PRODUCTION AND COSTS

EXAMPLE OF CAR WASH

- Our firm is Spotless Car Wash, whose output is a service: washing cars.
- The firm's capital consists of automated car-washing lines.
- It's labor is full-time workers who drive the cars onto the line, drive them out, towel them down at the end, and deal with customers

Short-run production

- In a short-run our car wash has at least one input fixed, cannot be changed.
- In our case this is automated car-washing line – due to lack of space in the courtyard where the car wash is, they cannot install one more line.
- For Spotless the long run is a time horizon of one year or longer (rent new space, buy extra washing line).
- The more the cars come to be washed, the only thing that can be increased is the number of workers.

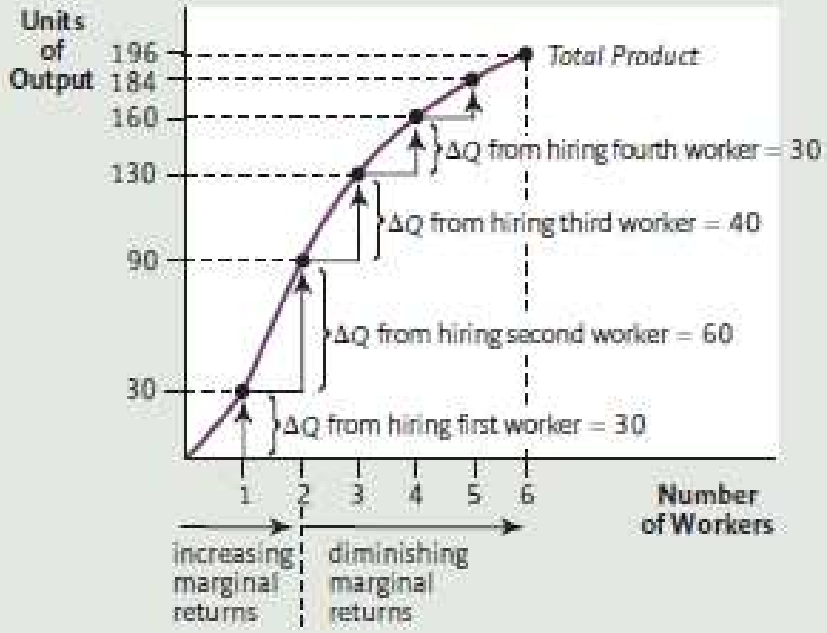
TABLE 1

Short-Run Production at Spotless Car Wash

Quantity of Capital	Quantity of Labor	Total Product (Cars Washed per Day)
1	0	0
1	1	30
1	2	90
1	3	130
1	4	160
1	5	184
1	6	196

FIGURE 1 Total and Marginal Product

The total product curve shows the total amount of output that can be produced using various numbers of workers. The marginal product of labor (MPL) is the change in total product when another worker is hired. The MPL for each change in employment is indicated by the length of the vertical arrows.



Explanation of the table and graph

- the table shows us that with one automated line but no labor, total product is zero.
- With one line and six workers, total product is 196 cars washed per day. The total product numbers in the table tell us the *maximum* output for each number of workers.
- We can also reverse this logic, and say that for each value of the total product, the labor column shows us the *lowest* number of workers that can produce it.
- If we hire 1 worker, he/she will daily wash 30 cars
- Two workers will wash daily 90 cars – additional output of second laborer is 60 newly washed cars. - law of increasing marginal returns to labor. For example, if employment rises from 2 to 3 workers, total product rises from 90 to 130, so the marginal product of labor for *that* change in employment is calculated as (130- 90)/(3-2) = 40 units of output.
- **diminishing marginal returns to labor happen =**The marginal product of labor decreases as more labor is hired.

Law of increasing marginal returns to labour (MPL)

- When the marginal product of labor rises as more workers are hired, there are **increasing marginal returns to labor.** Each time a worker is hired, total output rises by more than it did when the previous worker was hired. Why might this happen?
- Additional workers may allow production to become more specialized.
- While one worker *could* operate the car wash alone, he or she would have to do everything: drive the cars on and off the line, towel them down, and deal with customers. Much time would be wasted switching from one task to another. Table 1 tells us that one worker can wash only 30 cars each day.
- Add a second worker, though, and now specialization is possible. One worker can collect money and drive the cars onto the line, and the other can drive them off and towel them down. Thus, with two workers, output rises all the way to 90 car washes per day; the second worker adds more to production (60 car washes) than the first (30 car washes) by making *both* workers more productive.
- That doesn't mean that 1 person washes 60 cars more. This just means that due to specialization, both workers can do more per day (in average, 45 cars per person – when two workers are working together.)

Law of diminishing marginal returns to labor

- It happens when the marginal product of labor decreases as more labor is hired.
- Output still rises when another worker is added, so marginal product is positive. But the rise in output is smaller and smaller with each successive worker.
- Why does this happen? For one thing, as we keep adding workers, additional gains from specialization will be harder and harder to achieve. Moreover, each worker will have less and less of the fixed inputs with which to work.
- This last point is worth stressing. It applies not just to labor but to any variable input. In all kinds of production, if we keep increasing the quantity of any one input, while holding the others fixed, diminishing marginal returns will eventually set in.

Short-run costs for Spotless car wash

TABLE 3

Short-Run Costs for Spotless Car Wash

	Labor cost = $120 per day				Capital cost = $150 per day				
(1) Output (per Day)	(2) Capital	(3) Labor	(4) TFC	(5) TVC	(6) TC	(7) MC	(8) AFC	(9) AVC	(10) ATC
0	1	0	$150	$ 0	$150		—	—	—
						$ 4.00			
30	1	1	$150	$120	$270		$5.00	$4.00	$9.00
						$ 2.00			
90	1	2	$150	$240	$390		$1.67	$2.67	$4.33
						$ 3.00			
130	1	3	$150	$360	$510		$1.15	$2.77	$3.92
						$ 4.00			
160	1	4	$150	$480	$630		$0.94	$3.00	$3.94
						$ 5.00			
184	1	5	$150	$600	$750		$0.82	$3.26	$4.08
						$10.00			
196	1	6	$150	$720	$870		$0.77	$3.67	$4.44

Explanation of the table

- The question we ask ourselves is how the change in the number of washed cars influences the change of inputs and costs.
- Total fixed cost (TFC) is 150 $ per day – cost of leasing automated line
- Workers are variable costs – 120 $ per day (Total variable costs = TVC)
- Total Costs = Total variable costs + Total fixed costs
- For example, at 90 units of output, *TFC is* $150 and *TVC is* $240, so *TC is* $150 + $240 = $390. Because total variable cost rises with output, total cost rises as well.

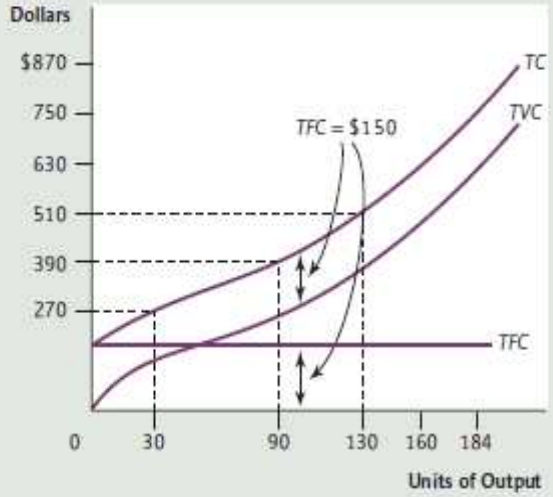
Average and marginal costs

- While total costs are important, sometimes it is more useful to track a firm's costs *per unit* of output, which we call its *average cost.*
- No matter what kind of production or what kind of firm, *AFC* will always fall as output rises. Why? Because *TFC* remains constant, so a rise in *Q must* cause the ratio *TFC/Q* to fall. Business managers often refer to this decline in *AFC* as "spreading their overhead" over more output.
- The *AVC* numbers first decrease and then increase. Economists believe that this pattern of decreasing and then increasing average variable cost is typical at many firms. (Due to increase in MPL and then decrease)
- *ATC* first falls and then rises. Due to rise in AVC!
- Marginal cost– *It tells us how much cost rises per unit increase in output.*– first it declines then it starts rising

Marginal Cost first declines and then rises. Why is this?

- Here, we can use what we learned earlier about marginal returns to labor. At low levels of employment and output, there are increasing marginal returns to labor: $MPL = \Delta Q/\Delta L$ is rising. That is, each worker hired adds more to production than the worker before. But that means *fewer additional workers are needed to produce an additional unit of output*, so the *cost* of an additional unit of output (*MC*) must be falling.
- Thus, as long as *MPL* is rising, *MC* must be falling.

FIGURE 2 The Firms Total Cost Curves



At any level of output, total cost (TC) is the sum of total fixed cost (TFC) and total variable cost (TVC).

FIGURE 3 Average and Marginal Costs

Average variable cost (AVC) and average total cost (ATC) are U-shaped, first decreasing and then increasing. Average fixed cost (AFC), the vertical distance between ATC and AVC, becomes smaller as output increases. The marginal cost (MC) curve is also U-shaped, reflecting first increasing and then diminishing marginal returns to labor. MC passes through the minimum points of both the AVC and ATC curves.