

16 | MORE PRODUCTION AND COST IN THE SHORT-RUN

Purpose: To illustrate the relationship between changes in technology and a firm's cost of production in the short-run.

Computer file: **tpc298.xls**

Instructions and background information:

You own and operate an apartment cleaning service firm in Detroit. Your business is to clean and repair apartments for landlords whose tenants have recently moved out. The left graph shows the total product curve for your firm. The input is the number of workers you hire per day, and the output is the number of apartments cleaned per day.

Just as in the last problem set, the value called "Labor efficiency (new)" is an index of how efficiently labor services are used to clean apartments. Labor efficiency here is part of the technology of production.

The baseline value for "labor efficiency" is .50. You can experiment with what happens to the total product curve for different values for the index. Technological improvements mean an increase in the labor efficiency index, as you can verify with a little experimentation. Notice that an improvement in technology allows you to get more output from the same amount of inputs, and allows you to produce the same level of output at lower cost because you'll need fewer workers.

The figure at the right of the screen shows the short-run total cost curve for your apartment cleaning business. The daily wage you must pay is \$10.00, and there are fixed costs, mostly in the form of rental contracts on machinery, and insurance. Under the "TOTAL COST CURVE" information you can select a value for output, and Excel computes the total cost needed to produce that output in the short-run. Notice that under the "TOTAL COST CURVE" information Excel also computes the labor required to produce the output you desire.

You can change the labor use in the left diagram and the level of output in the right diagram independently. Experiment with changing output and the efficiency index until you understand how each kind of change affects the display.

Here are some things to watch for and learn as you do the problems:

1) A change in technology changes the total product curve and the total cost curve. An improvement in technology *increases* the output you get from a given amount of labor, and *decreases* the cost of producing a given level of output.

2) It is no accident that the total product curves and total cost curves are logically linked. In this example, the total product curve increases at a decreasing rate (the marginal product of labor diminishes as more labor is used), and the total cost curve increases at an increasing rate (the marginal cost rises as more output is produced).

Here are some hints to help you get the answers quicker:

1) Word answers (as opposed to numbers) must be entered as lower case.

2) Average cost is total cost divided by output.

3) Marginal cost is the change in total cost per unit change in output. In economists' jargon, the "marginal cost of the 10th unit of output" is the increase in total cost in going from 9 to 10 units of output.

MATH MAVEN'S CORNER: The total product curve in this problem is the same functional form as the previous problem set.

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Questions

Set efficiency to the baseline value of .50.

- 1) How many apartments can you clean per day with 20 workers?

Keep efficiency at its baseline value.

- 2) Does the production function (total product curve) have the property of diminishing marginal product? [yes or no]

Increase efficiency to .60.

- 3) How many apartments can you now clean per day with 20 workers?

Keep the efficiency index at .60.

- 4) Does the production function (total product curve) still have the property of diminishing marginal product? [yes or no]

Set the efficiency index to its baseline value.

- 5) What's the TOTAL COST of cleaning 15 apartments?
- 6) What are the labor requirements for cleaning 15 apartments per day?

Now set the efficiency index to .60.

- 7) What's the TOTAL COST of cleaning 15 apartments?
- 8) What are the labor requirements for cleaning 15 apartments per day?

Set efficiency to its baseline value of .50.

- 9) What's the AVERAGE COST of cleaning 15 apartments?

Increase the efficiency index to .60.

- 10) What's the AVERAGE COST of cleaning 15 apartments?

Set the efficiency index to its baseline value.

- 11) What's the MARGINAL COST of cleaning the 15th apartment?

Now set the efficiency index to .60.

- 12) What's the MARGINAL COST of cleaning the 15th apartment?

You can summarize your results now. For each cost concept listed, does an improvement in efficiency cause an INCREASE or a DECREASE in cost?

- 13) Total cost.
- 14) Average cost.
- 15) Marginal cost.