Economics 101 – Section 5

Lecture #13 – February 26, 2004

Production – costs in the short run

Outline

- Explain some of HW#5
- Recap from last lecture
  - Short-run vs long-run production
  - Fixed inputs
  - Variable inputs
  - Total product
  - Marginal product and diminishing returns
- Short run production
  - Total Costs
  - Average costs
  - Marginal costs
- Long run production

Basics

- The production function lets us know what is the maximum amount of output that can be produced with a given number of inputs
  - Inputs are those items which are used to produce a good or service
- In the short-run at least one input is variable, in the long-run all inputs are variable
- Fixed inputs
  - Inputs whose quantities do not change as output is varied are called fixed inputs

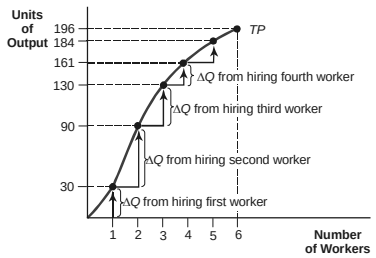
Basics

- Variable inputs
  - The owner of a firm can change the quantity of these inputs used to change the amount of output
- Total product
  - is the maximum level of output that can be produced with the given inputs
- Simple example – washing cars

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	161
1	5	184
1	6	196

Total and Marginal Product



- Marginal product of labor (MPL)
  - is the additional output produced when one more worker is hired.
  - The equation for this relationship is

$$MPL = \frac{\Delta \text{ Quantity of output}}{\Delta \text{ in the number of workers hired}} = \frac{\Delta Q}{\Delta L}$$

- Increasing marginal returns to labor occur when the marginal product of labor increases when employment increases
- Diminishing marginal returns to labor occur when additional units of labor result in smaller incremental gains in output than before.
- Graph of marginal product

- Law of diminishing marginal returns
  - As we continue to add more of any one input, while holding all other inputs constant, the marginal product will eventually decline.

Costs

- A firms total cost of production is the total opportunity cost
  - That is, everything the firm owners must give up in order to produce output.
- Different types of costs
  - Sunk costs
    - Costs paid in the past and will not change regardless of your current decisions
    - Sunk costs should be ignored when making any current decisions

Costs

- Explicit costs
  - Money actually paid out for the inputs
  - Examples – wages, rent, interest, machines
- Implicit costs
  - No money actually changes hands
  - Examples –
    - Rent if you own the land
    - If you are the manager, your foregone wages

Explicit Costs	Implicit Costs
Rent paid out	Opportunity cost of:
Interest on loans	Owner's land (rent foregone)
Managers' salaries	Owner's money (investment income foregone)
Hourly workers' wages	Owner's time (labor income foregone)
Cost of raw materials	

Costs in the Short run

- Total cost

  TC = Total Fixed Cost (TFC) + Total Variable Costs (TVC)

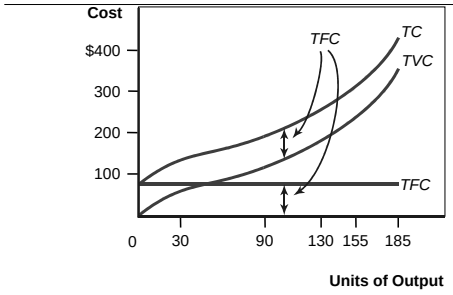
  $= TFC + TVC$
- Average costs
  - Average Fixed cost (AFC)

    $$AFC = \frac{TFC}{Q}$$
  - Average variable cost

    $$AVC = \frac{\text{TVC}}{\text{Q}}$$
  - Average total cost

    $$ATC = \frac{\text{TC}}{\text{Q}}$$

(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	$75	$ 0	$ 75		–	–	–
						$2.00			
30	1	1	$75	$ 60	$135		$2.50	$2.00	$4.50
						$1.00			
90	1	2	$75	$120	$195		$0.83	$1.33	$2.17
						$1.50			
130	1	3	$75	$180	$255		$0.58	$1.38	$1.96
						$1.94			
161	1	4	$75	$240	$315		$0.48	$1.49	$1.96
						$2.61			
184	1	5	$75	$300	$375		$0.44	$1.63	$2.04
						$5.00			
196	1	6	$75	$360	$435		$0.41	$1.84	$2.22

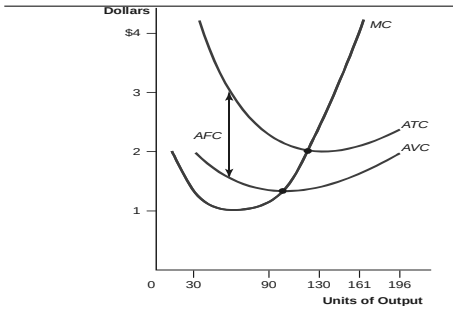


Costs in the Short run

- Marginal cost
  - Is the increase in total cost from producing one more unit of output

$$MC = \frac{\Delta TC}{\Delta Q}$$

The relationship between MC and average cost



The relationship between MC and average cost

- When the MPL (marginal product of labor) is rising then MC (marginal cost is falling)
  - MPL will be working in the opposite direction when compared to MC
    - The reason is when MPL is rising then you are getting more output for each unit of input
    - In other words, you are getting more output for each dollar spent.
    - The reverse holds true when MPL is falling since each additional unit of input gives a smaller incremental increase in output thus the MC is rising

Other interesting relationships with MC

- At low levels of output MC is below ATC and AVC so these curves will be downward sloping in this region
- At higher levels of output, MC is above the ATC and AVC so the ATC and AVC will be upward sloping
- The above relationships will give a “U” shape to the ATC and AVC curves

Other interesting relationships with MC

- The MC curve will intersect the ATC and AVC curves at their minimum points

Production in the Long-run

- In the long run all inputs are variable
  - In the car washing example the firm manager will have the option to open up more automated car washing lines
  - The option to vary all inputs in the short run is not an option
- “In the long run we are all dead” – John Maynard Keynes