University of Macerata
Economics - A.Y. 2022/2023
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- Analysis of costs

REF. Chapter 7 (excluding p. 134; and 7.C (pp. 139-141))

Production costs

The performance of a company and the decisions related to how much to produce are strongly influenced by production costs.

Costs are the expenses incurred to produce the good or service during the period. They are **the value of the production factors** used/consumed in the period.

The company must therefore be able to determine and analyze costs.

Different measures of costs

- **Total cost (TC):** represents the lowest total dollar expense needed to produce each level of output *q* (TC rises as q rises).
- **Fixed cost (FC):** represents the total dollar expense that is paid out even when no output is produced (fixed cost is unaffected by any variation in the quantity of output, e.g., the cost of renting warehouses, installed machinery, etc.).
- **Variable cost (VC):** represents expenses that vary with the level of output—such as raw materials, wages, and fuel—and includes all costs that are not fixed.

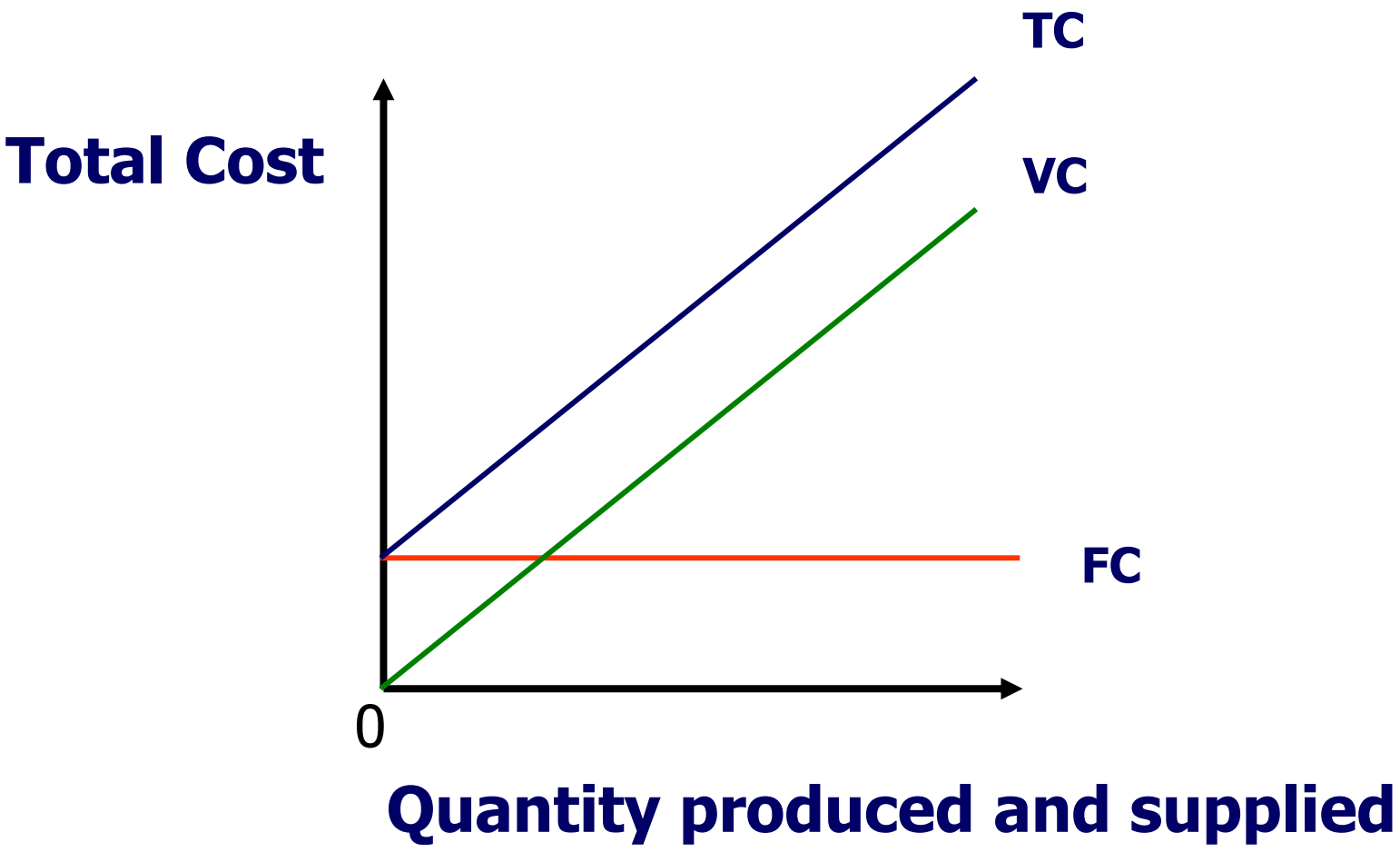
Always, by definition, **TC = FC + VC**

Example

(1) Quantity q	(2) Fixed cost FC ($)	(3) Variable cost VC ($)	(4) Total cost TC ($)
0	55	0	55
1	55	30	85
2	55	55	110
3	55	75	130
4	55	105	160
5	55	155	210
6	55	225	280

TABLE 7-1. Fixed, Variable, and Total Costs

Graphical representation of TC, VC, FC



Average and Marginal cost

Refer to the **relationship between cost and quantity of output produced** (total or incremental).

1) Average (or Unit) Cost (AC) is the total cost divided by the **total number of units produced**.

$$TC / Q$$

2) Marginal cost (MC) is the extra or additional cost of producing **1 extra unit of output**.

$$\Delta TC / \Delta Q$$

1) Average (or Unit) Cost (AC)

CT / Q

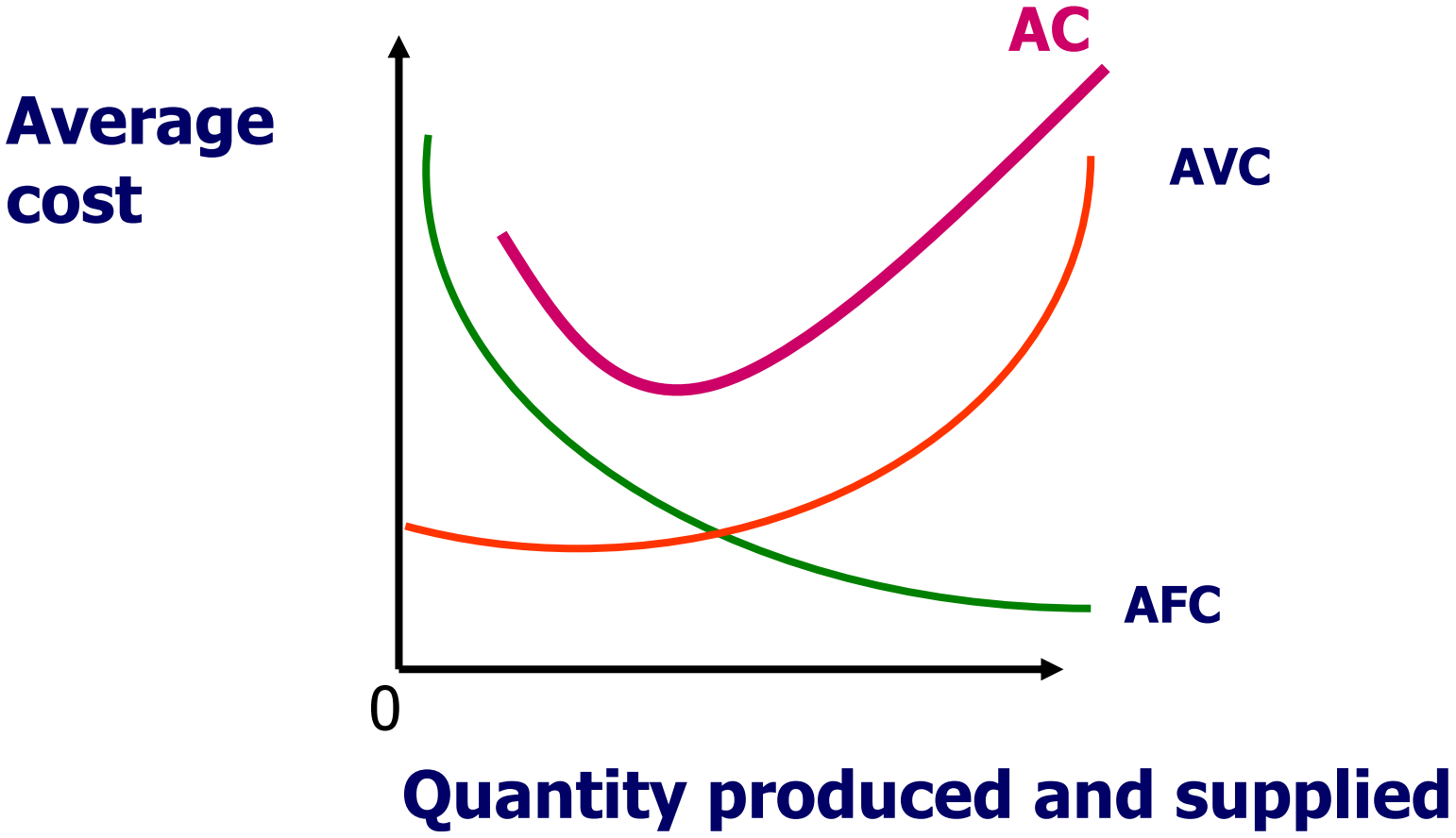
1.1) Average fixed cost (AFC) is defined as FC/q. Since total fixed cost is a constant, dividing it by an increasing output gives a steadily falling average fixed cost curve.

FC / Q

1.2) Average variable cost (AVC) equals variable cost divided by output (Usually AVC first falls and then rises => the *law of diminishing returns*, see below).

VC / Q

Graphical representation of Average costs



2. Marginal Cost (MC)

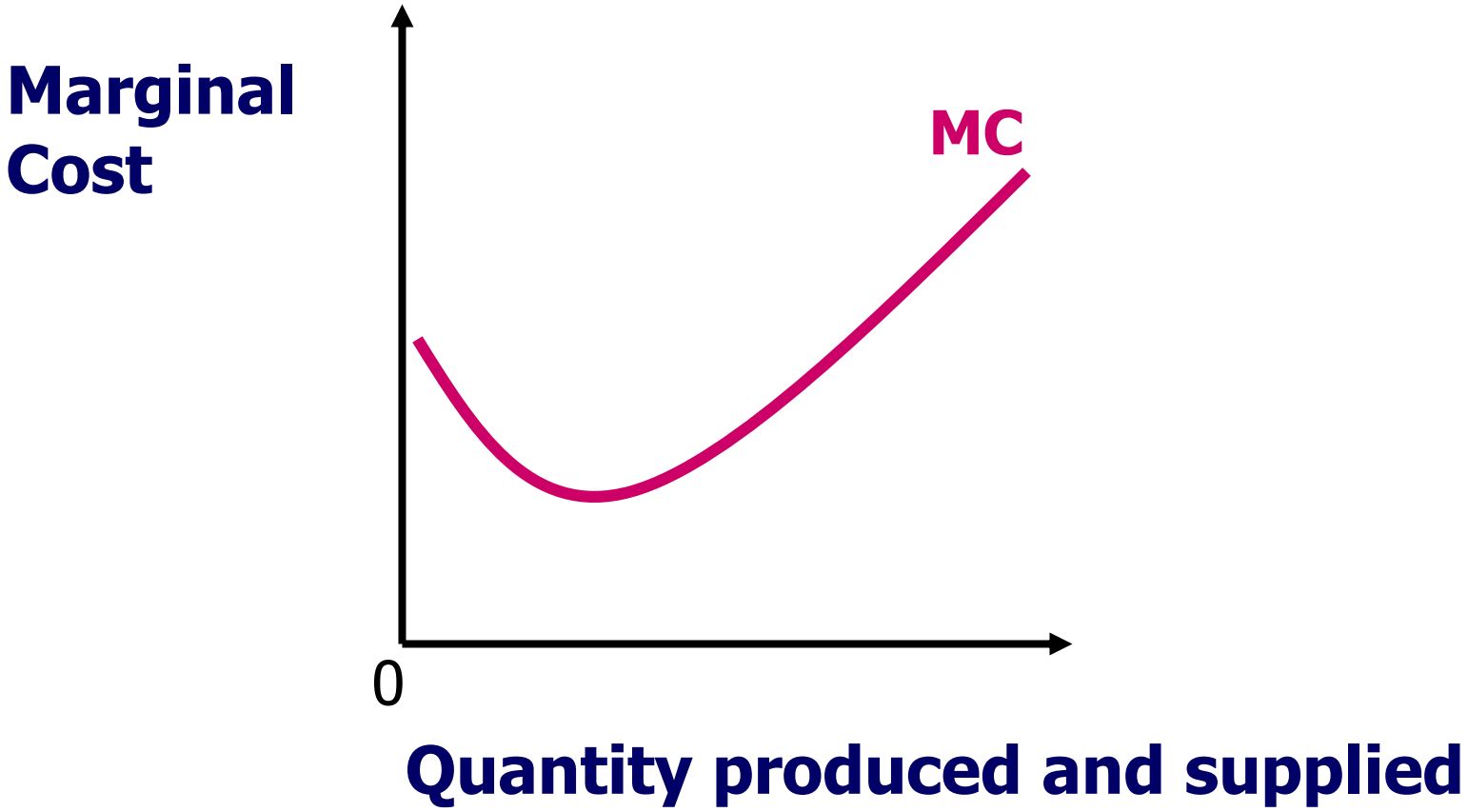
Δ CT / Δ Q

Marginal Cost is the extra or additional cost of producing 1 extra unit of output.

(1) Output q	(2) Total cost TC ($)	(3) Marginal cost MC ($)
0	55	
		30
1	85	
		25
2	110	
		20
3	130	
		—
4	160	
		50
5	210	

TABLE 7-2. Calculation of Marginal Cost

Marginal Cost: typical trend



The Relationship between Total Cost and Marginal Cost

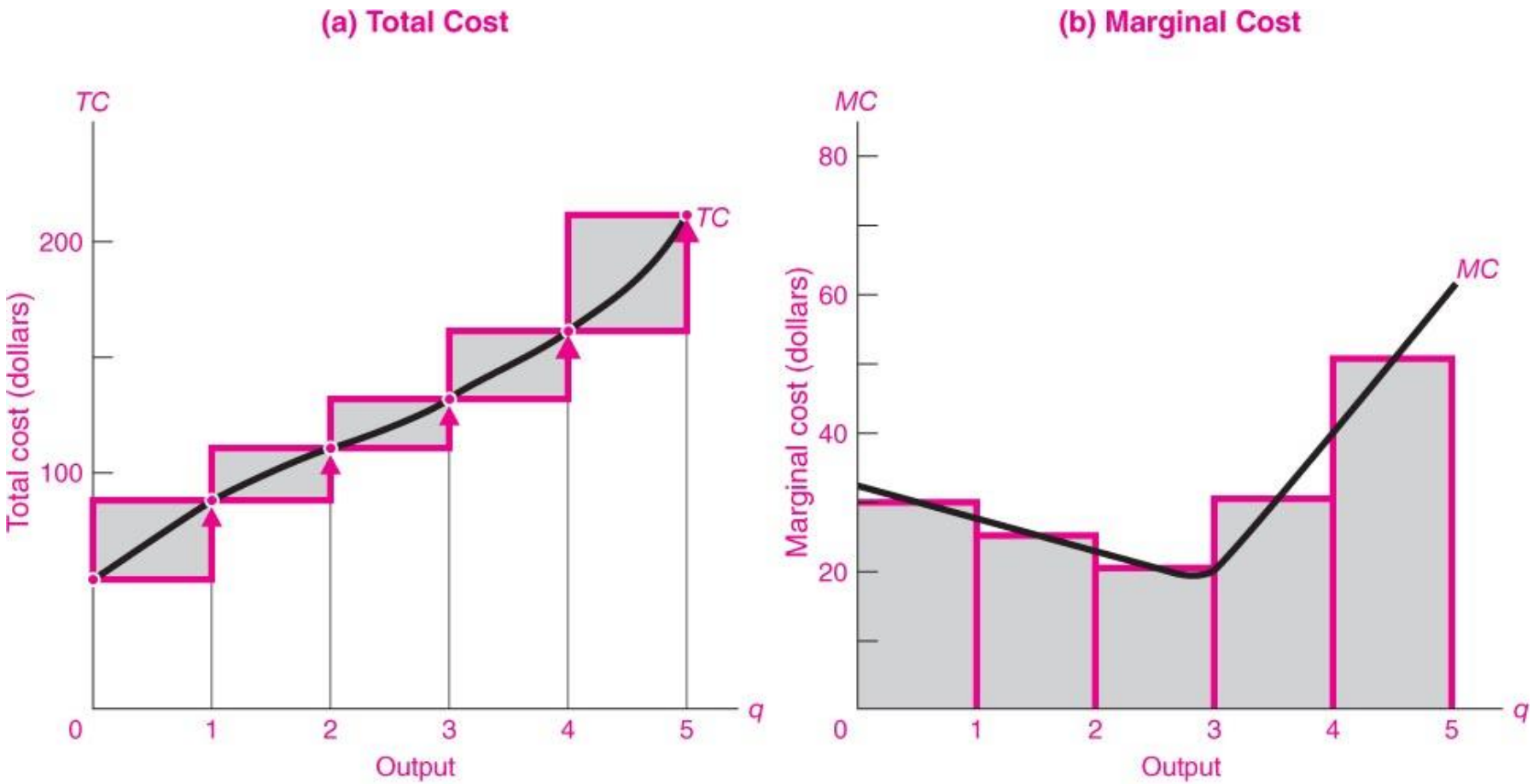


FIGURE 7-1. The Relationship between Total Cost and Marginal Cost

The overall picture

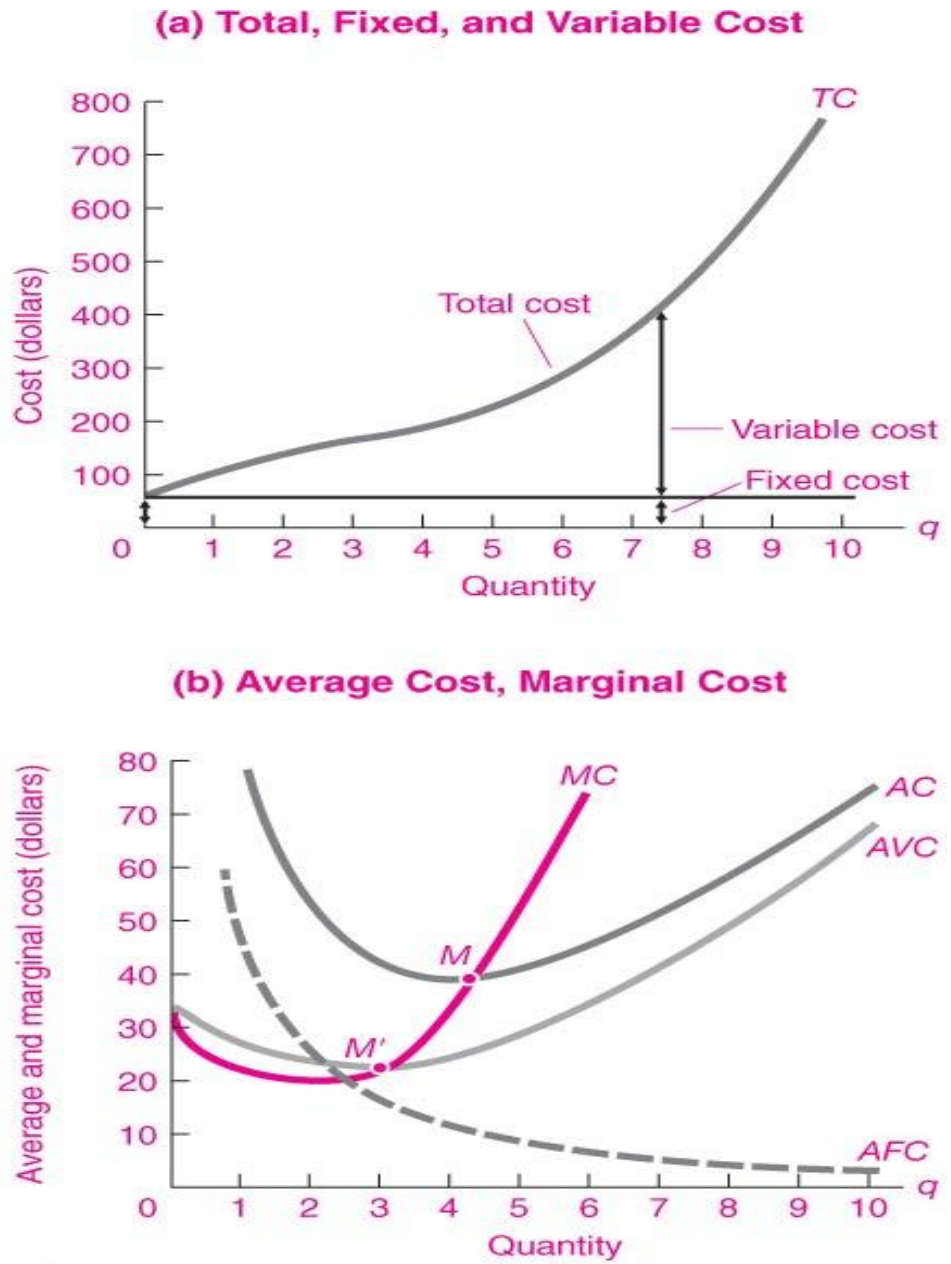
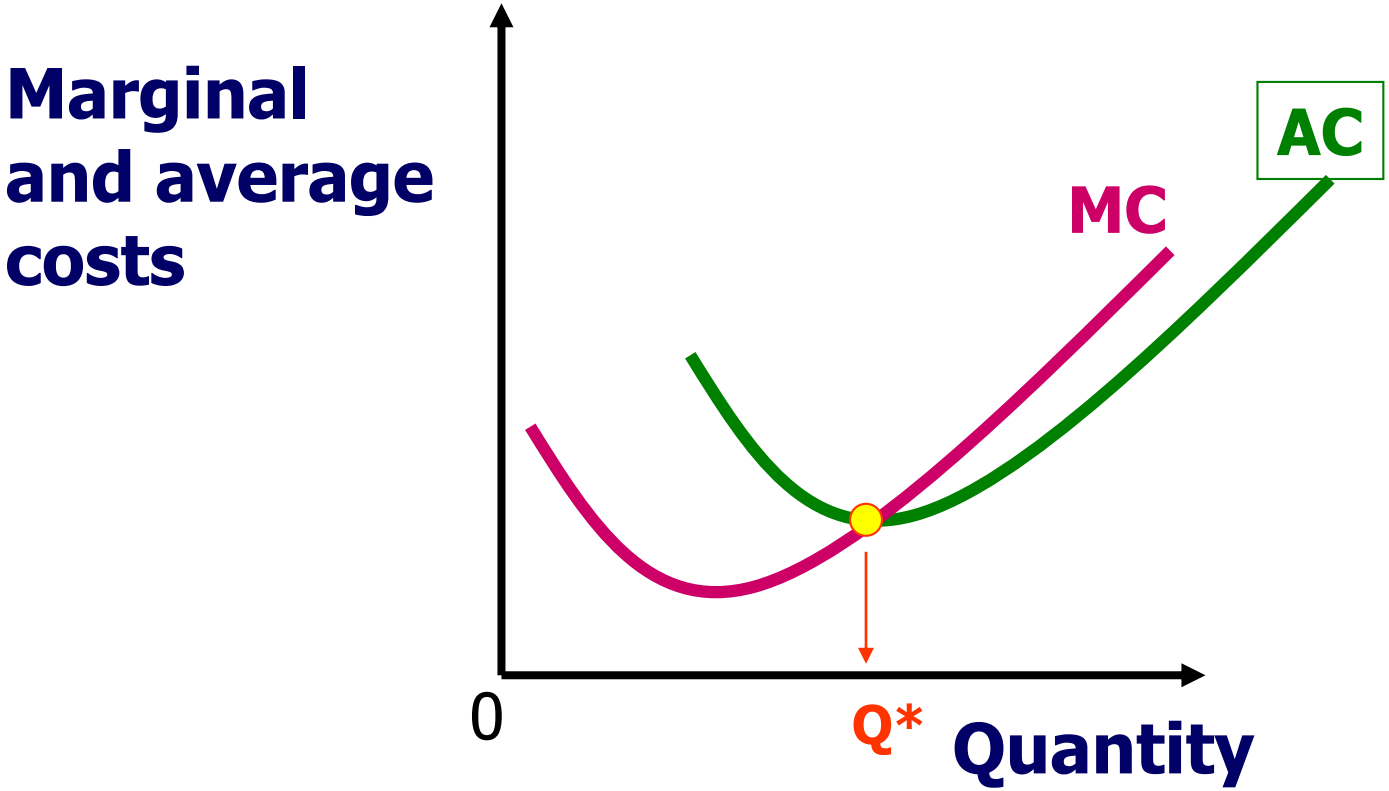


FIGURE 7-2. All Cost Curves Can Be Derived from the Total Cost Curve

The Relation between Average Cost and Marginal Cost



- When marginal cost is below average cost, it is pulling average cost down.
- When MC is above AC, it is pulling up AC .
- When MC just equals AC, AC is constant.

At the bottom of a U-shaped AC, MC=AC= minimum AC.

THE LINK BETWEEN PRODUCTION AND COSTS

Short and long run

In analyzing costs, it is necessary to distinguish two different contexts of analysis:

- **short run** = time horizon in which the company can only partially vary the use of inputs. **Fixed** and **variable** costs are present.

Example: the company may vary the amount of work but not the machinery

- **long run** = time horizon in which the company can vary the quantities purchased of **all inputs**

The link between production and costs

Marginal productivity of factors of production has direct implications on the cost structure of the firm (in fact **the costs depend on the quantities produced, which in turn depend on the inputs used** => example: if increasing an **input** by one unit, the **output** increases **less than proportionally**, it means that producing that output has **increasing costs** because it requires more inputs than the previous quantities produced => **increasing marginal cost**):

- **The trend of marginal productivity of a factor in the short run** (the increase in production resulting from the use of an additional unit of a factor, keeping the quantity of all the others constant) **influences the shape of the cost curves**
- **The trend of returns to scale in the long run affects the production scale** (installed production capacity) **and therefore the position of the cost curves** (fixed costs increase for each level of production)

We are interested in analyzing in particular what happens in the **short run** (the decisions that a company can make by varying only the variable production factors)

Short run

In analyzing the short-term costs, we refer to …

Principle of **decreasing marginal productivity** of the variable factor (**the law of diminishing returns**): the increase in production given by an increase in the variable factor is gradually smaller.

Initially, the increase in the production factor increases the output more than proportionally ... later there will be a level of production from which, by increasing the production factor, **the marginal costs increase**.

This is the reason why the **average** and **marginal cost** curves have a **typical "U" trend**.

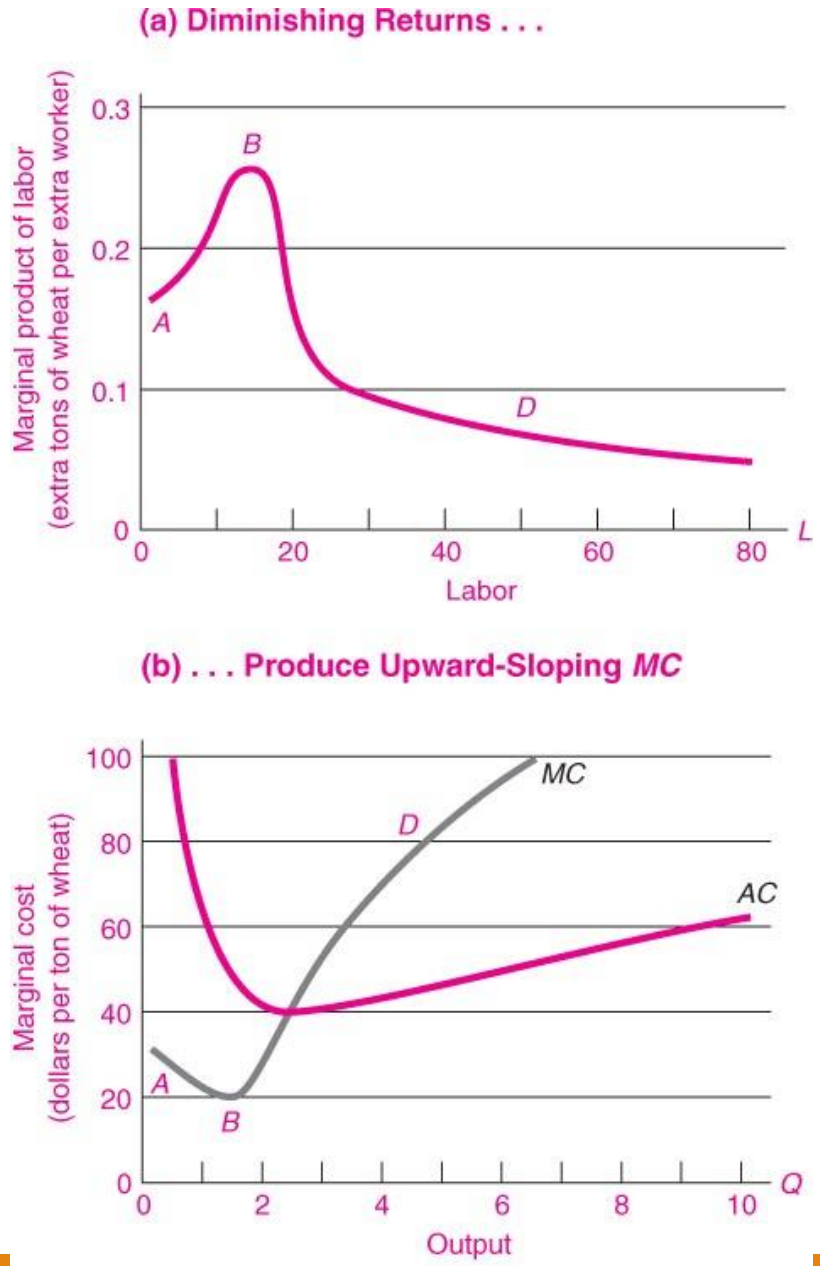


FIGURE 7-3. Diminishing Returns and U-Shaped Cost Curves

The choice of the quantity to be produced

What amount of output will the company decide to produce?

The analysis of the cost structure of the company reveals, for example, the level of output for which the average cost is minimal (technical efficiency).

However, the objective of the company, in neoclassical economic theory, is not merely the minimization of costs, but the **maximization of profit**:

$$\pi = (p \times q) - C(q)$$

- **Revenues (pxq)**

Value of sales of goods or services, during a period (value of goods / services sold).

- **Costs (C (q))**

Expenses incurred to produce the good or service during the period. They are the value of the production factors used / consumed in the period.

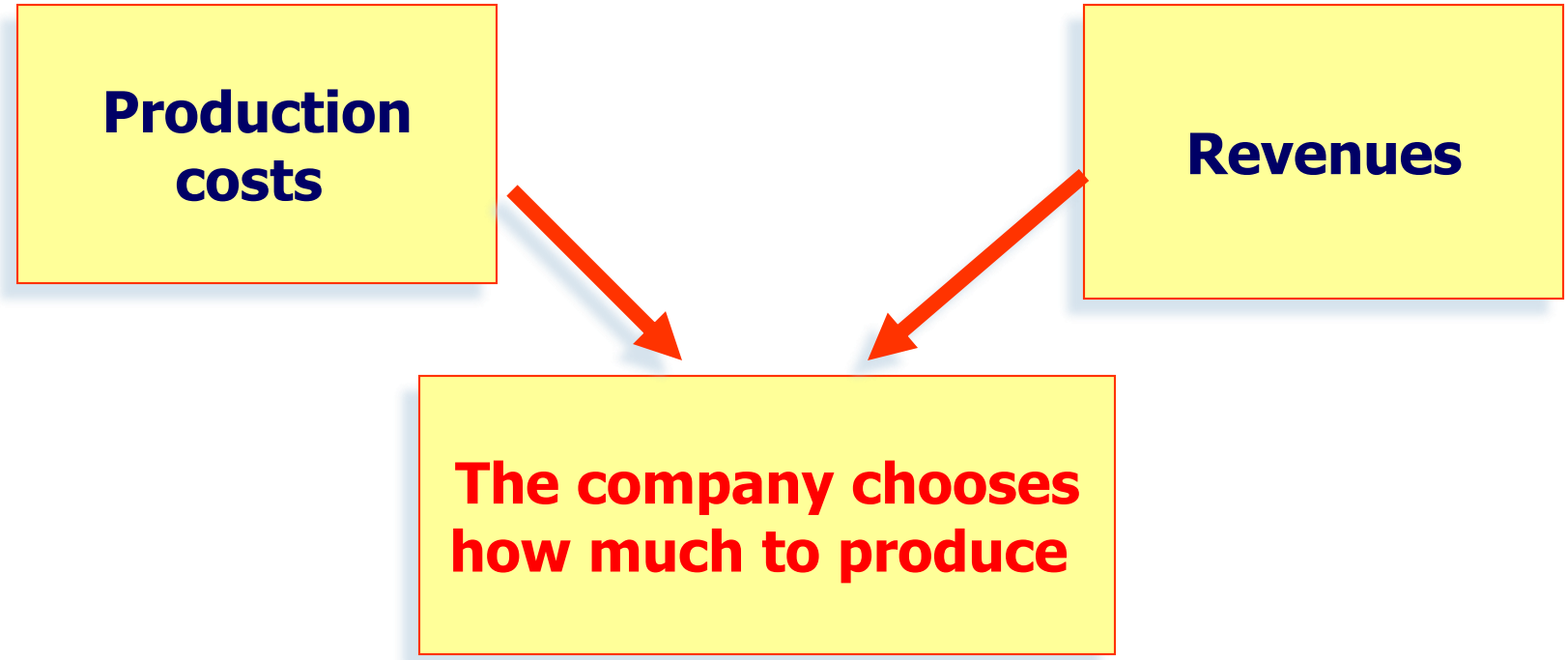
- **Profit (or loss) (π)**

The excess of revenues over costs (or vice versa), i.e. R - C.

- **Extra profit**

Profit that exceeds the normal remuneration of production factors and the entrepreneur (which can be eroded by price competition)

The company's decision about how much to produce therefore depends on both the production costs and the revenues that can be obtained from the sale of the products, on the basis of which the profit is determined.

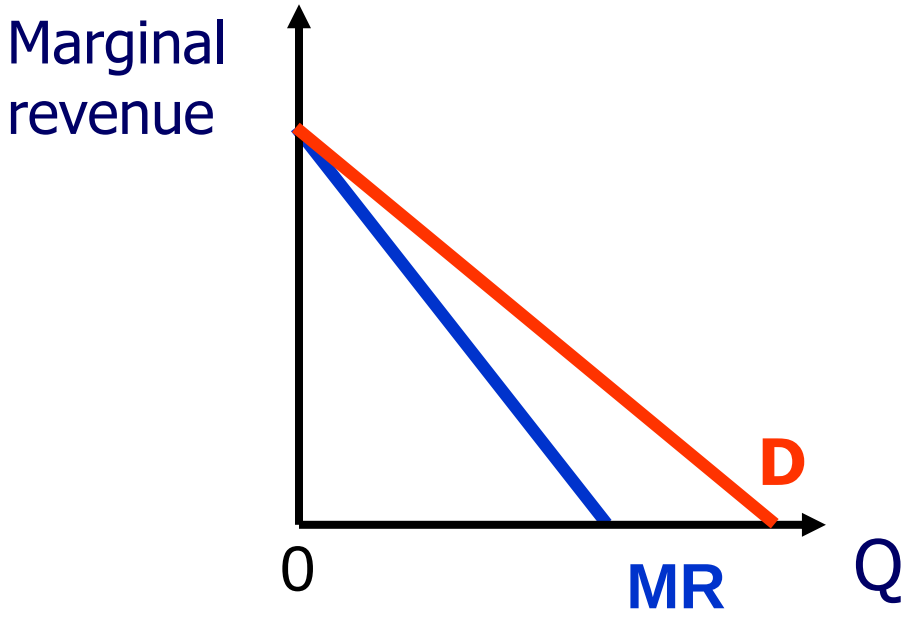


The choice of the quantity to be produced

- The initial hypothesis is that the company seeks to **maximize profits**
- **Production volume** will be chosen to realize the maximum profit
- Profits depend on both **COSTS** and **REVENUES** (each of the two varies as the output varies)
- It is necessary to vary the output **in search** of that level that guarantees the maximum profit
- **It is necessary to compare the trend of marginal cost (MC) with that of marginal revenue (MR)**

Marginal revenue

Marginal revenue comes from the demand function…



Marginal revenue (MR) is the change in revenue that is generated by an additional unit of sales. MR can be either positive or negative ($\Delta RT/\Delta Q$). It is decreasing, because the greater the quantities to buy, the lower the price that consumers are willing to pay (to sell an additional unit of output the price must fall) => if the total revenue is (pxq) and p decreases to increasing by q, then the additional unit of q produces a smaller and smaller revenue.

Average revenue (AR) is the price per unit of production sold: the function that indicates the relationship between price and quantities is the demand function, so market demand is the average revenue.

Total and Marginal Revenue

(1) Quantity q	(2) Price $P = AR = TR/q$ ($)	(3) Total revenue $TR = P \times q$ ($)	(4) Marginal revenue MR ($)
0	200	0	
			+180
1	180	180	
			+140
2	160	320	
			+100
3	140	420	
			+60
4	120	480	
			+40
			+20
5	100	500	
			—
6	80	480	
			−60
7	60	—	
			−100
8	40	320	
			−140
9	—	180	
			−180
10	0	0	

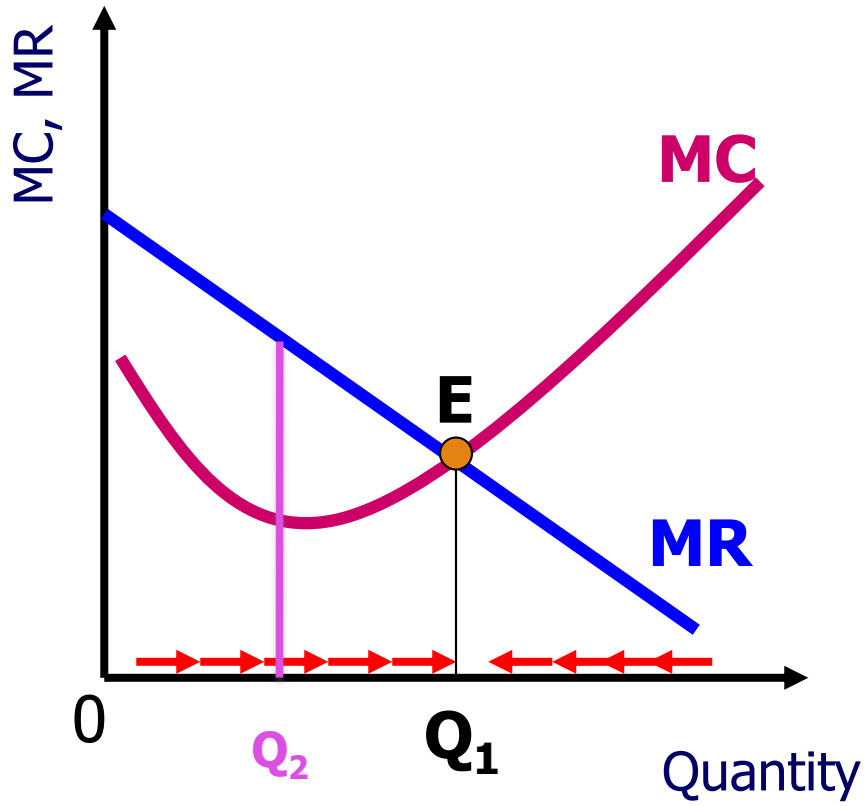
TABLE 9-3. Marginal Revenue Is Derived from Demand Schedule

PROFIT-MAXIMIZING CONDITION

Intuitively, the company should increase production (q) to the point where the increase in revenues deriving from an additional unit of output produced (marginal revenue) is not less than the increase in costs deriving from the production of an additional unit of output (marginal cost): you get more than you spend!

Max. profit → **Marginal revenue = Marginal cost**

The maximization of profit



If MR > MR, an increase in output leads to an increase in profits.

If MR < MC, a decrease in output leads to an increase in profits

Profits are then maximum in Q1, where MR = MC

BUSINESS ACCOUNTING (documents in which the costs and revenues of the company are represented)

1) THE INCOME STATEMENT (OR STATEMENT OF PROFIT AND LOSS)

- **Revenues**

The value of the products / services sold

- **Costs**

The value of the inputs consumed for production

- **Profit (or Loss) of the year**

Net income (or profit) = total revenue - total expenses

Income Statement of Hot Dog Ventures, Inc.
(January 1, 2009 to December 31, 2009)

(1)	**Net sales (after all discounts and rebates)**		**$250,000**
	Less cost of goods sold:		
(2)	Materials	$ 50,000	
(3)	Labor cost	90,000	
(4)	Miscellaneous operating costs (utilities, etc.)	10,000	
(5)	Less overhead costs:		
(6)	Selling and administrative costs	15,000	
(7)	Rent for building	5,000	
(8)	Depreciation	15,000	
(9)	Operating expenses	$185,000	185,000
(10)	Net operating income		$ 65,000
	Less:		
(11)	Interest charges on equipment loan		6,000
(12)	State and local taxes		4,000
(13)	Net income (or profit) before income taxes		$ 55,000
(14)	Less: Corporation income taxes		18,000
(15)	**Net income (or profit) after taxes**		**$ 37,000**
(16)	Less: Dividends paid on common stock		15,000
(17)	Addition to retained earnings		$ 22,000

TABLE 7-6. The Income Statement Shows Total Sales and Expenses for a Period of Time

2) THE BALANCE SHEET

- **Assets**

Value of what the company owns (Investments)

- **Liabilities**

Any debts the company has, whether it's bank loans, mortgages, unpaid bills, or any other sum of money (Sources of financing)

- **Net worth (Net value)**

Net worth = assets - liabilities

Balance Sheet of Hot Dog Ventures, Inc.
(December 31, 2009)

Assets		Liabilities and net worth	
		Liabilities	
Current assets:		Current liabilities:	
Cash	$ 20,000	Accounts payable	$ 20,000
Inventory	80,000	Notes payable	20,000
Fixed assets:		Long-term liabilities:	
Equipment	150,000	Bonds payable	100,000
Buildings	100,000		
		Net worth	
		Stockholders' equity:	
		Common stock	10,000
		Retained earnings	.....
Total	**$350,000**	**Total**	**$350,000**

TABLE 7-7. The Balance Sheet Records the Stock of Assets and Liabilities, plus Net Worth, of a Firm at a Given Point in Time