

**Unit 5.**  
**Producer theory:**  
**revenues and costs**

## **In accordance with the APT programme objectives of the lecture are to help You to:**

- understand the concept of the short-run production function, describing the relationship between the quantity of inputs and the quantity of output;
- understand within the context of the production function, average and marginal products as well as the law of diminishing marginal returns;
- learn the link between productivity and costs;
- examine the relationships among the short-run costs: total, average and marginal;
- consider the process of cost minimization;
- explain the properties of long-run costs;
- examine economies and diseconomies of scale, as well as returns to scale;
- make the distinction between accounting and economic profits;
- establish the profit-maximizing rule, using marginal analysis.

# Required reading

Begg, D., R.Dornbusch, S.Fischer. Economics. 8th edition. McGraw Hill. 2005.

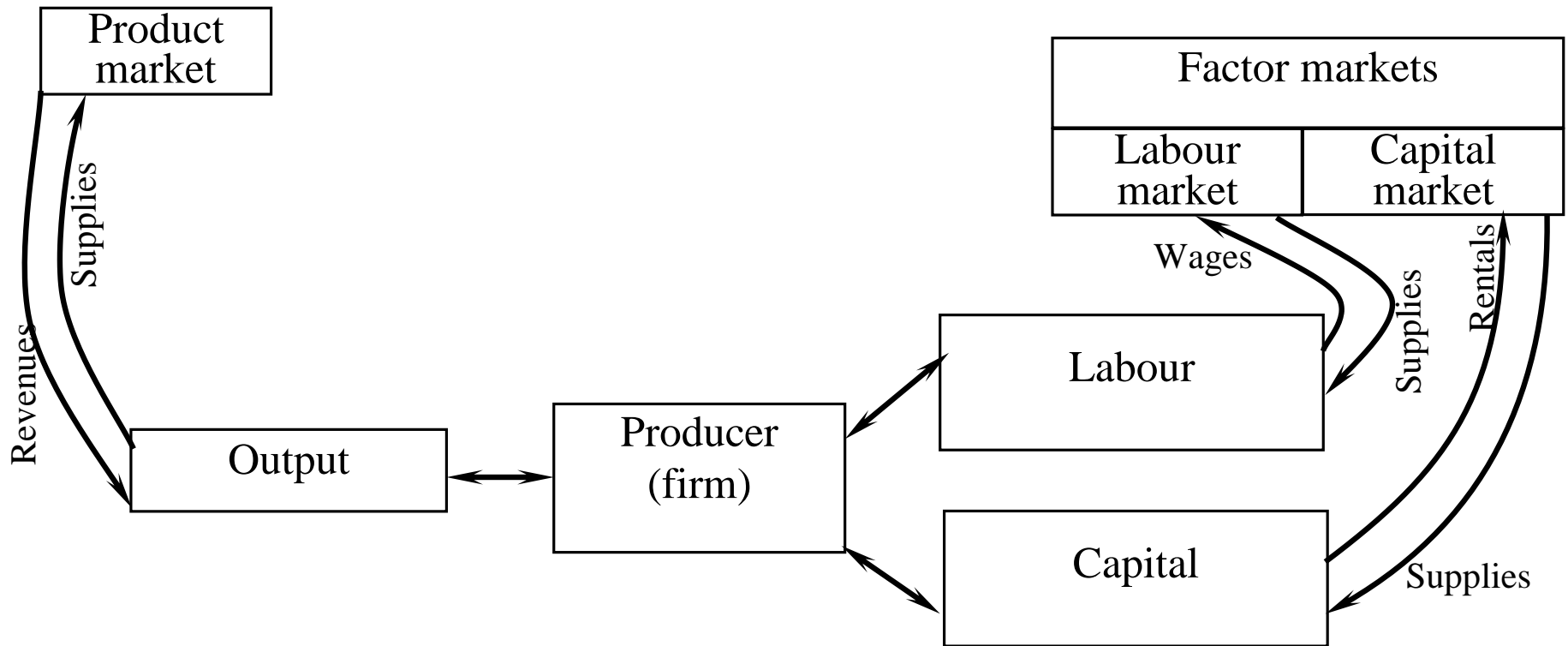
**Chapter 6. Introducing supply decisions.**

**Chapter 7. Costs and supply.**

# Questions to be revised

- ✓ Utility maximization: optimal consumption bundle;
- ✓ Opportunity cost.

# Supply Side: a firm in a market economy



# Technology

- A factor of production is an aggregate input that plays a sufficient role in production of output.

Main factors: capital and labor.

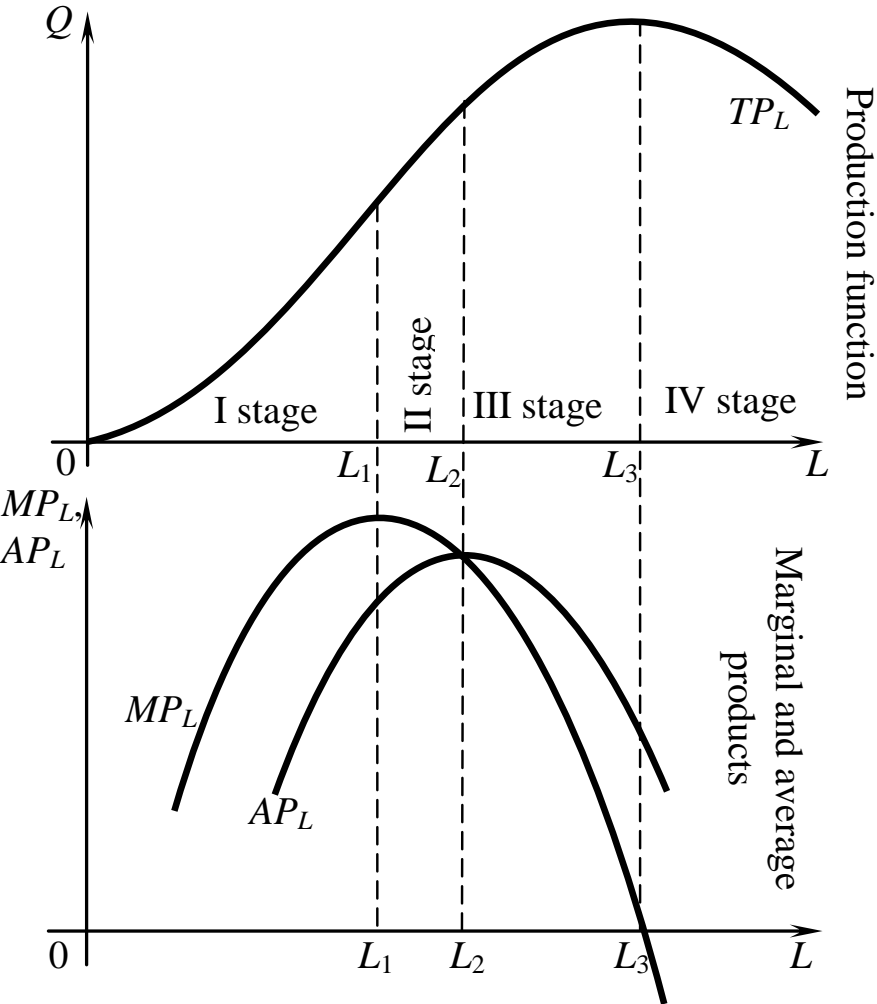
Other factors: land and entrepreneurship

- A production function specifies the *maximum* output that can be produced from any given amount of inputs.

# Long Run and Short Run

- The long run is a sufficient period of time for a firm to adjust *all its inputs* to a change in economic environment.
- The short run is the period in which the firm can make *only partial adjustment* of its inputs to a change in economic environment.
- We typically assume that capital is fixed in the short run. (It takes up to several years to build a new plant.)

# Short run products



Average product of a factor (labour) is given by the output related to the quantity of the factor:

$$AP_L = \frac{Q}{L}$$

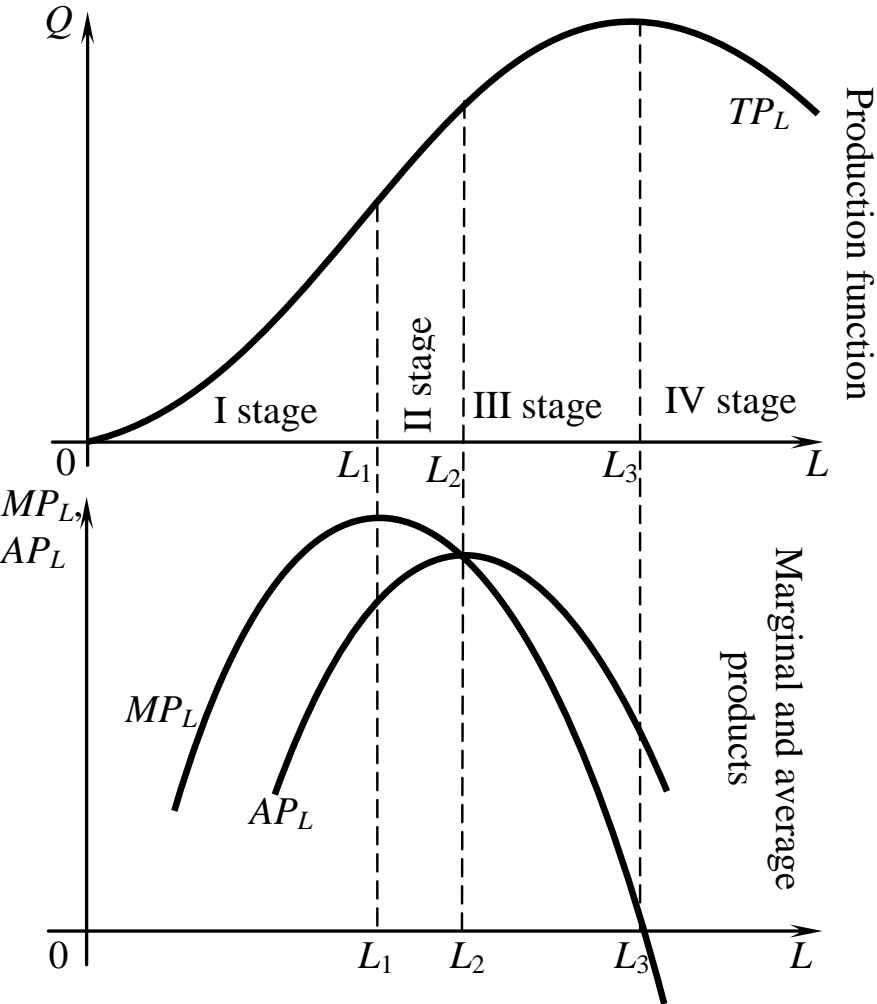
Marginal product of a *variable factor* (labour) is a change in output obtained by an increment of the *variable factor* (labour), holding constant all other factors:

$$MP_L = \frac{dQ}{dL}$$

The law of **diminishing marginal returns**: beyond the 1<sup>st</sup> stage of production, continual increments in the variable input lead to the steadily decreasing marginal product.



# Short run products



Marginal and average product curves intersect at the point of maximum of average product of the variable factor. To prove it take a derivative of average product of labour:  $AP'_L = \frac{MP_L - AP_L}{L}$

At the point of maximum it is zero:

$$AP'_L = 0$$

It follows that marginal product is equal to average product at this point:  $MP_L = AP_L$

# Supply Side:

Producer (firm) cares about

- Costs (depend on technology, what inputs it uses and in what proportions; prices of inputs), and
- Revenues (depend on demand). A firm's revenue is the amount it earns by selling goods or services.  $R = P(Q) * Q$

Firm seeks to maximize profit:

$$\text{Profit} = \text{Revenue} - \text{Cost}$$

# Economic vs. Accounting Costs and Profits

Economic costs: Accounting costs and *opportunity costs*.

- Accounting costs are the actual payments of a firm.
- Opportunity cost is the amount lost by not using the resource (labor or capital) in its best alternative use.

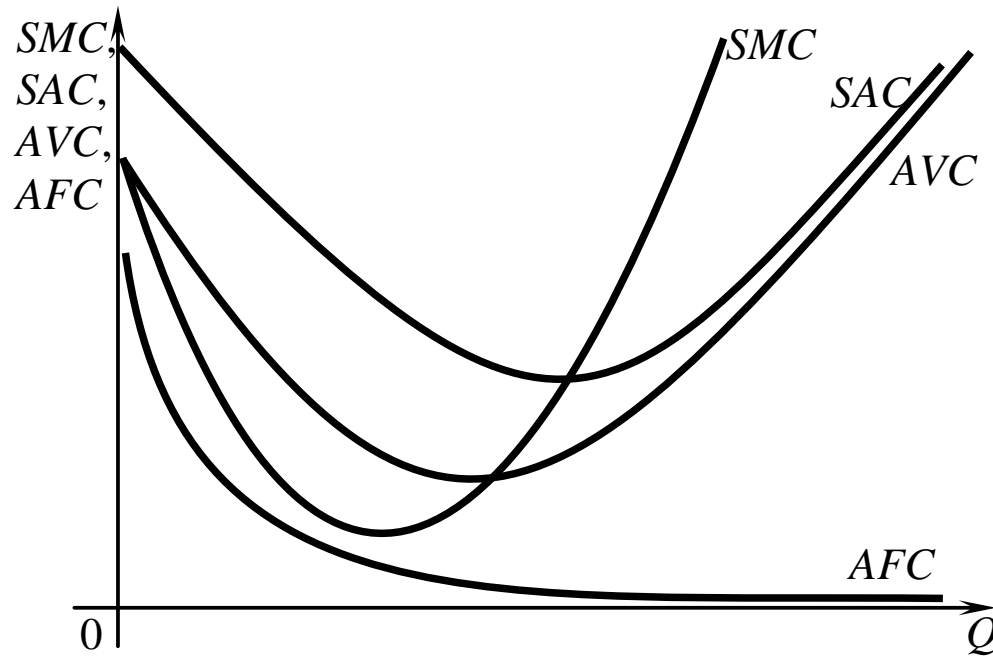
Economic profit = Revenue – economic costs

Accounting profit = Revenue – accounting costs

# Short-Run Cost Curves

- A fixed factor of production is a factor whose level cannot be varied in the short-run.
- A variable factor can be adjusted, even in the short-run.
- Fixed costs are costs that do not vary with output level.
- Variable costs are costs that vary with output level.
- Short-run total cost = short-run fixed cost + short-run variable cost.  $STC=SVC+SFC$

# Short-Run Average & Marginal Costs



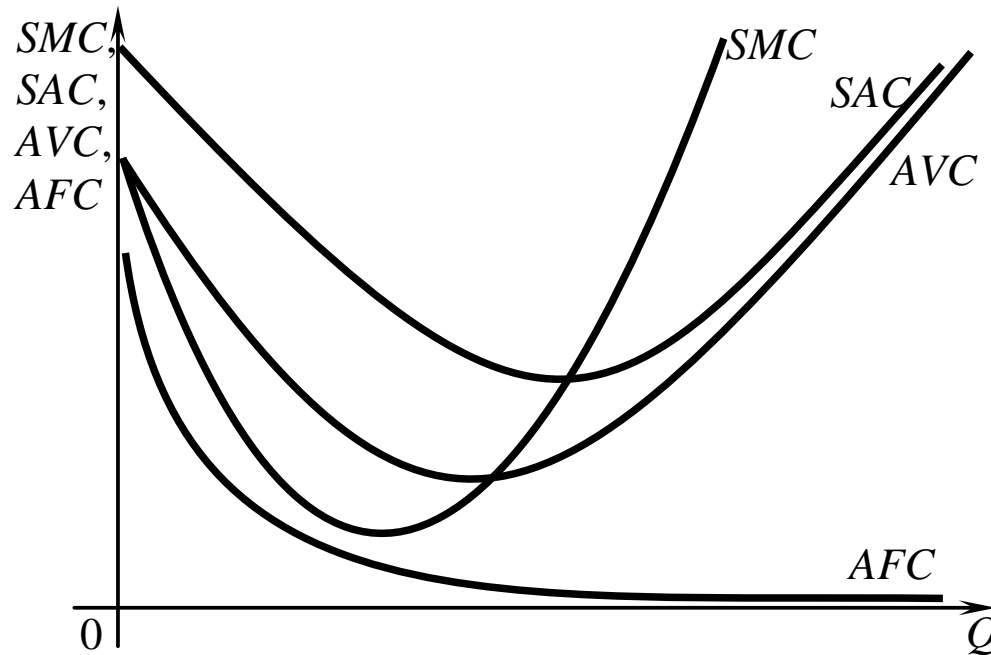
$$AC = \frac{TC}{Q} = AFC + AVC$$

$$AFC = \frac{FC}{Q}$$

$$AVC = \frac{VC}{Q}$$

$$MC = \frac{dTC}{dQ} = \frac{d(VC + FC)}{dQ} = \frac{dVC}{dQ}$$

# Short-Run Average & Marginal Costs



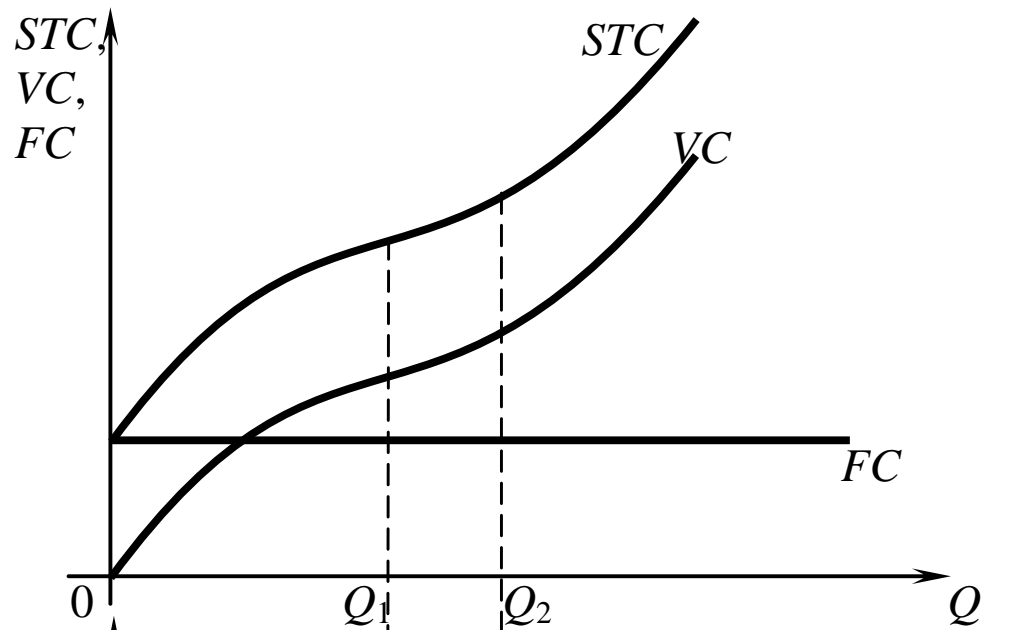
$$\frac{dAC}{dQ} = \frac{d}{dQ} \left( \frac{TC}{Q} \right) = \frac{Q \cdot MC - TC}{Q^2} = \frac{MC - AC}{Q}$$

$$\frac{dAC}{dQ} = 0 \quad Q \cdot MC = TC$$

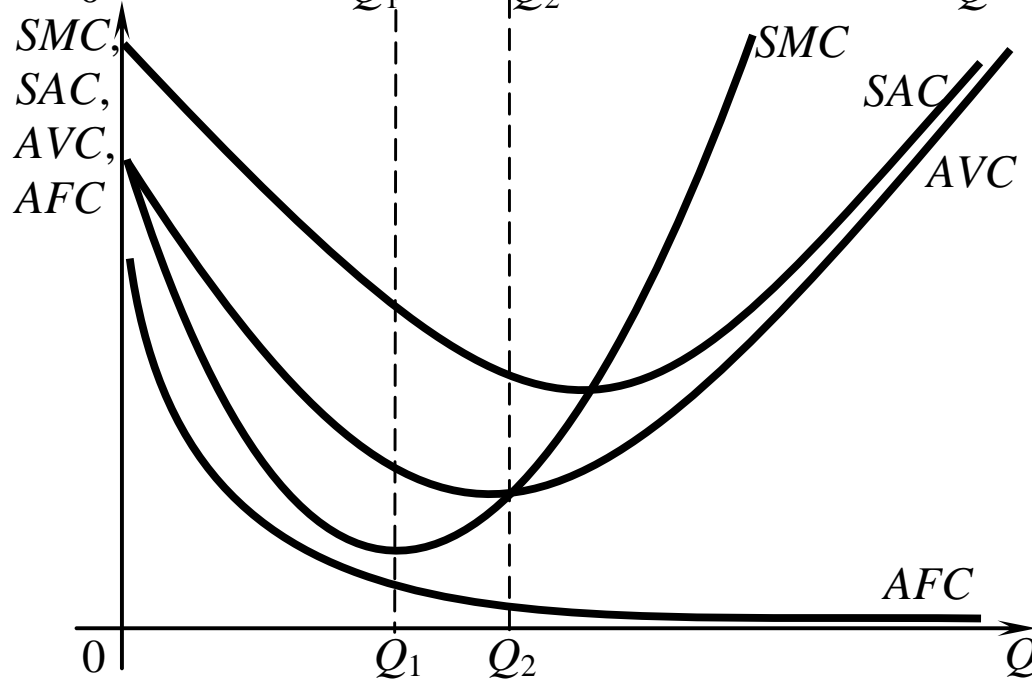
$$MC = \frac{TC}{Q} \equiv AC$$

- 1) AC, AVC, and MC curves are first decreasing and then increasing;
- 2) AC and AVC are declining whenever MC is below AC and AVC correspondingly, and rising whenever MC is above the average cost curves;
- 3) MC curve cuts the AC and AVC curves at the minimum points of the average cost curves.

Costs in short run.



Variable, fixed and total costs



Average and marginal costs

# Short run costs: example №1

## 2006 AP<sup>®</sup> MICROECONOMICS FREE-RESPONSE QUESTIONS

Short-Run Total Cost Function

Quantity Produced	Total Cost (in dollars)
0	20
1	27
2	38
3	53
4	72
5	95
6	122

2. The table above gives the short-run total cost function for a typical firm in a perfectly competitive industry.
- What is the dollar value of the firm's total fixed cost?
  - Calculate the marginal cost of producing the first unit of output.

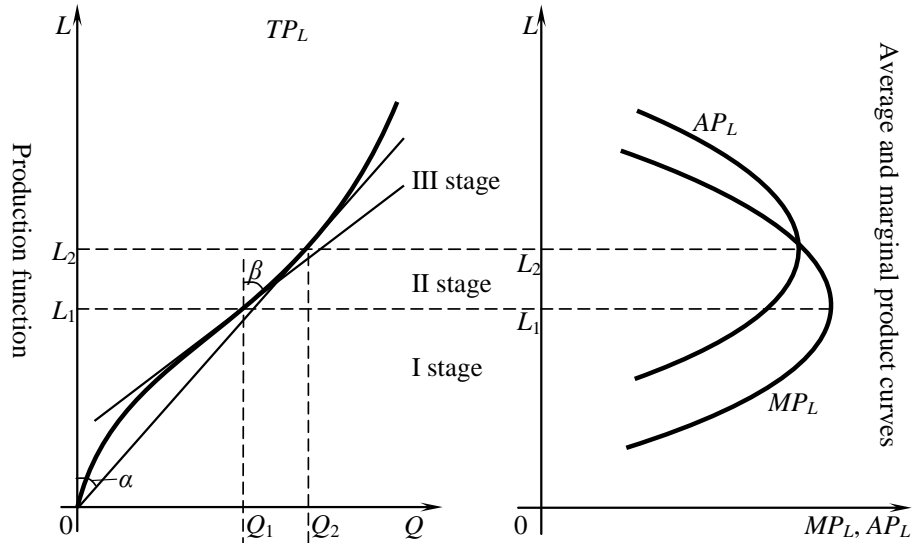


# Short run costs: example №2

## **2007 AP<sup>®</sup> MICROECONOMICS FREE-RESPONSE QUESTIONS (Form B)**

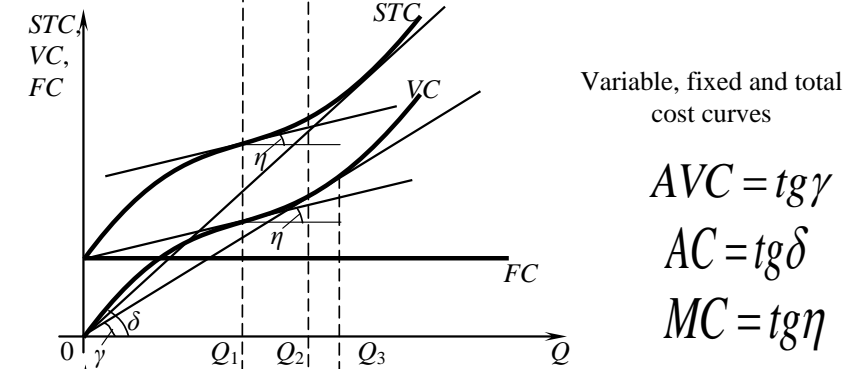
3. For each of the following statements, indicate whether it is true, false, or uncertain and explain why.
  - (a) Average total cost is always greater than average variable cost by a constant amount.

Short run product and cost curves

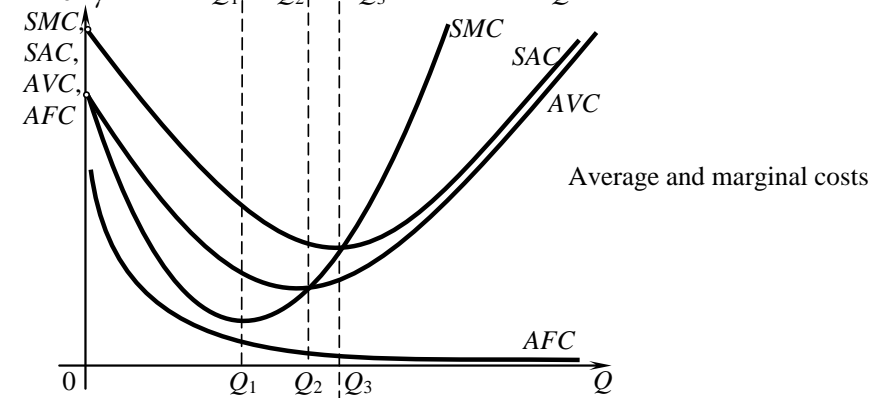


$$AP_L = tg\alpha \quad MP_L = tg\beta$$

$$AVC = \frac{wL}{Q} = \frac{w}{Q/L} = \frac{w}{AP_L}$$

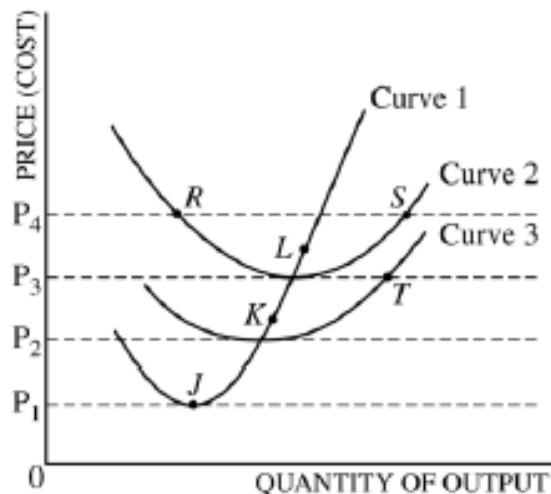


$$MC = \frac{d}{dQ}(wL(Q)) = w \frac{dL}{dQ} = \frac{w}{dQ/dL} = \frac{w}{MP_L}$$



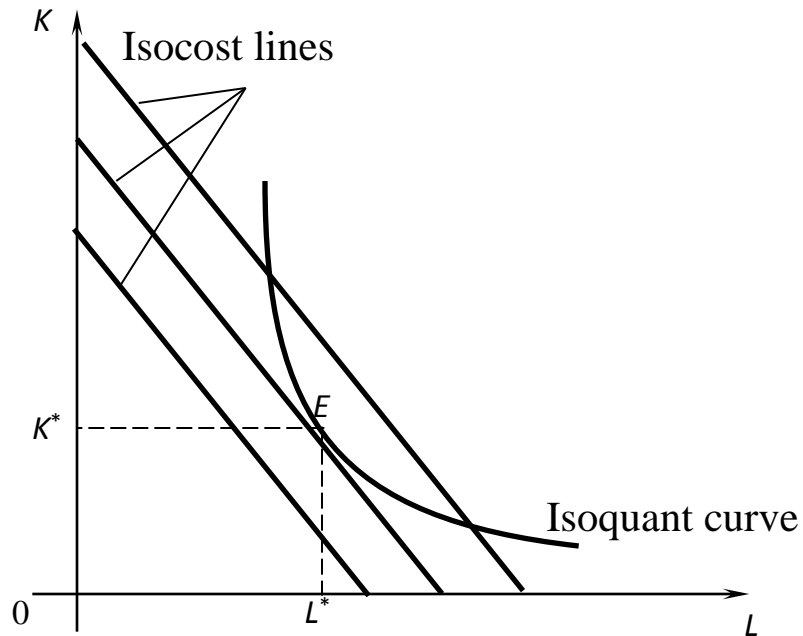
# Short run costs: example №3

2005 AP<sup>®</sup> MICROECONOMICS FREE-RESPONSE QUESTIONS (Form B)



2. The graph above shows the short-run cost structure of a firm in a perfectly competitive industry.
- Identify the cost curves that are denoted by each of the following labels.
    - Curve 1
    - Curve 2
    - Curve 3
  - Explain why curve 1 does each of the following as output increases.
    - Initially decreases
    - Finally increases
  - What measure of cost is represented by the vertical distance between curve 2 and curve 3?
  - Explain why the vertical distance between curve 2 and curve 3 decreases as output increases.
  - Using the letters on the graph, identify two points on the firm's short-run supply curve.

# Cost minimizing output combination



Minimize costs of  
production of a  
particular output

# Cost minimization: example

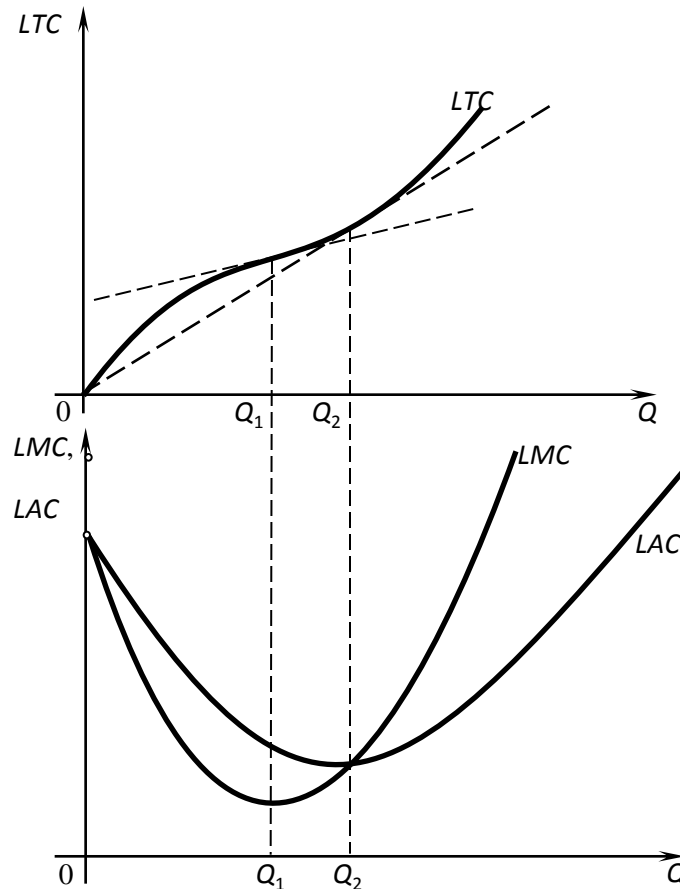
## 2010 AP<sup>®</sup> MICROECONOMICS FREE-RESPONSE QUESTIONS

2. The John Lamb Company, a profit-maximizing firm producing widgets, is in a perfectly competitive widget market. Assume John Lamb employs a fixed number of employees and rents a machine for a variable number of hours from a perfectly competitive market.
- (c) John Lamb is employing the cost-minimizing combination of inputs. The marginal product of labor is 28 widgets per worker hour and the wage rate is \$14 per hour. The marginal product of the machine is 60 widgets per machine-hour. What is the hourly rental price of a machine?

# Cost shifters

- Costs of inputs,
- Changes in technology.

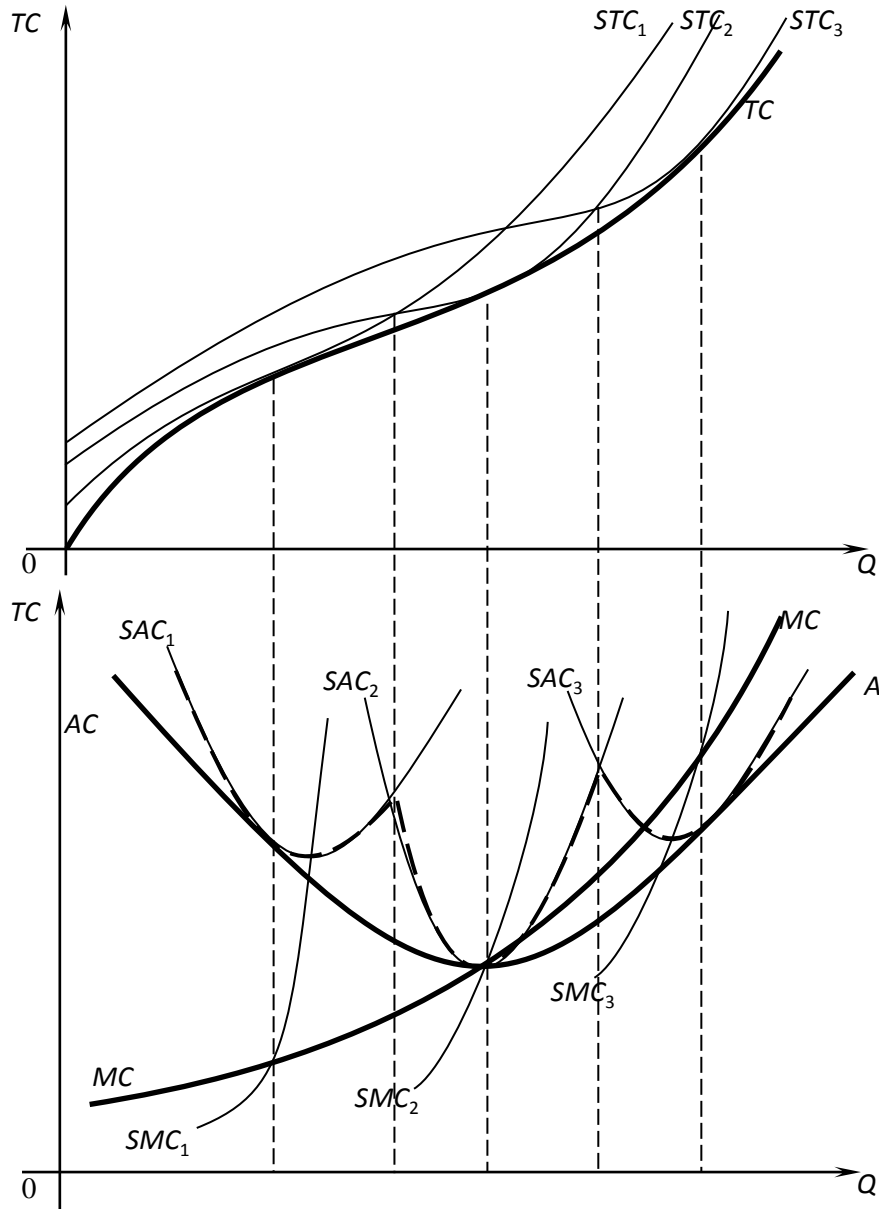
# Long run cost curves



Long run  
total cost curve

Average and  
marginal  
cost curves

# Long-Run & Short-Run Cost Curves



- $SAC_i$  are short-run average total cost curves for different plant sizes
- $AC$  curve shows the minimum average cost to produce a given output when all factors (incl. capital) can be varied



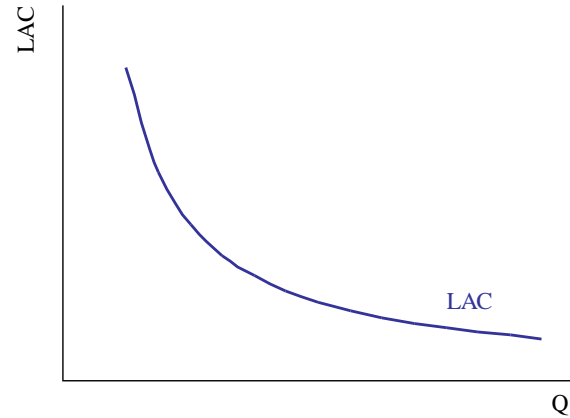
# Long Run: Technology and Returns to Scale

Technology dictates how costs (average) change with the amount of output.

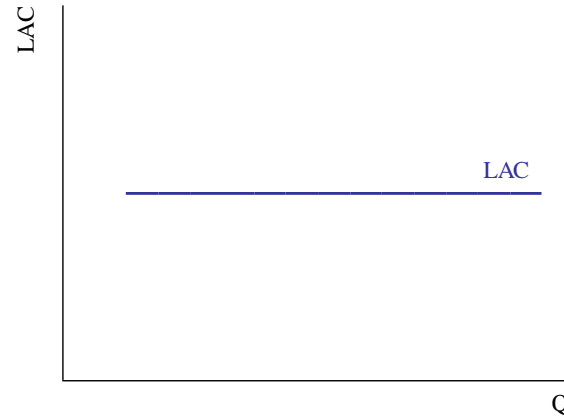
- Increasing returns to scale:  $Q(\alpha K, \alpha L) > \alpha Q(K, L)$
- Decreasing returns to scale:  $Q(\alpha K, \alpha L) < \alpha Q(K, L)$
- Constant returns to scale:  $Q(\alpha K, \alpha L) = \alpha Q(K, L)$

$$\alpha > 1$$

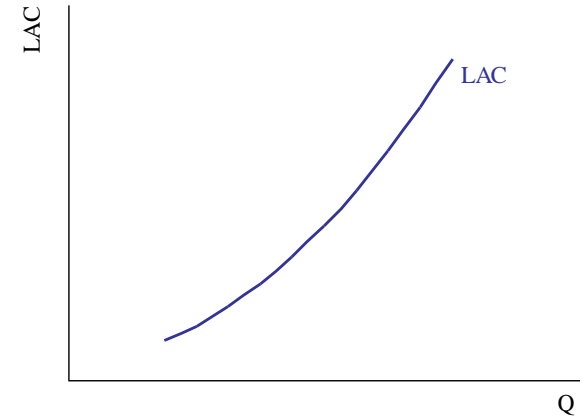
# Long-Run Average Cost (LAC) & Returns to Scale



- Increasing returns to scale, or economies of scale
- LAC curve is downward sloping.



- Constant returns to scale
- AC are constant



- Decreasing returns to scale, or diseconomies of scale
- LAC curve is upward sloping

# Diseconomies of Scale Versus Diminishing Marginal Returns

- Diseconomies of scale – ALL factors can be varied. Relationship between output and LAC.
- Diminishing marginal returns – only one factor is varied, others are fixed at particular level. Relationship between changes in quantity of one input and output.

# Marginal Revenue

Marginal Revenue under imperfect competition declines with an increase in output, because it depends on demand.

- Can sell more output only if the price is lower.
- MR = extra revenue from selling last unit. To sell an additional unit of output means to lose revenue from the previous units, selling them at lower price.

# Profit maximization.

