Lecture 5

The firm behavior – the costs of production

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Presentation is based on:
http://www.swlearning.com/economics/mankiw/mankiw4e/powerpoint_micro.html

Key concepts

- Total revenue
- Total cost
- Profit
- Explicit v. implicit costs
- Economic v. accounting profit
- Fixed v. variable costs
- Average total, fixed and variable cost
- Marginal cost and marginal benefit
- Efficient scale of production
- Economies v. diseconomies of scale
- Constant returns to scale

Business firm

- A commercial organization that operates on a for-profit basis and participates in selling goods or services to consumers.
- The management of a business firm will typically develop a set of organizational objectives and a strategy for meeting those goals.

http://www.moneyglare.com/wp-content/uploads/2012/09/business.jpg

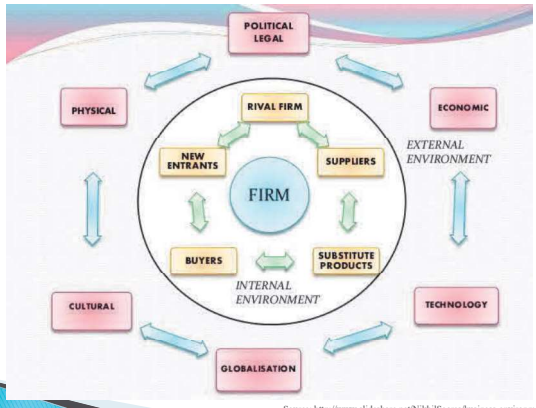
Various types of firms

- Firms can be divided according to various criteria…
  - Size
    - Number of employees (small, medium, large)
    - Balance sheet total
    - Investments…
  - Type of ownership (e.g. private limited company (LTD), Sole trader, Partnership, etc…)

Types of business ownership

- **Small and medium-sized enterprises**, abbreviated as **SMEs**: fewer than 250 persons employed;
- SMEs are further subdivided into:
  - **micro enterprises**: fewer than 10 persons employed;
  - **small enterprises**: 10 to 49 persons employed;
  - **medium-sized enterprises**: 50 to 249 persons employed;
- **Large enterprises**: 250 or more persons employed.

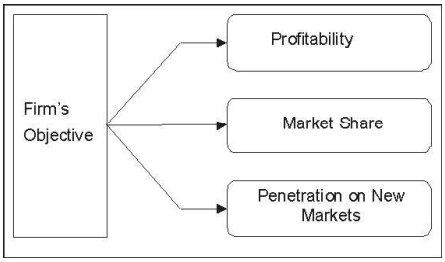
Micro and macro environment of the firm



Source: http://www.slideshare.net/NikhilSoares/business-environment-featuresmeaningimportanceobjectives-porters-model

What is the firm's main goal?

- The Firm's Objective
  - The economic goal of the firm is to maximize profits.



Source: http://www.fao.org/docrep/ARTICLE/WFC/XII/0483-A1.HTM

Total revenue, total cost and total profit
Marginal costs & revenues

What are the costs?

- What do we know about the costs so far?
  - Firms are willing to produce and sell a greater quantity of a good when the price of the good is high (law of supply).
  - This results in a supply curve that slopes upward.
  - The supply curve shows the marginal seller (if the costs were any higher, the seller would leave the market).

Total Revenue, Total Cost, and Profit

- *Total Revenue*
  - The amount a firm receives for the sale of its output.

$$TR = (P \times Q)$$

- *Total Cost*
  - The market value of the inputs a firm uses in production.

Total Revenue, Total Cost, and Profit

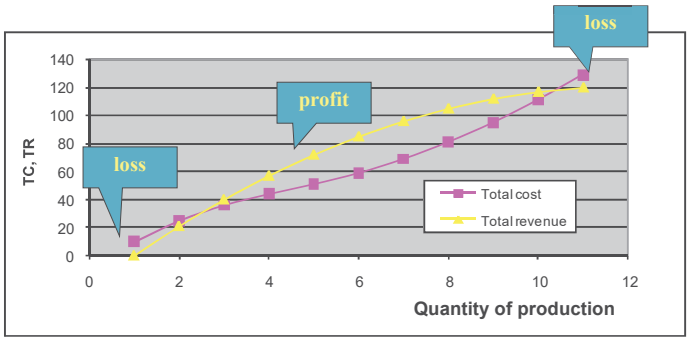
- *Profit* is the firm's total revenue minus its total cost.

Profit = Total revenue – Total cost
Profit = TR – TC

$$TP = TR - TC$$

Q (production)	Total cost (TC)	Price (P)	Total revenue (TR = PxQ)	Profit (TR – TC)
0	10	0	0	-10
1	25	21	21	-4
2	36	20	40	4
3	44	19	57	13
4	51	18	72	21
5	59	17	85	26
6	69	16	96	27
7	81	15	105	24
8	95	14	112	17
9	111	13	117	6
10	129	12	120	-9

Total Revenue, Total Cost, and Profit



Marginal revenue (MR)

- marginal revenue – the amount by which a firm's revenue changes if the firm produces one more unit of output.
- It is derivative of the Total Revenue.
- MR helps answer the following question:
  - How much does the firm earn from the additional unit of output?

$$MR = \frac{\Delta TR}{\Delta Q}$$

Marginal Cost (MC)

- marginal cost – the amount by which a firm's cost changes if the firm produces one more unit of output.
- It is a derivative of the Total Costs.
- Marginal Cost helps answer the following question:
  - How much does it cost to produce an additional unit of output?

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

Firm's optimal decisions

- By the given production costs and demand, each business firm wants to optimize the size of production in order to maximize its profit.
- The firm should increase the production as long as the MR > MC.
- The golden rule of profit maximazation:

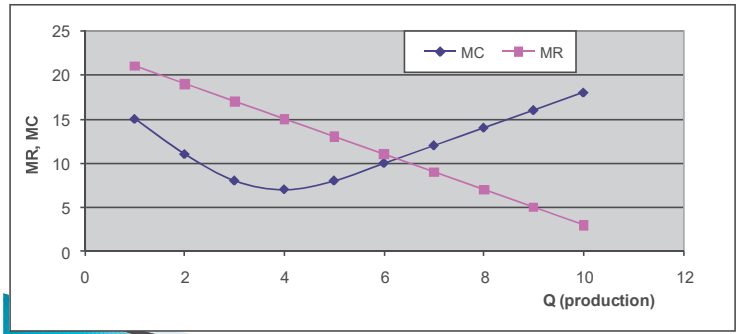
MR = MC

production	TC	TR	MC	MR	MR-MC	decision
0	10	0				
1	25	21	15	21	6	increase
2	36	40	11	19	8	increase
3	44	57	8	17	9	increase
4	51	72	7	15	8	increase
5	59	85	8	13	5	increase
6	69	96	10	11	1	
7	81	105	12	9	-3	decrease
8	95	112	14	7	-7	decrease
9	111	117	16	5	-11	decrease
10	129	120	18	3	-15	decrease

MR > MC – increase production

MC > MR – decrease production

MC = MR – optimal level of production (in case there are no losses)



Example

- Demand curve is described by the following equation: P=1000-2Qd, where P is the price and Qd is the quantity demanded. What is the maximum value of the total revenue?

Types of costs and their relations

The Total-Cost Curve

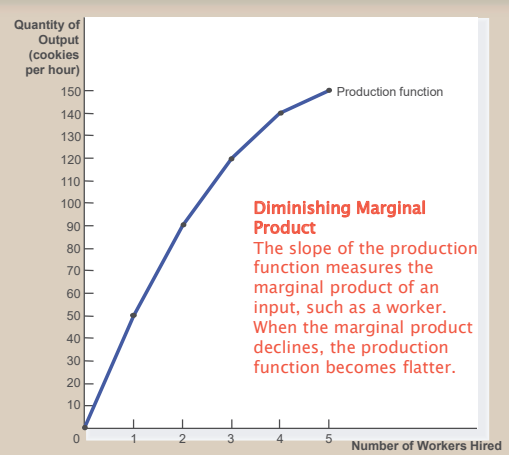
- The relationship between the quantity a firm can produce and its costs determines pricing decisions.
- The *total-cost curve* shows this relationship graphically.

A Production Function and Total Cost: Helen's Cookie Factory

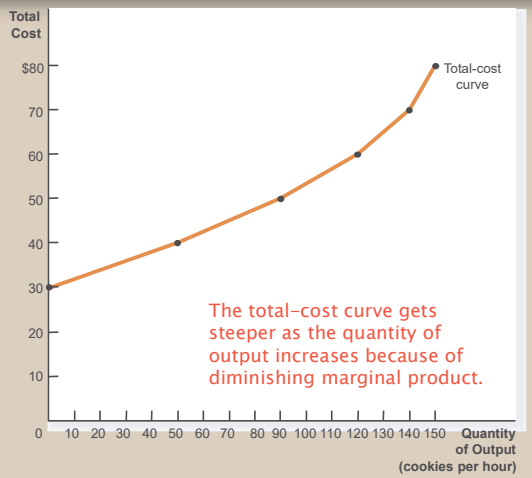
Number of Workers	Output (quantity of cookies produced per hour)	Marginal Product of Labor	Cost of Factory	Cost of Workers	Total Cost of Inputs (cost of factory + cost of workers)
0	0		$30	$ 0	$30
		50			
1	50		30	10	40
		40			
2	90		30	20	50
		30			
3	120		30	30	60
		20			
4	140		30	40	70
		10			
5	150		30	50	80

Assumption: in the short-run the size of the company is fixed. The number of workers influences the quantity of production.

Helen's Production Function



Helen's Total-Cost Curve



The various measures of cost

- Costs of production can be divided:
  - Fixed costs are those costs that do *not* vary with the quantity of output produced.
  - Variable costs are those costs that *do vary* with the quantity of output produced.

Costs in the short-run

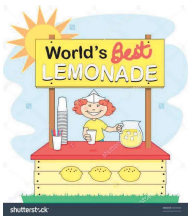
Variable costs (VC)	Fixed costs (FC)
• Wages of blue-collar workers • Costs of fuels, materials, energy, water, etc.	• Wages of white-collar workers (accounter, HR-manager, sales director, assitants) • Amortization • Renting the land, the factory • Interest rates and other liabilities from the borrowed financial capital

Fixed and Variable Costs

- Total Costs
  - Total Fixed Costs (*FC*)
  - Total Variable Costs (*VC*)
  - Total Costs (*TC*)
  - $TC = FC + VC$

Decision how much to produce..

- A key part of this decision is how the costs will vary as the level of production changes.
- In making this decision, answering two questions is needed:
  - How much does it cost to make the typical glass of lemonade?
  - How much does it cost to increase production of lemonade by 1 glass?



The Various Measures of Cost: Thirsty Thelma's Lemonade Stand

Quantity of Lemonade (glasses per hour)	Total Cost	Fixed Cost	Variable Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Marginal Cost
0	$3.00	$3.00	$0.00	—	—	—	
							$0.30
1	3.30	3.00	0.30	$3.00	$0.30	$3.30	
							0.50
2	3.80	3.00	0.80	1.50	0.40	1.90	
							0.70
3	4.50	3.00	1.50	1.00	0.50	1.50	
							0.90
4	5.40	3.00	2.40	0.75	0.60	1.35	
							1.10
5	6.50	3.00	3.50	0.60	0.70	1.30	
							1.30
6	7.80	3.00	4.80	0.50	0.80	1.30	
							1.50
7	9.30	3.00	6.30	0.43	0.90	1.33	
							1.70
8	11.00	3.00	8.00	0.38	1.00	1.38	
							1.90
9	12.90	3.00	9.90	0.33	1.10	1.43	
							2.10
10	15.00	3.00	12.00	0.30	1.20	1.50	

Decision how much to produce..

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  - How much does it cost to make the typical glass of lemonade?
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Fixed and Variable Costs

- Average Costs
  - Average costs can be determined by dividing the firm's costs by the quantity of output it produces.
  - The average cost is the cost of each typical unit of product.

http://all-free-download.com/free-vector/download/lemonade-glass-clip-art_23303.html

Fixed and Variable Costs

- Average Costs
  - Average Fixed Costs (*AFC*)
  - Average Variable Costs (*AVC*)
  - Average Total Costs (*ATC*)
  - $ATC = AFC + AVC$

Average Costs

$$AFC = \frac{\text{Fixed cost}}{\text{Quantity}} = \frac{FC}{Q}$$

$$AVC = \frac{\text{Variable cost}}{\text{Quantity}} = \frac{VC}{Q}$$

$$ATC = \frac{\text{Total cost}}{\text{Quantity}} = \frac{TC}{Q}$$

Decision how much to produce..

- A key part of this decision is how the costs will vary as the level of production changes.
- In making this decision, answering two questions is needed:
  - How much does it cost to make the typical glass of lemonade?
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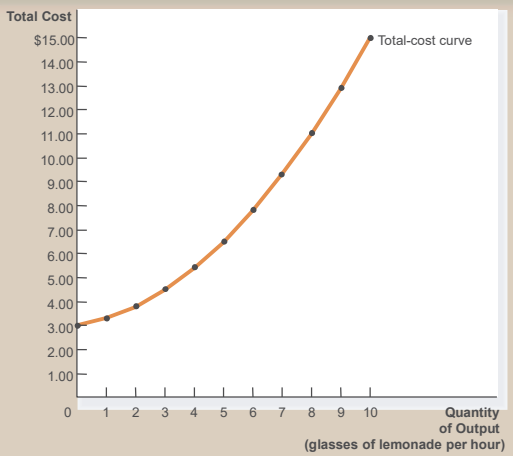
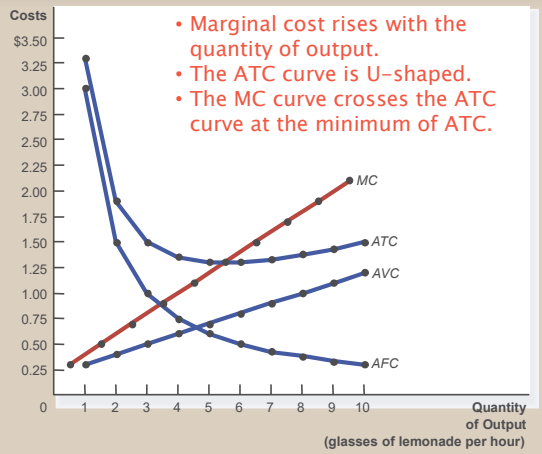
The Various Measures of Cost: Thirsty Thelma's Lemonade Stand

Quantity of Lemonade (glasses per hour)	Total Cost	Fixed Cost	Variable Cost	Average Fixed Cost	Average Variable Cost	Average Total Cost	Marginal Cost
0	$3.00	$3.00	$0.00	—	—	—	
1	3.30	3.00	0.30	$3.00	$0.30	$3.30	$0.30
2	3.80	3.00	0.80	1.50	0.40	1.90	0.50
3	4.50	3.00	1.50	1.00	0.50	1.50	0.70
4	5.40	3.00	2.40	0.75	0.60	1.35	0.90
5	6.50	3.00	3.50	0.60	0.70	1.30	1.10
6	7.80	3.00	4.80	0.50	0.80	1.30	1.30
7	9.30	3.00	6.30	0.43	0.90	1.33	1.50
8	11.00	3.00	8.00	0.38	1.00	1.38	1.70
9	12.90	3.00	9.90	0.33	1.10	1.43	1.90
10	15.00	3.00	12.00	0.30	1.20	1.50	2.10

Thirsty Thelma's Total-Cost Curves

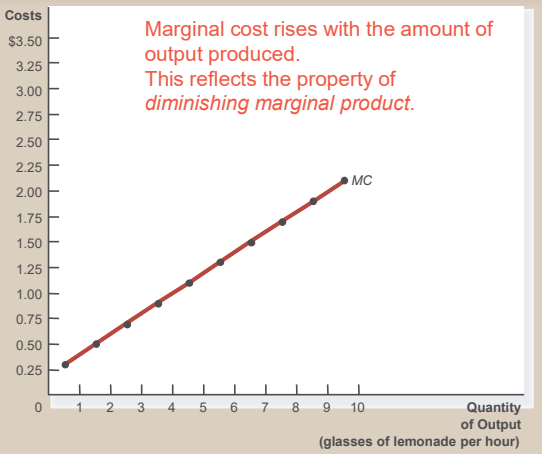


Thirsty Thelma's Average-Cost and Marginal-Cost Curves



- Marginal cost rises with the quantity of output.
- The ATC curve is U-shaped.
- The MC curve crosses the ATC curve at the minimum of ATC.

Thirsty Thelma's Average-Cost and Marginal-Cost Curves

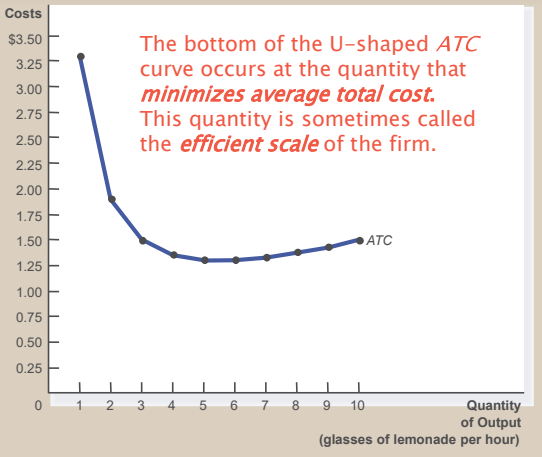


Marginal cost rises with the amount of output produced.
This reflects the property of *diminishing marginal product.*

Cost Curves and Their Shapes

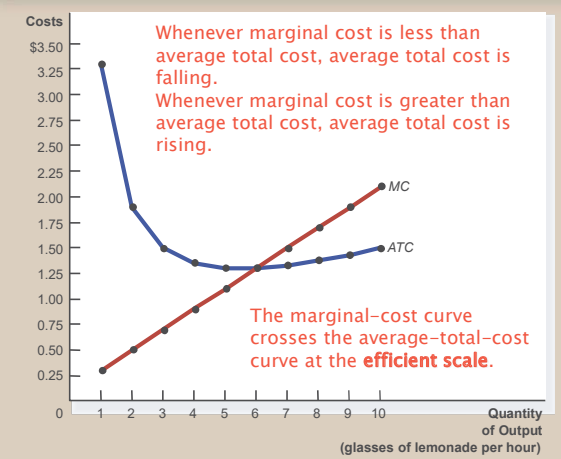
- The average total-cost (ATC) curve is *U-shaped*.
- At very low levels of output average total cost is high because fixed cost is spread over only a few units.
- Average total cost declines as output increases.
- Average total cost starts rising because average variable cost rises substantially.

Thirsty Thelma's Average-Cost Curve



The bottom of the U-shaped *ATC* curve occurs at the quantity that ***minimizes average total cost.***
This quantity is sometimes called the ***efficient scale*** of the firm.

Figure 5 Thirsty Thelma's Average-Cost and Marginal-Cost Curves



Whenever marginal cost is less than average total cost, average total cost is falling.
Whenever marginal cost is greater than average total cost, average total cost is rising.

The marginal-cost curve crosses the average-total-cost curve at the **efficient scale**.

Typical Cost Curves

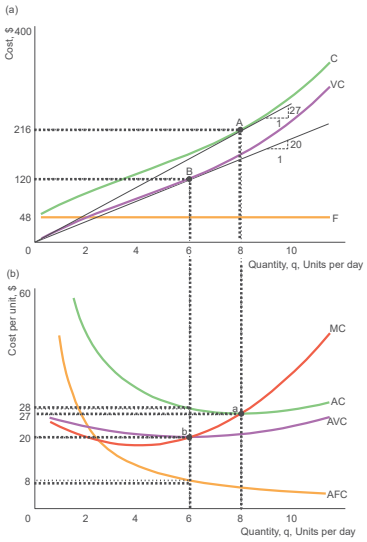
It is now time to examine the relationships that exist between the different measures of cost.

Table: Variation of Short-Run Cost with Output

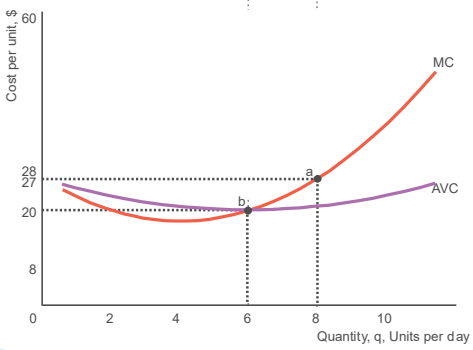
Output, q	Fixed Cost, F	Variable Cost, VC	Total Cost, C	Marginal Cost, MC	Average Fixed Cost, $AFC = F/q$	Average Variable Cost, $AVC = VC/q$	Average Cost, $AC = C/q$
0	48	0	48				
1	48	25	73	25	48	25	73
2	48	46	94	21	24	23	47
3	48	66	114	20	16	22	38
4	48	82	130	16	12	20.5	32.5
5	48	100	148	18	9.6	20	29.6
6	48	120	168	20	8	20	28
7	48	141	189	21	6.9	20.1	27
8	48	168	216	27	6	21	27
9	48	198	246	30	5.3	22	27.3
10	48	230	278	32	4.8	23	27.8
11	48	272	320	42	4.4	24.7	29.1
12	48	321	369	49	4.0	26.8	30.8

Figure: Short-Run Cost Curves

Output, q	Fixed Cost, F	Variable Cost, VC	Total Cost, C
0	48	0	48
1	48	25	73
2	48	46	94
3	48	66	114
4	48	82	130
5	48	100	148
6	48	120	168
7	48	141	189
8	48	168	216
9	48	198	246
10	48	230	278
11	48	272	320
12	48	321	369



Relationship between average and marginal cost curves



Example

- The firm produces 3 types of notebooks. Knowing that FC for the whole company is 300, evaluate if the production is profitable.

Type of notebook	Q (units/week	P price	AVC
A	100	20	15
B	300	10	8
C	200	15	10

Example

- The total cost function of the firm that operates in the perfect competitive market is given as: TC = 0,5Q3 + 20Q + 64. The company sells its products by the market price that equals 50.
- Calculate the production level, by which the firm has the lowest average cost.
- What is the price of the goods? What is the unit profit?
- What is the total profit at the production level from point a)

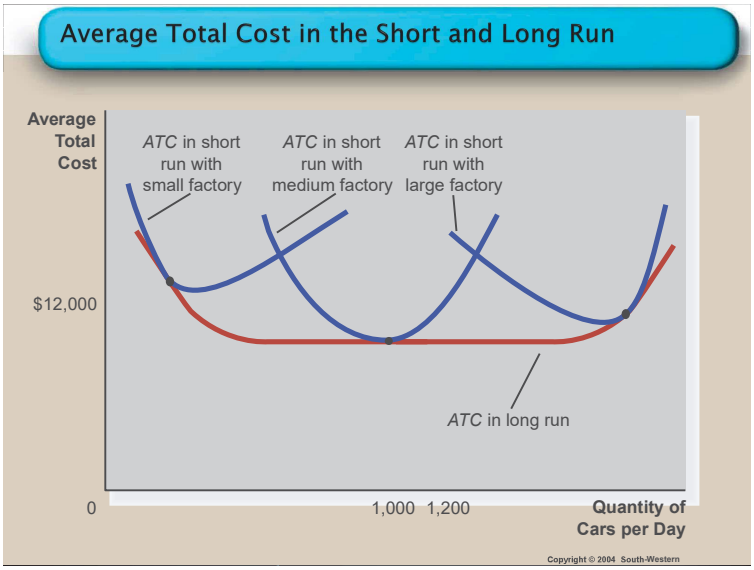
Costs in the short run and in the long run

- In its long-run planning, a firm chooses a plant size and makes other investments so as to minimize its long-run cost on the basis of how many units it produces.
- Division of costs depends on the time horizon
  - In the short run, some costs are fixed.
  - In the long run, fixed costs become variable costs.

LAC = LVC

Costs in the short run and in the long run

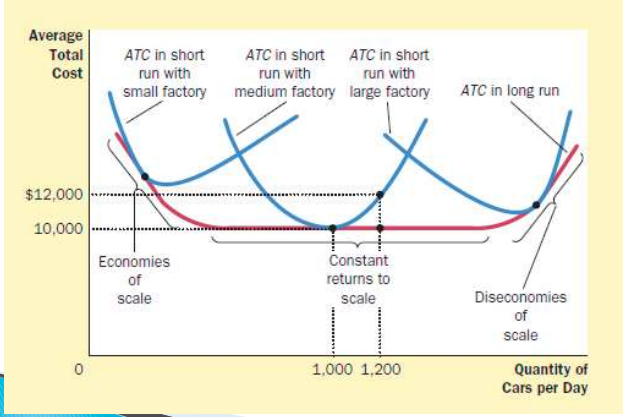
- Because many costs are fixed in the short run but variable in the long run, a firm's long-run cost curves differ from its short-run cost curves.



Economies and Diseconomies of Scale

- *Economies of scale* refer to the property whereby long-run average total cost falls as the quantity of output increases.
- *Diseconomies of scale* refer to the property whereby long-run average total cost rises as the quantity of output increases.
- *Constant returns to scale* refers to the property whereby long-run average total cost stays the same as the quantity of output increases

Economies and Diseconomies of Scale



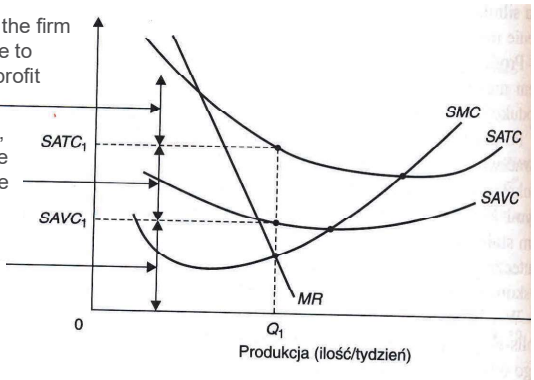
Firm's short and long-run decisions

Firm's decisions in the short-run (perfectly competitive market)

If **P > ATC**, the firm will continue to produce a profit

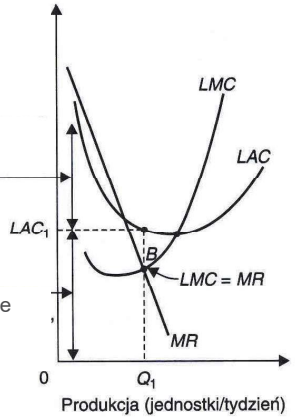
If **AVC<P< ATC**, firm will continue to produce in the short-run (with losses)

Firm shuts down if **P < AVC**



Firm's decisions in the long-run

If **P> LAC**, firm will continue to produce (Q1)
If the **P=LAC**, the firm is in its break-even point.
If **P< LAC**, firm will leave the market



Recap:

Decisions:	Marginal analysis	Does the production brings any profits?
Short-run	Choose the production level of Q units, at which MR=SMC	If P > SAVC, continue production of Q units. If not, shut down the firm.
Long-run	Choose the production level of Q units, at which MR=LMC	If P>LAC, continue production of Q units. If not, leave the market.

Example

- The firm has established the level of production. Now the firm is checking the relations between the average costs in short- and long-run: LATC = 12£, SAFC = 6£, SAVC = 11£, SATC = 17£.
- Mark the appropriate decisions in short- and long-run, which the company should make about its further production at the different price levels:

	SHORT-RUN DECISIONS		
Price [£]	Continue profitable production	Produce even if there are losses	Stop the production
18			
5			
7			
13			
11,5			
	LONG-RUN DECISIONS		
	Continue profitable production	Produce even if there are losses	Leave the market
18			
5			
7			
13			
11,5			

Summary

- The goal of firms is to maximize profit, which equals total revenue minus total cost.
- When analyzing a firm's behavior, it is important to include all the opportunity costs of production.
- Some opportunity costs are explicit while other opportunity costs are implicit.

Summary

- A firm's total costs are divided between fixed and variable costs.
- Fixed costs do not change when the firm alters the quantity of output produced; variable costs do change as the firm alters quantity of output produced.

Summary

- Average total cost is total cost divided by the quantity of output.
- Marginal cost is the amount by which total cost would rise if output were increased by one unit.
- The marginal cost always rises with the quantity of output.
- Average cost first falls as output increases and then rises.

Summary

- The average-total-cost curve is U-shaped.
- The marginal-cost curve always crosses the average-total-cost curve at the minimum of ATC.
- A firm's costs often depend on the time horizon being considered.
- In particular, many costs are fixed in the short run but variable in the long run.