University of Macerata
Economics - A.Y. 2022/2023
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- Intro to Microeconomics
- Theory of Production

REF. Chapter 6 (excluding Section B, pp. 118-122)

Microeconomics

Microeconomics studies the behavior of:

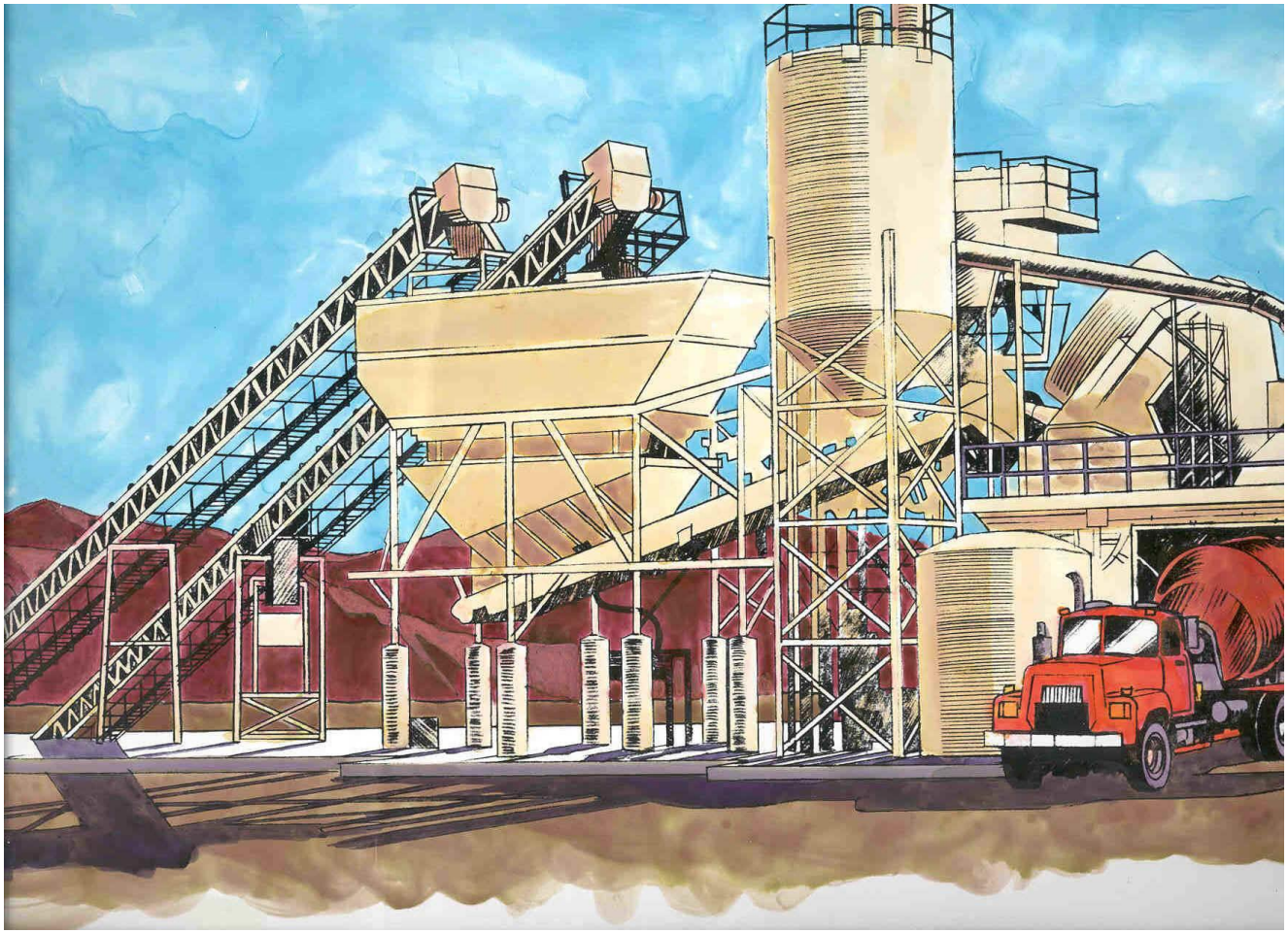
- individual companies (profits, costs, productivity, production, etc ...);
- consumers;
- markets.

In our course:

- Study of individual companies, to understand how they decide the quantity of output to be produced in a market (theory of production and costs).
- Study of markets, to understand how different markets (perfect and imperfect competition; regulations; market failures, etc ...) produce different results for companies and the community (e.g. in terms of prices and quantities, profits, etc.).

What does happen within a company?

The **production process**: a firm uses **inputs**, to transform them into **outputs**



Production function

The **Production Function** expresses the link between the quantities of the production factors used (**inputs**) and the maximum quantity of product obtainable (**output**), given the level of technical knowledge available.

In mathematical terms, the production function is:

$$q = f(L, K)$$

q = output
L = labour
K = capital

Difference between short and long term production

The behavior of firms is summarized by the production function, which takes on a different meaning in the **short run** and in the **long run**.

In the **short run**, some production factors are FIXED (e.g., Capital => plants): the company can vary the degree of use of its plants, modulating the use of VARIABLE factors (e.g., Labor), until the production capacity is saturated.

In the **long run**, there are no constraints on production, as all factors can be varied => the overall production capacity of the firm can vary.

Productivity and production in the short run

The short-term perspective allows us to analyze how the quantity produced varies with the variation of a **single production factor** (**Labor**):

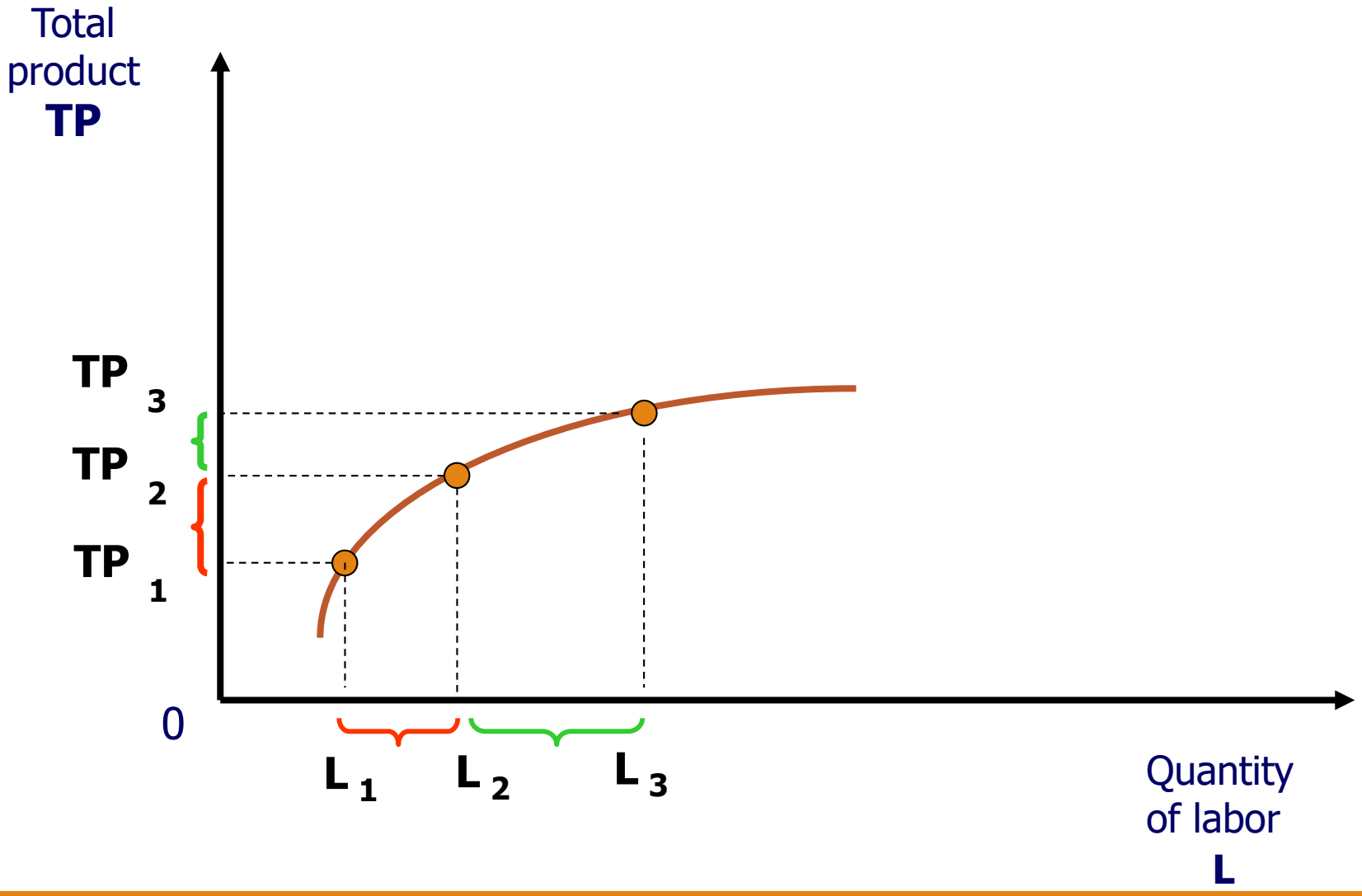
=> marginal productivity (or returns) of a factor

The marginal product of an input is the extra output produced by 1 additional unit of that input while other inputs are held constant.

What is the relationship between changes in inputs and quantity produced in the **short run**?

- short run - only one factor is variable
- to analyze the marginal productivity of a factor, we observe the trend of the **total product**. We discover **the law of diminishing returns**: the increase in production resulting from the use of an additional unit of a factor, keeping the quantity of all the other factors constant, is decreasing. In other words, the marginal product of each unit of input will decline as the amount of that input increases, holding all other inputs constant.

Trend of the total product with the variation of a single production factor (Labor)



Total, Average, and Marginal Product

- Total product (Y): physical quantities of obtainable output
- Marginal product: physical quantities of output that can be obtained in addition, by increasing a certain production factor by 1 unit (all other factors used being equal), that is ($\Delta Y / \Delta L$)
- Average product: total output obtained / input units used, i.e. (Y / L)

(1) Units of labor input	(2) Total product	(3) Marginal product	(4) Average product
0	0		
		2,000	
1	2,000		2,000
		1,000	
2	3,000		1,500
		500	
3	3,500		1,167
		300	
4	3,800		950
		100	
5	3,900		780

TABLE 6-1. Total, Marginal, and Average Product

Total product and marginal product

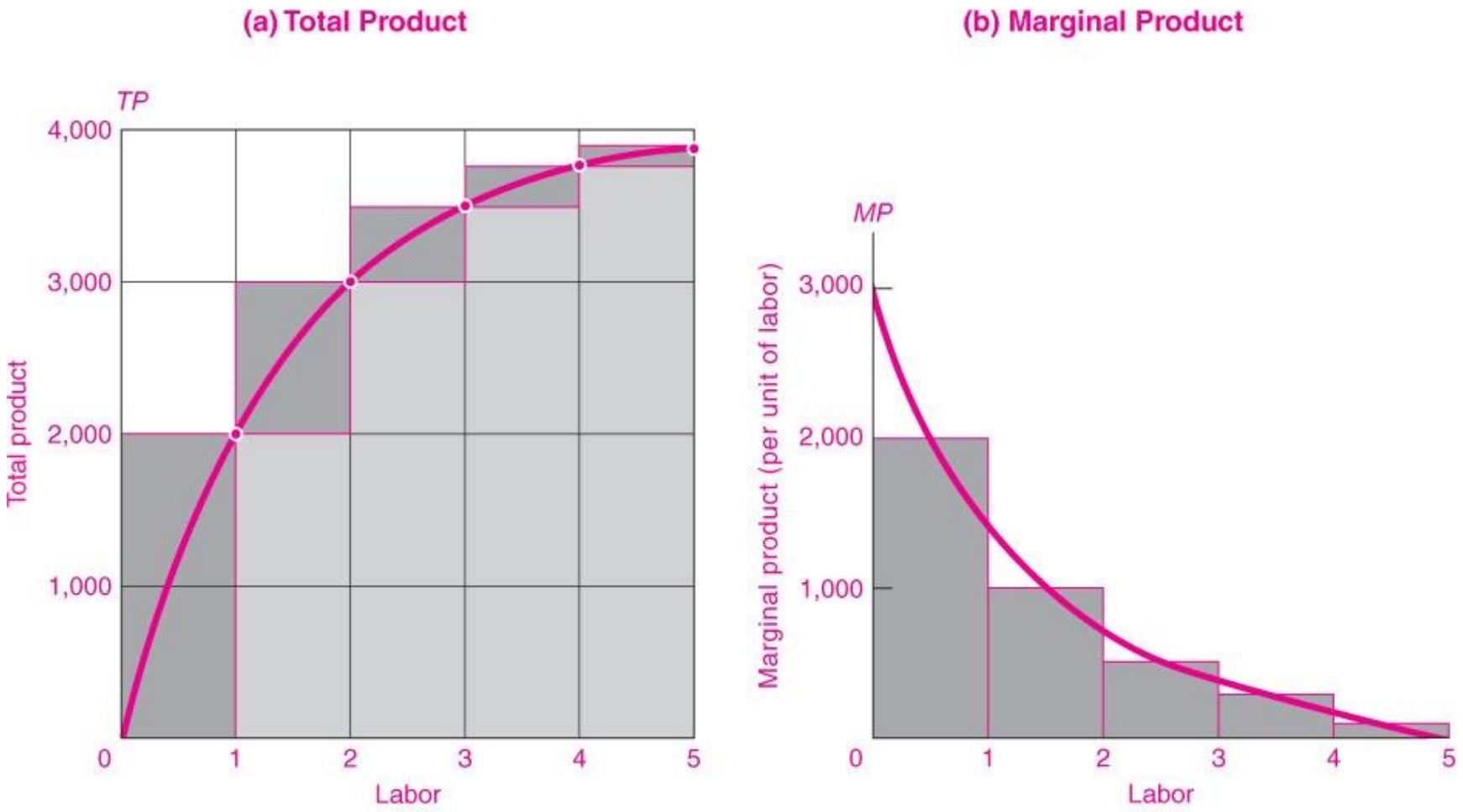


FIGURE 6-1. Marginal Product Is Derived from Total Product

The law of diminishing returns

If the quantity used of one factor of production is increased in successive equal incremental quantities, keeping the quantities of the other factors constant, the production will increase up to a certain limit.
However, each increase will be smaller than the previous one (decreasing marginal productivity).

=> reason: each additional unit of labor can count on less capital!

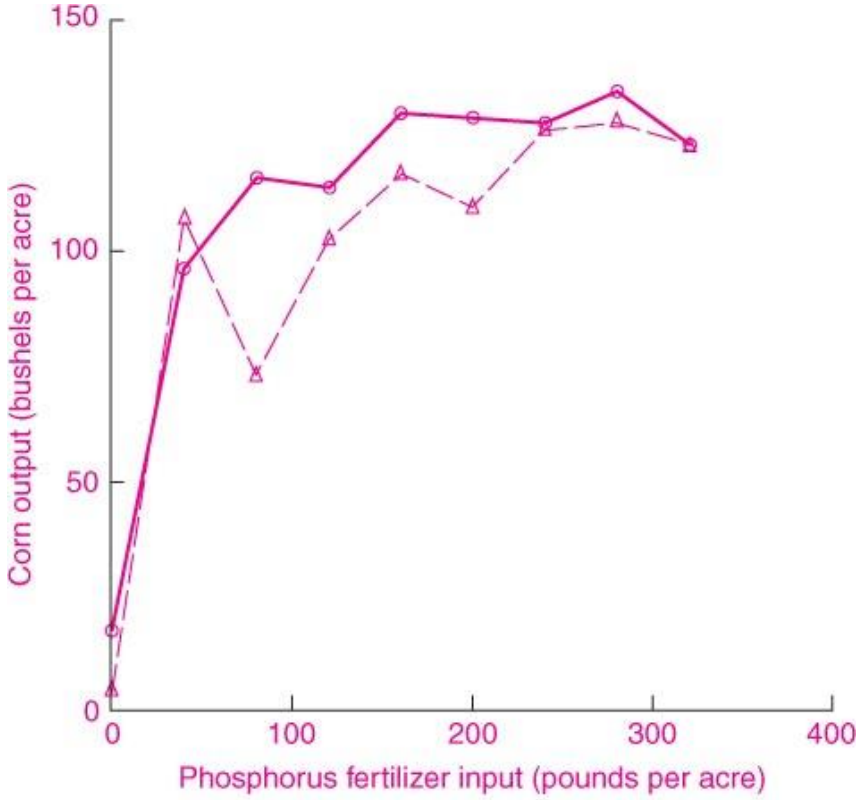


FIGURE 6-2. Diminishing Returns in Corn Production

Agricultural researchers experimented with different doses of phosphorus fertilizer on **two different plots** to estimate the production function for corn in western Iowa. In conducting the experiment, they were careful to hold constant other things such as nitrogen fertilizer, water, and labor inputs. If you fit a smooth curve to the data, you will see that the relationship displays **diminishing returns** for every dose and that marginal product becomes negative for a phosphate input of around 300.

Productivity and production in the long run
(Returns of a singol factor *vs.* RETURNS TO SCALE)

What is the relationship between changes in inputs and quantity produced in the **long run**?

- long run - all factors may change
- one can examine how total output varies when all factors of production increase / decrease proportionally (**to scale**). => **Returns to scale** (i.e. of all factors, not just one).

Productivity and production in the long run

- **Constant returns to scale**: denote a case where a change in all inputs leads to a proportional change in output. When capital and labor vary together, returns are not necessarily diminishing because each additional unit of labor can rely on the same share of capital.
- **Increasing returns to scale (also called Economies of scale)**: arise when an increase in all inputs leads to a more-than-proportional increase in the level of output. (Causes: more efficient plants, learning, specialization, efficient use of installed production capacity).
- **Decreasing returns to scale**: occur when a balanced increase of all inputs leads to a less-than-proportional increase in total output. (Causes: e.g. Problems of management, coordination and control of production activities within the company).

Production concept	Definition
Diminishing returns	Declining marginal product of an input, holding all other inputs constant
Returns to scale	Increase in output for balanced increase in all inputs is
Decreasing	. . . less than proportional
Constant	. . . proportional
Increasing	. . . more than proportional

TABLE 6-2. Important Production Concepts

Technological progress and production function

The Production Function expresses the link between an input and the maximum quantity of output, given the level of technical knowledge available.
Technological progress (e.g. more efficient machinery) shifts the production function upwards (=> higher output for each level of the single factor used)

Product or **process** innovations advance economic systems.

Product innovations expand the quality/number of products/sectors.

Process innovations, by improving existing techniques, shift the production function of a given sector.

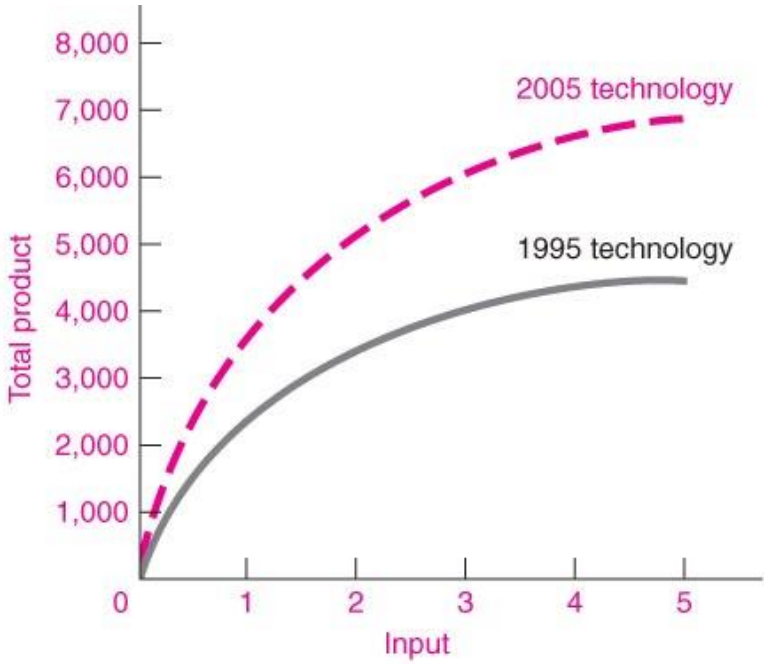


FIGURE 6-3. Technological Change Shifts Production Function Upward