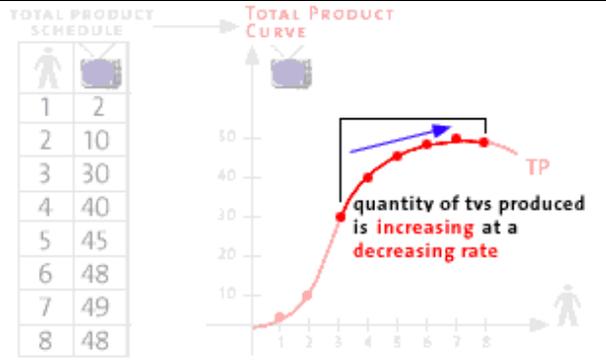


### Explaining the Total Product Curve

>> Key Concepts:

- ↪ The **total product (TP) curve** graphically explains a firm's total output in the short run. It plots total product as a function of the variable input, labor.
- ↪ **Marginal product (MP) of labor** is the change in output generated from adding one more unit of the variable input, labor.
- ↪ The shape of the total product curve is a function of teamwork, specialization, and using the **variable input** with the **fixed inputs**.

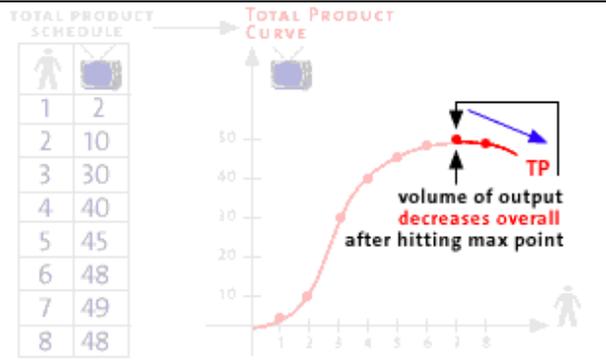
<div style="display: flex; align-items: flex-start;"> <div style="margin-right: 20px;"> <p><b>TOTAL PRODUCT SCHEDULE</b></p> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">1</td> <td style="width: 20px;">2</td> </tr> <tr> <td>2</td> <td>10</td> </tr> <tr> <td>3</td> <td>30</td> </tr> <tr> <td>4</td> <td>40</td> </tr> <tr> <td>5</td> <td>45</td> </tr> <tr> <td>6</td> <td>48</td> </tr> <tr> <td>7</td> <td>49</td> </tr> <tr> <td>8</td> <td>48</td> </tr> </table> </div> <div> <p><b>TOTAL PRODUCT CURVE</b></p> </div> </div> <p><b>THE TOTAL PRODUCT CURVE:</b> 1. Is S-shaped</p>	1	2	2	10	3	30	4	40	5	45	6	48	7	49	8	48	<p>The <b>total product (TP) curve</b> represents the total amount of output that a firm can produce with a given amount of labor. As the amount of labor changes, total output changes.</p> <p>The total product curve is a short-run curve, meaning that technology and all inputs <b>except labor</b> are held constant. This assumption is the familiar <i>ceteris paribus</i> rule.</p> <p>In the example on the left, you plot output/labor combinations from the total product schedule. The vertical axis is output and the horizontal axis is labor.</p>
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**THE TOTAL PRODUCT CURVE:**  
 1. Is S-shaped  
 2. Is Convex when the output is increasing at an increasing rate  
 3. Is Concave when the output is increasing at a decreasing rate

In the middle production range, the slope of the total product curve gets flatter, and the curve becomes concave. Concavity means that the production of TVs is increasing but at a decreasing rate.

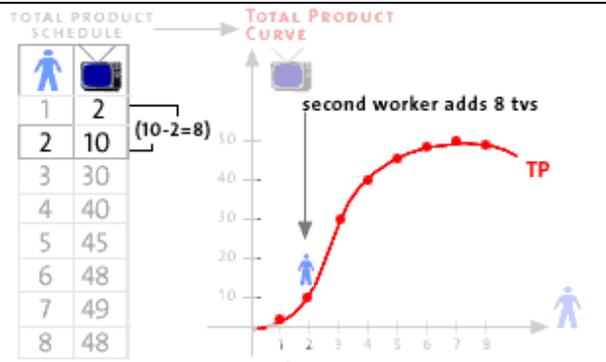
The economic interpretation of concavity is that as workers are added, there is less and less specialization available and that the workers are less and less efficient in using the fixed inputs.



**THE TOTAL PRODUCT CURVE:**  
 1. Is S-shaped  
 2. Is Convex when the output is increasing at an increasing rate  
 3. Is Concave when the output is increasing at a decreasing rate

Finally, the total product curve hits a maximum point after which output decreases with each additional worker.

After the maximum, additional employees are nonproductive and unable to use the fixed inputs efficiently. In fact, employees may be getting in each other's way and hindering production, causing total product to decrease.

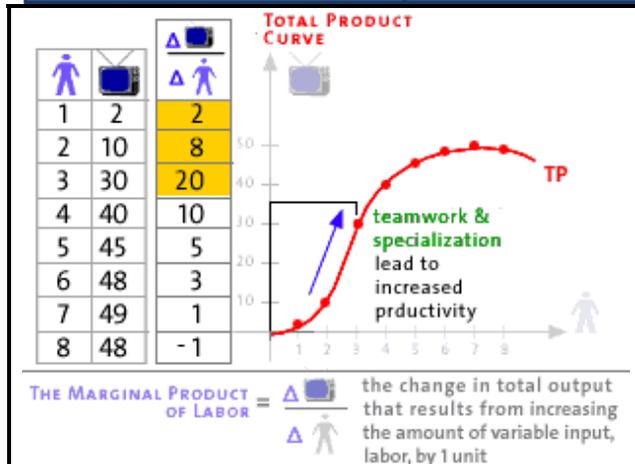


**THE MARGINAL PRODUCT OF LABOR** =  $\frac{\Delta \text{TV}}{\Delta \text{L}}$  the change in total output that results from increasing the amount of variable input, labor, by 1 unit

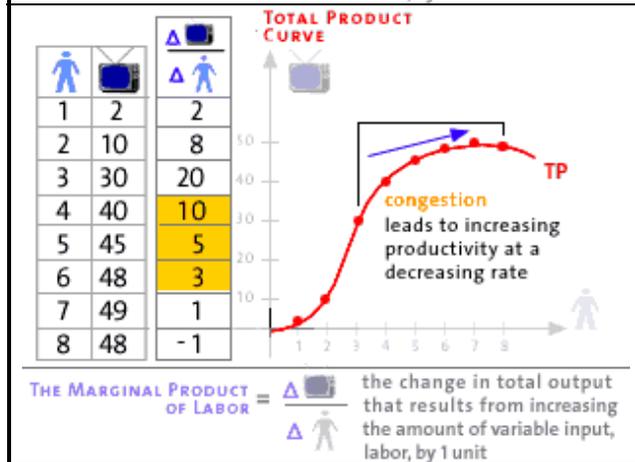
The **marginal product (MP) of labor** is the change in total product that results from a one-unit change in labor.

In the example on the left, the second worker adds eight TVs to TP, the third one adds twenty TVs, the fourth one adds ten TVs, the fifth one adds five TVs, the sixth one adds three TVs, the seventh one adds one TV, and the eighth worker causes production to fall by one TV.

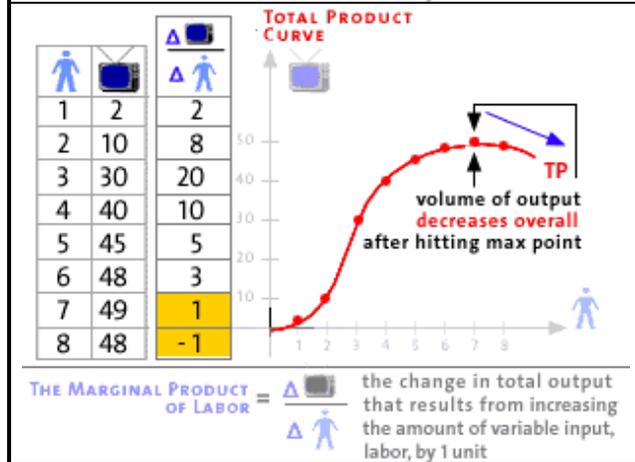
The S-shaped TP curve reflects the schedule on the far left.



In the convex area of the TP curve, teamwork and specialization lead to increased productivity. Additional workers very efficiently use the available fixed inputs.



In the concave portion, production increases at a decreasing rate because additional employees are less able to use the plant and other fixed inputs efficiently.



At some point, total product hits a maximum. After the maximum, additional labor becomes inefficient, and output falls.