative of a natural monopoly (we'll talk about this again in several weeks). For now, just notice that the graphs we see in lecture are probably more realistic, but that we used simpler form here to avoid some very complicated equations.

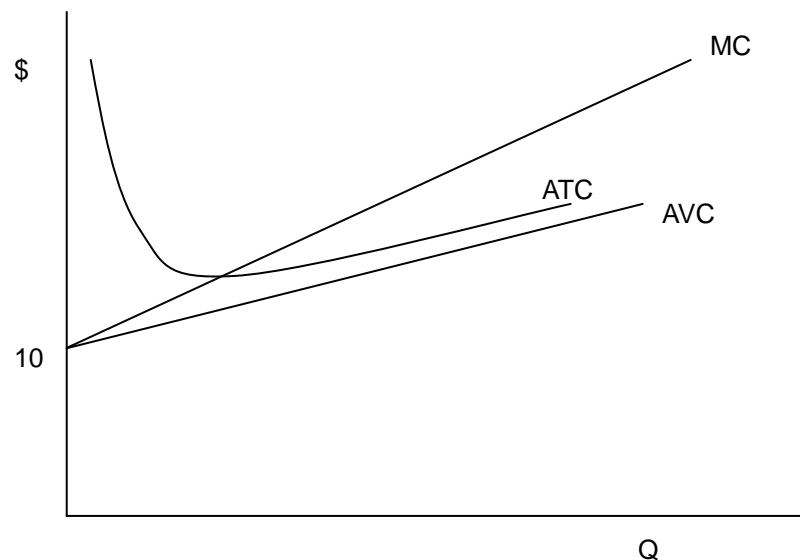


2) The farmer's marginal cost (MC) of production is the increase in costs associated with producing one more bushel of wheat. Thus, a local microbrewery has total costs of production given by the equation $TC=500+10Q+5Q^2$. This implies that the firm's marginal cost is given by the equation $MC = 10 + 10Q$ (you do not need to be able to show this).

a. $ATC = TC/Q = (500 + 10Q + 5Q^2)/Q = 500/Q + 10 + 5Q,$

$AVC = VC/Q = (10Q + 5Q^2)/Q = 10 + 5Q.$

b. Notice that MC cost cuts ATC at its minimum, and that ATC is approaching AVC as Q increases (This is because $AFC = 500/Q$, the difference between ATC and AVC is decreasing as Q increases.)



c. Note that MC crosses ATC at its minimum. Hence, $MC(Q) = ATC(Q)$ at the crossing point output.

$$10+10Q = 500/Q+10+5Q,$$

$$Q = 10$$

d. From the picture above, it is clear that AVC is minimized at $Q = 0$. However, more often we see non-linear AVC curves (see figures in chapter 14). So more general approach is to use the fact that MC always crosses AVC at its minimum. Hence, the at the crossing point output level, $MC(Q) = AVC(Q)$, which means $10+10Q = 10+5Q, \rightarrow Q = 0$

3) D

4) C

5) A

6) D