Econ 200
Module 4
Lecture 11

UNIVERSITY *of* WASHINGTON

Outline

1. Marginal Costs
2. Graphing Cost Curves
3. Long Run Cost Curve
4. Efficiencies of Scale in Production

Reading: Ch 12.6-12.8

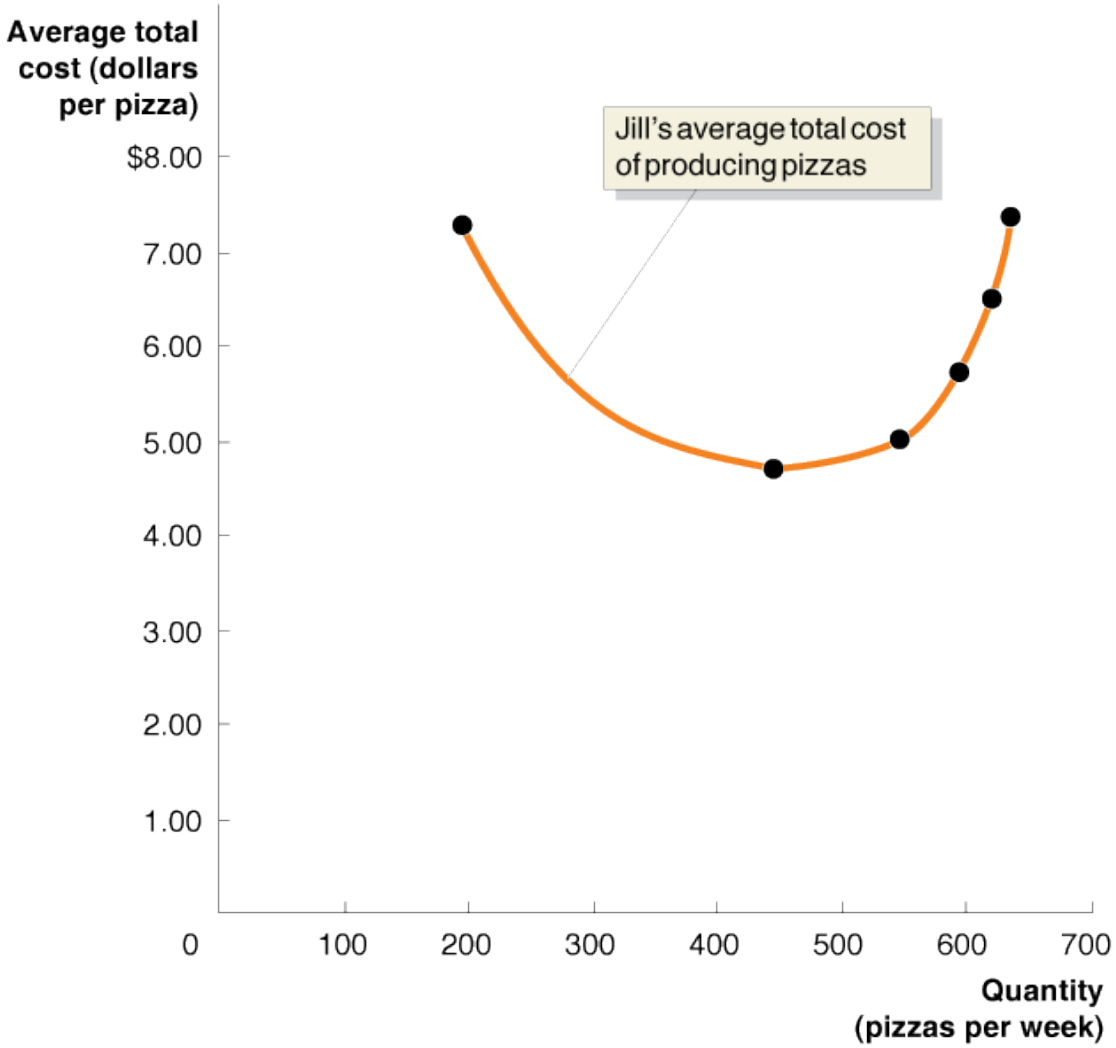
Jill's Average Total Cost per Pizza

If we divide the total cost of the pizzas by the number of pizzas, we get the **average total cost** of the pizzas.

Quantity of Workers	Quantity of Pizza Ovens	Quantity of Pizzas per Week	Cost of Pizza Ovens (Fixed Cost)	Cost of Workers (Variable Cost)	Total Cost of Pizzas per Week	Cost per Pizza (Average Total Cost)
0	2	0	$800	$0	$800	—
1	2	200	800	650	1,450	$7.25
2	2	450	800	1,300	2,100	4.67
3	2	550	800	1,950	2,750	5.00
4	2	600	800	2,600	3,400	5.67
5	2	625	800	3,250	4,050	6.48
6	2	640	800	3,900	4,700	7.34

The Restaurant's Average Total Cost Curve

The "falling-then-rising" nature of average total costs results in a U-shaped average total cost curve.



(b) Average total cost

Decomposing the Total and Average Costs

$$TC / Q = FC / Q + VC / Q$$

The first quantity is *average total cost*.

The second is **average fixed cost**: fixed cost divided by the quantity of output produced.

The third is **average variable cost**: variable cost divided by the quantity of output produced.

So $$ATC = AFC + AVC$$

Marginal Costs of Production

We can also define the **marginal cost** as the change in a firm's total cost from producing one more unit of a good or service; in symbols,

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

Quantity of Workers	Quantity of Pizzas	Marginal Product of Labor	Total Cost of Pizzas	Marginal Cost of Pizzas	Average Total Cost of Pizzas
0	0	–	$800	–	–
1	200	200	1,450	$3.25	$7.25
2	450	250	2,100	2.60	4.67
3	550	100	2,750	6.50	5.00
4	600	50	3,400	13.00	5.67
5	625	25	4,050	26.00	6.48
6	640	15	4,700	43.33	7.34

Marginal Costs of Production

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

The ΔQ is generally needed, because we don't see quantity increasing by only one unit at a time.

Quantity of Workers	Quantity of Pizzas	Marginal Product of Labor	Total Cost of Pizzas	Marginal Cost of Pizzas	Average Total Cost of Pizzas
0	0	–	$800	–	–
1	200	200	1,450	$3.25	$7.25
2	450	250	2,100	2.60	4.67
3	550	100	2,750	6.50	5.00
4	600	50	3,400	13.00	5.67
5	625	25	4,050	26.00	6.48
6	640	15	4,700	43.33	7.34

Marginal Costs of Production

Since the only part of TC that changes with output is the variable cost, then we see that:

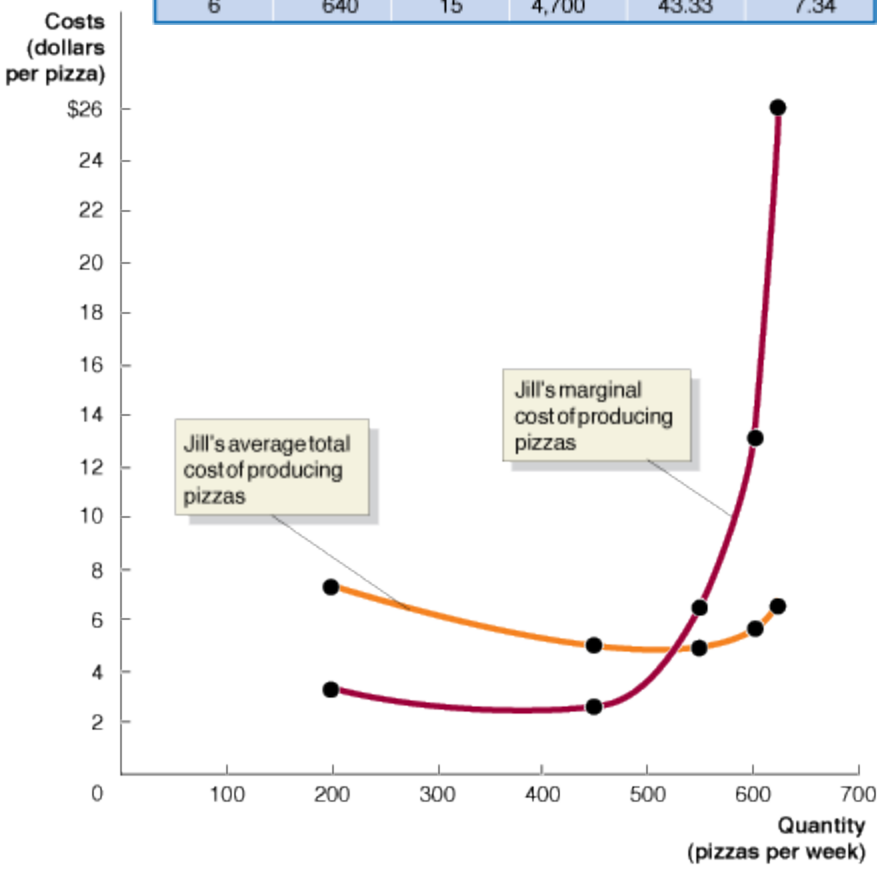
$$MC = \frac{\Delta VC}{\Delta Q} = \frac{w}{MPL}$$

Quantity of Workers	Quantity of Pizzas	Marginal Product of Labor	Total Cost of Pizzas	Marginal Cost of Pizzas	Average Total Cost of Pizzas
0	0	–	$800	–	–
1	200	200	1,450	$3.25	$7.25
2	450	250	2,100	2.60	4.67
3	550	100	2,750	6.50	5.00
4	600	50	3,400	13.00	5.67
5	625	25	4,050	26.00	6.48
6	640	15	4,700	43.33	7.34

Graphing Average and Marginal Costs

Since the average cost of production “follows” the marginal cost down and then up, this generates a U-shaped average cost curve.

Quantity of Workers	Quantity of Pizzas	Marginal Product of Labor	Total Cost of Pizzas	Marginal Cost of Pizzas	Average Total Cost of Pizzas
0	0	–	$800	–	–
1	200	200	1,450	$3.25	$7.25
2	450	250	2,100	2.60	4.67
3	550	100	2,750	6.50	5.00
4	600	50	3,400	13.00	5.67
5	625	25	4,050	26.00	6.48
6	640	15	4,700	43.33	7.34



Observations about Costs

Observe that:

- In each row, *ATC* = *AFC* + *AVC.*
- When *MC* is above *ATC*, *ATC* is rising..

Quantity of Workers	Quantity of Ovens	Quantity of Pizzas	Cost of Ovens (fixed cost)	Cost of Workers (variable cost)	Total Cost of Pizzas	*ATC*	*AFC*	*AVC*	*MC*
0	2	0	$800	$0	$800	—	—	—	—
1	2	200	800	650	1,450	$7.25	$4.00	$3.25	$3.25
2	2	450	800	1,300	2,100	4.67	1.78	2.89	2.60
3	2	550	800	1,950	2,750	5.00	1.45	3.54	6.50
4	2	600	800	2,600	3,400	5.67	1.33	4.33	13.00
5	2	625	800	3,250	4,050	6.48	1.28	5.20	26.00
6	2	640	800	3,900	4,700	7.34	1.25	6.09	43.33

Observations about Costs

Observe that:

- When *MC* is above *ATC*, *ATC* is rising.
- The same is true for *MC* and *AVC*.

Quantity of Workers	Quantity of Ovens	Quantity of Pizzas	Cost of Ovens (fixed cost)	Cost of Workers (variable cost)	Total Cost of Pizzas	*ATC*	*AFC*	*AVC*	*MC*
0	2	0	$800	$0	$800	—	—	—	—
1	2	200	800	650	1,450	$7.25	$4.00	$3.25	$3.25
2	2	450	800	1,300	2,100	4.67	1.78	2.89	2.60
3	2	550	800	1,950	2,750	5.00	1.45	3.54	6.50
4	2	600	800	2,600	3,400	5.67	1.33	4.33	13.00
5	2	625	800	3,250	4,050	6.48	1.28	5.20	26.00
6	2	640	800	3,900	4,700	7.34	1.25	6.09	43.33

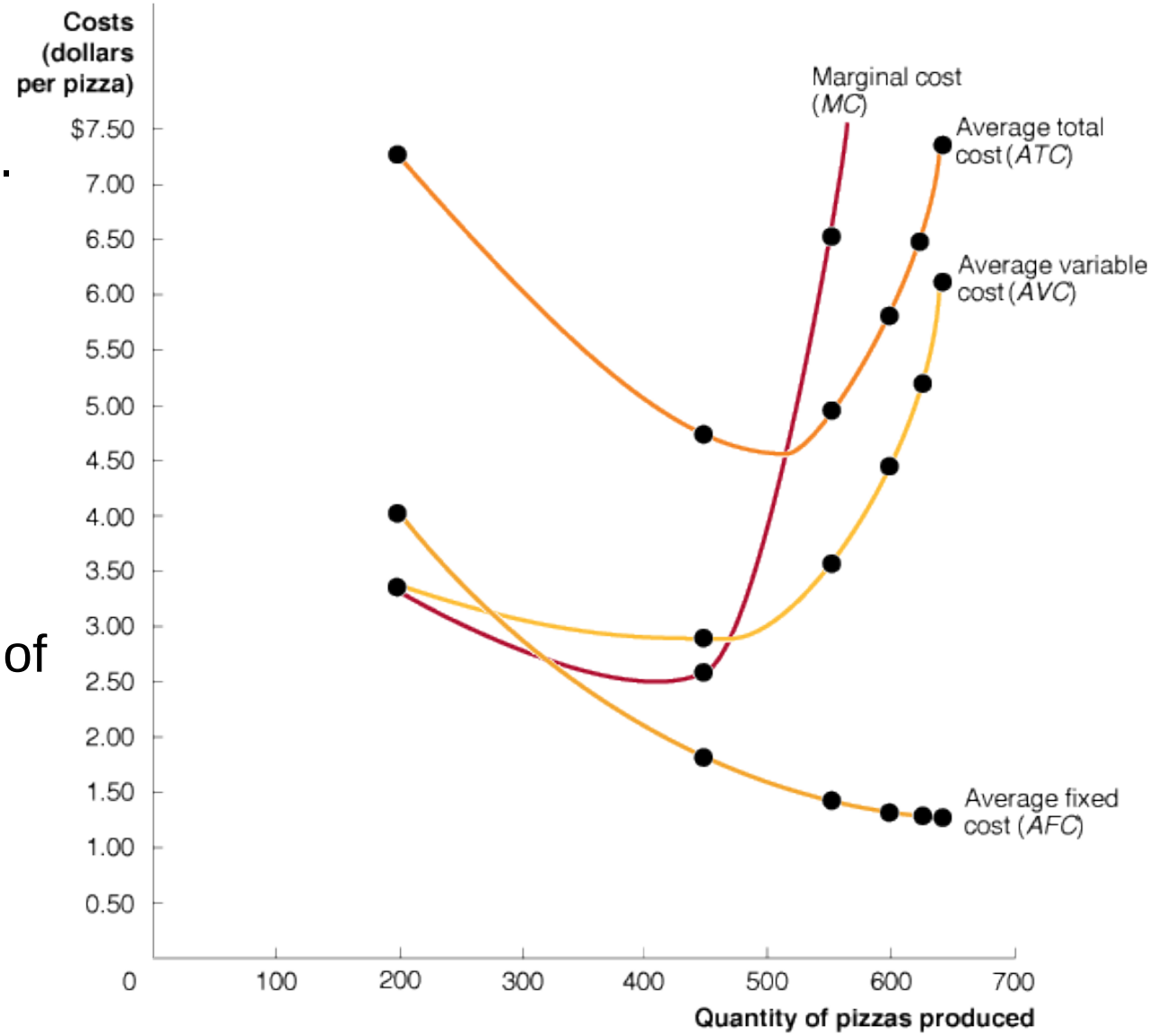
Graphing the Various Cost Curves

This results in both *ATC* and *AVC* having their U-shaped curves.

→The *MC* curve cuts through each at its minimum point.

→ATC is vertical sum of AVC and AFC curves.

→The *ATC and AVC* curves converge.



The Long Run and Average Costs

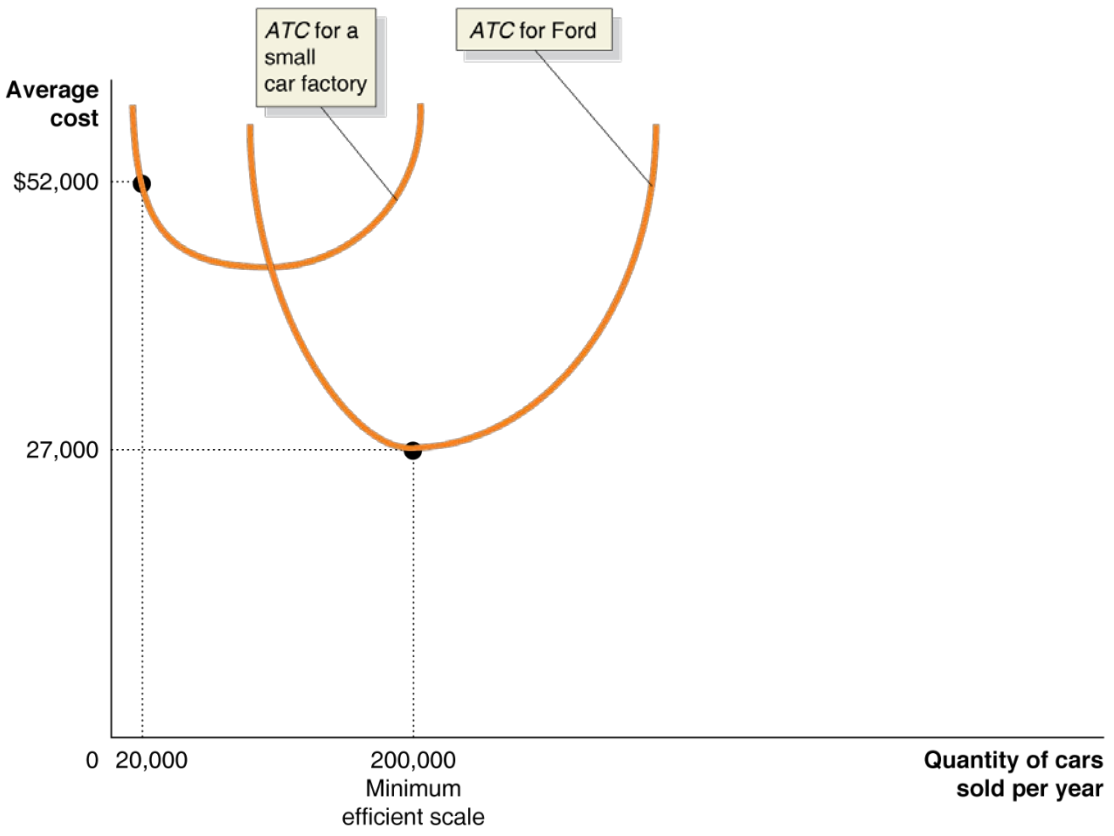
Recall that the long run is a sufficiently long period of time that all costs are variable.

So In the long run, there is no distinction between fixed and variable costs.

A **long-run average cost curve** shows the lowest cost at which a firm is able to produce a given quantity of output in the long run, when no inputs are fixed.

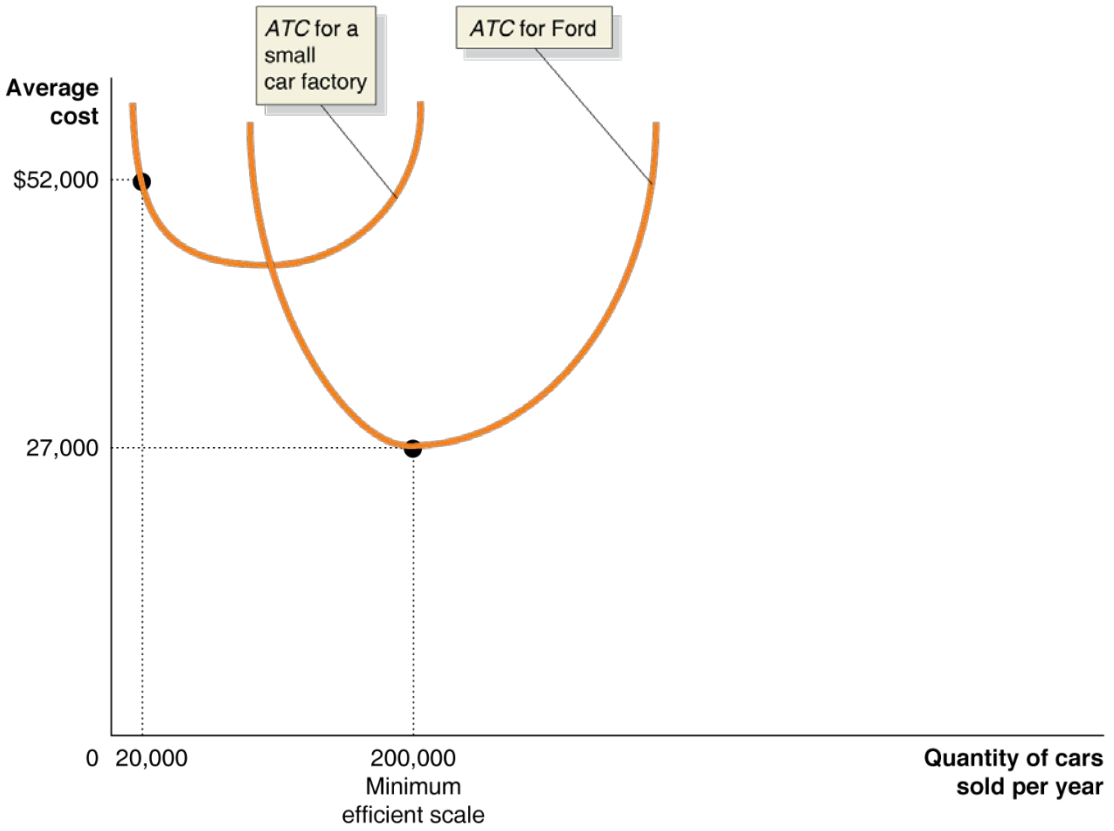
Changes in the Long Run Cost Curves

Here, a small car factory can produce at a lower average cost than a large one, for small quantities. For more output, a larger factory is more efficient.



Economies of Scale

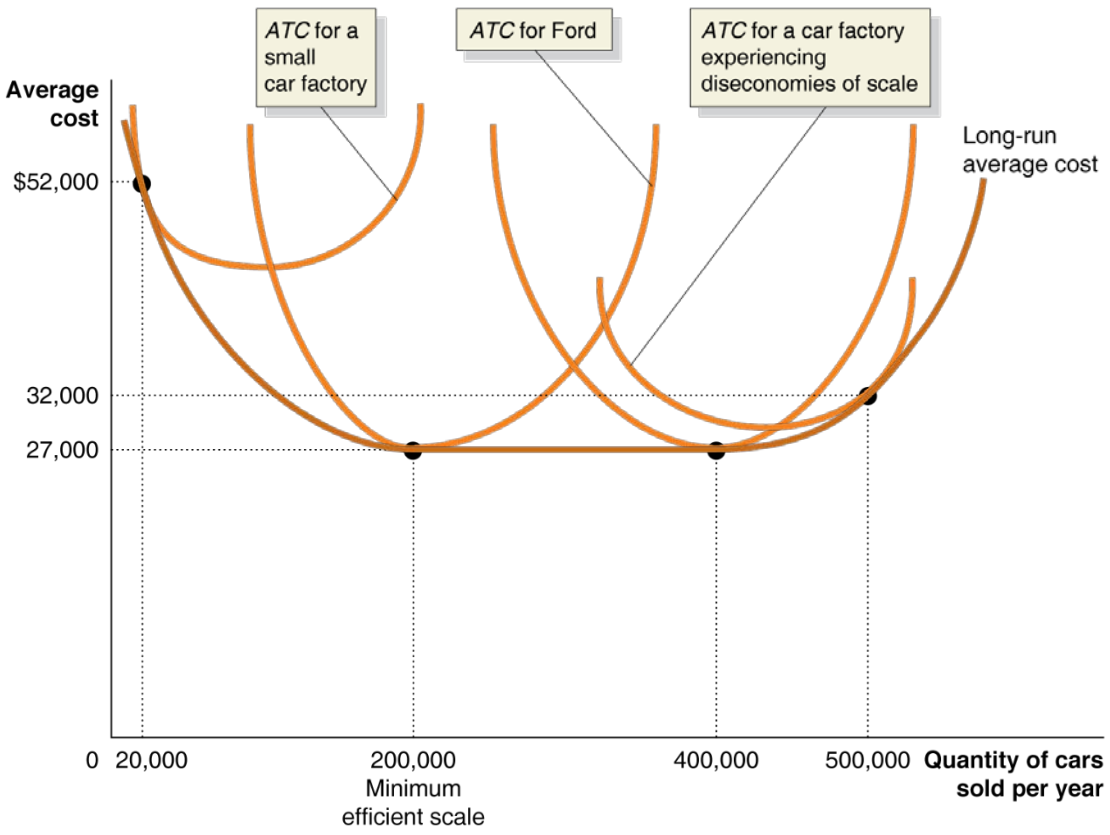
At low quantities, a firm might experience **economies of scale**.



Constant Returns to Scale

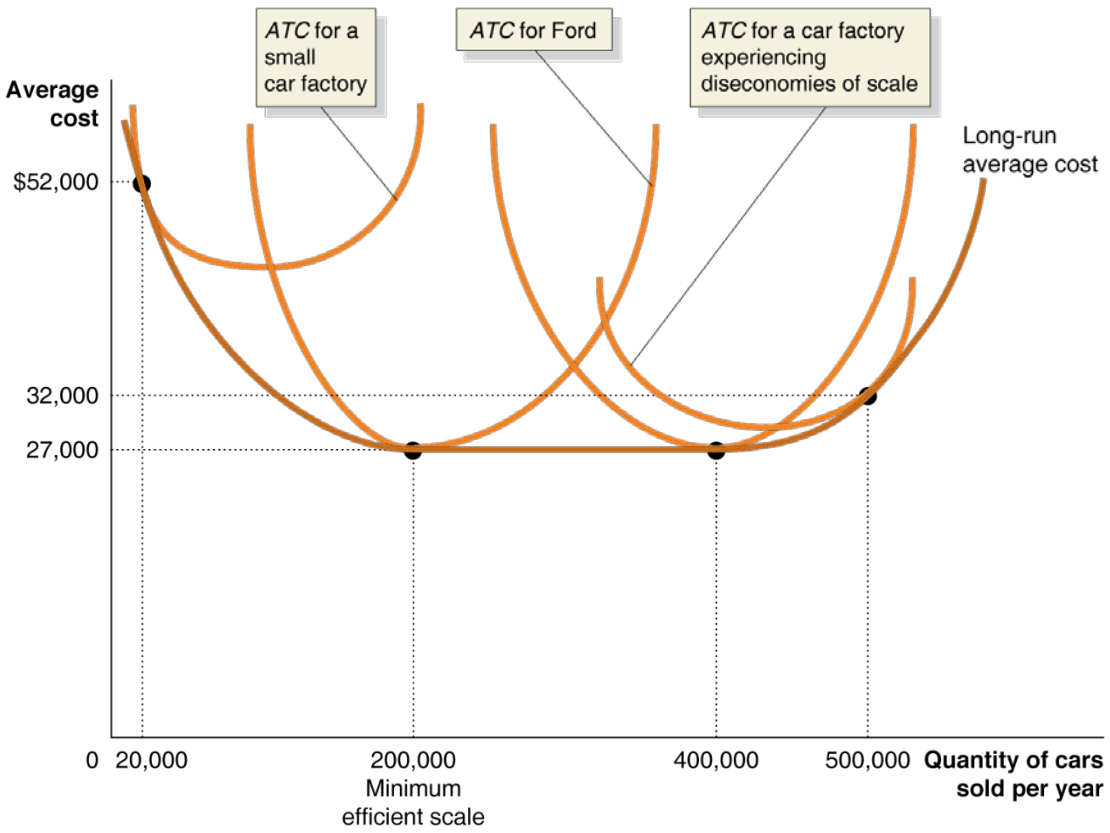
The lowest level of output at which all economies of scale are exhausted is known as the **minimum efficient scale**.

At some point, the firm experiences **constant returns to scale**.

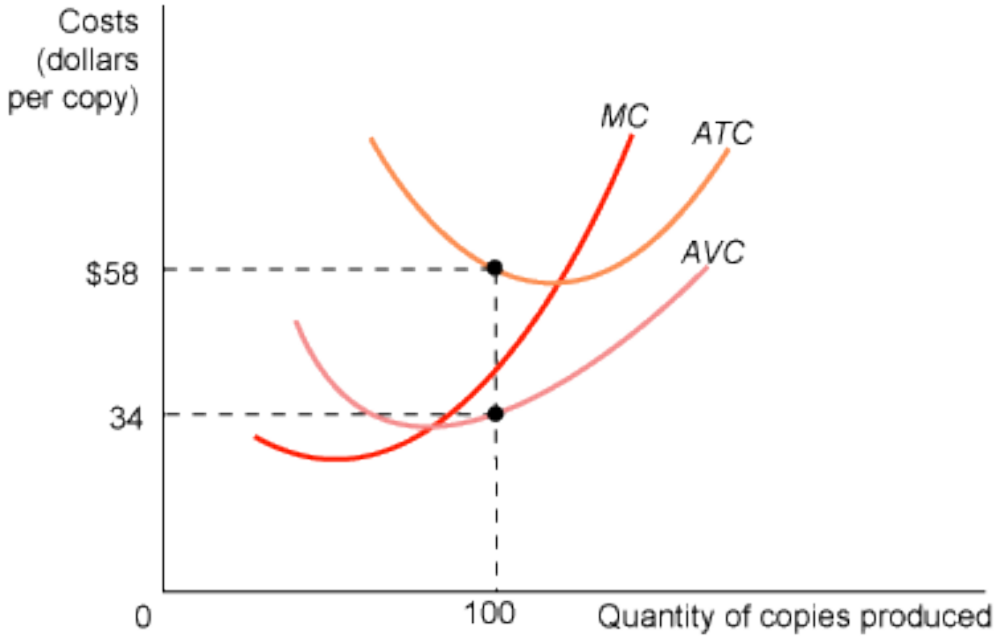


Diseconomies of Scale

Eventually, firms might get so large that they experience **diseconomies of scale**.

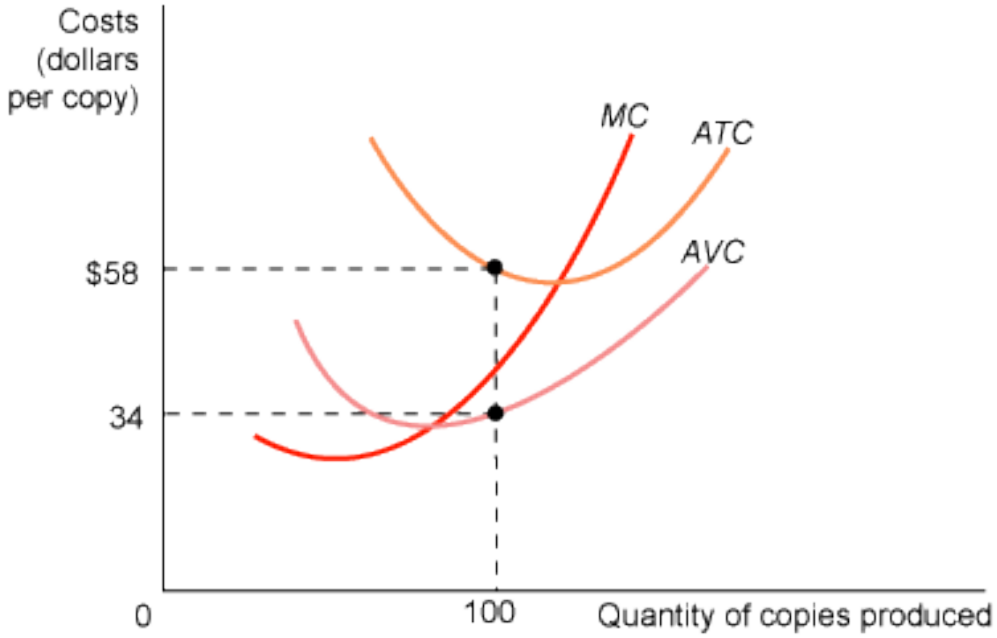


Refer to the graph below. How much is the value of *total fixed cost (Q=100, ATC=$58 and AVC=$34)*?



a. 2,400
b. 3,400
c. 5,800
d. None of the above. Total fixed cost cannot be computed using this graph.

Refer to the graph below. How much is the value of *total fixed cost*?



a. 2,400

Refer to the table below. What is the *marginal cost* of producing the first 625 copies when the wage is $50?

Quantity of Workers	Quantity of Copies	Marginal Product of Labor
0	0	-
1	625	625
2	1,325	700
3	2,200	875
4	2,600	400
5	2,900	300
6	3,100	200

a. Zero.
b. $75.00.
c. $0.08
d. $625.

Refer to the table below. What is the *marginal cost* of producing the first 625 copies when the wage is $50?

Quantity of Workers	Quantity of Copies	Marginal Product of Labor
0	0	-
1	625	625
2	1,325	700
3	2,200	875
4	2,600	400
5	2,900	300
6	3,100	200

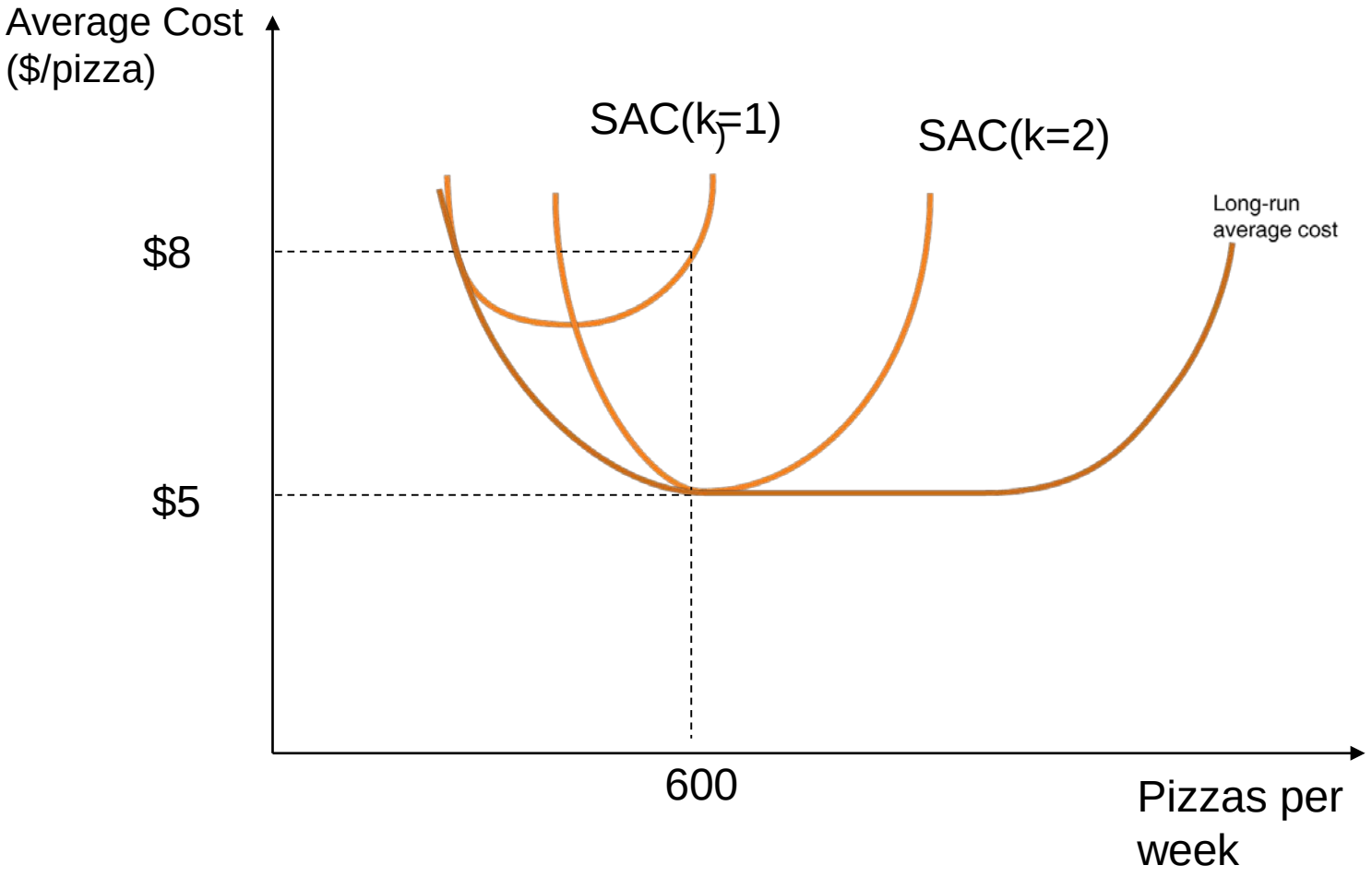
$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta VC}{\Delta Q} = \frac{w}{MPL} = \frac{\$50}{625} = \$0.08$$

Bruno produces 600 pizzas a week with one pizza oven. On average, each pizza costs $8 to produce. If Bruno buys another pizza oven, he could produce each pizza for $5 on average, but a third pizza oven would raise his average cost. Which of the following statements are TRUE? **Select all that apply**.

A. In the long run, Bruno should buy another pizza oven.
B. Bruno is experiencing diseconomies of scale.
C. 600 pizzas and $8 is on Bruno's LRATC curve.
D. 600 pizzas and $5 is on Bruno's LRATC curve.

Bruno produces 600 pizzas a week with one pizza oven. On average, each pizza costs $8 to produce. If Bruno buys another pizza oven, he could produce each pizza for $5 on average, but a third pizza oven would raise his average cost. Which of the following statements are TRUE? **Select all that apply**.

A. **In the long run, Bruno should buy another pizza oven.**
B. Bruno is experiencing diseconomies of scale.
C. 600 pizzas and $8 is on Bruno's LRAC curve.
D**. 600 pizzas and $5 is on Bruno's LRAC curve**.


Average Cost
($/pizza)
SAC(k=1)
SAC(k=2)
Long-run
average cost
$8
$5
600
Pizzas per
week

Fill in the table. At approximately what quantity does the MC curve cross the ATC curve?

Quantity	Total Cost	ATC	MC
0	1000	***	***
20	1200	60	10
45	1400	31.1	
75	1600		6.7
100	1800	18	
120	2000	16.7	
135	2200		13.3
145	2400		20
150	2600	17.3	

Fill in the table. At approximately what quantity does the MC curve cross the ATC curve?

Quantity	Total Cost	ATC	MC
0	1000	***	***
20	1200	60	10
45	1400	31.1	8
75	1600	21.3	6.7
100	1800	18	8
120	2000	16.7	10
135	2200	16.3	13.3
145	2400	16.6	20
150	2600	17.3	40