

CHAPTER **13**

The Costs of Production

PRINCIPLES OF
Economics
N. Gregory Mankiw


Premium PowerPoint Slides
by Ron Cronovich

© 2009 South-Western, a part of Cengage Learning, all rights reserved

ACTIVE LEARNING 1
Brainstorming costs

You run General Motors.

- § List 3 different costs you have.
- § List 3 different business decisions that are affected by your costs.



1

In this chapter, look for the answers to these questions:

- § What is a production function? What is marginal product? How are they related?
- § What are the various costs, and how are they related to each other and to output?
- § How are costs different in the short run vs. the long run?
- § What are "economies of scale"?

2

Total Revenue, Total Cost, Profit

§ We assume that the firm's goal is

$$\text{Profit} = \text{Total revenue} - \text{Total cost}$$

the amount a firm receives from the sale of its output

THE COSTS OF PRODUCTION

3

Costs: Explicit vs. Implicit

§ **Explicit costs** require an outlay of money, e.g., paying wages to workers.

§ **Implicit costs**

§ Remember one of the Ten Principles:

The cost of something is what you give up to get it.

§ This is true whether the costs are implicit or explicit. Both matter for firms' decisions.

THE COSTS OF PRODUCTION

4

Explicit vs. Implicit Costs: An Example

You need \$100,000 to start your business.
The interest rate is 5%.

§ Case 1: borrow \$100,000
§ explicit cost =

§ Case 2: use \$40,000 of your savings, borrow the other \$60,000
§ explicit cost = \$3000 (5%) interest on the loan
§ implicit cost =

In both cases,

THE COSTS OF PRODUCTION

5

Economic Profit vs. Accounting Profit

§ Accounting profit

= total revenue minus

§ Economic profit

= total revenue minus

§ Accounting profit ignores implicit costs, so it's higher than economic profit.

THE COSTS OF PRODUCTION

6

ACTIVE LEARNING 2

Economic profit vs. accounting profit

The equilibrium rent on office space has just increased by \$500/month.

Compare the effects on accounting profit and economic profit if

- a. you rent your office space
- b. you own your office space

7

The Production Function

§ A production function

§ It can be represented by a table, equation, or graph.

§ Example 1:

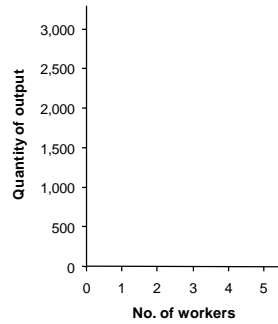
- § Farmer Jack grows wheat.
- § He has 5 acres of land.
- § He can hire as many workers as he wants.

THE COSTS OF PRODUCTION

9

Example 1: Farmer Jack's Production Function

L (no. of workers)	Q (bushels of wheat)
0	0
1	1000
2	1800
3	2400
4	2800
5	3000



THE COSTS OF PRODUCTION

10

Marginal Product

§ If Jack hires one more worker, his output rises by the *marginal product of labor*.

§ The **marginal product** of any input is

§ Notation:

Examples:

$\Delta Q =$

§ Marginal product of labor (*MPL*) =

THE COSTS OF PRODUCTION

11

EXAMPLE 1: Total & Marginal Product

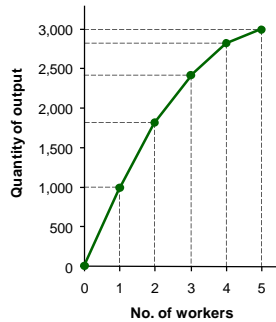
	L (no. of workers)	Q (bushels of wheat)	MPL
	0	0	
$\Delta L = 1$	1	1000	$\Delta Q = 1000$
	2	1800	
	3	2400	
	4	2800	
	5	3000	

THE COSTS OF PRODUCTION

12

EXAMPLE 1: MPL = Slope of Prod Function

L (no. of workers)	Q (bushels of wheat)	MPL
0	0	1000
1	1000	800
2	1800	600
3	2400	400
4	2800	200
5	3000	



THE COSTS OF PRODUCTION

13

Why MPL Is Important

§ Recall one of the Ten Principles:
Rational people think at the margin.

§ When Farmer Jack

§ Comparing them helps Jack decide whether he would benefit from hiring the worker.

THE COSTS OF PRODUCTION

14

Why MPL Diminishes

§ Farmer Jack's output rises by a smaller and smaller amount for each additional worker. Why?

§ As Jack adds workers,

§ In general, *MPL* diminishes as *L* rises

§ **Diminishing marginal product:**

THE COSTS OF PRODUCTION

15

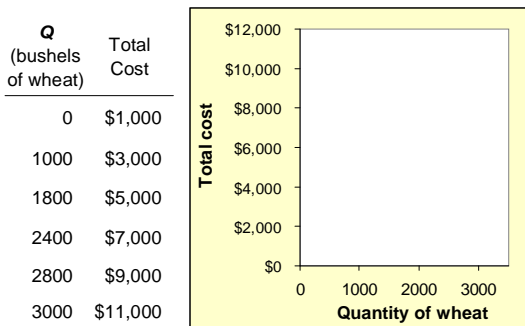
EXAMPLE 1: Farmer Jack's Costs

- § Farmer Jack must pay \$1000 per month for the land, regardless of how much wheat he grows.
- § The market wage for a farm worker is \$2000 per month.
- § So Farmer Jack's costs are related to how much wheat he produces....

EXAMPLE 1: Farmer Jack's Costs

L (no. of workers)	Q (bushels of wheat)	Cost of land	Cost of labor	Total Cost
0	0	\$1,000	\$0	\$1,000
1	1000	\$1,000	\$2,000	\$3,000
2	1800	\$1,000	\$4,000	\$5,000
3	2400	\$1,000	\$6,000	\$7,000
4	2800	\$1,000	\$8,000	\$9,000
5	3000	\$1,000	\$10,000	\$11,000

EXAMPLE 1: Farmer Jack's Total Cost Curve



Marginal Cost

§ Marginal Cost (MC)

THE COSTS OF PRODUCTION

19

EXAMPLE 1: Total and Marginal Cost

	Q (bushels of wheat)	Total Cost	Marginal Cost (MC)
	0	\$1,000	
$\Delta Q = 1000$	1000	\$3,000	\$2.00
	1800	\$5,000	
	2400	\$7,000	
	2800	\$9,000	
	3000	\$11,000	

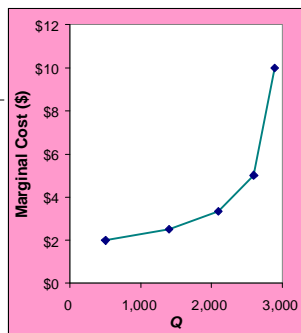
$\Delta TC = \$2000$

THE COSTS OF PRODUCTION

20

EXAMPLE 1: The Marginal Cost Curve

Q (bushels of wheat)	TC	MC
0	\$1,000	
1000	\$3,000	\$2.00
1800	\$5,000	\$2.50
2400	\$7,000	\$3.33
2800	\$9,000	\$5.00
3000	\$11,000	\$10.00



THE COSTS OF PRODUCTION

21

Why MC Is Important

§ Farmer Jack is rational and wants to maximize his profit. To increase profit, should he produce more or less wheat?

§ To find the answer, Farmer Jack needs to “think at the margin.”

Fixed and Variable Costs

§ **Fixed costs (FC)**

§ For Farmer Jack,

§ Other examples:

§ **Variable costs (VC)**

§ For Farmer Jack, VC =

§ Other example:

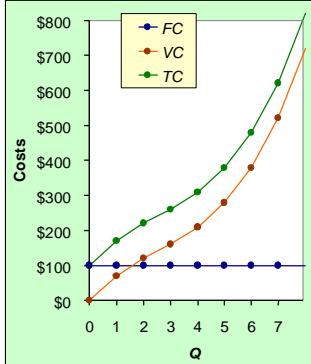
§ **Total cost (TC) =**

EXAMPLE 2

§ Our second example is more general, applies to any type of firm producing any good with any types of inputs.

EXAMPLE 2: Costs

Q	FC	VC	TC
0	\$100	\$0	\$100
1	100	70	170
2	100	120	220
3	100	160	260
4	100	210	310
5	100	280	380
6	100	380	480
7	100	520	620

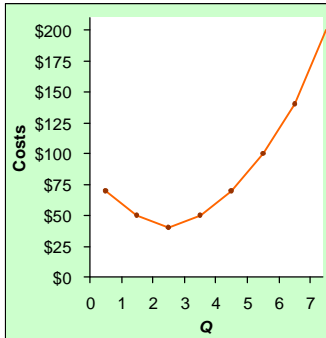


THE COSTS OF PRODUCTION

25

EXAMPLE 2: Marginal Cost

Q	TC	MC
0	\$100	
1	170	\$70
2	220	50
3	260	40
4	310	50
5	380	70
6	480	100
7	620	140

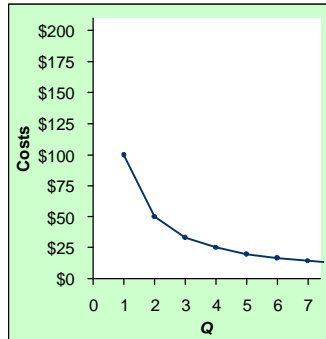


THE COSTS OF PRODUCTION

26

EXAMPLE 2: Average Fixed Cost

Q	FC	AFC
0	\$100	n/a
1	100	\$100
2	100	50
3	100	33.33
4	100	25
5	100	20
6	100	16.67
7	100	14.29

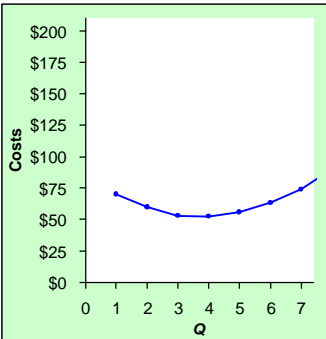


THE COSTS OF PRODUCTION

27

EXAMPLE 2: Average Variable Cost

Q	VC	AVC
0	\$0	n/a
1	70	\$70
2	120	60
3	160	53.33
4	210	52.50
5	280	56.00
6	380	63.33
7	520	74.29



THE COSTS OF PRODUCTION

28

EXAMPLE 2: Average Total Cost

Q	TC	ATC	AFC	AVC
0	\$100	n/a	n/a	n/a
1	170	\$170	\$100	\$70
2	220	110	50	60
3	260	86.67	33.33	53.33
4	310	77.50	25	52.50
5	380	76	20	56.00
6	480	80	16.67	63.33
7	620	88.57	14.29	74.29

Average total cost (ATC)

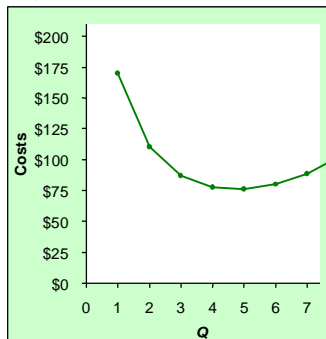
Also,

THE COSTS OF PRODUCTION

29

EXAMPLE 2: Average Total Cost

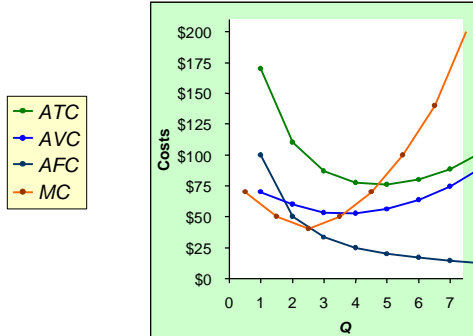
Q	TC	ATC
0	\$100	n/a
1	170	\$170
2	220	110
3	260	86.67
4	310	77.50
5	380	76
6	480	80
7	620	88.57



THE COSTS OF PRODUCTION

30

EXAMPLE 2: The Various Cost Curves Together



THE COSTS OF PRODUCTION

31

ACTIVE LEARNING 3
Calculating costs

Fill in the blank spaces of this table.

Q	VC	TC	AFC	AVC	ATC	MC
0		\$50	n/a	n/a	n/a	
1	10			\$10	\$60.00	\$10
2	30	80				30
3			16.67	20	36.67	
4	100	150	12.50		37.50	
5	150			30		
6	210	260	8.33	35	43.33	

32

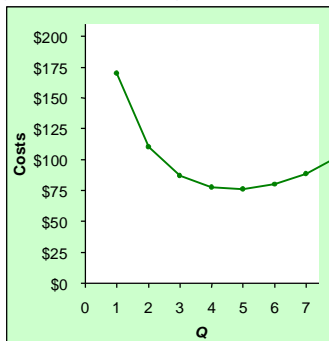
EXAMPLE 2: Why ATC Is Usually U-Shaped

As Q rises:

Initially,

Eventually,

Efficient scale:



THE COSTS OF PRODUCTION

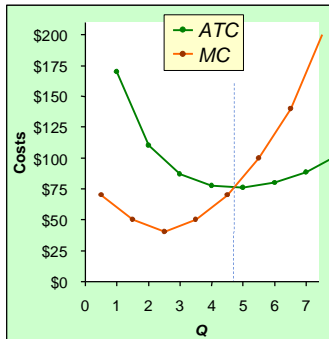
34

EXAMPLE 2: ATC and MC

When $MC < ATC$,

When $MC > ATC$,

The MC curve crosses the ATC curve at



THE COSTS OF PRODUCTION

35

Costs in the Short Run & Long Run

§ Short run:

§ Long run:

§ In the long run,

(e.g., the factory size with the lowest ATC).

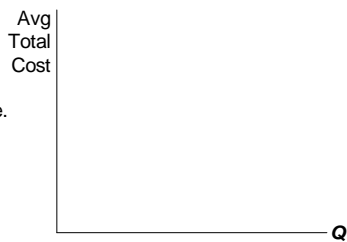
THE COSTS OF PRODUCTION

36

EXAMPLE 3: LRATC with 3 factory Sizes

Firm can choose from 3 factory sizes: **S, M, L**.

Each size has its own $SRATC$ curve.



THE COSTS OF PRODUCTION

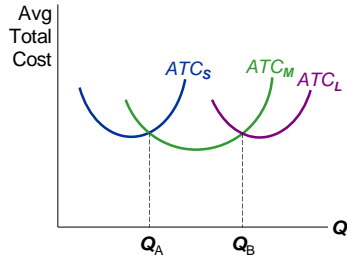
37

EXAMPLE 3: LRATC with 3 factory Sizes

To produce less than Q_A , firm will choose

To produce between Q_A and Q_B , firm will choose

To produce more than Q_B , firm will choose



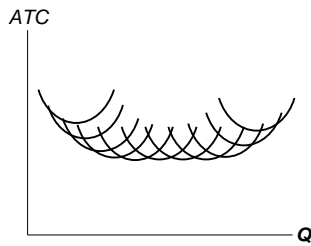
THE COSTS OF PRODUCTION

38

A Typical LRATC Curve

In the real world, factories come in many sizes, each with its own SRATC curve.

So a typical LRATC curve looks like this:



THE COSTS OF PRODUCTION

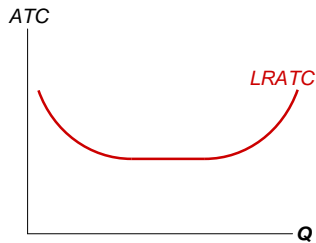
39

How ATC Changes as the Scale of Production Changes

Economies of scale:

Constant returns to scale:

Diseconomies of scale:



THE COSTS OF PRODUCTION

40

**How ATC Changes as
the Scale of Production Changes**

§ Economies of scale occur when

§ Diseconomies of scale are due to

CONCLUSION

§ Costs are critically important to many business decisions, including production, pricing, and hiring.

§ This chapter has introduced the various cost concepts.

§ The following chapters will show how firms use these concepts to maximize profits in various market structures.
