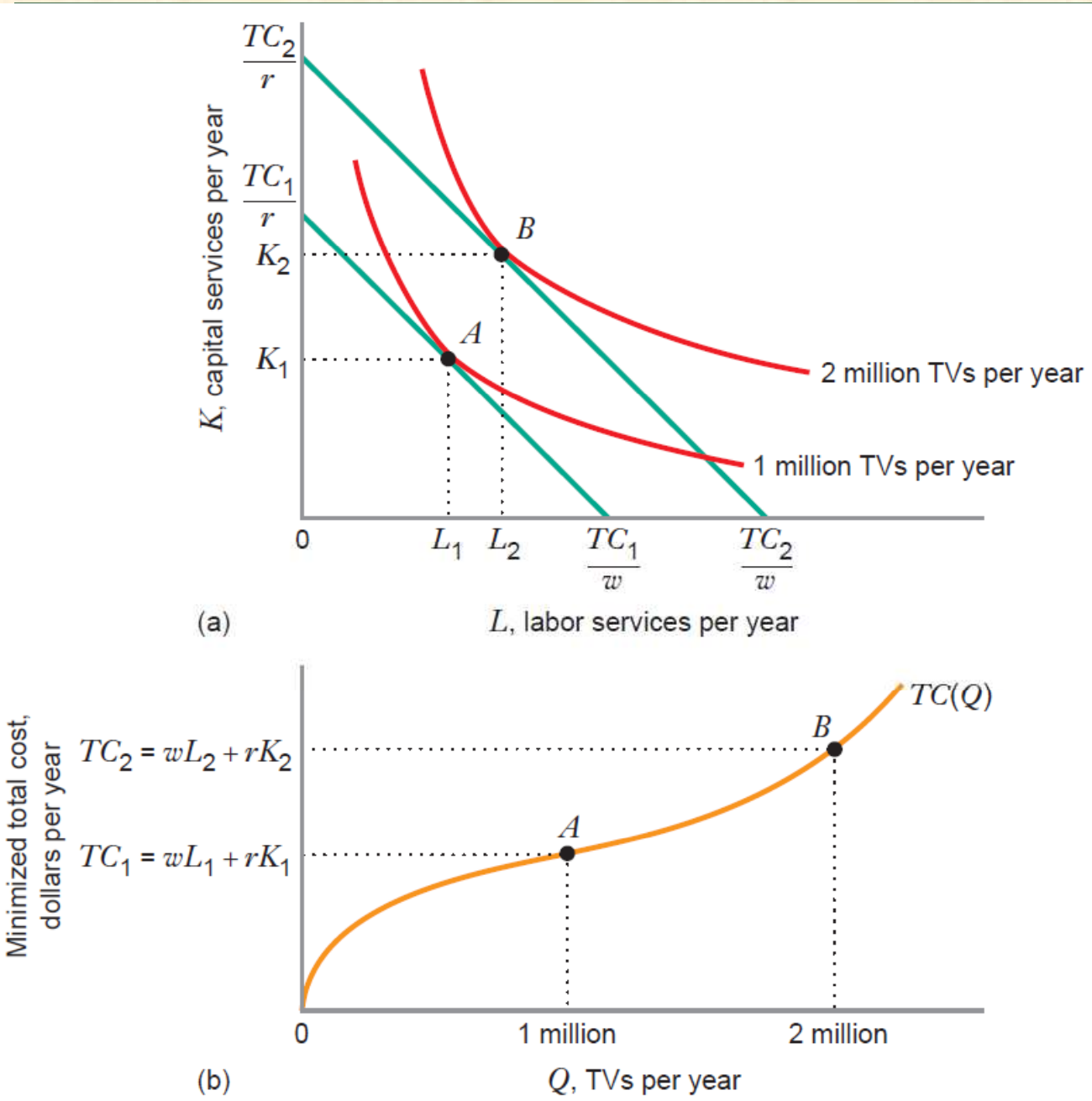
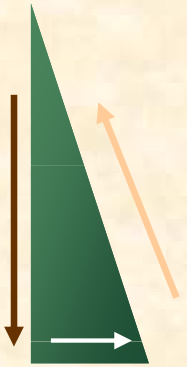
Cost Curves in long run



The quantity of output increases from 1 million to 2 million television sets per year, with the prices of labor w and capital r held constant. The comparative statics analysis in panel (a) shows how the cost-minimizing input combination moves from point A to point B, with the minimized total cost increasing from TC_1 to TC_2. Panel (b) shows the long-run total cost curve $TC(Q)$, which represents the relationship between output and minimized total cost.

Long-run total cost curve

- shows how minimized total cost varies with output, holding input prices fixed and selecting inputs to minimize cost
- Because the cost-minimizing input combination moves us to higher isocost lines, the long-run total cost curve must be increasing in Q.
- when Q=0 => long-run TC=0 (because the firm is free to vary all inputs even the capital if it produces a zero quantity, the cost-minimizing input combination is zero labor and zero capital)

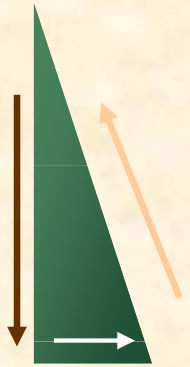


- We have production function:

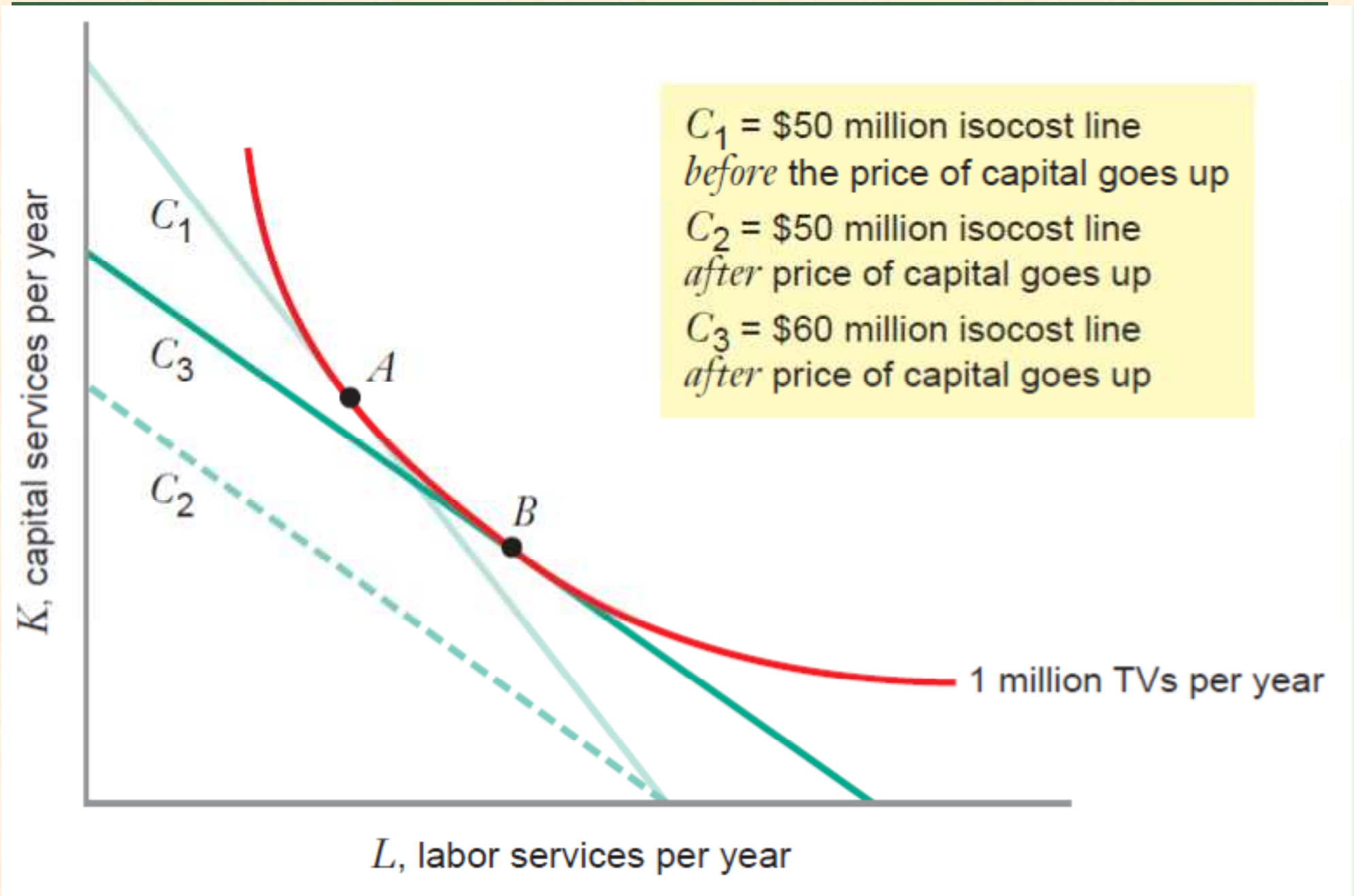
$$Q = 50\sqrt{LK}$$

1) **How does minimized total cost depend on the output Q and the input prices w and r for this production function?**

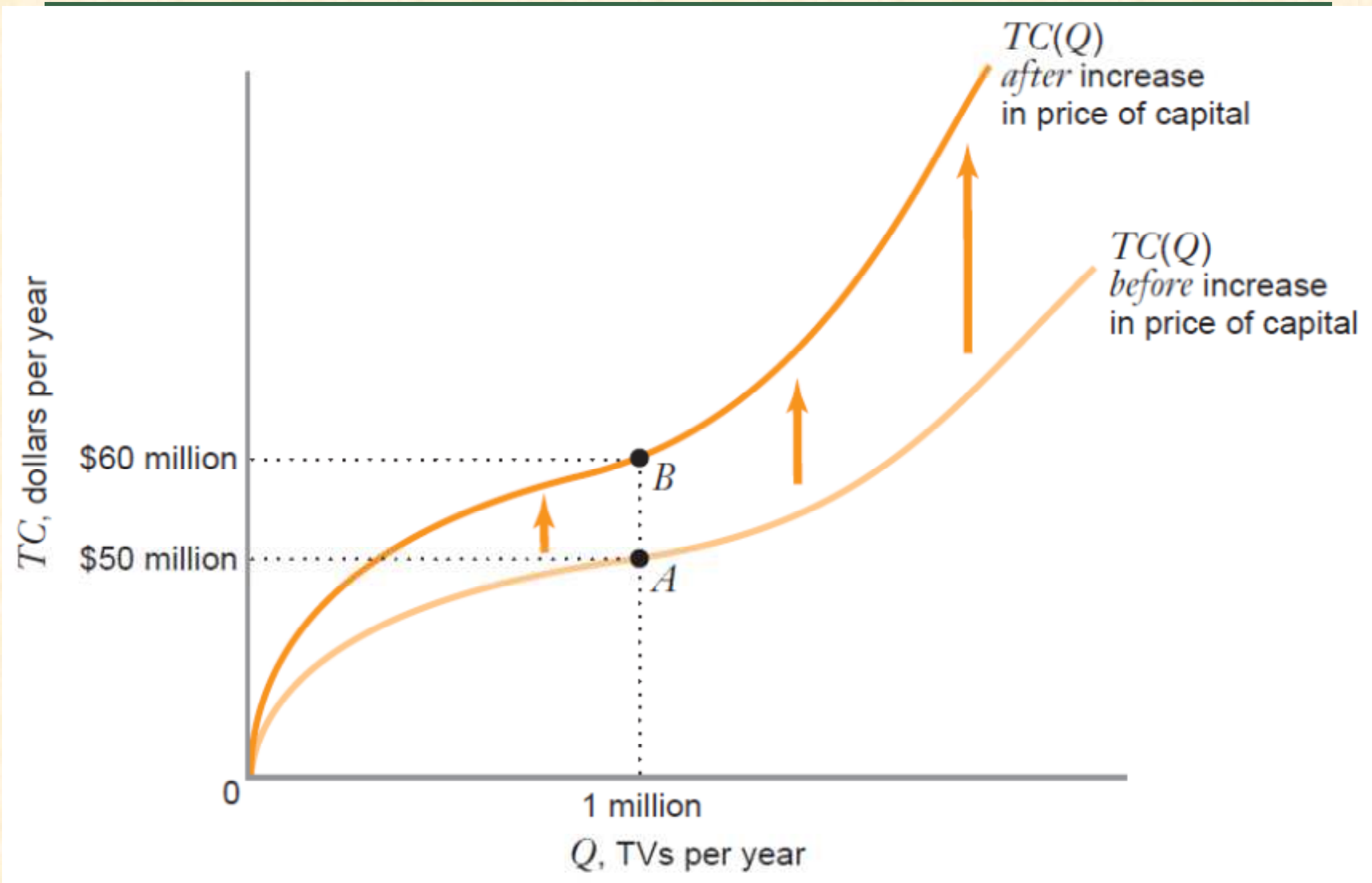
2) **What is the graph of the long-run total cost curve when w=25 and r=100?**



Long-run total cost curve – one input price (capital) change?



Long-run total cost curve – one input prices (capital) change?

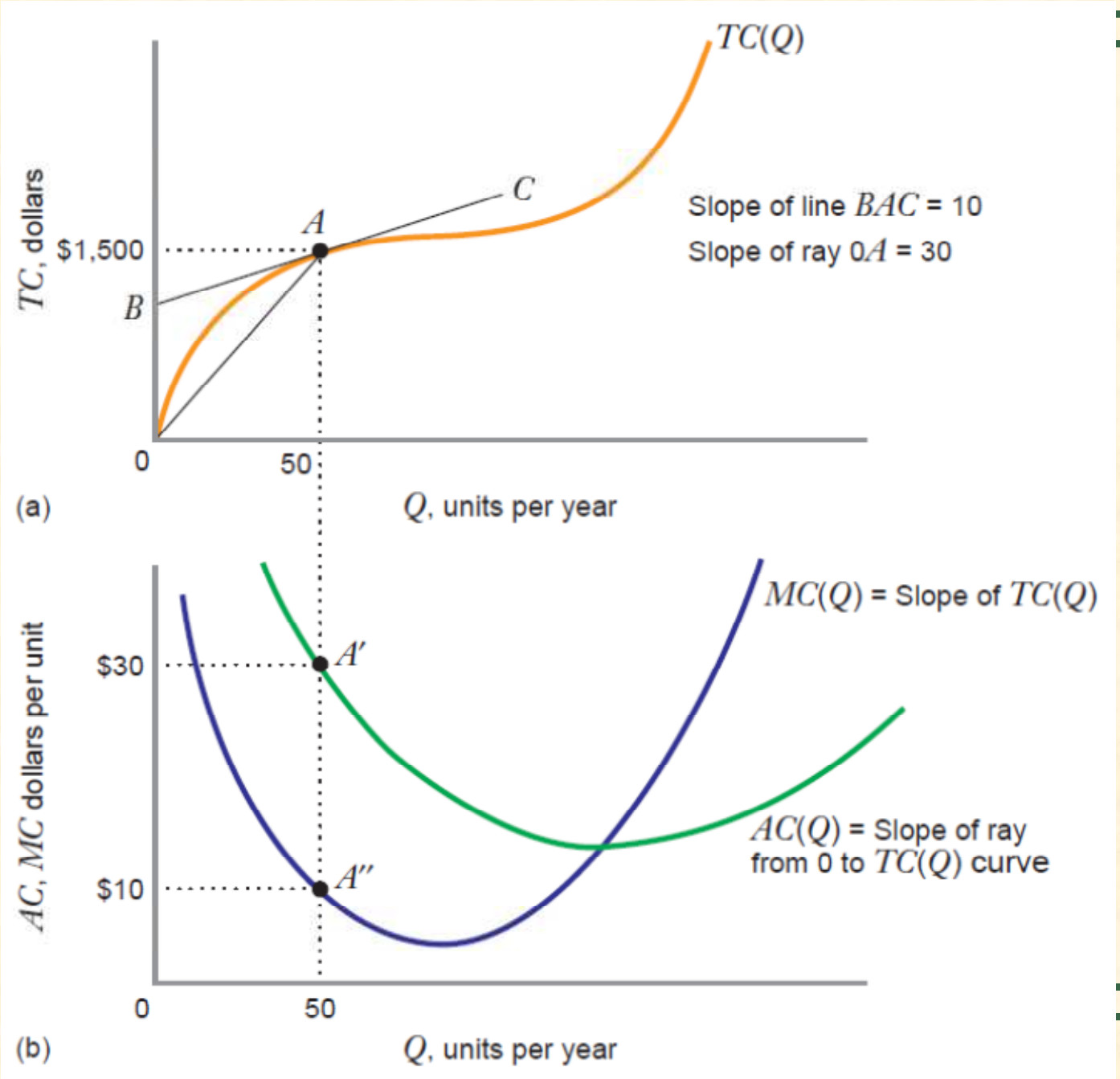


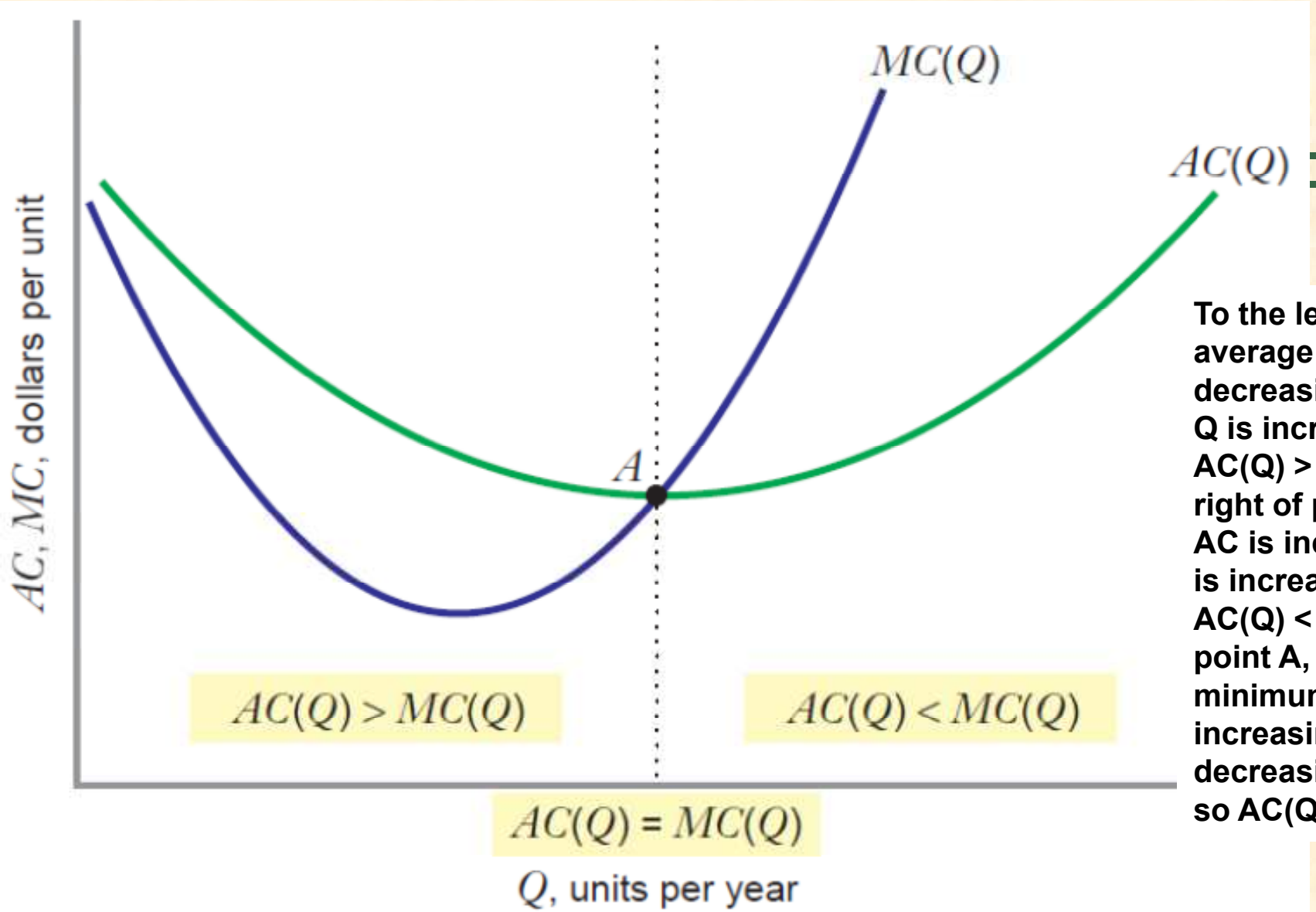
LONG-RUN AVERAGE AND MARGINAL COST CURVES

- **Long-run average cost** is the firm's cost per unit of output. It equals long-run total cost divided by Q: AC(Q) = [TC(Q)]/Q.
- **Long-run marginal cost** is the rate at which long-run total cost changes with respect to a change in output: MC(Q) = (ΔTC)/(ΔQ). Thus, MC(Q) equals the slope of TC(Q).
- Although long-run average and marginal cost are both derived from the firm's long-run total cost curve, the two costs are generally different
- **relationship between the longrun average and long-run marginal cost curves:**

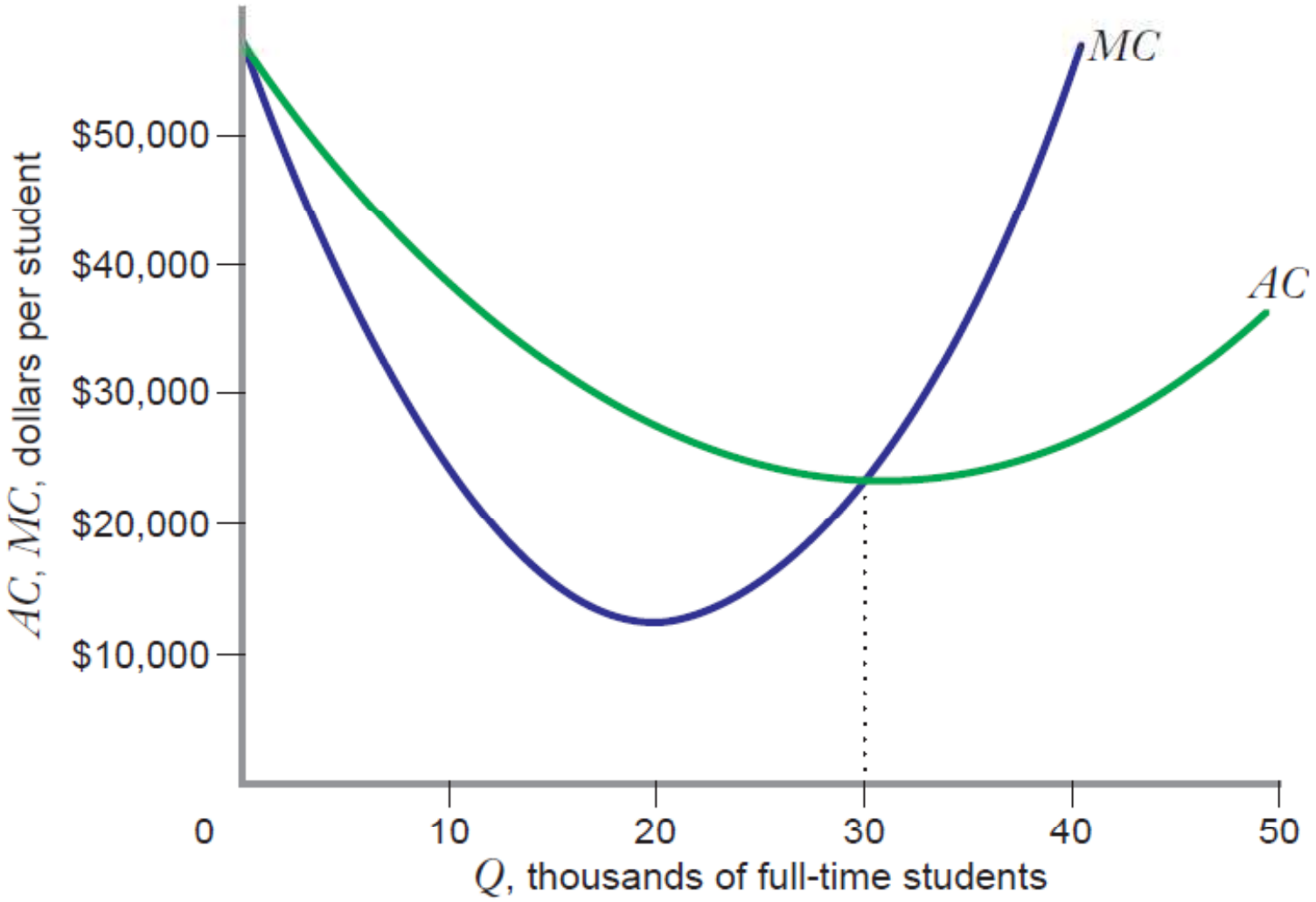
1) If average cost is decreasing as quantity is increasing, then average cost is greater than marginal cost: AC(Q) > MC(Q).
2) If average cost is increasing as quantity is increasing, then average cost is less than marginal cost: AC(Q) < MC(Q).
3) If average cost is neither increasing nor decreasing as quantity is increasing, then average cost is equal to marginal cost: AC(Q)=MC(Q).

Long-run total cost curve – input prices change?





To the left of point A, average cost AC is decreasing as quantity Q is increasing, so AC(Q) > MC(Q). To the right of point A, AC is increasing as Q is increasing, so AC(Q) < MC(Q). At point A, AC is at a minimum, neither increasing nor decreasing, so AC(Q) = MC(Q).



The marginal cost of an additional student is less than the average cost per student until enrollment reaches about 30,000 students. Until that point, average cost per student falls with the number of students. Beyond that point, the marginal cost of an additional student exceeds the average cost per student, and average cost increases with the number of students.

Exercise

- We have production function:

$$Q = 50\sqrt{LK}$$

1) **We know from previous exercise, that TC=2Q and w=25 and r=100. What are the long-run average and marginal cost curves associated with this long-run total cost curve?**

2) **Whenever the long-run total cost is a straight line long-run average and long-run marginal cost curves will be the same and will be a horizontal line.**

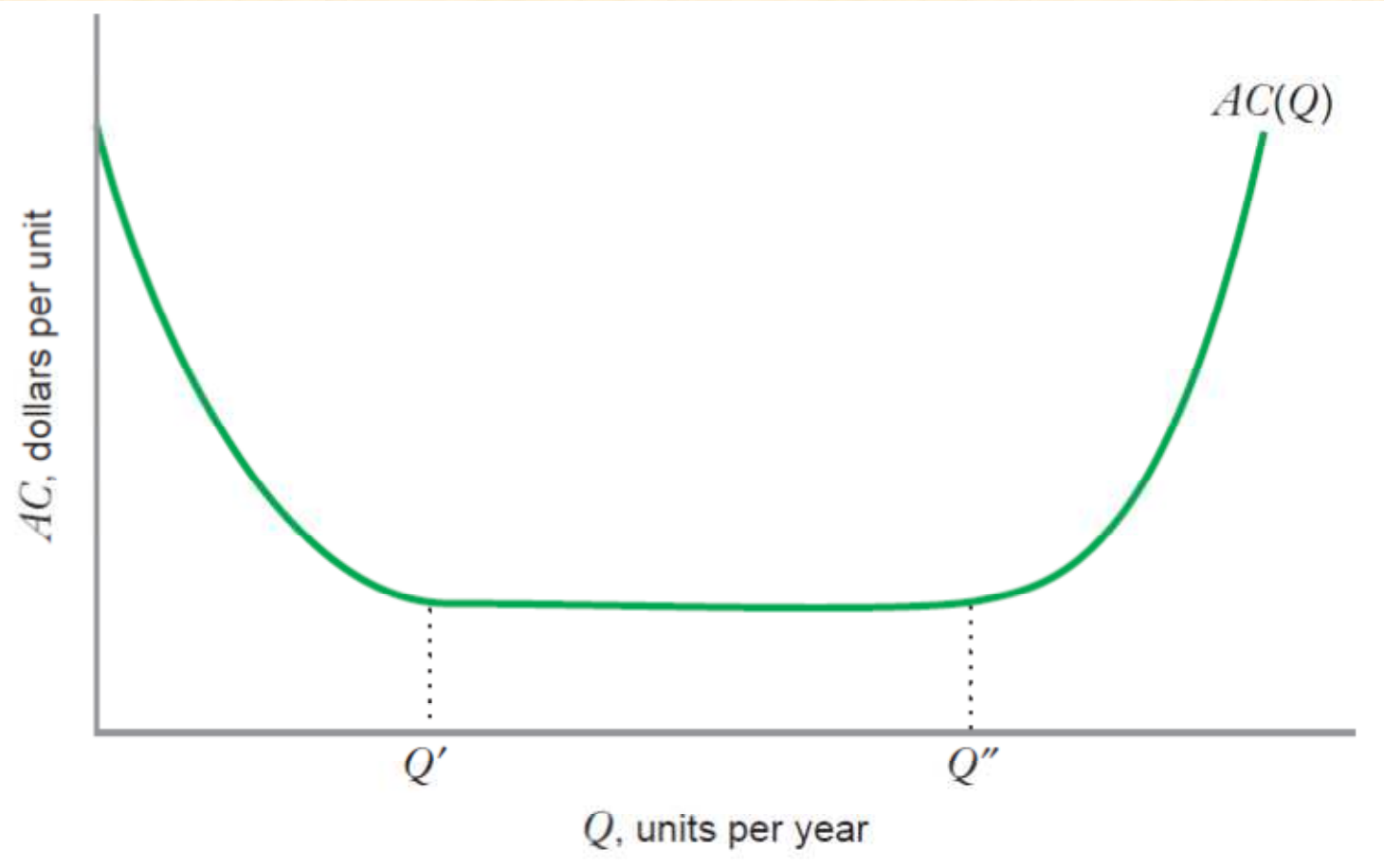
Economies and Diseconomies of Scale

- change in long-run average cost as output increases:

1) **economies of scale**: a characteristic of production in which average cost decreases as output goes up.

2) **diseconomies of scale**: opposite situation, where average cost goes up when output goes up.

- Economies of scale can also explain why some firms are more profitable than others in the same industry. Claims of economies of scale are often used to justify mergers between two firms producing the same product



There are economies of scale for outputs less than Q´. Average costs are flat between and Q´ and Q´´and there are diseconomies of scale thereafter. The output level Q is called the minimum efficient scale.

Economies of Scale

- **causes**:

1) physical properties of processing units that give rise to increasing returns to scale in inputs

2) can also arise due to specialization of labor (specialization which can increase worker productivity).

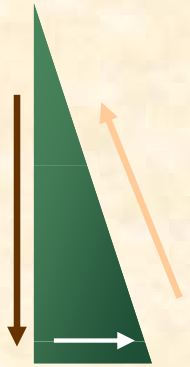
3) result from the need to employ **indivisible inputs** (An input that is available only in a certain minimum size. Its quantity cannot be scaled down as the firm's output goes to zero. An example of an indivisible input is a high-speed packaging line for breakfast cereal. Even the smallest such lines have huge capacity—14 million pounds of cereal per year. A firm that might only want to produce 5 million pounds of cereal a year would still have to purchase the services of this indivisible piece of equipment.

Diseconomies of Scale

- **causes**:

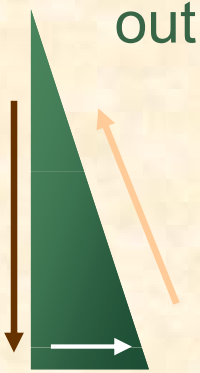
1) **managerial diseconomies** - a situation in which a given percentage increase in output forces the firm to increase its spending on the services of managers by more than this percentage.

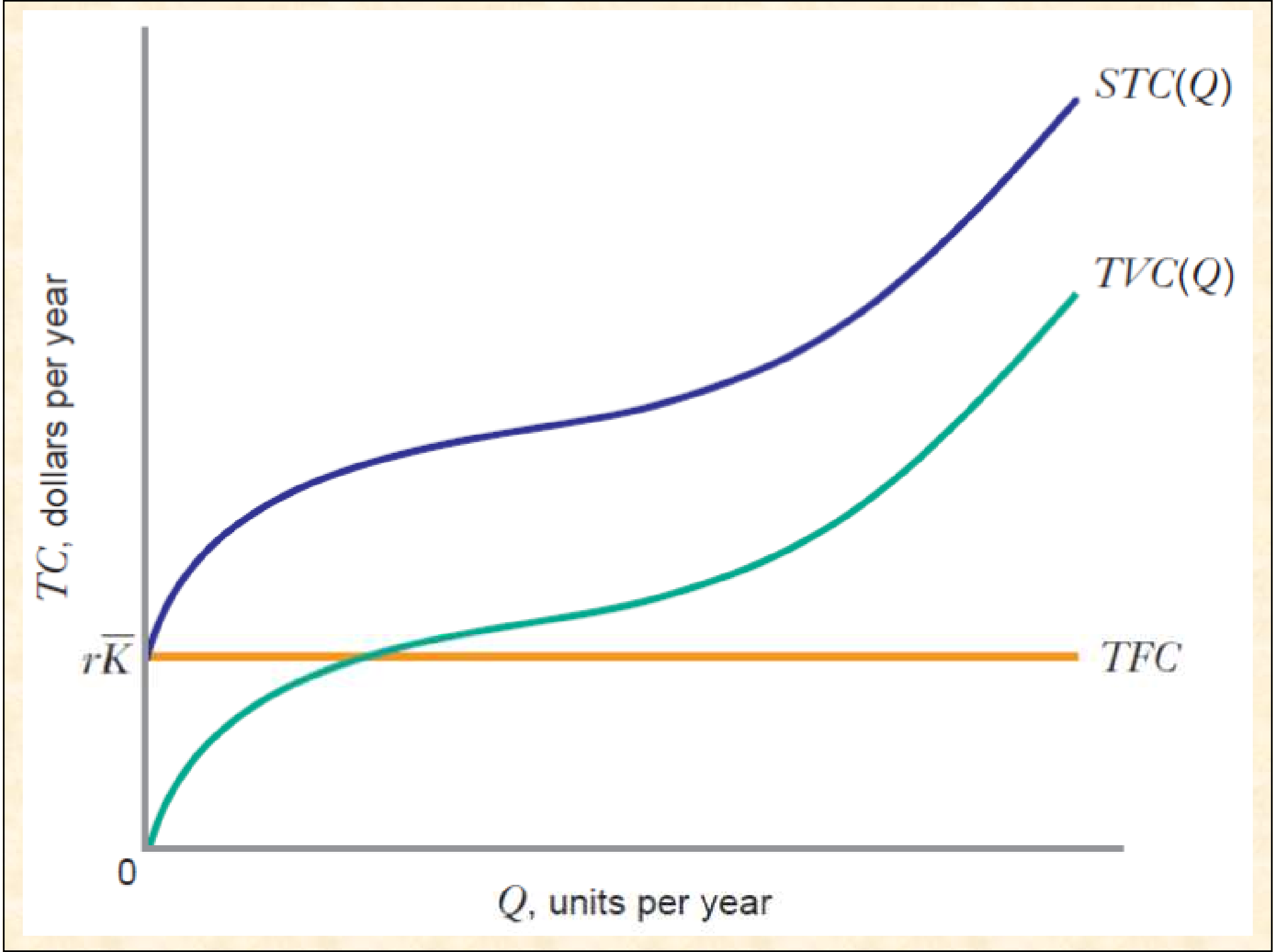
2) **minimum efficient scale** - the smallest quantity at which the long-run average cost curve attains its minimum point.



Short-run total cost curve

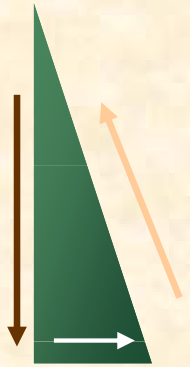
- tells us the minimized total cost of producing Q units of output when at least one input (usually capital) is fixed at a particular level.
- The short-run total cost curve is the sum of two components: the total variable cost curve TVC(Q) and the total fixed cost curve TFC—that is, STC(Q)=TVC(Q) + TFC.
- The total variable cost curve TVC(Q) is the sum of expenditures on variable inputs, such as labor and materials
- Total fixed cost is equal to the cost of the fixed capital services and thus does not vary with output (total fixed cost is independent of output)



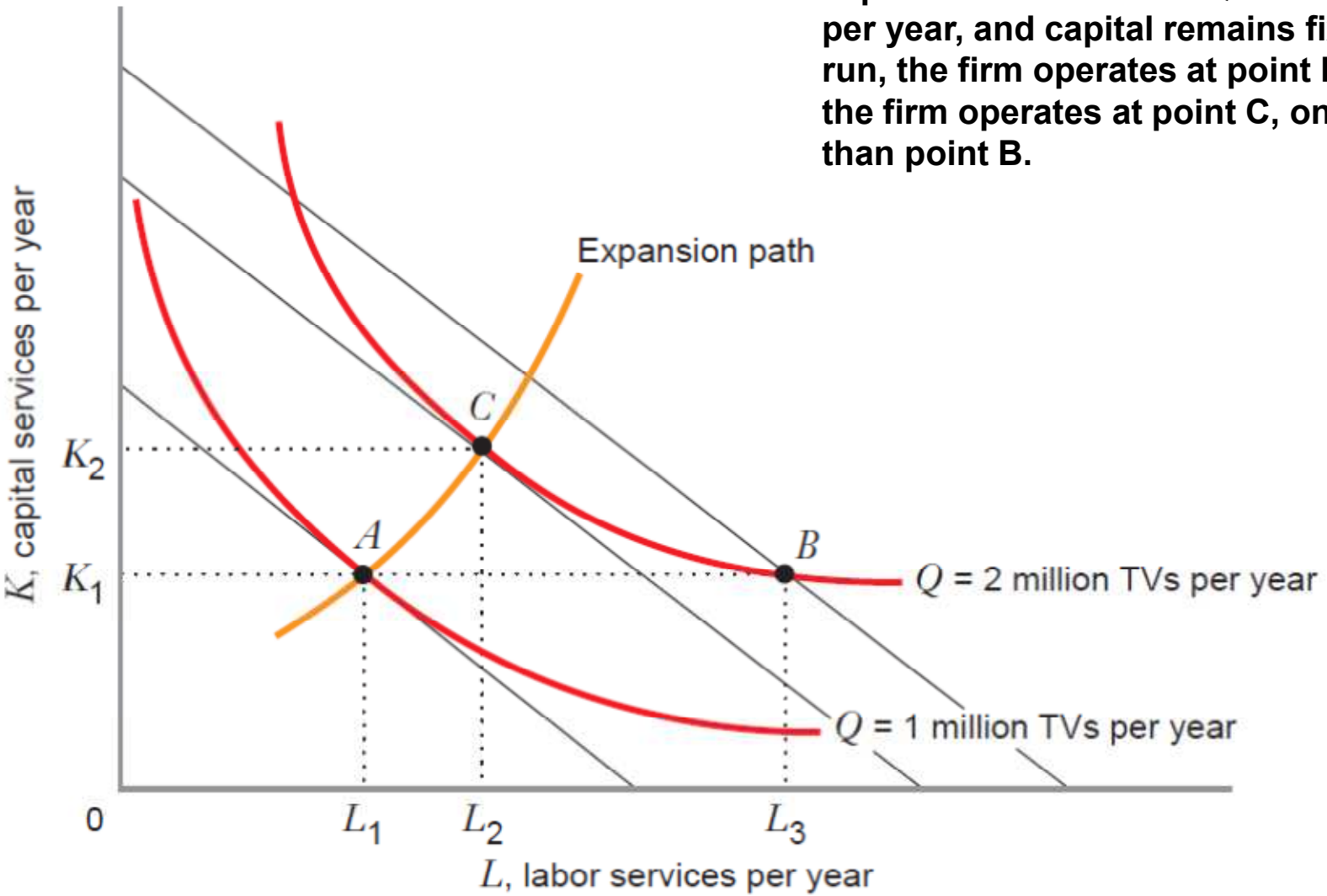

STC(Q)
TVC(Q)
TC, dollars per year
$r\overline{K}$
TFC
0
Q, units per year

Relationship between the LR and SR cost curves

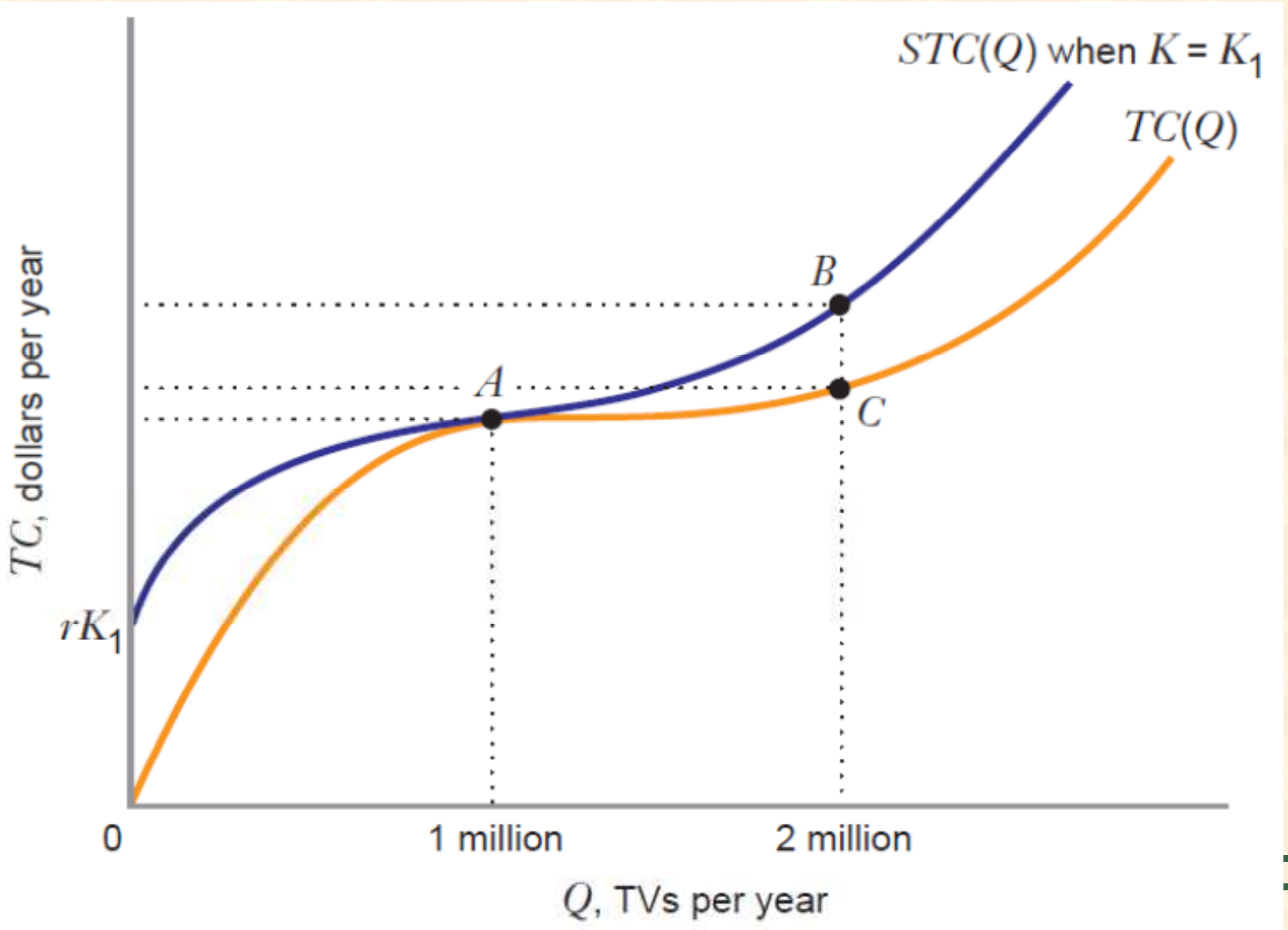
- In the long run, the firm can freely vary the quantity of both inputs, but in the short run the quantity of capital is fixed. Thus, the firm is more constrained in the short run than in the long run, so it makes sense that it will be able to achieve lower total costs in the long run



Initially, the firm produces 1 million TVs per year and operates at point A, which minimizes cost in both the long run and the short run, if the firm's usage of capital is fixed at K1. If Q is increased to 2 million TVs per year, and capital remains fixed at K1 in the short run, the firm operates at point B. But in the long run, the firm operates at point C, on a lower isocost line than point B.

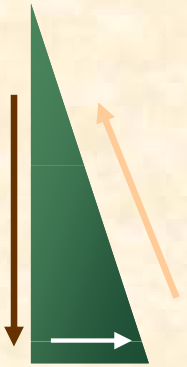


When the quantity of capital is fixed at K1, STC(Q) is always above TC(Q), except at point A. Point A solves both the long-run and the short-run cost-minimization problem when the firm produces 1 million TVs per year.



Fill in as much of the table as possible. If you cannot determine the number in a box, explain why it is not possible to do so.

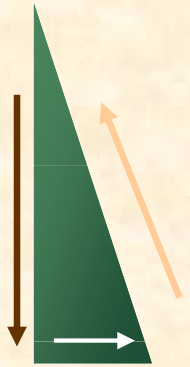
Q	TC	TVC	TFC	AC	MC	AVC
1	18					
2						10
3					16	
4	66					
5			10	18		
6		108				



Fill in as much of the table as possible. If you cannot determine the number in a box, explain why it is not possible to do so.

Q	TC	TVC	AFC	AC	MC	AVC
1				100		
2		50	30			
3					10	
4						30
5						
6	330				80	

- A firm produces a product with labor and capital, and its production function is described by Q=LK. Suppose that the price of labor equals 2 and the price of capital equals 1. Derive the equations for the long-run total cost curve and the long-run average cost curve.



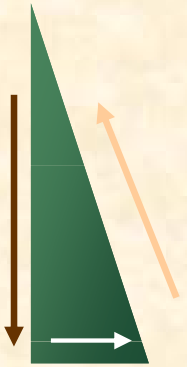
- Consider a production function of two inputs, labor and capital, given by:

$$Q = (\sqrt{L} + \sqrt{K})^2$$

a) Suppose the firm is required to produce Q units of output. Show how the cost-minimizing quantity of labor depends on the quantity Q. Show how the cost-minimizing quantity of capital depends on the quantity Q.

b) Find the equation of the firm's long-run total cost curve.

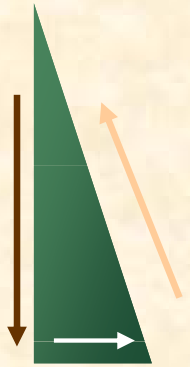
c) Find the equation of the firm's long-run average cost curve.



Perfectly Competitive Markets

Market Characteristics:

- The industry is **fragmented** – many buyers and sellers with imperceptible effect on market price
- **Undifferentiated products** - products are identical no matter who produces them
- Consumers have **perfect information about prices**
- The industry is characterized by **equal access to resources -** All firms (those currently in the industry, as well as prospective entrants) have access to the same technology and inputs



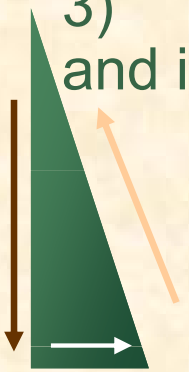
Perfectly Competitive Markets

- three implications for how perfectly competitive markets work:

1) **Price taking**: the individual firm sells a very small share of total market output and so cannot influence market price. The individual consumer buys too small a share of output to have any impact on the price.

2) **Product homogeneity**: the products of all firms are perfect substitutes.

3) **Free entry and exit**: new firm has access to the same technology and inputs that existing firms have.



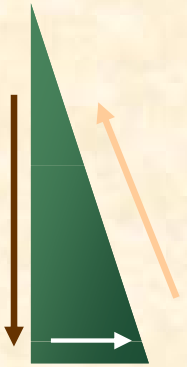
Perfectly Competitive Markets

- In previous chapter, we distinguished between economic cost and accounting cost:

  economic profit = sales revenue - economic costs

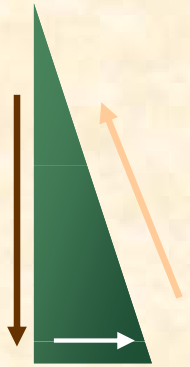
  accounting profit = sales revenue - accounting costs

  - Note: economic costs = accounting costs + opportunity costs



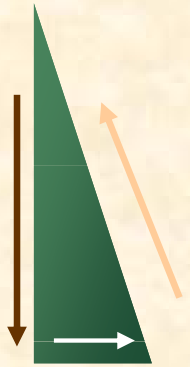
Profit Maximization

- Do firms maximize profits?
  - Possibility of other objectives
    - Revenue maximization
    - Dividend maximization
    - Short-run profit maximization
  - Implications of non-profit objective
    - Over the long-run investors would not support the company
    - Without profits, survival unlikely



Marginal Revenue, Marginal Cost and π Maximization

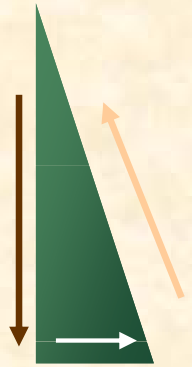
- Determining the profit maximizing level of output
  - Profit (π) = Total Revenue - Total Cost
  - Total Revenue (T*R*) = *PxQ*
  - Total Cost (T*C*) = *CxQ*
  - Therefore:

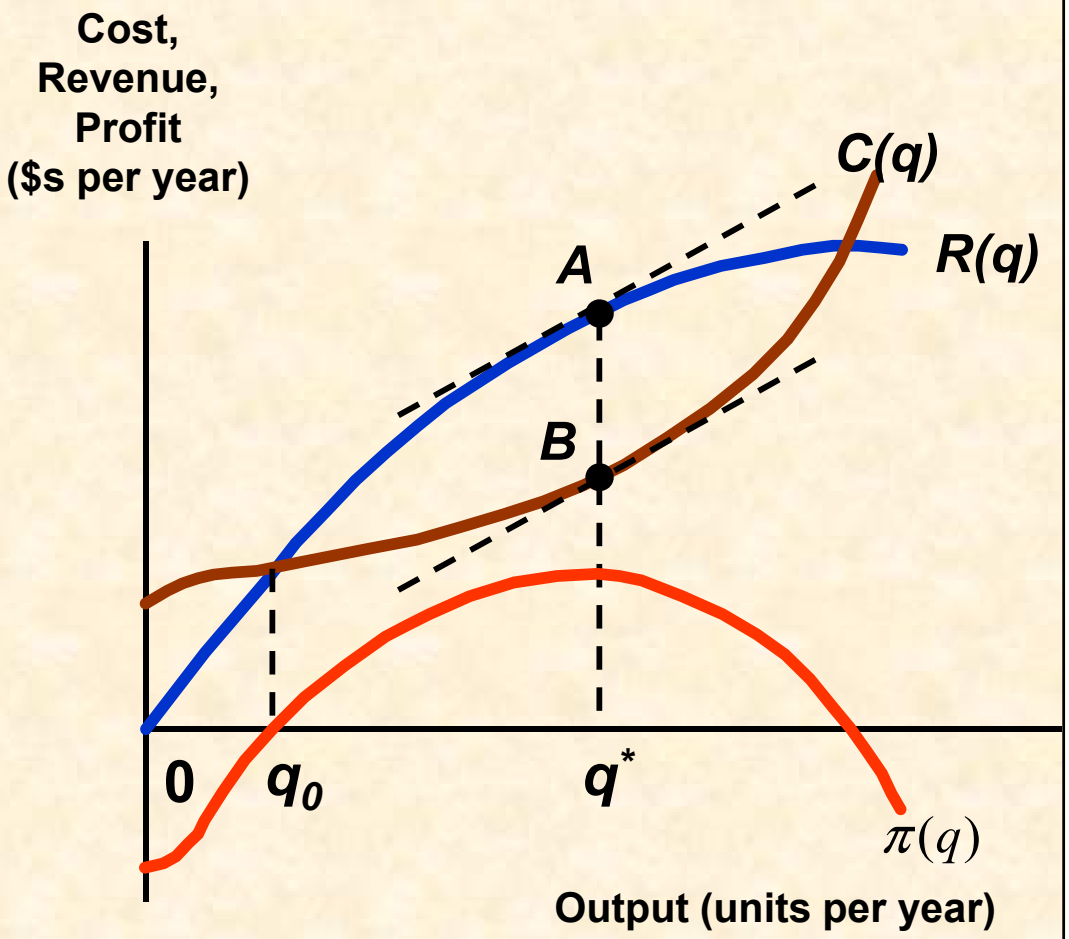


$$\pi(q) = R(q) - C(q)$$

Marginal Revenue, Marginal Cost and π Maximization

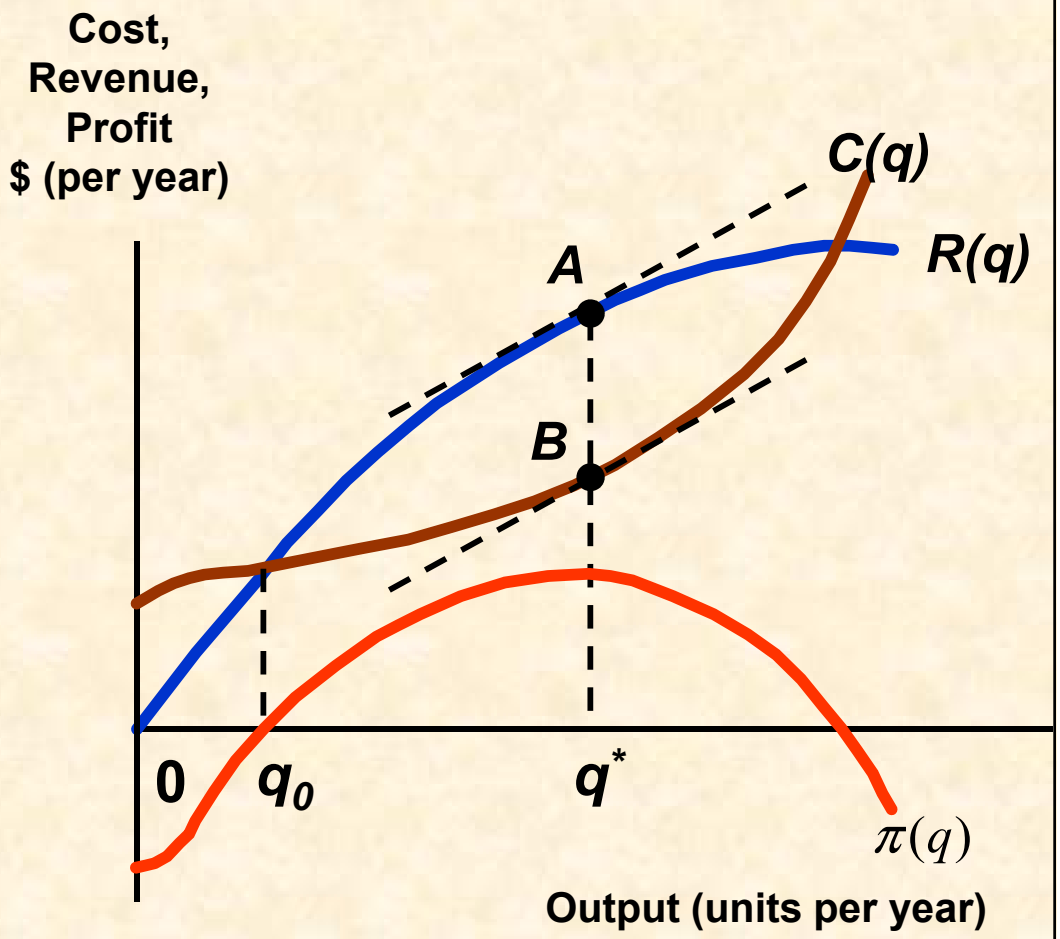
- Comparing *R(q)* and *C(q)*
  - Output levels: 0 - q_0:
    - *C(q)*> *R(q):* negative profit
    - FC + VC > *R(q)*
    - MR > MC
  - Output levels: q_0 - q^*
    - R*(q)*> *C(q)*
    - MR > MC: higher profit at higher output. Profit is increasing



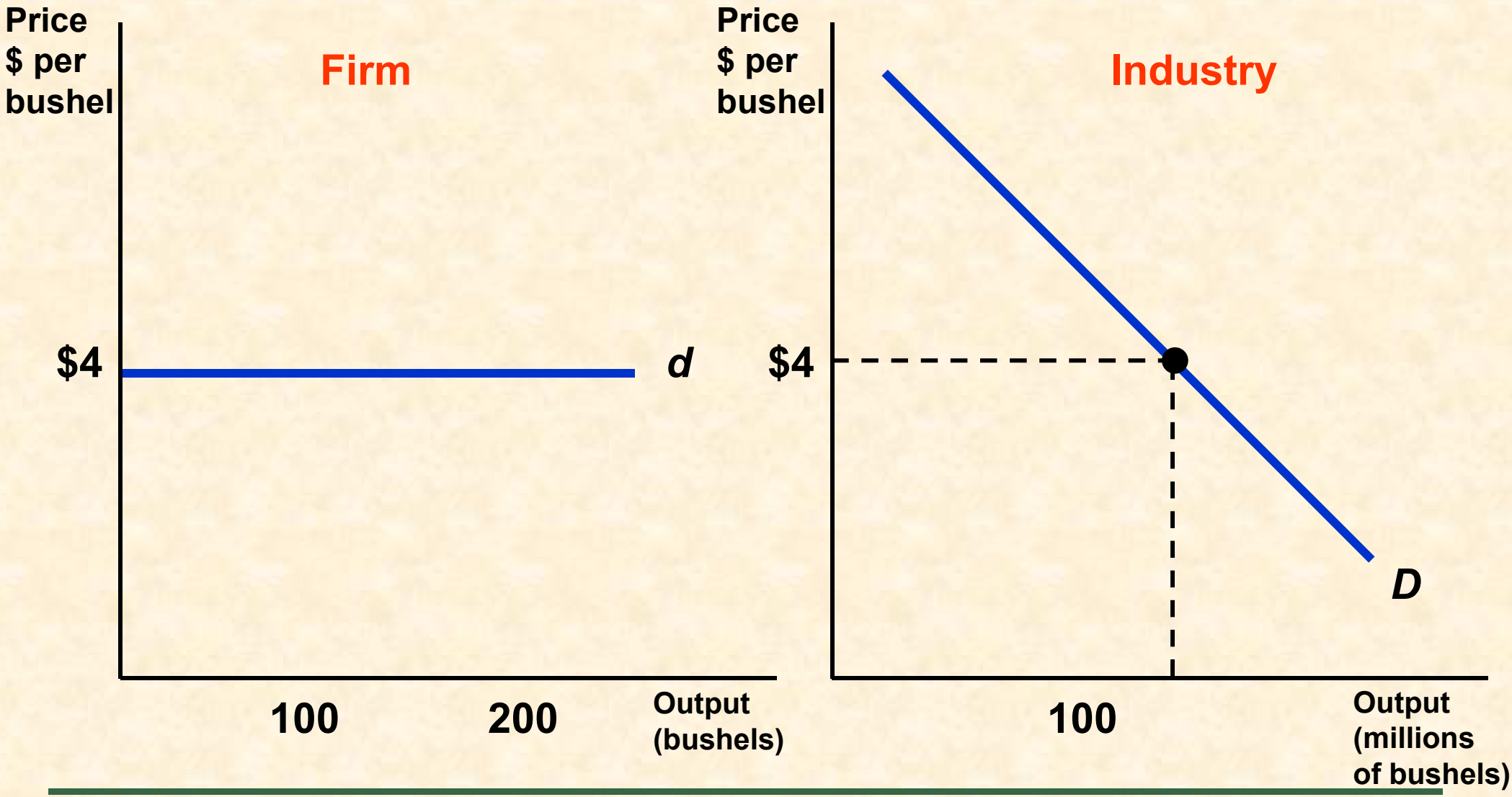


Marginal Revenue, Marginal Cost and π Maximization

- Comparing *R(q)* and *C(q)*
  - Output level: q^*
    - R*(q)*= *C(q)*
    - MR = MC
    - Profit is maximized

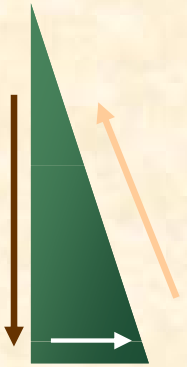


Demand and MR Faced by a Competitive Firm

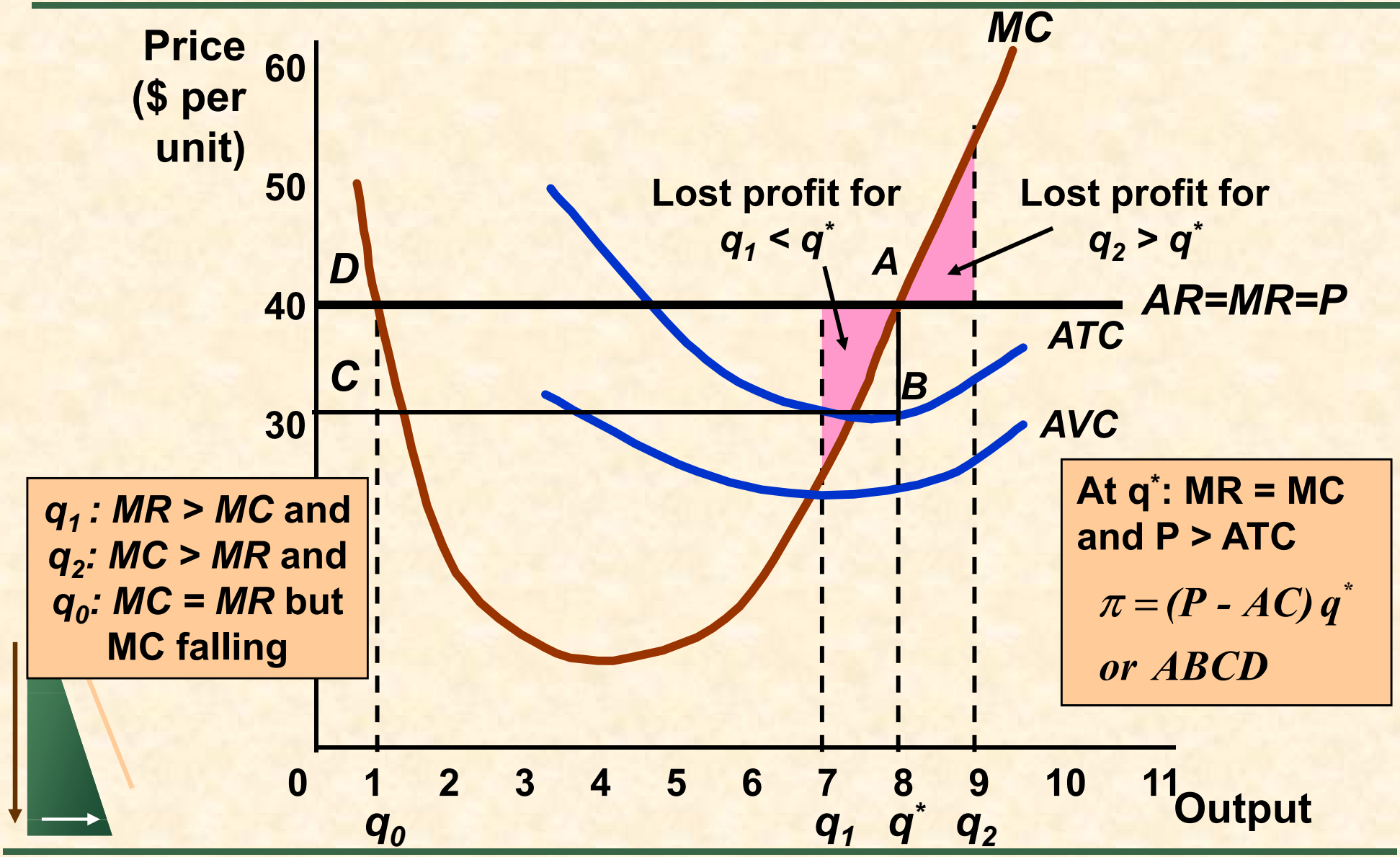


Marginal Revenue, Marginal Cost and π Maximization

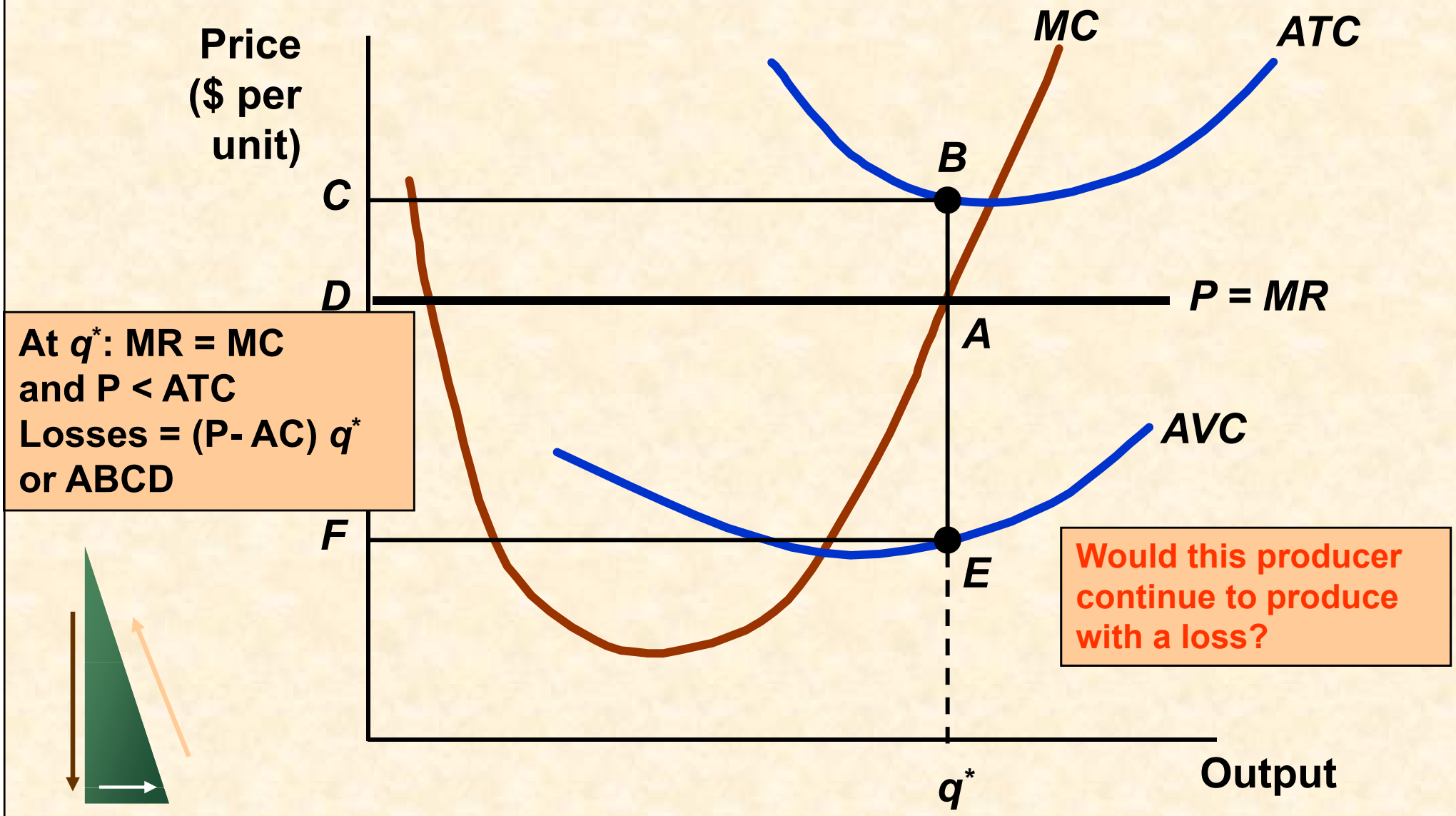
- The competitive firm's demand
  - Individual firm sells all units for $4 regardless of their level of output.
  - If the firm tries to raise price, sales are zero.
  - If the firm tries to lower price, he cannot increase sales
  - *P = D = MR = AR*
  - *Profit Maximization: MC(q) = MR = P*



A Competitive Firm making a Positive Profit: SR



A Competitive Firm Incurring Losses: SR

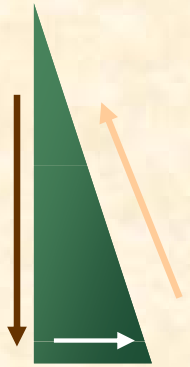


At q^*: MR = MC
and P < ATC
Losses = (P- AC) q^*
or ABCD

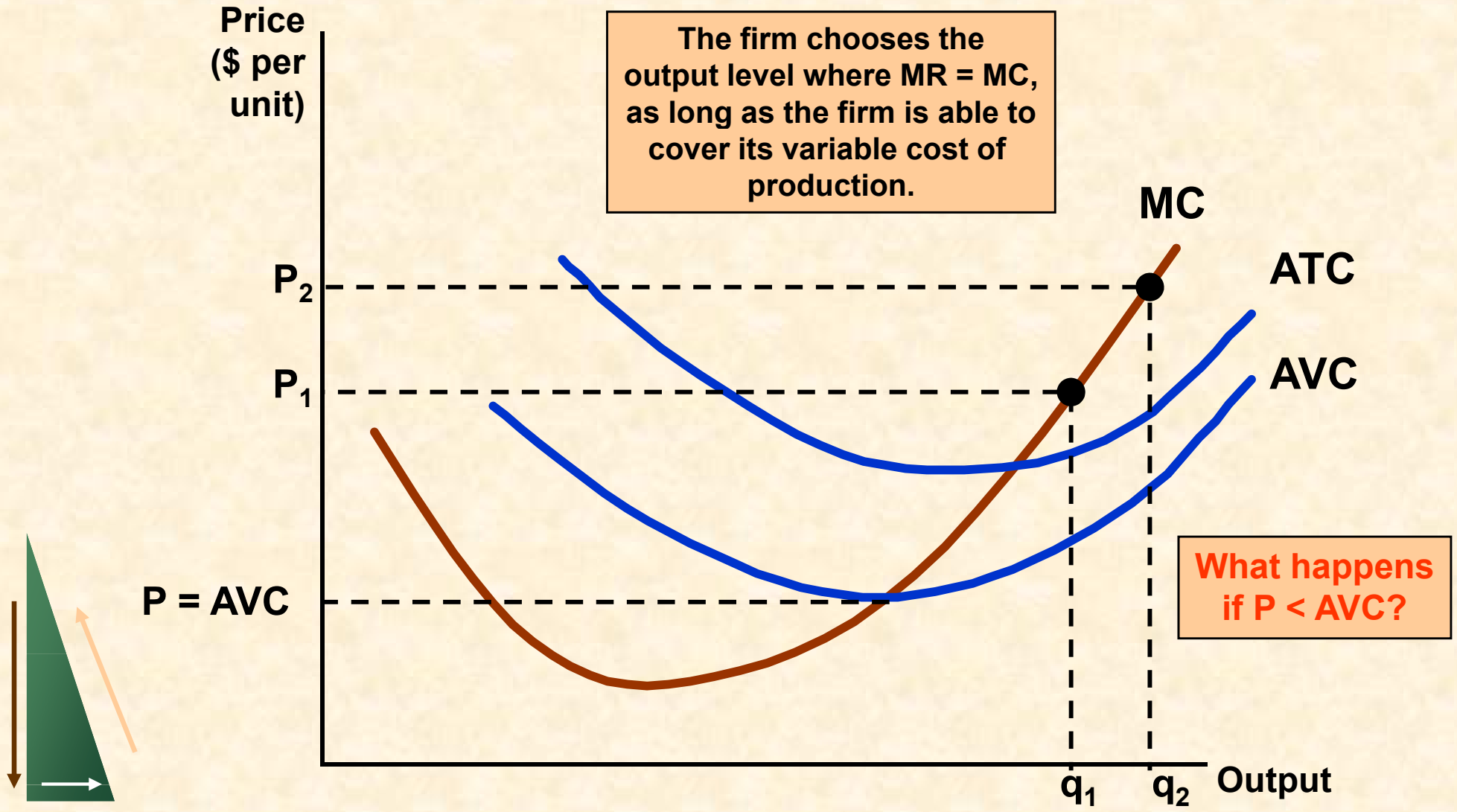
Would this producer continue to produce with a loss?

Choosing Output in the Short Run

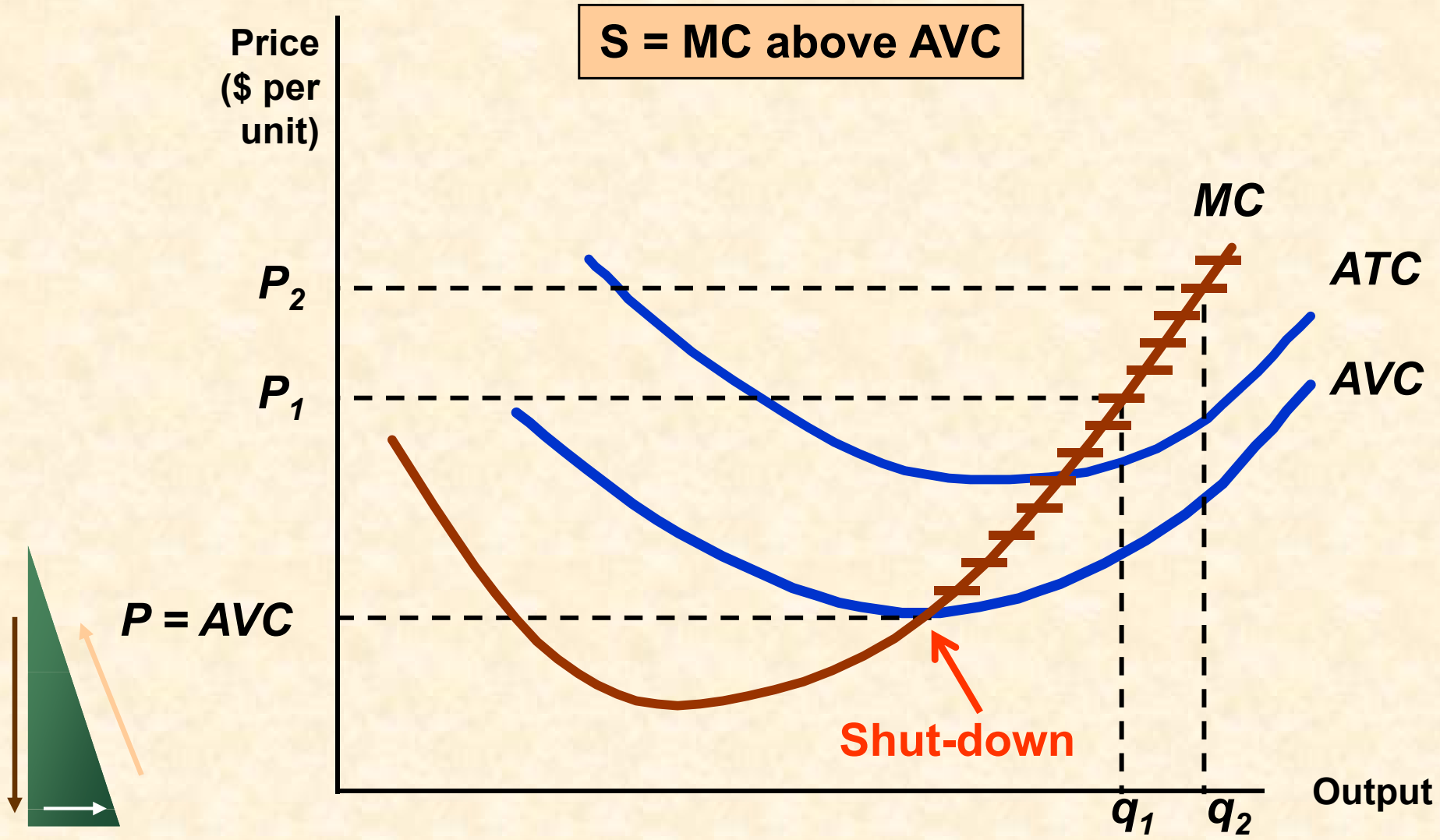
- Summary of Production Decisions
  - Profit is maximized when *MC* = *MR*
  - If *P* > *ATC* the firm is making profits.
  - If *AVC* < *P* < *ATC* the firm should produce at a loss.
  - If *P* < *AVC* < *ATC* the firm should shut-down.



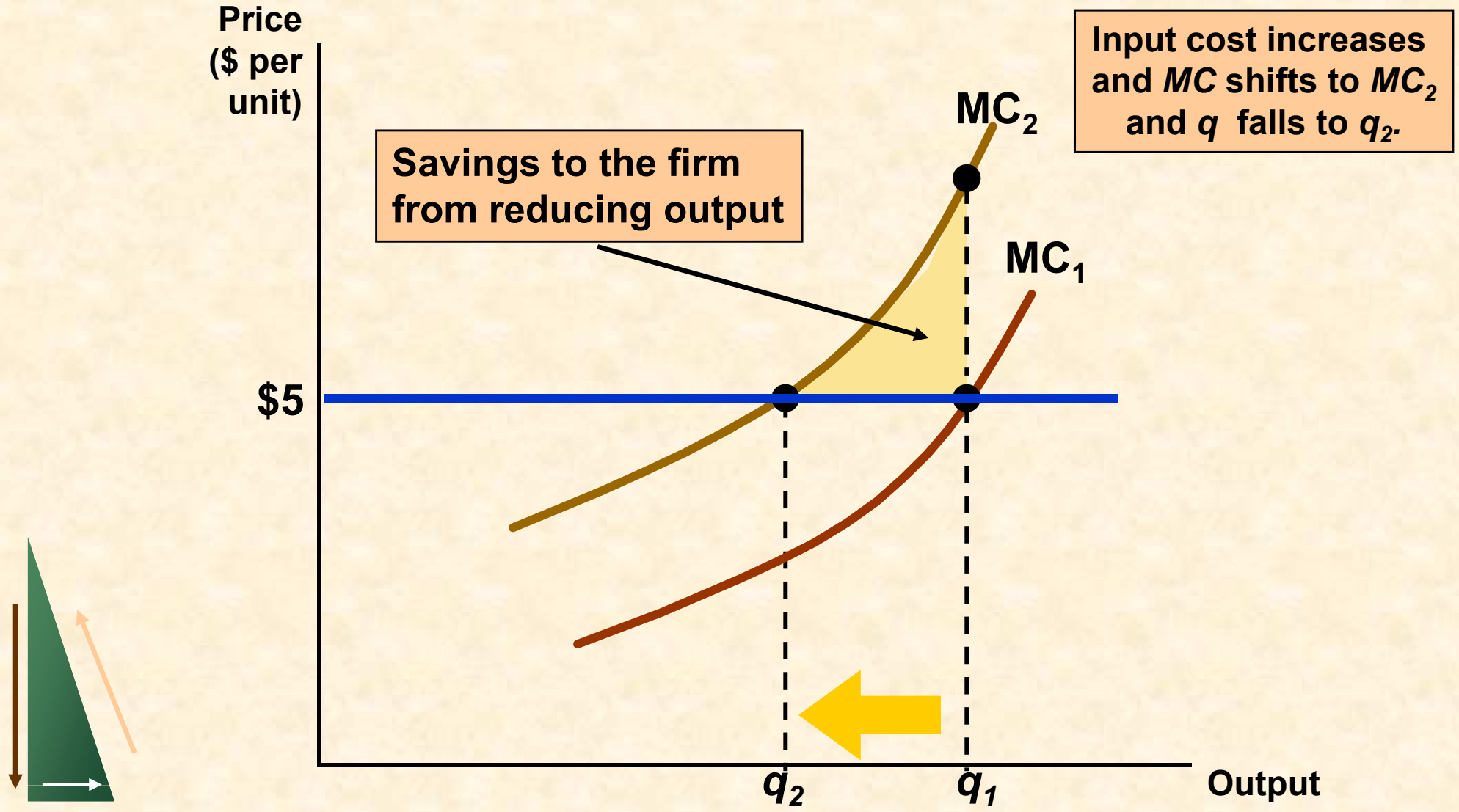
A Competitive Firm's Short-Run Supply Curve



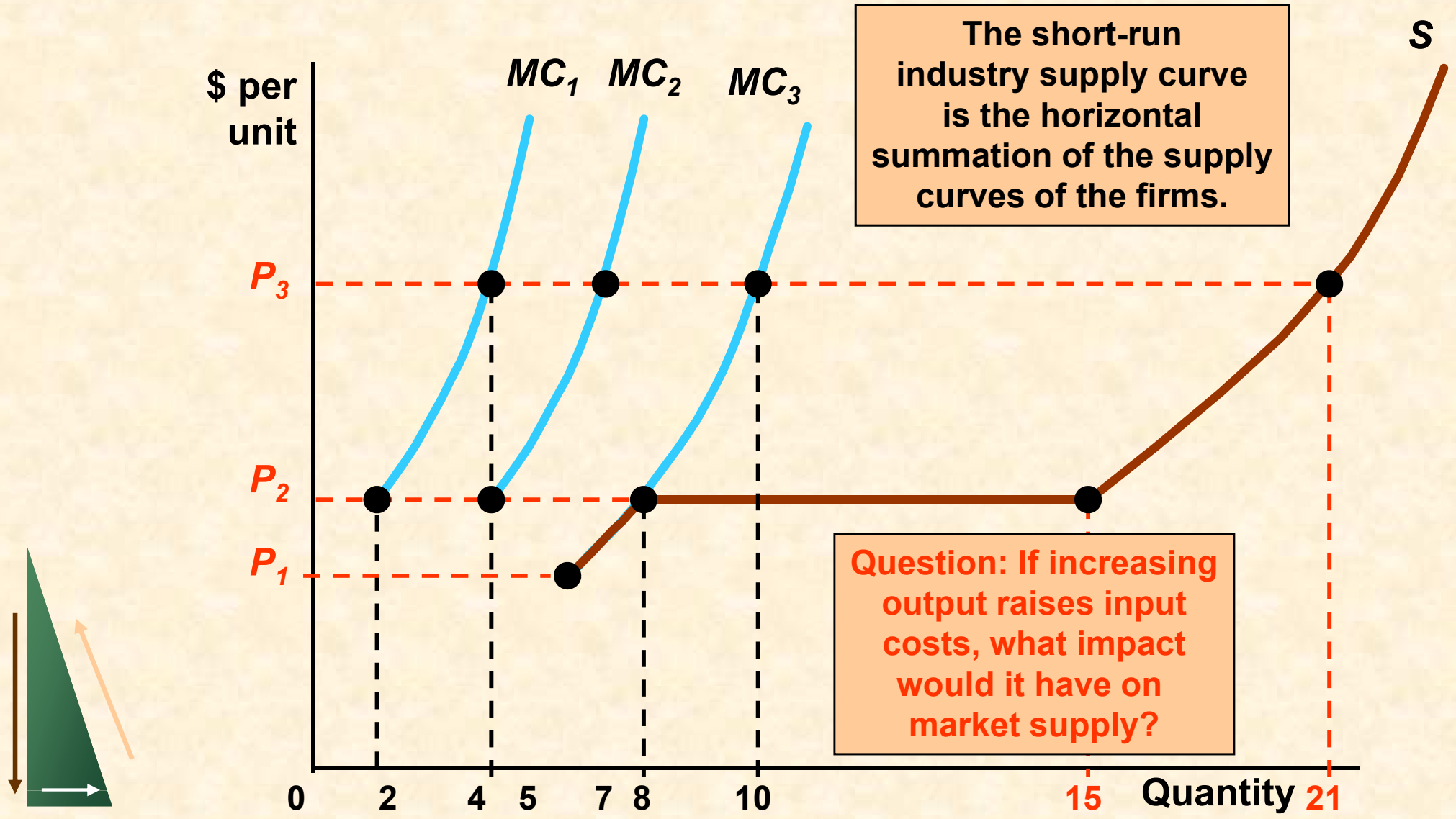
A Competitive Firm's Short-Run Supply Curve



The Response of a Firm to a Change in Input Price



Industry Supply in the Short Run

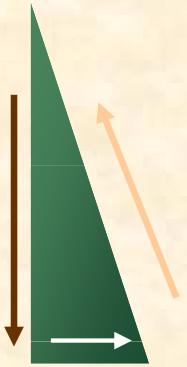


The Short-Run Market Supply Curve

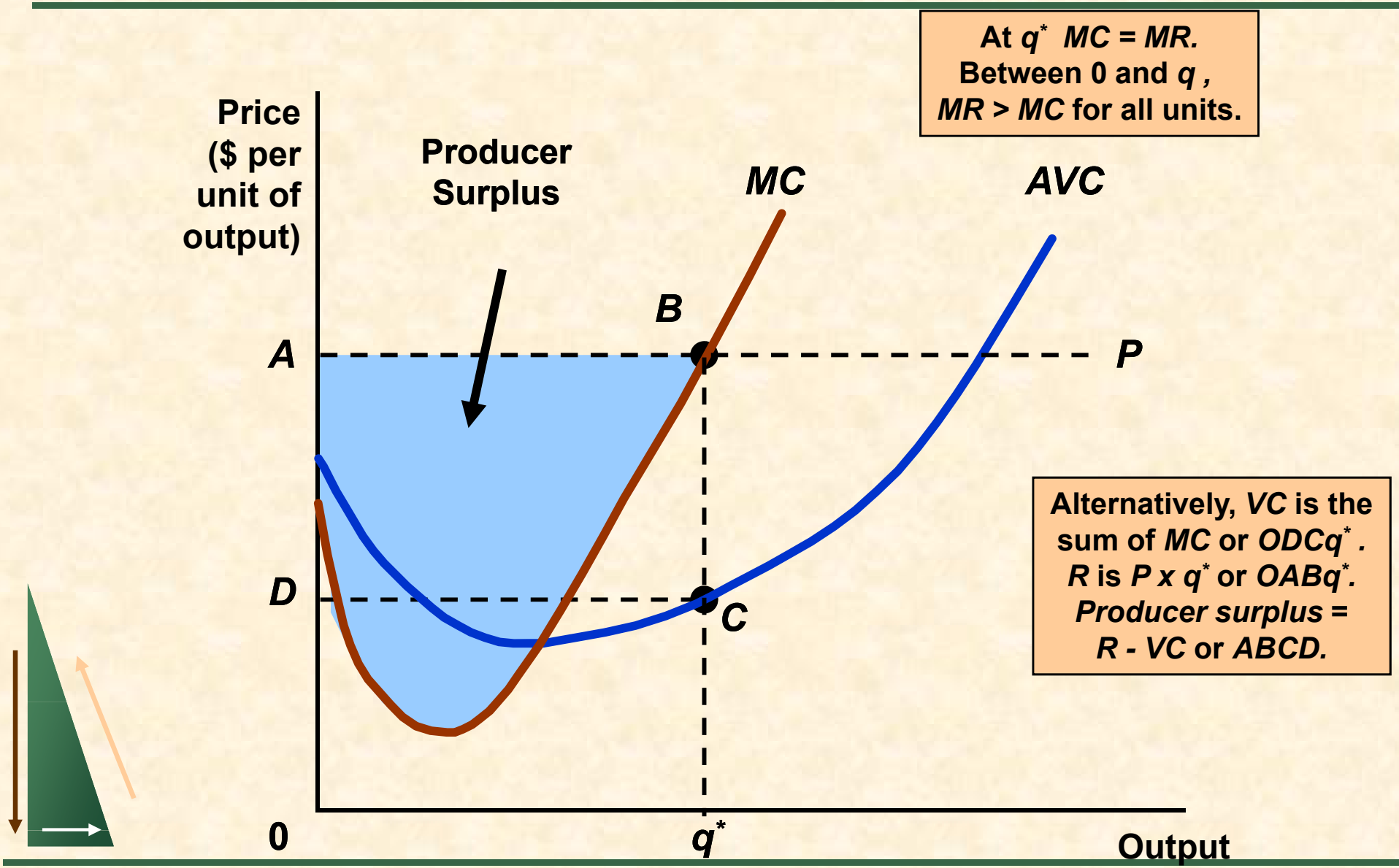
- Elasticity of Market Supply

$$E_s = (\Delta Q / Q) / (\Delta P / P)$$

- Perfectly inelastic short-run supply arises when the industry's plant and equipment are so fully utilized that new plants must be built to achieve greater output.
- Perfectly elastic short-run supply arises when marginal costs are constant.



Producer Surplus for a Firm

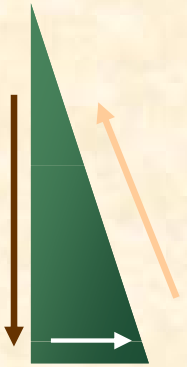


The Short-Run Market Supply Curve

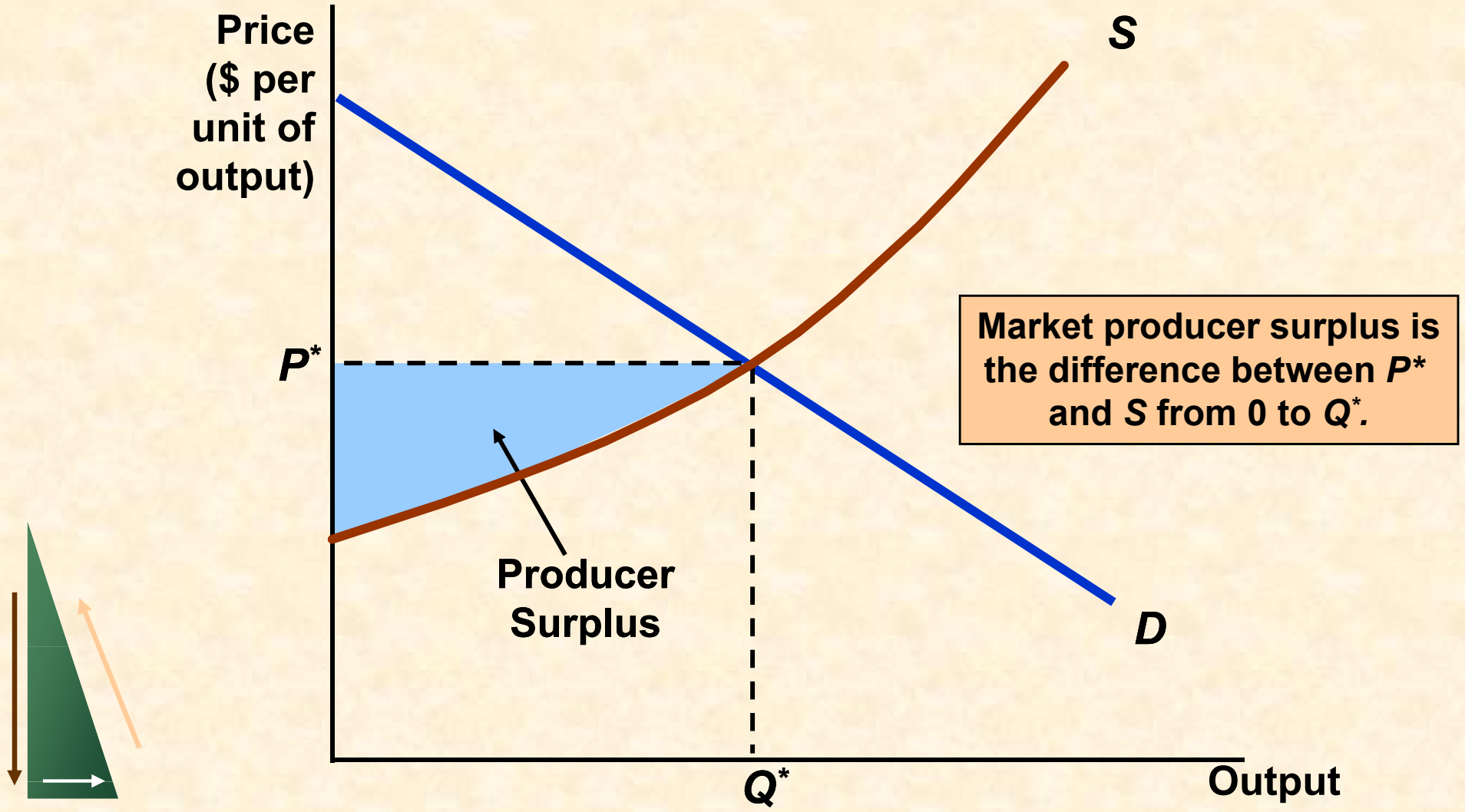
- Producer Surplus in the Short-Run

$$\text{Producer Surplus} = \text{PS} = \text{R - VC}$$

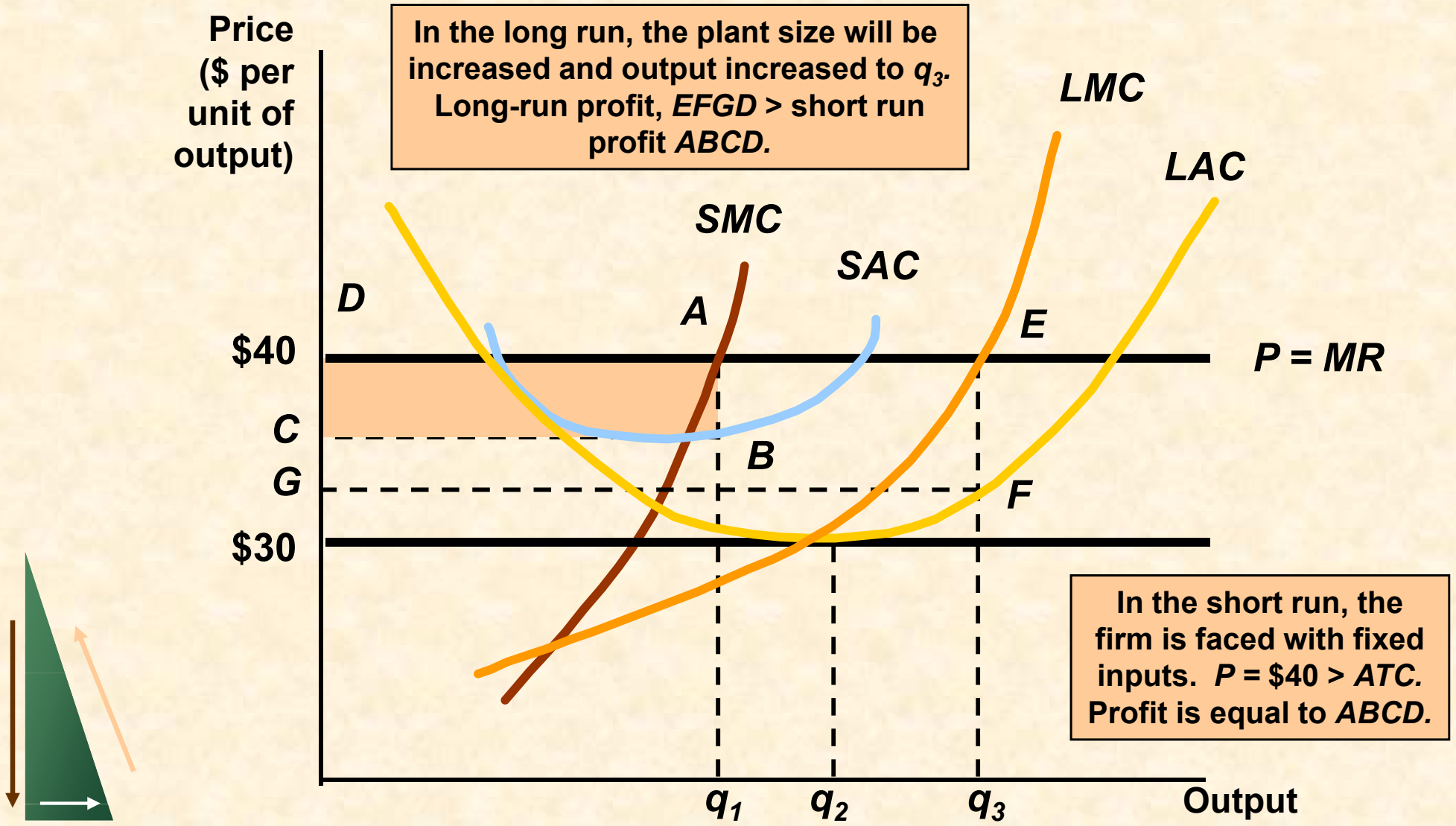
$$\text{Profit} = \pi = \text{R - VC - FC}$$



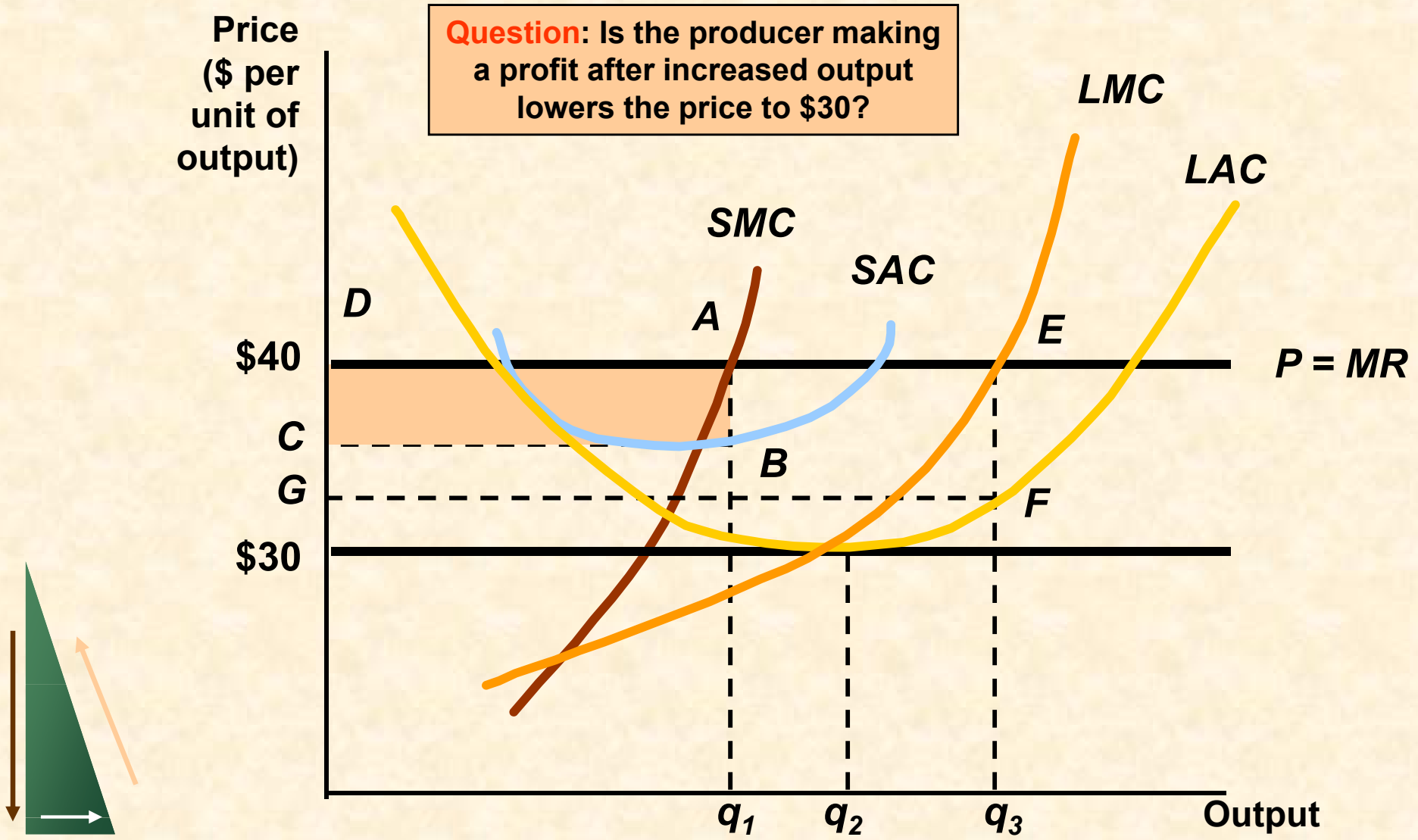
Producer Surplus for a Market



Output Choice in the Long Run



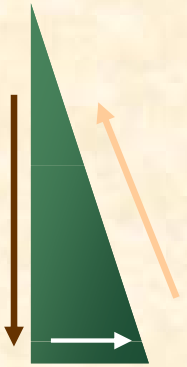
Output Choice in the Long Run



Choosing Output in the Long Run

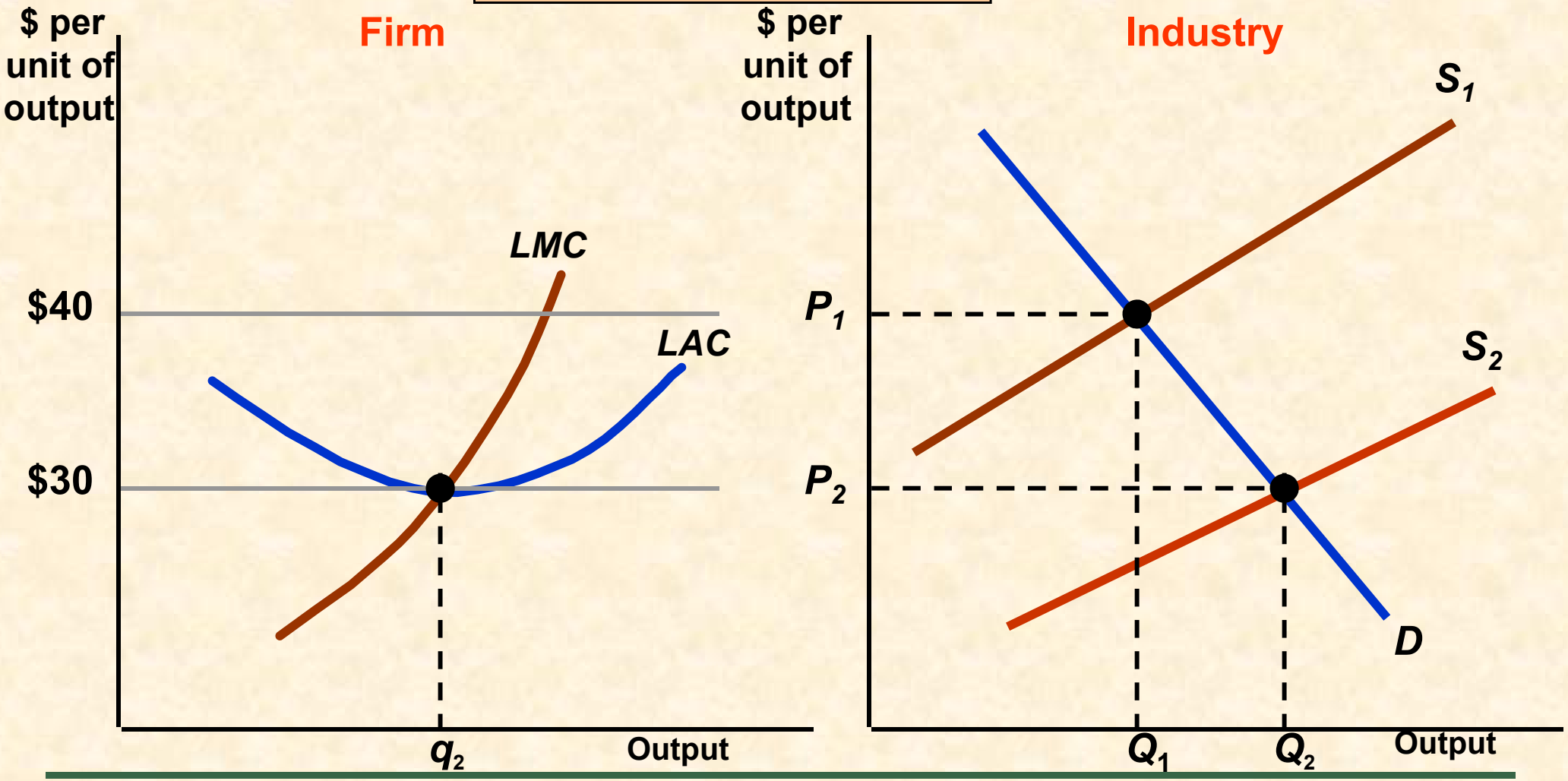
Long-Run Competitive Equilibrium

- Zero-Profit
  - If $R > wL + rK$, economic profits are positive
  - If $R = wL + rK$, zero economic profits, but the firm is earning a normal rate of return; indicating the industry is competitive
  - If $R < wL + rK$, consider going out of business



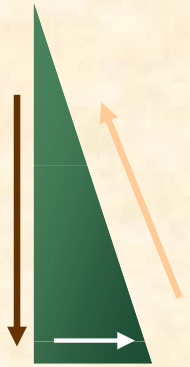
Long-Run Competitive Equilibrium

- Profit attracts firms
- Supply increases until profit = 0



Choosing Output in the Long Run

- Long-Run Competitive Equilibrium
  1) *MC* = *MR*
  2) *P* = *LAC*
     - No incentive to leave or enter
     - Profit = 0
  3) Equilibrium Market Price



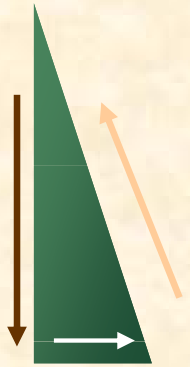
Choosing Output in the Long Run

- Questions

1) Explain the market adjustment when $P < LAC$ and firms have identical costs.

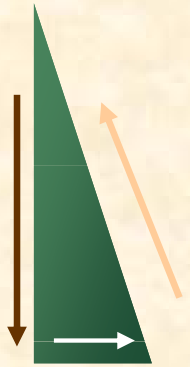
2) Explain the market adjustment when firms have different costs.

3) What is the opportunity cost of land?



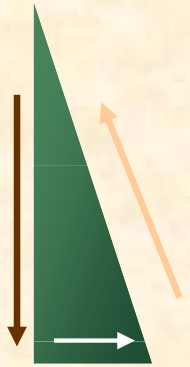
Choosing Output in the Long Run

- Economic Rent = the difference between what firms are willing to pay for an input minus the minimum amount necessary to obtain it.
- An Example: Two firms, *A* & B, both own their land
  - *A* is located on a river which lowers *A's* shipping cost by $10,000 compared to *B.* The demand for *A's* river location will increase the price of *A's* land to $10,000
  - Economic rent = $10,000
    - $10,000 - zero cost for the land
  - Economic rent increases; Economic profit of *A* = 0



The Industry's Long-Run Supply Curve

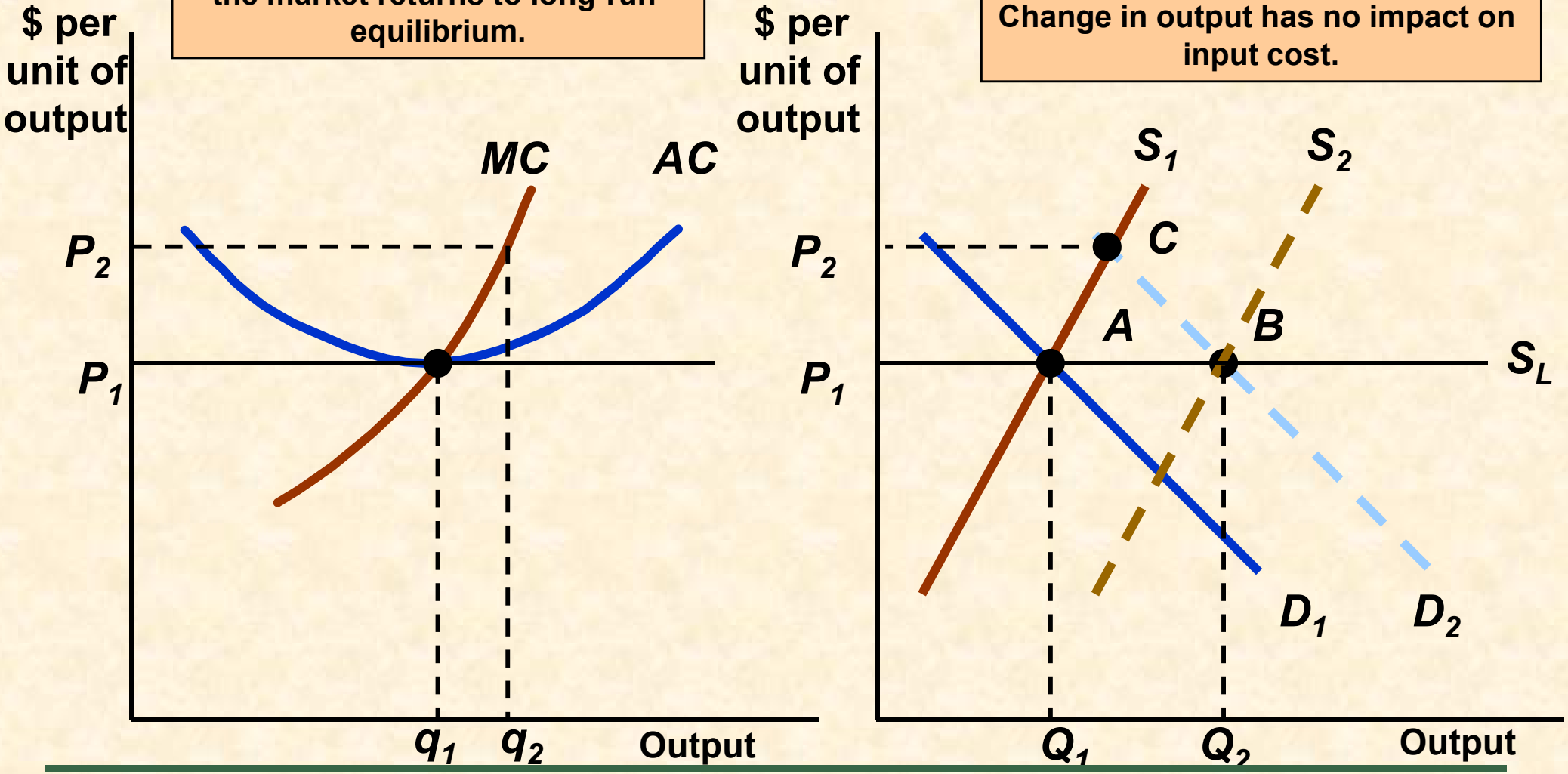
- The shape of the long-run supply curve depends on the extent to which changes in industry output affect the prices the firms must pay for inputs.
- To determine long-run supply, we assume:
  - All firms have access to the available production technology.
  - Output is increased by using more inputs, not by invention.
  - The market for inputs does not change with expansions and contractions of the industry.



LR Supply in a Constant-Cost Industry

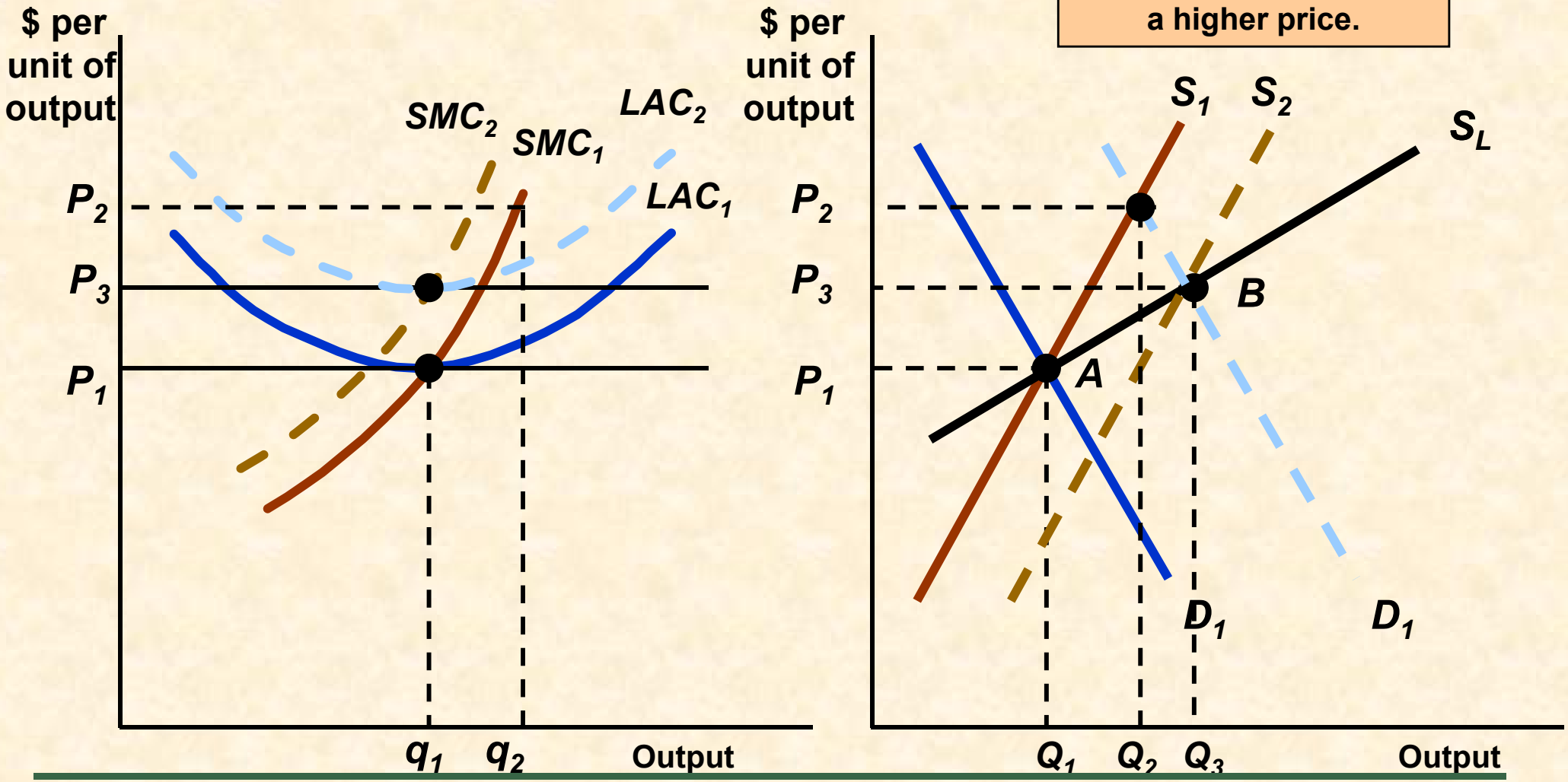
Economic profits attract new firms. Supply increases to S_2 and the market returns to long-run equilibrium.

Q_1 increase to Q_2.
Long-run supply = S_L = LRAC.
Change in output has no impact on input cost.



LR Supply in an Increasing-Cost Industry

Due to the increase in input prices, long-run equilibrium occurs at a higher price.



LR Supply in a Decreasing-Cost Industry

Due to the decrease in input prices, long-run equilibrium occurs at a lower price.