

Economics 101 – Section 5

Lecture #14 – March 2, 2004

Production – long run production

Overview

- Recap of short run production
- What happens when all inputs are variable?
 - Large capital investments are not fixed in the long run
- Next lecture will start into the firms problem
 - Profit maximization
 - Marginal revenue and marginal cost together

Basics from last class

- 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

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

Basics from last class

- In the short-run must incur fixed costs even if you do not produce anything
 - Pay rent even if you don't use the building
 - Make payments on the factory even if it is not in use

(1) Output (per Day)	(2) Capital	(3) Labor	(4) <i>TFC</i>	(5) <i>TVC</i>	(6) <i>TC</i>
0	1	0	\$75	\$ 0	\$ 75
30	1	1	\$75	\$ 60	\$135
90	1	2	\$75	\$120	\$195
130	1	3	\$75	\$180	\$255
161	1	4	\$75	\$240	\$315
184	1	5	\$75	\$300	\$375
196	1	6	\$75	\$360	\$435

Production in the long-run

- In the long run all inputs are variable
- How long is “long-run”?
 - 6 months
 - A year
 - Five years
 - 50 years
 - Until “we are all dead”
- The long run is sufficiently long enough so that all inputs used in production can be varied

Production in the long-run

- In the long-run there are no fixed inputs or fixed input costs
- All inputs and all costs are variable
- In the long-run the firm needs to decide what combination of inputs to use in producing any level of output

Production in the long-run

- How does the firm choose where to produce in the long-run?
 - To produce at any given level of output, the firm will choose the input mix with the lowest cost.

Production in the long-run

- Some definitions
- Long-run total cost (LRTC)
 - Is the cost of producing each quantity of output when the least-cost input mix is chosen in the long-run
- Long-run average total cost (LRATC)
 - Is the cost per unit of output in the long run when all inputs are variable

$$LRATC = \frac{LRTC}{Q}$$

Production in the long-run

- Recall from last class that to wash 196 cars cost \$435 in total
 - In the short run the manager was restricted to using only one automated car washing line
- What if the manager could acquire more capital in the future? What would be the lowest cost alternative?

Production in the long-run

- Recall cost of capital is \$75 and a worker is \$60

Method	Quantity of Capital	Quantity of Labor	Cost
<i>A</i>	0	9	\$540
<i>B</i>	1	6	\$435
<i>C</i>	2	4	\$390
<i>D</i>	3	3	\$405

Production in the long-run

- By looking at what amount of capital and labor used together will give the lowest cost we can come up with the long run cost schedule
- With the existing technology, there is no way we could produce a given quantity at a lower total cost

Production in the long-run

<u>Output</u>	<u>LRTC</u>	<u>LRATC</u>
0	\$ 0	-
30	\$ 100	\$3.33
90	\$ 195	\$2.17
130	\$ 255	\$1.96
161	\$ 315	\$1.96
184	\$ 360	\$1.96
196	\$ 390	\$1.99
250	\$ 650	\$2.60
300	\$1,200	\$4.00

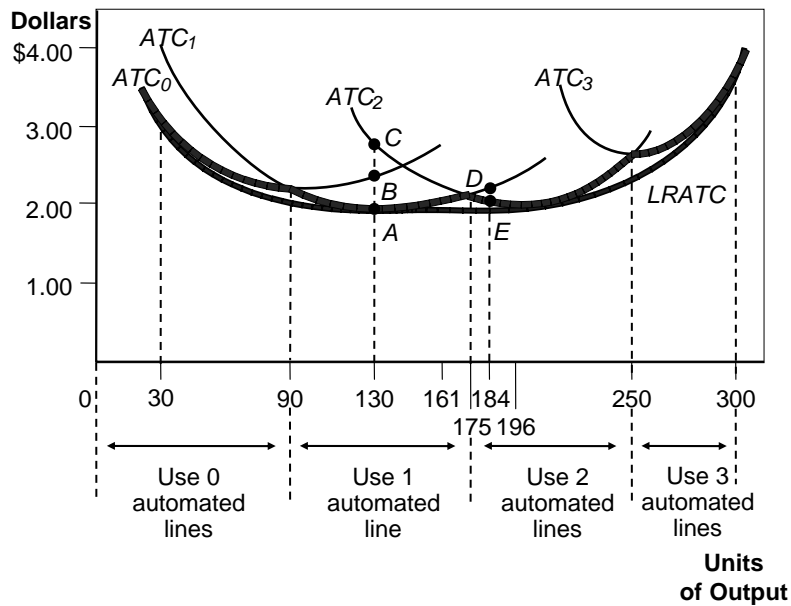
Production in the long-run

- Some intuitive results from the long-run
 - The long-run cost of producing a given level of output can be less than or equal to, but never greater than, the short-run total cost
 - i.e. $LRTC \leq (\text{short-run})TC$
 - The long-run average cost of producing a given level of output can be less than or equal to, but never greater than the short-run average total cost
 - i.e. $LRATC \leq (\text{short-run})ATC$

Production in the long-run

- Why should these results be intuitive?
 - In the long-run you have production options you did not have in the short-run so greater freedom in choosing the input mix could never make you worse off
- The LRATC will never be above any of the short-run TC curves

Figure 7 Long-Run Average Total Cost



Production in the long-run

- In the short-run the firm can only move along the current ATC, but in the long-run can move along the LRATC by varying large capital investments like the number and size of the plant

Production in the long-run

- Economies of scale
 - Economies of scale exist when you can double the inputs and more than double the amount of output
 - When doubling the inputs the firm costs will double but output is more than double
 - So long-run average total cost will decrease over regions where economies of scale exist

Production in the long-run

- Constant returns to scale
 - Doubling of all the inputs leads to a doubling of output
- Diseconomies of scale
 - Doubling all the inputs leads to less than a doubling of output
 - The LRATC will be upward sloping over regions of diseconomies of scale

Figure 8 The Shape of *LRATC*

