

Producer Theory.

Problem (APT'98, P3)

Suppose that the table below presents the production schedule of Company XYZ, where labor is the only variable input.

<u>Number of workers</u>	<u>Units of output</u>
1	50
2	150
3	300
4	600
5	1,000
6	1,300
7	1,500
8	1,200

- (a) Define the law of diminishing returns.
- (b) Explain why diminishing marginal returns occur.
- (c) With reference to the number of workers in this production process, at what point do diminishing marginal returns set in?
- (d) What is the typical relationship between the average product curve and the marginal product curve?
- (e) What is the typical relationship between the average product curve and the average variable cost curve?

Sample answer:

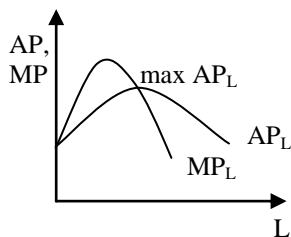
- (a) The law of diminishing returns states that after a certain point an increase in one variable factor will result in an ever smaller increase in output, given that all other factors do not change.
- (b) The reason why marginal product (the increase in output caused by a 1 unit increase in a variable factor) starts to decrease after some level of the factor's employment is reached is satiation. In the case of labor, for example, owing to division of labor and specialization, every additional worker contributes more to the total output than the previous one, when only a few workers are employed. However, as more and more workers are doing the job, it becomes increasingly difficult for them to go around the working place and use the equipment whose amount is limited, so that their marginal product starts to diminish. It is even possible that, at some point, there will be so many people at the working place that any new laborer will only hinder the production process and bring the total output down.

(c) From the given data let's calculate the marginal product of each worker:

<u>Number of workers</u>	<u>Units of output</u>	<u>Marginal product</u>
1	50	50
2	150	100
3	300	150
4	600	300
5	1,000	400
6	1,300	300
7	1,500	200
8	1,200	-300

As you can see, marginal product starts to decrease when the 6th worker is taken on.

(d) It can be shown mathematically that when marginal product exceeds average product, average product is increasing, and, conversely, when marginal product is less than average product, the latter is decreasing. It follows then, that the marginal product curve crosses the average product curve at the point of maximum of average product:



(e) Given that there is only one variable factor (labor, as in the example above), average product and average variable costs are inversely related, that is, when average product increases, average variable costs go down, and vice versa. The following considerations explain why this relationship holds.

By definition, average product of labor is given by $AP = Q/L$, where Q denotes the total output and L is the amount of labor employed. Average variable costs are equal to the cost of the variable factor (in our case, labor) per unit of output, that is, $AVC = wL/Q$, and since $L/Q = 1/AP$ we have that $AVC = w/AP$, where w is the wage rate. The diagram below illustrates this relationship graphically (note that along the horizontal axis output is measured, although it might as well have been the amount of labor used):

