L6 – Theory of the Firm:

I. Costs

1. Implicit vs. Explicit Cost

- Explicit costs require an outlay of money,
  e.g., paying wages to workers, buying equipment

- Implicit costs do not require a cash outlay,
  e.g., the opportunity cost of the owner's time.

- Both matter for firm's decisions.

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

Case 1:
Borrow $100,000
Explicit cost = $5000 interest on loan

Case 2:
Use $40,000 of your savings,
Borrow the other $60,000
Explicit cost = $3000 (5%) interest on the loan
Implicit cost = $2000 (5%) foregone interest you could have earned on your $40,000.
In both cases, total (explicit + implicit) costs are $5000.

2. Fixed vs. Variable Costs

- Costs that <u>do not</u> vary with the quantity of output produced are **fixed costs.**
  Examples: monthly rent, cost of equipment, interest

  - Fixed costs are not fixed in a long run. They will change over time, but they are fixed in a short run, given a relevant production period.

- Costs that <u>do</u> vary with the quantity of output produced are **variable costs**.
  Example: raw materials, labor

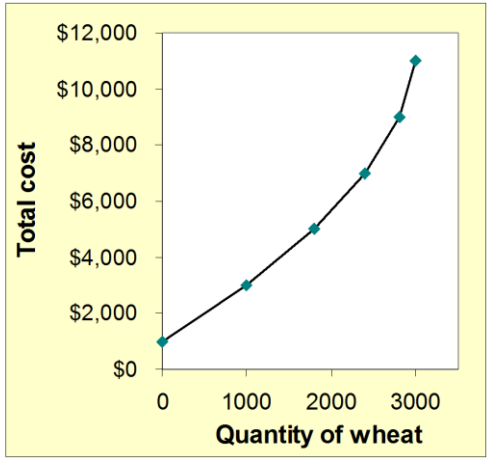
- Total cost is equal to fixed cost plus variable cost.
  TC = FC + VC

❖ The total cost curve gets steeper as the quantity of output rises because of ***diminishing marginal product***.

Example 1: Farmer Jack's Total Cost Curve

L (no. of workers)	***Q*** (bushels of wheat)	Cost of land	Cost of labour	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

Q (bushels of wheat)	Total Cost
0	$1,000
1000	$3,000
1800	$5,000
2400	$7,000
2800	$9,000
3000	$11,000



- The TC curve gets steeper as the number of workers rise because the amount of land is fixed and adding more workers increases output by a smaller and smaller amount as each worker has less and less land to work with and hence becomes less productive.

3. Average and Marginal Costs

Notations:
ATC = Average total cost
AFC = Average fixed cost
AVC = Average variable cost

$$ATC = \frac{TC}{Q} \; ; AVC = \frac{VC}{Q} \; ; AFC = \frac{FC}{Q}$$

❖ **Marginal cost** is the increase in total cost that arises from an extra unit of production.

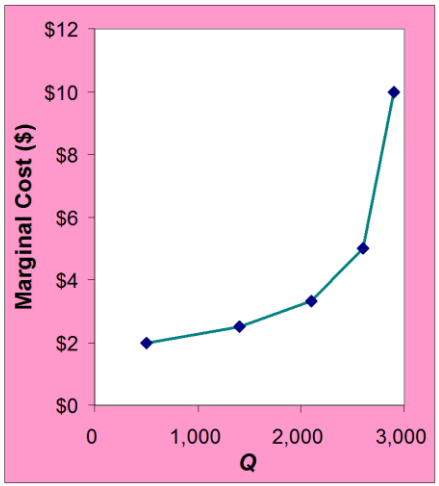
$$MC = \frac{\Delta TC}{\Delta Q}$$

❖ Average total cost tells us the cost of a *typical* unit of output and marginal cost tells us the cost of an *additional* unit of output.

Example 1: Farmer Jack's MC

	Q (bushels of wheat)	Total Cost		Marginal Cost (*MC*)
	0	$1,000		
ΔQ = 1000	1000	$3,000	ΔTC = $2000	$2.00
ΔQ = 800	1800	$5,000	ΔTC = $2000	$2.50
ΔQ = 600	2400	$7,000	ΔTC = $2000	$3.33
ΔQ = 400	2800	$9,000	ΔTC = $2000	$5.00
ΔQ = 200	3000	$11,000	ΔTC = $2000	$10.00

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



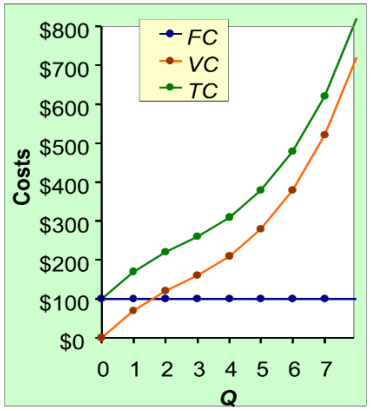
Why MC is important?

- Farmer Jack is rational and wants to maximize his profit. To increase profit, should he produce more or less wheat?
- If the cost of additional wheat (MC) is less than the revenue he would get from selling it, then Jack's profits rise if he produces more.

Example 2: General Example

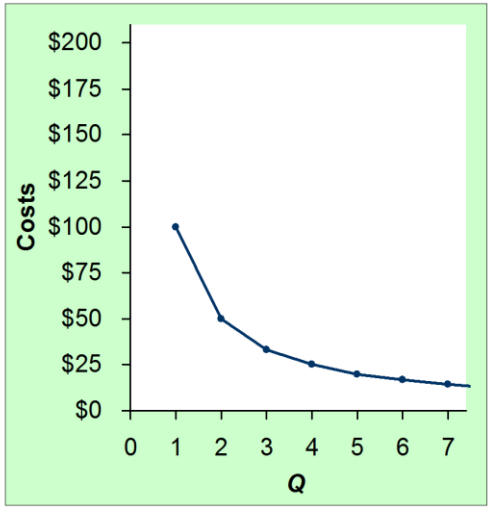
1) Fixed Cost, Variable Cost and Total Cost Curves

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



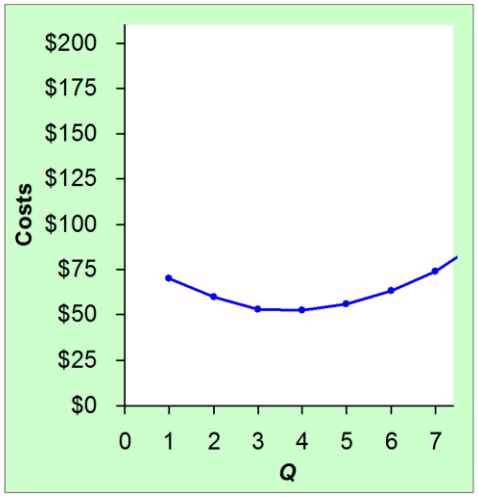
2) Average Fixed Cost Curve

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



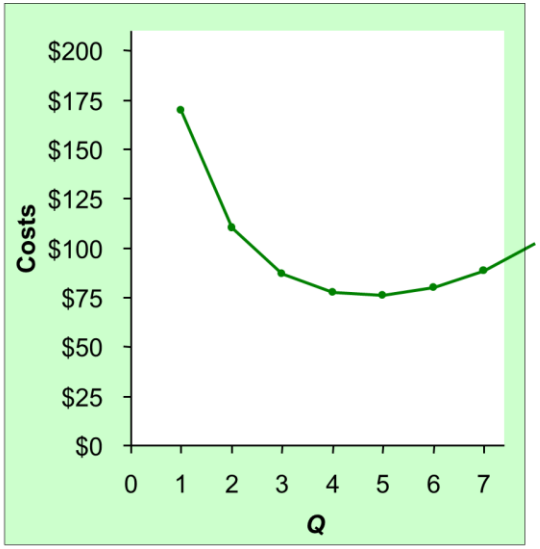
3) Average Variable Cost Curve

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



4) Average Total Cost Curve

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



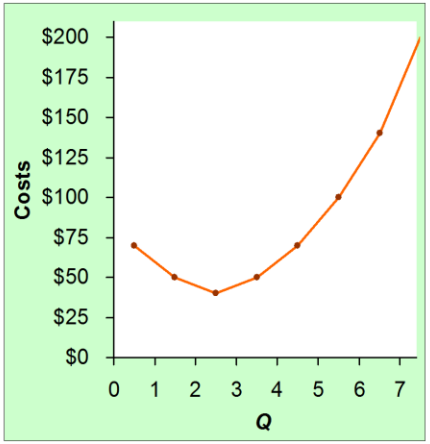
II. Cost Curves and Their Shapes

1. Rising Marginal Cost

MC curve first decreases then rises. Why?

Example 2 (continued): Marginal Cost Curve

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



a. Decreasing because of rising marginal products as a result of specialization or improvement in capacity utilization.

   Example: At a low level of output, there are few workers and a lot of idle equipment. Adding workers will increase productivity by utilizing idle equipment.

b. Rising because of diminishing marginal product.

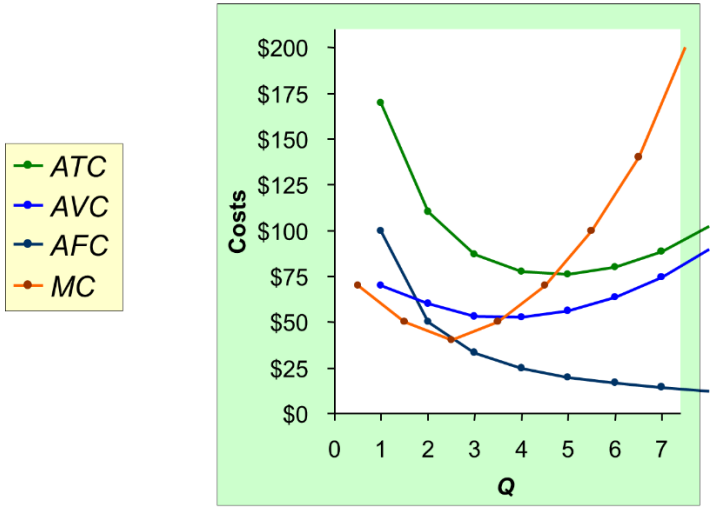
   Example: When the factory is approaching its full capacity, adding more workers will cause the rate of increase in output to be smaller than the rate of increase in total cost. Hence, MC will be rising.

   Example: Coffee shop

2. U-Shaped Average Total Cost

$$ATC = AFC + AVC$$

Example 2 (continued):

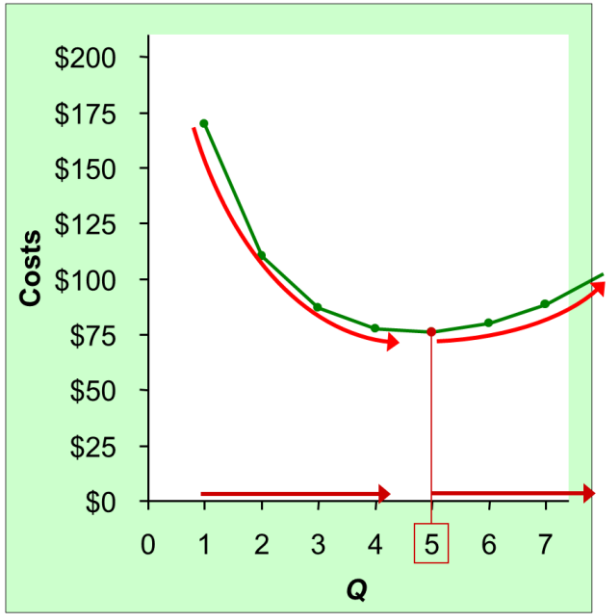


a. AFC is high when output levels are low. As output expands, AFC declines, pulling ATC down. As fixed costs get spread over a large number of units, the effect of AFC on ATC falls and ATC begins to rise because of diminishing marginal product.

b. Which production scale is efficient?

Efficient scale is the quantity of output that minimizes average total cost.

Example 2 (continued):



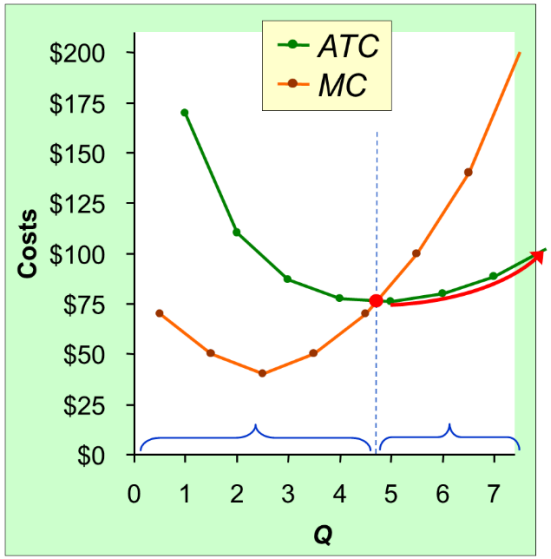
In this example, the efficient scale is Q=5, where ATC = $76.

At any Q below or above 5, ATC > $76.

3. Marginal Cost and Average Total Cost

- When MC < ATC, ATC is falling.
- When MC > ATC, ATC is rising.
- The MC curve crosses the ATC curve at the ATC curve's minimum (i.e. the efficient scale).

Example 2 (continued):



Example 3: A Student's Grade

A student's GPA is like ATC.
The grade she earns in her next course is like MC.

Question 1: Her current GPA is B. If she receives a C in Economics. What happens to her GPA?

Answer: Decrease

Question 2: Her current GPA is B. If she receives an A in Economics. What happens to her GPA?

Answer: Increase

4. Costs in the SR and in the LR

1) The division of total costs into fixed and variable costs will vary from firm to firm.

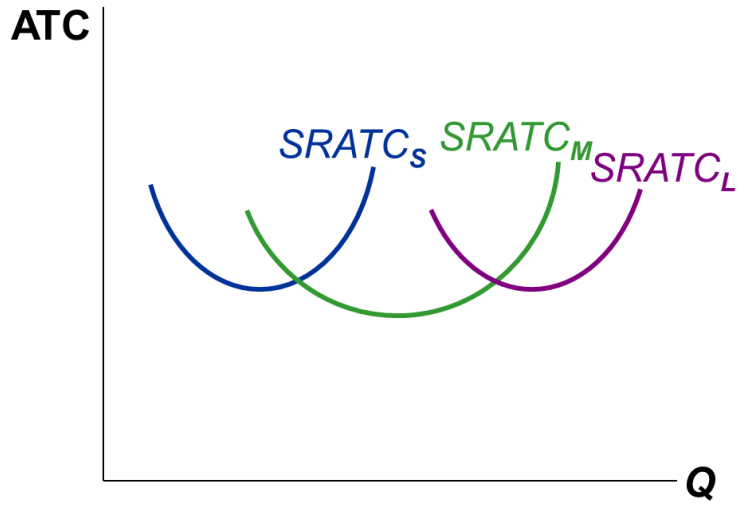
2) Some costs are fixed in the short run, but all are variable in the long run.

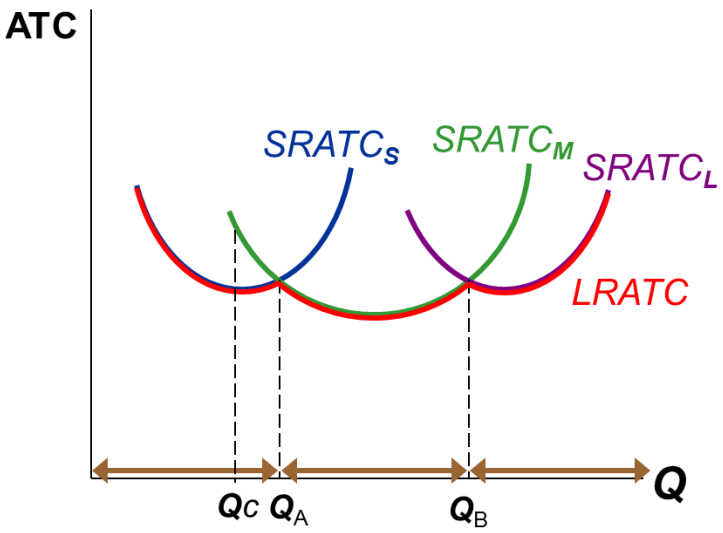
   Example:
   In the long run a firm could choose the size of its factory. Once a factory is chosen, the firm must deal with the short-run costs associated with that plant size.

3) The long-run average-total-cost curve (LRATC) lies along the lowest points of the short-run average-total-cost curves because the firm has more flexibility in the long run to deal with changes in production.

   Example: LRATC with 3 Factory Sizes

   - Firm can choose from 3 factory sizes: S, M, L.
   - Each size has its own SRATC curve.
   - The firm can change to a different factory size in the long run, but not in the short run.





To produce less than Q_A,
firm will choose size S in the long run.

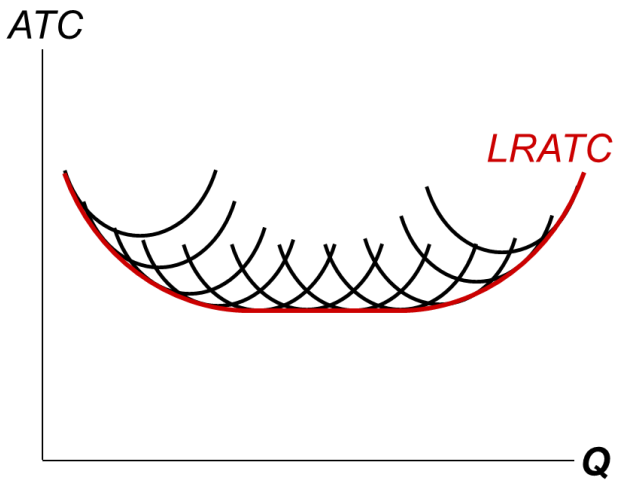
- Pick a Q < Q_A. From this Q, go up to the SRATC curves. Notice that cost per unit is lower for the small factory than the medium one.
- The firm may be stuck with a medium factory in the short run, but in the long run – if it wishes to produce this level of output – it will choose the small factory to have the lowest cost per unit.
- Hence, for Q < Q_A, the LRATC curve is the portion of SRATC$_S$ from 0 to Q_A.

To produce between Q_A and Q_B,
firm will choose size M in the long run.

- Pick a Q between Q_A and Q_B. From this Q, go up to the SRATC curves. Notice that cost/unit is lower for the medium factory than the small or large one.
- Hence, for Q_A < Q < Q_B, the LRATC curve is the portion of SRATC$_M$ from Q_A to Q_B.

Same logic is applied to Q > Q_B.
To produce more than Q_B, firm will choose size L in the long run.

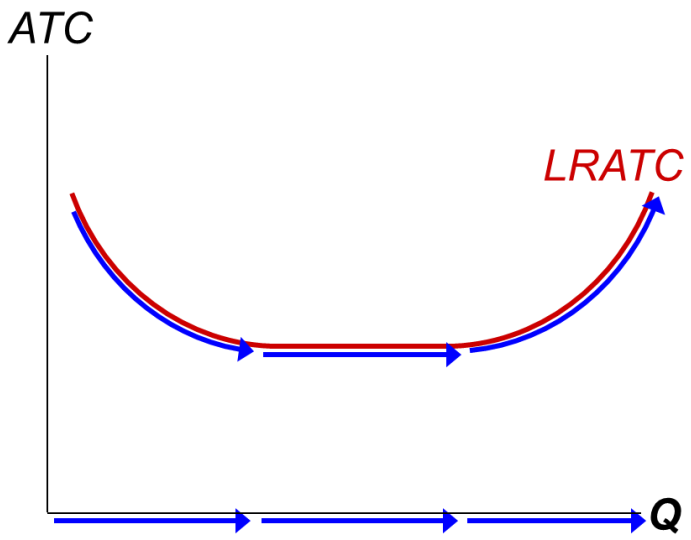
4) The long-run average total cost curve is typically U-shaped, but is much flatter than a typical short-run average-total-cost curve.



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

5) The length of time for a firm to get to the long run will depend on the firm involved.

6) How ATC Changes as the Scale of Production Changes?



a. **Increasing returns to scale** (also called economies of scale): ATC falls as Q increases.

   - This occurs when increasing production allows greater **specialization**: workers more efficient when focusing on a narrow task.

   - More common when Q is low.

b. **Constant returns to scale**: ATC stays the same as Q increases

c. **Decreasing returns to scale** (also called diseconomies of scale): ATC rises as Q increases.

   - This occurs when there are coordination problems in large organizations.

     Example: management becomes stretched, can't control costs (e.g. company becomes more bureaucratic).

   - More common when Q is high.

III. Economic Profit vs. Accounting Profit

Recall in general: Profit = Total Revenue (TR) – Total Cost (TC)

- Accountants keep track of how much money flows into and out of the firm, so they ignore implicit costs.

  Accounting profit = TR - Total Explicit Cost

- Economists study the pricing and production decisions of firm, which are affected by implicit as well as explicit costs.

  Economic profit = TR – Total (Explicit + Implicit) Cost

- Economic cost includes the cost of all resources including a "normal return or profit" to compensate the firm's owner for the risks and other efforts put into the business.

- As a result, accounting profit is higher than economic profit. This explains why firms continue to operate even if they are earning zero economic profit in the long run.

Example:
The 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

   Explicit costs increase $500/month.
   Accounting profit & economic profit each fall $500/month.

b. you own your office space

   Explicit costs do not change, so accounting profit does not change.

   Implicit costs increase $500/month (opp. cost of using your space instead of renting it), so economic profit falls by $500/month.

IV. Summary

1. $Total\ Revenue = Price \times Quantity$

2. $Total\ Cost =$
   $Market\ Value\ of\ the\ Inputs\ used\ in\ Production$

3. $Profit = Total\ Revenue - Total\ Cost$

4. $MP\ of\ an\ Input = \frac{Change\ in\ Output}{Change\ in\ that\ Input}$

5. $TC = FC + VC$

$$ATC = \frac{TC}{Q}\ ;\ AVC = \frac{VC}{Q}\ ;\ AFC = \frac{FC}{Q}$$

6. $ATC = AFC + AVC$

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