

Answers (Practice: Production in the Long run)

Question 1

Cost minimization is necessary but not sufficient for profit maximization. To see this, note that profits (Π) equal revenues (R) minus costs (C), or

$$\Pi = R - C$$

For any given level of output, Q , profit maximization therefore requires that the difference between $R(Q)$ and $C(Q)$ be maximized. If the firm is *not* minimizing its costs, then profits can be increased for any given $R(Q)$. Thus cost minimization is necessary for profit maximization.

To see why cost minimization is not *sufficient* for profit maximization, imagine a situation in which the firm has minimized $C(Q)$ for any given level of Q . But if the firm has not maximized $R(Q)$ for that same level of Q , then profits will not be maximized.

Question 2

- a. The ratios of marginal products to factor prices in this case are:

$$K : MP_K/p_K = 80/2 = 40$$

$$L : MP_L/p_L = 20/10 = 2$$

This firm is *not* minimizing its costs; to do so it should use more K and less L .

- b. The ratios in this case are:

$$K : MP_K/p_K = 80/20 = 4$$

$$L : MP_L/p_L = 20/5 = 4$$

This firm is minimizing its costs. No further substitution is required.

- c. The ratios in this case are:

$$K : MP_K/p_K = 80/40 = 2$$

$$L : MP_L/p_L = 20/5 = 4$$

This firm is *not* minimizing its costs; to do so it should use less K and more L .

Question 3

- a. Both price changes are working in the same direction—increasing the price of labor relative to computers. Firms are predicted to substitute away from labor and toward computers, as has been occurring in many industries in the past several years.
- b. Buildings are predicted to get taller over time. This tendency toward high-rise construction in big cities has in fact occurred.
- c. The higher relative wages in the United States suggests that new plants will be built in China and U.S. plants will be phased out.

- d. The rise in wages is predicted to cause firms to substitute away from labor toward other factors of production. Thus more capital-intensive production methods will be used.

Question 6

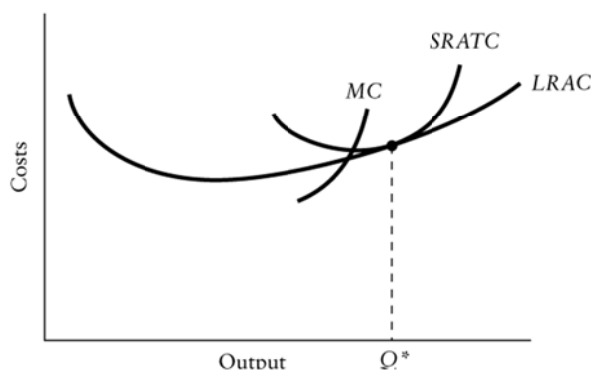
- With Plant #1 and output Q_1 , average costs are equal to c_1 .
- At Q_1 , the firm is experiencing decreasing costs because at this output level the LRAC curve is downward sloping.
- The decreasing costs in (b) are due to economies of scale.
- Now consider output Q_2 with Plant #2:
 - average costs are c_2
 - the LRAC curve is horizontal, and so there are constant costs
 - no further economies of scale

With output Q_3 and Plant #3:

- average costs are c_3
- the LRAC curve is upward sloping and so there are increasing costs
- diseconomies of scale

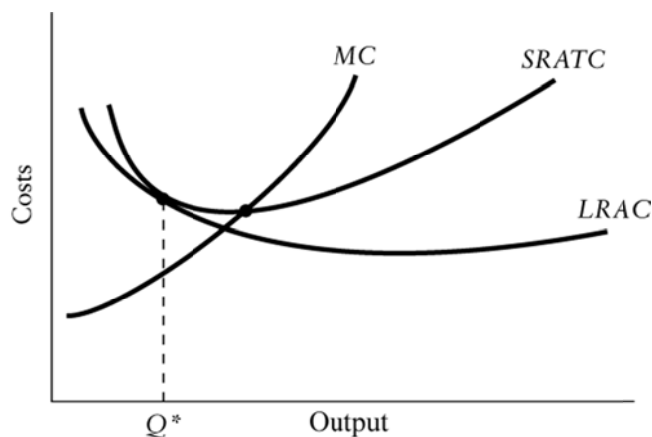
Question 7

- “Diseconomies of scale” describes what happens to unit costs as all factors of production are increased by the same proportion. For example, if the firm increases its capital stock and its labor force by 10 percent, what happens to unit costs? Since all factors are variable in this exercise, it is clearly a long-run concept. The most often cited explanation for diseconomies of scale (unit costs increasing as scale rises) is that after some point the costs associated with planning, managing, and monitoring the operations of a large firm start to rise. It simply becomes difficult to keep everything running smoothly, and unit costs rise as a result of organizational and management mistakes. “Diminishing marginal product” refers to the relationship between changes in output and changes in one variable factor when other factors of production are being held constant. Since one or more factors are fixed in this exercise, this is clearly a short-run concept.
- See the diagram below that shows an *LRAC* curve as well as an *SRATC* curve. At output equal to Q^* , long-run average costs are rising, indicating diseconomies of scale. Also, at Q^* short-run average total costs are rising. Recall that *SRATC* rises if *MC* is above *SRATC*, and *MC* rises when there is diminishing marginal product of the variable factor. Thus, we draw *MC* rising at Q^* so there is diminishing marginal returns.



Question 8

- a. “Economies of scale” describes what happens to unit costs as all factors of production are increased by the same proportion. For example, if the firm increases its capital stock and its labor force by 10 percent, what happens to unit costs? Since all factors are variable in this exercise, it is clearly a long-run concept. The most often cited explanation for economies of scale (unit costs decreasing as scale rises) is that as the scale of operation increases, the firm is better able to take advantage of the benefits of specialization and the division of labor. These productivity gains imply a reduction in unit costs. “The spreading of overhead” refers to the behavior of average *fixed* costs as the level of output rises. For a given amount of fixed costs (capital costs, product development costs, etc.), average fixed costs clearly decline as the level of output rises. Since this dilution of fixed costs relies on the existence of some fixed factors of production, it must be a short-run concept. This is an important reason for declining average total costs in the short run. Even if average variable costs have started to rise due to diminishing marginal product, a large enough decline in *AFC* can still make *ATC* decline.
- b. See the diagram below that shows an *LRAC* curve as well as an *SRATC* curve. At output equal to Q^* , long-run average costs are falling, indicating economies of scale. Also, at Q^* short-run average total costs are falling. Note that even though *MC* is shown to be rising at Q^* , and thus diminishing returns to the variable factor has already set in, *SRATC* is still falling. This must be due to the continued spreading of overhead, as reflected by an *AFC* curve that is falling as Q rises (not shown).



Question 9

- a. See the diagram below. Economies of scale (long run) mean that we are on the downward-sloping portion of the *LRAC* curve. Diminishing marginal product (short run) means that we are on the upward-sloping portion of the *SRATC* curve. The left-hand diagram has the output level Q^* which satisfies both conditions.
- b. See the diagram below. Diseconomies of scale (long run) mean that we are on the upward-sloping portion of the *LRAC* curve. But falling short-run total costs means that the effect from spreading one's overhead is offsetting the falling marginal product of the variable factor. The right-hand diagram has the output level Q^* which satisfies both conditions.

