

Lecture 4

Analysis of Costs and Perfect Competition

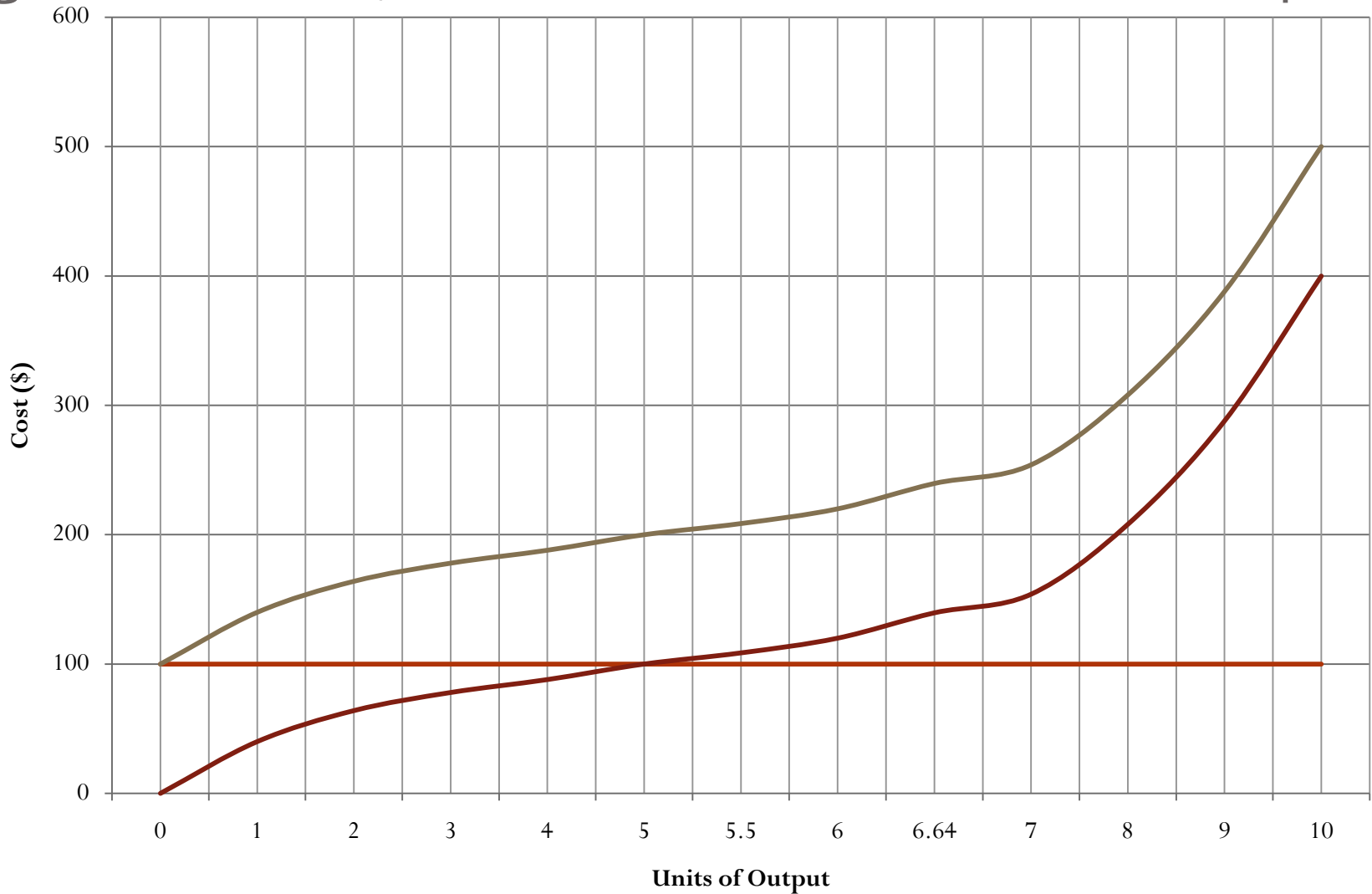
Introduction to Analysis of Costs

- Even if a manager fully understands the relationship between inputs and outputs, she still cannot make “optimal” production decisions without cost information.
- The key question managers must ponder is how are costs related to output?
- A full understanding of costs is necessary since virtually any business decision requires a comparison between costs and benefits.

Table 5.1: Fixed, Variable & Total Costs: Media Corporation

Units of Output Q	TFC: Total Fixed Cost (Dollars per Day)	TVC: Total Variable Cost (Dollars per Day)	TC: Total Cost (Dollars per Day)
0	100	0	100
1	100	40	140
2	100	64	164
3	100	78	178
4	100	88	188
5	100	100	200
<u>5.5</u>	<u>100</u>	<u>108.625</u>	<u>208.625</u>
6	100	120	220
<u>6.64</u>	<u>100</u>	<u>139.6</u>	<u>239.6</u>
7	100	154	254
8	100	208	308
9	100	288	388
10	100	400	500

Figure 5.1: Fixed, Variable & Total Costs: Media Corporation

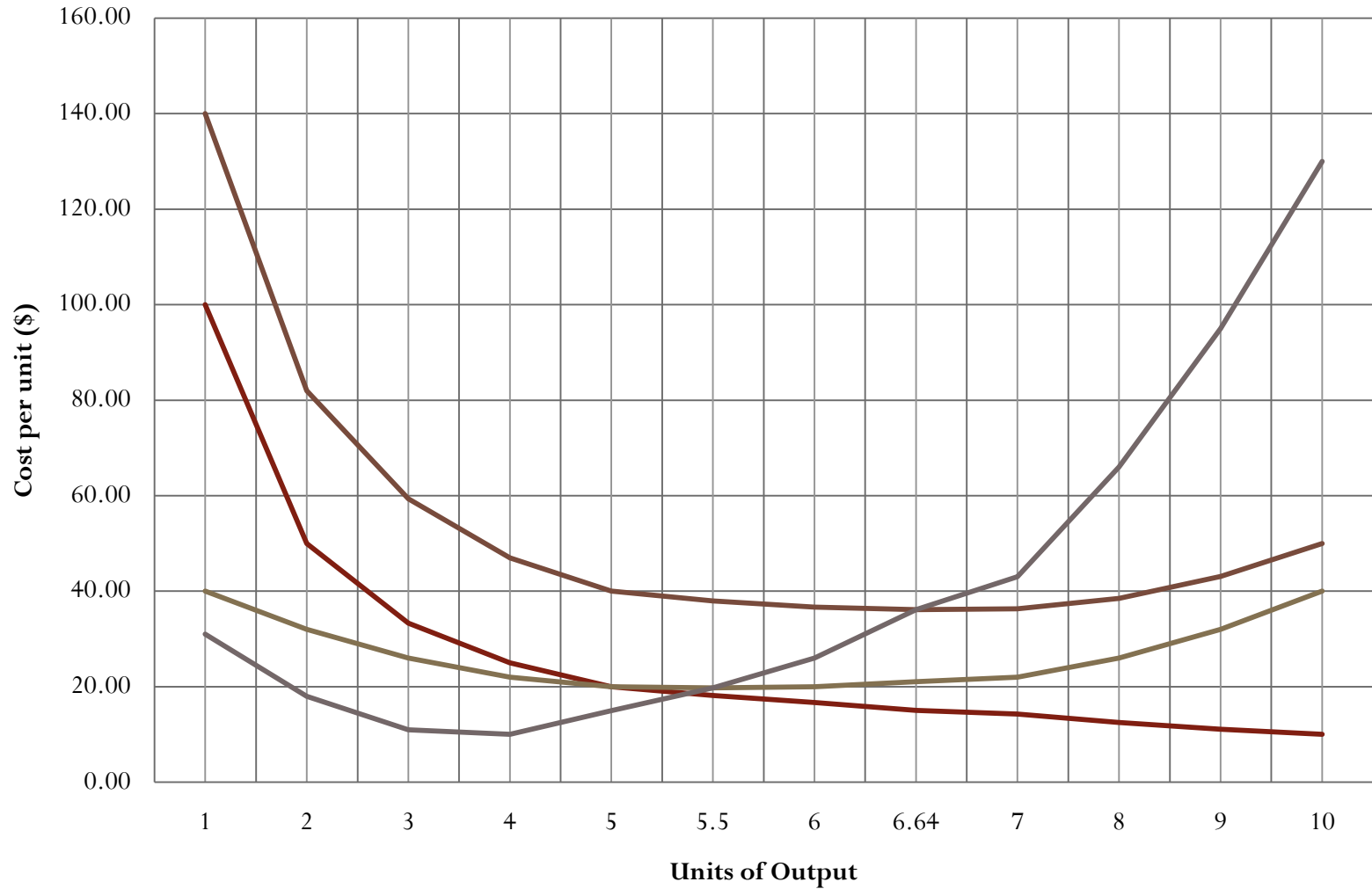


— TFC: Total Fixed Cost (Dollars per Day) — TVC: Total Variable Cost (Dollars per Day)
— TC: Total Cost (Dollars per Day)

Table 5.2: Average & Marginal Costs: Media Corporation

Units of Output Q	Average Fixed Cost (TFC/Q)	Average Variable Cost (TVC/Q)	Average Total Cost (TC/Q)	Marginal Cost (dTC/dQ)
1	100.00	40.00	140.00	31.00
2	50.00	32.00	82.00	18.00
3	33.33	26.00	59.33	11.00
4	25.00	22.00	47.00	10.00
5	20.00	20.00	40.00	15.00
<u>5.5</u>	<u>18.18</u>	<u>19.75</u>	<u>37.93</u>	<u>19.75</u>
6	16.67	20.00	36.67	26.00
<u>6.64</u>	<u>15.06</u>	<u>21.02</u>	<u>36.11</u>	<u>36.11</u>
7	14.29	22.00	36.29	43.00
8	12.50	26.00	38.50	66.00
9	11.11	32.00	43.11	95.00
10	10.00	40.00	50.00	130.00

Figure 5.2: Average & Marginal Costs: Media Corporation

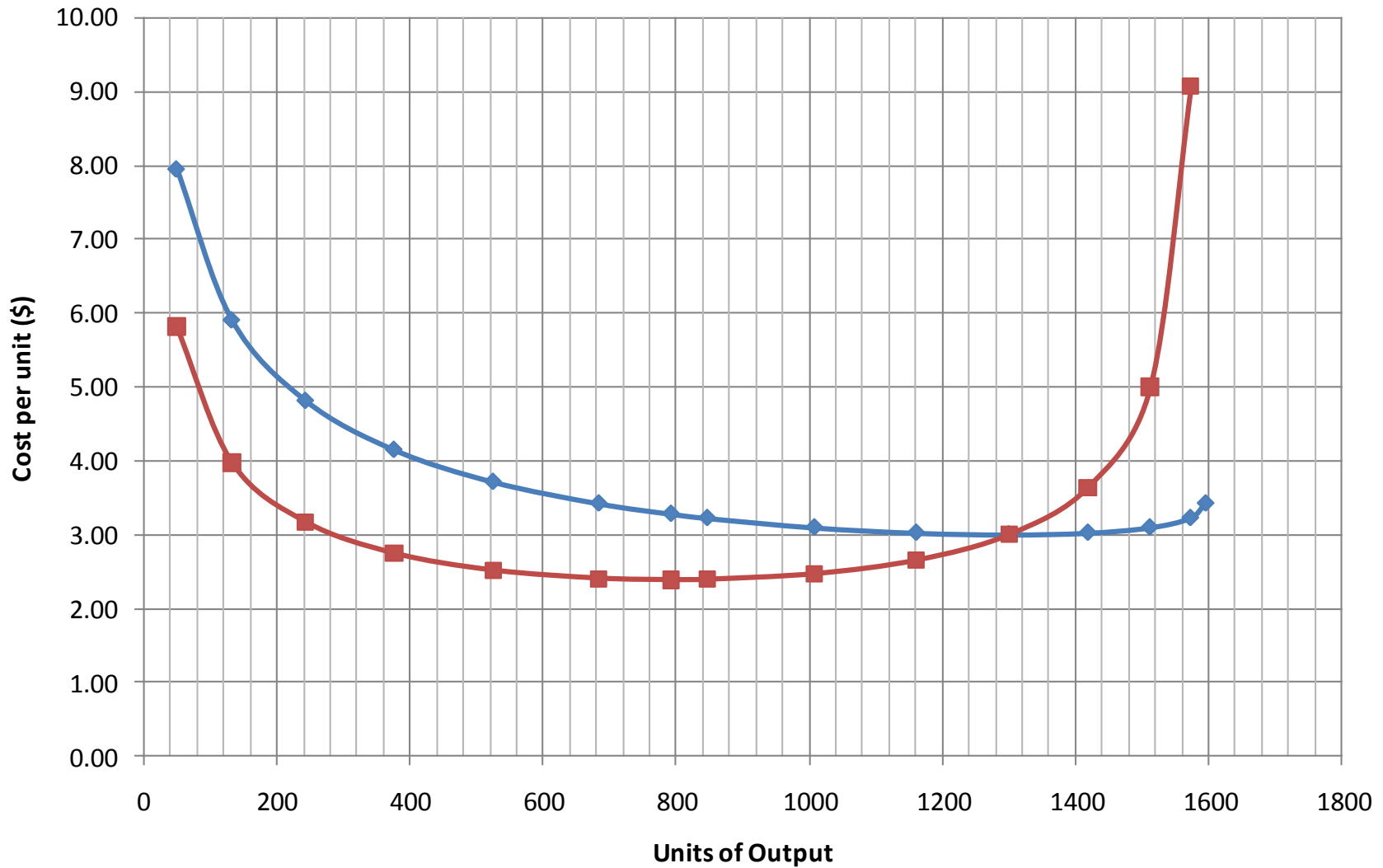


— Average Fixed Cost (TFC/Q) — Average Variable Cost (TVC/Q)
— Average Total Cost (TC/Q) — Marginal Cost (dTC/dQ)

Table 5.3: Thomas Machine Short-Run Costs

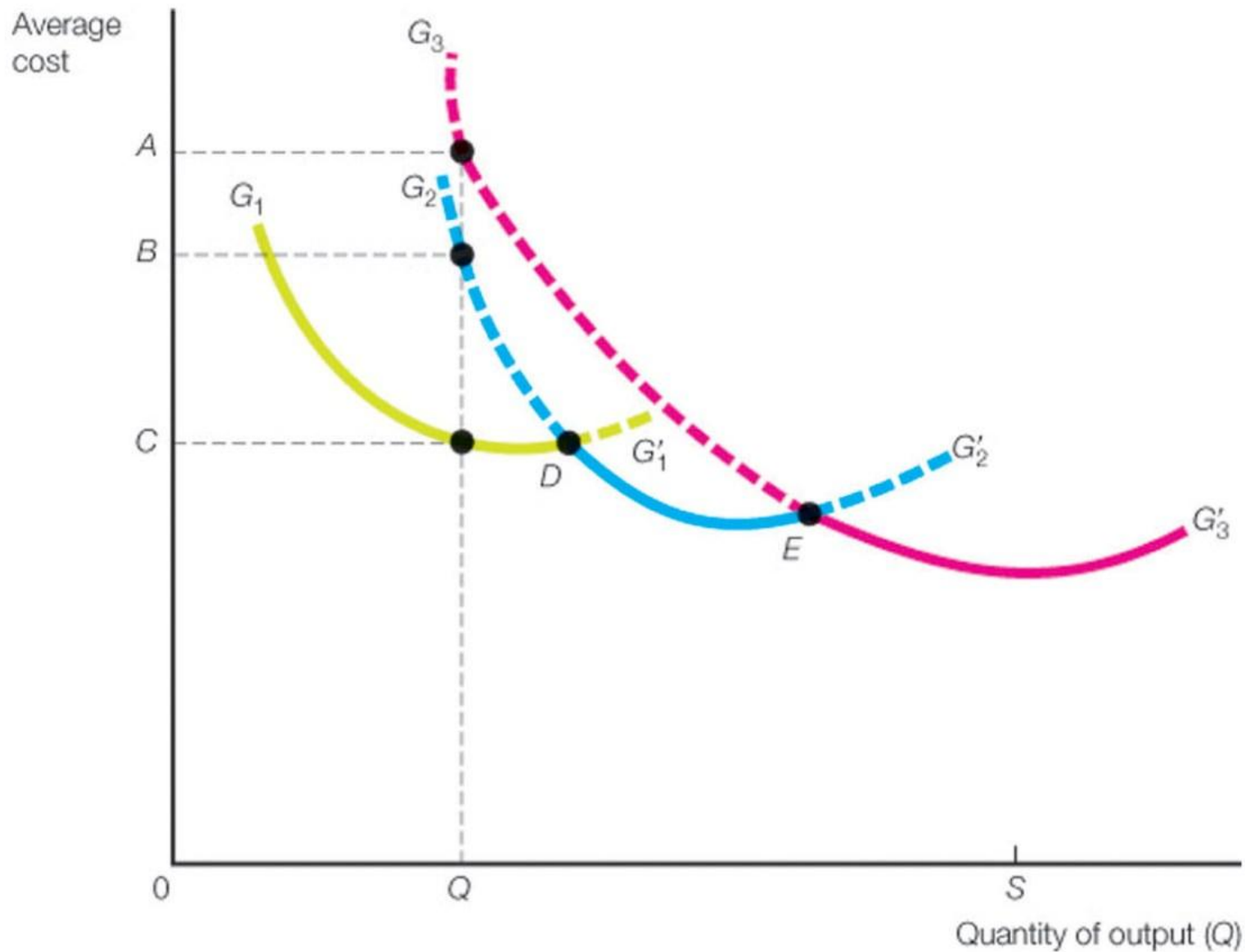
			MPL =		AVC=	MC=		
L	Q	APL	dD/dL	W	W/APL	W/MPL		
1	49	49	67	390	7.96	5.82		
2	132	66	98	390	5.91	3.98		
3	243	81	123	390	4.81	3.17		
4	376	94	142	390	4.15	2.75		
5	525	105	155	390	3.71	2.52		
6	684	114	162	390	3.42	2.41		
<u>6.67</u>	<u>792.59</u>	<u>118.9</u>	<u>163.33</u>	<u>390</u>	<u>3.28</u>	<u>2.388</u>	MPL max, MC min	
7	847	121	163	390	3.22	2.393		
8	1008	126	158	390	3.10	2.47		
9	1161	129	147	390	3.02	2.65		
<u>10</u>	<u>1300</u>	<u>130</u>	<u>130</u>	<u>390</u>	<u>3.00</u>	<u>3.00</u>	APL max, AVC min	
11	1419	129	107	390	3.02	3.64		
12	1512	126	78	390	3.10	5.00		
13	1573	121	43	390	3.22	9.07		
14	1596	114	2	390	3.42	195.00		
15	1575	105	-45	390	3.71	-		

Chart of Table 5.3: Thomas Machine Short-Run Costs

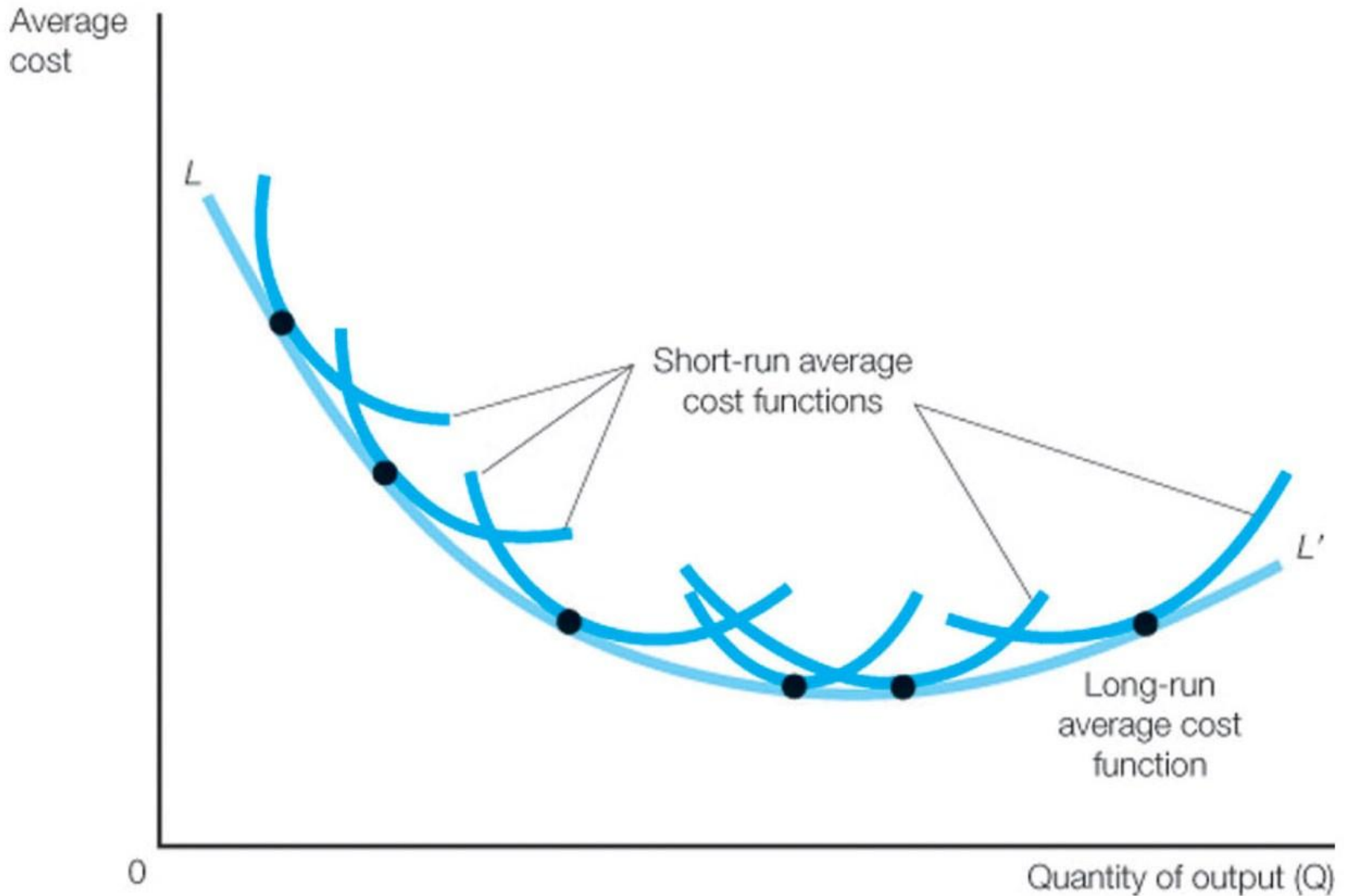


◆ Average Cost ■ Marginal Cost

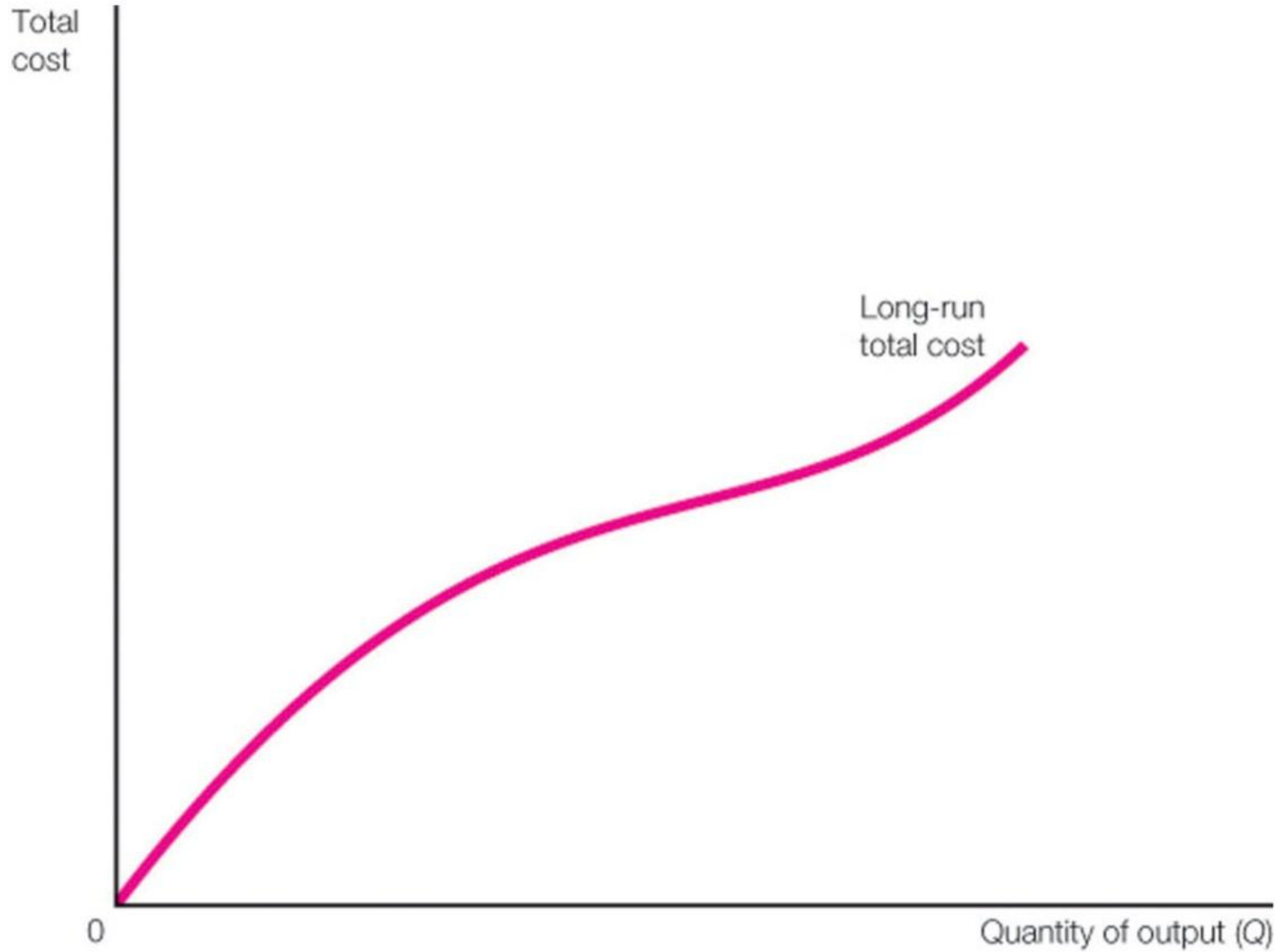
Short-Run Average Cost Functions for Various Scales of Plant



Short-Run Average Cost Functions for Various Scales of Plant



Long-Run Total Cost Function



Managerial Use of Cost Functions (Martin Division)

$$Q = 4K^{0.5}L^{0.5} \Rightarrow L = \frac{Q^2}{16K} \quad (5.2)$$

$$TC = 8L + 2K = \frac{Q^2}{2K} + 2K \quad (5.3)$$

$$TC_s = \frac{Q^2}{20} + 20 \quad (5.4)$$

$$AC_s = \frac{TC_s}{Q} = \frac{Q}{20} + \frac{20}{Q}$$

$$MC_s = \frac{dTC_s}{dQ} = \frac{Q}{10}$$

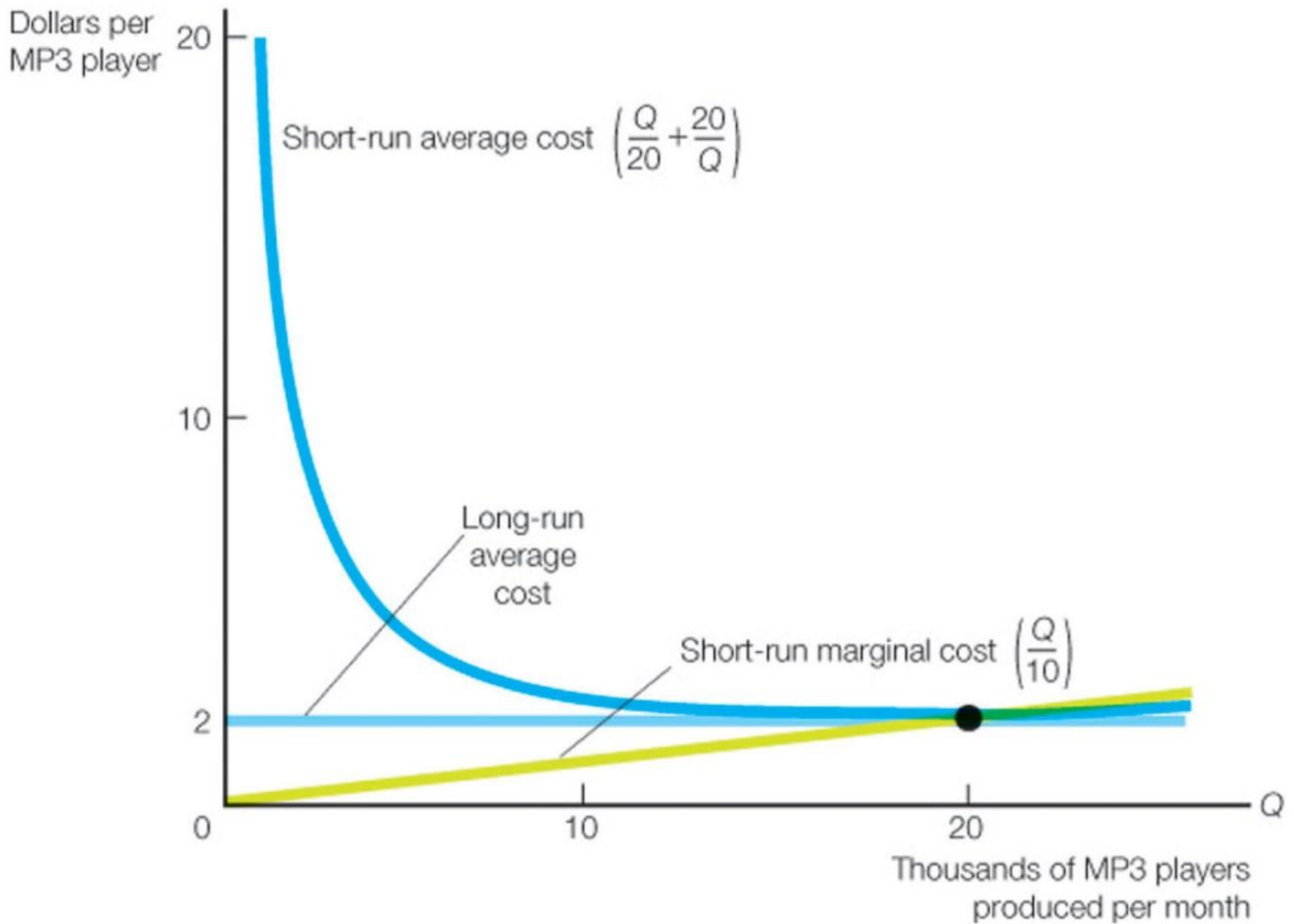
Managerial Use of Cost Functions (Martin Division)

$$TC = 8L + 2K = \frac{Q^2}{2K} + 2K \quad (5.3)$$

$$\frac{dTC}{dK} = -\frac{Q^2}{2K^2} + 2 = 0 \Rightarrow K = Q / 2$$

$$\therefore TC_L = \frac{Q^2}{2K} + 2K = \frac{Q^2}{2(Q / 2)} + \frac{2Q}{2} = 2Q \quad (5.5)$$

$$\therefore AC_L = \frac{TC_L}{Q} = 2 = MC_L = \frac{dTC_L}{dQ}$$



Examples of Economies of Scale

- Managers at UPS use scale economies in their distribution network to decrease costs.
- Exxon Mobil managers use scale economies to decrease costs in their refining and chemical production processes.
- The size of cruise ships keeps growing because larger ships have a lower cost per passenger thanks to scale economies.
- Others???

Class Problem 5.1

- Gold Screen Inc. (GSI) manufactures screens for color-television sets. GSI has manufacturing facilities in California, and the firm is considering opening a plant in Asia.
- GSI's engineers estimate the cost function of the new plant to be: $TC = 800,000 + 40Q + 0.0025Q^2$
- GSI expects to sell 15,000 screens this year, and expects demand to grow in the future.
 - What is the expected total cost and average cost for sales of 15,000 screens?
 - Calculate the output level that will yield the lowest average total cost.

Economies of Scope

Economies of scope exist when the cost of producing two (or more) products jointly is less than the cost of producing each one alone:

$$S = \frac{C(Q_1) + C(Q_2) - C(Q_1 + Q_2)}{C(Q_1 + Q_2)} \quad (5.6)$$

For example, the Martin Company produces 1,000 milling machines and 500 lathes per year at a cost of \$15 million, whereas “standalone” firm costs would be \$12 million for 1,000 milling machines and \$6 million for

500 lathes; $\therefore S = \frac{12 + 6 - 15}{15} = 0.20$.

Examples of Economies of Scope

- Cable TV, high speed internet, and VOIP services
- Timber and particle board production
- Corn and ethanol production
- Power generation and distribution
- Joint cargo and passenger transportation by airlines
- Others???

Perfect Competition

- Characteristics of perfect competition
 - Many firms producing identical products with no control over price, no non-price competition (e.g., advertising is unnecessary since identical products cannot be meaningfully differentiated), no barriers to entry or exit
 - Examples include agricultural markets, commodity markets, financial markets, eBay auctions, open source software, etc.
 - No buyer or seller has *any* market power; firms in such a market act as “price takers” (i.e., take prices as “given”), and economic profit = 0.

Monopoly and Monopolistic Competition

- Characteristics of monopolistic and monopolistically competitive markets
 - Control over price is either complete (monopoly) or limited (monopolistic competition); thus firms set prices and quantities and earn economic profits.
 - However, market power is not unlimited; firms must consider willingness of consumers to pay.
 - Entry barriers are very high in monopolistic markets; low in monopolistically competitive markets.
 - “Obvious” examples of monopoly include public utility firms; retail trade is typically given as an “obvious” example of monopolistic competition.

Oligopoly

- Characteristics of oligopolistic markets
 - Limited number of firms and high barriers to entry.
 - “Obvious” examples of oligopoly include the automobile, airline, pharmaceutical, and overnight (express) delivery industries (e.g., UPS and FEDEX),
 - Behavior of firms in an oligopolistic market is often difficult to predict
 - Sometimes firms compete vigorously; e.g., Coke and Pepsi, airline industry
 - Sometimes they explicitly or implicitly collude (the OPEC cartel)

Table 6.1. Characteristics of Perfect Competition, Monopolistic Competition, Oligopoly, and Monopoly

Market Structure	Examples	Number of Producers	Type of Product	Power of Firm over Price	Barriers to Entry	Nonprice Competition
Perfect competition	Some sectors of agriculture	Many	Standardized	None	Low	None
Monopolistic competition	Retail trade	Many	Differentiated	Some	Low	Advertising and product differentiation
Oligopoly	Computers, oil, steel	Few	Standardized or differentiated	Some	High	Advertising and product differentiation
Monopoly	Public utilities	One	Unique product	Considerable	Very high	Advertising

Figure 6.1. Determination of Price in a Perfectly Competitive Market

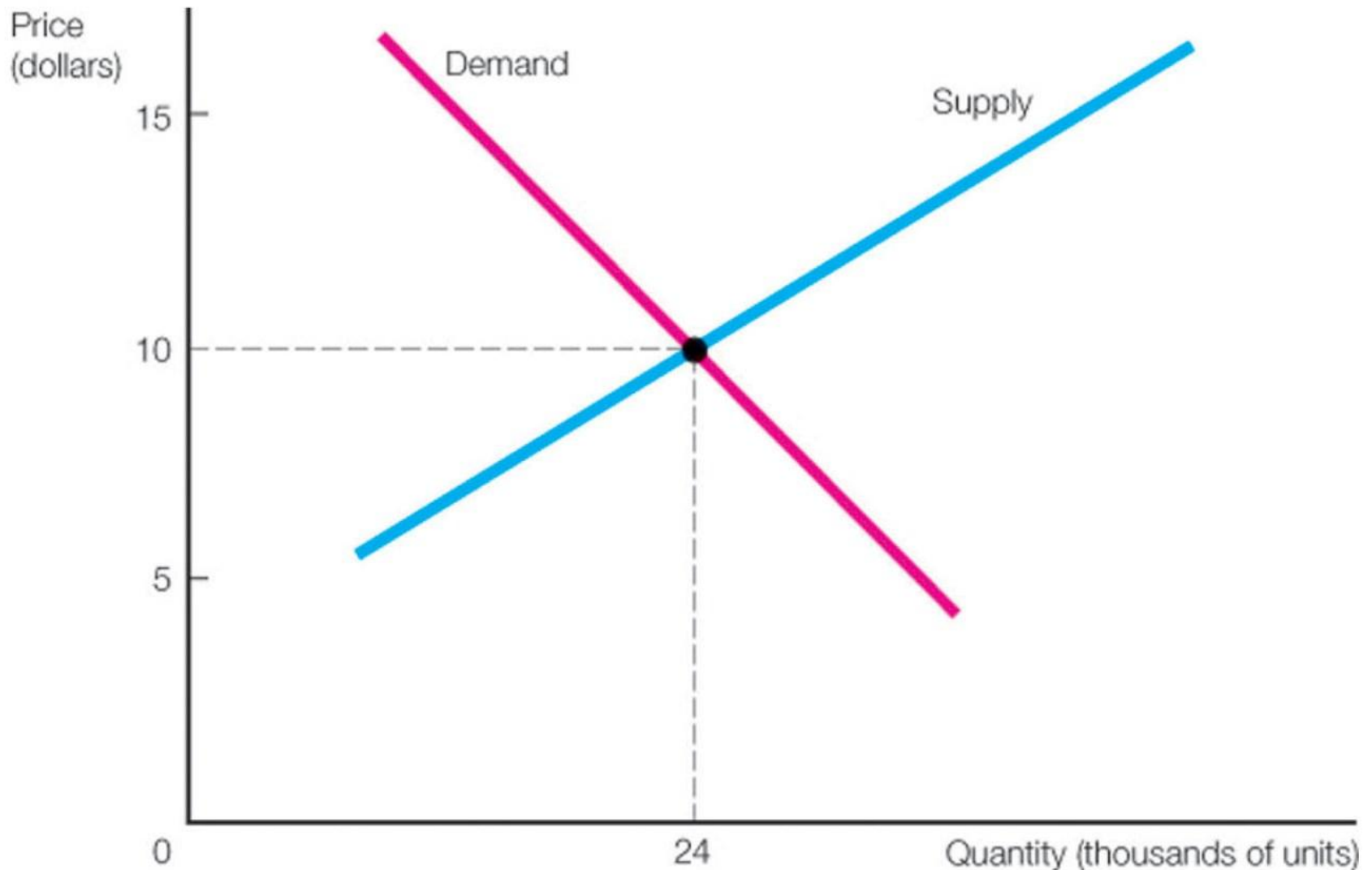


Table 6.2. Costs and Revenues of a Perfectly Competitive Firm

Units of Output Period	Price (Dollars)	Total Revenue (Dollars)	Total Fixed Costs (Dollars)	Total Variable Costs (Dollars)	Total Cost (Dollars)	Total Profit (Dollars)
0	10	0	1	0	1	-1
1	10	10	1	3	4	6
2	10	20	1	8	9	11
3	10	30	1	15	16	14
4	10	40	1	24	25	15
5	10	50	1	35	36	14
6	10	60	1	48	49	11
7	10	70	1	63	64	6
8	10	80	1	80	81	-1
9	10	90	1	99	100	-10

Figure 6.2. Relationship between TC and TR of a Perfectly Competitive Firm

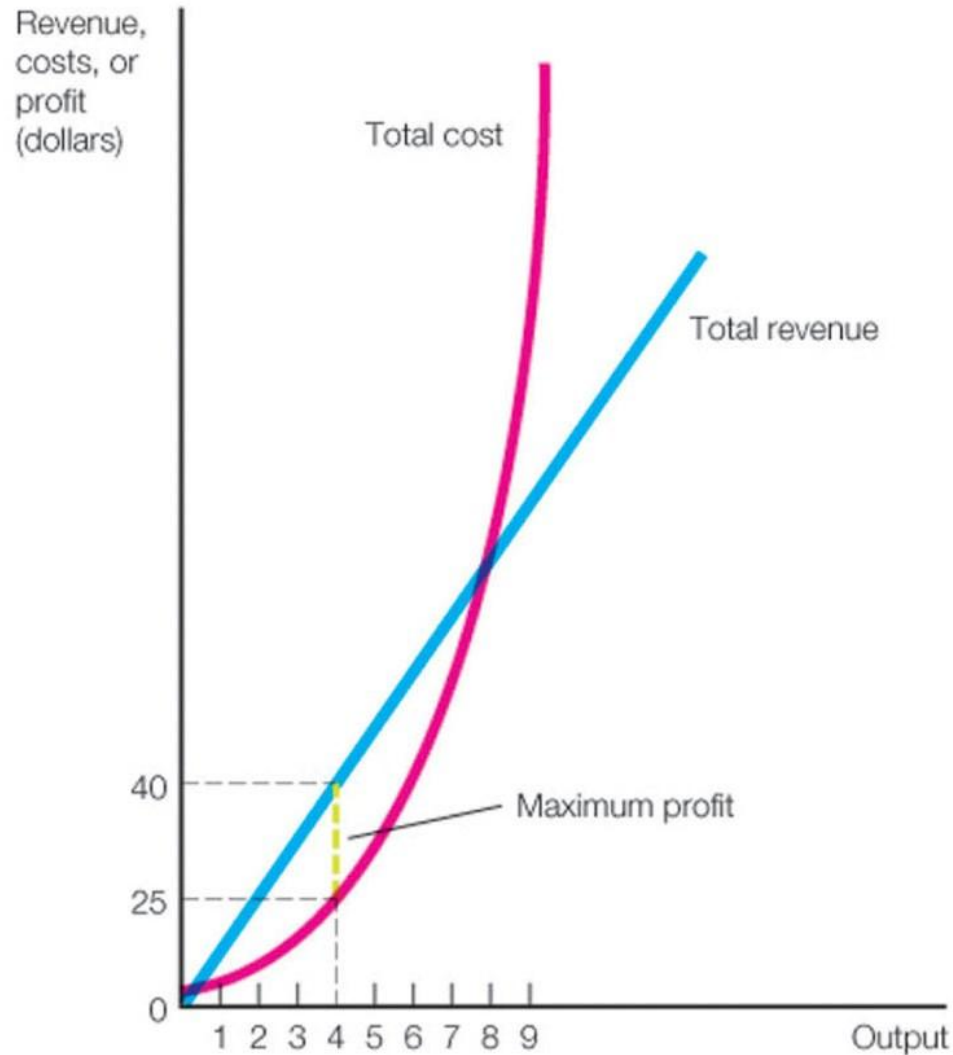


Figure 6.3. Relationship of π and Q of a Perfectly Competitive Firm

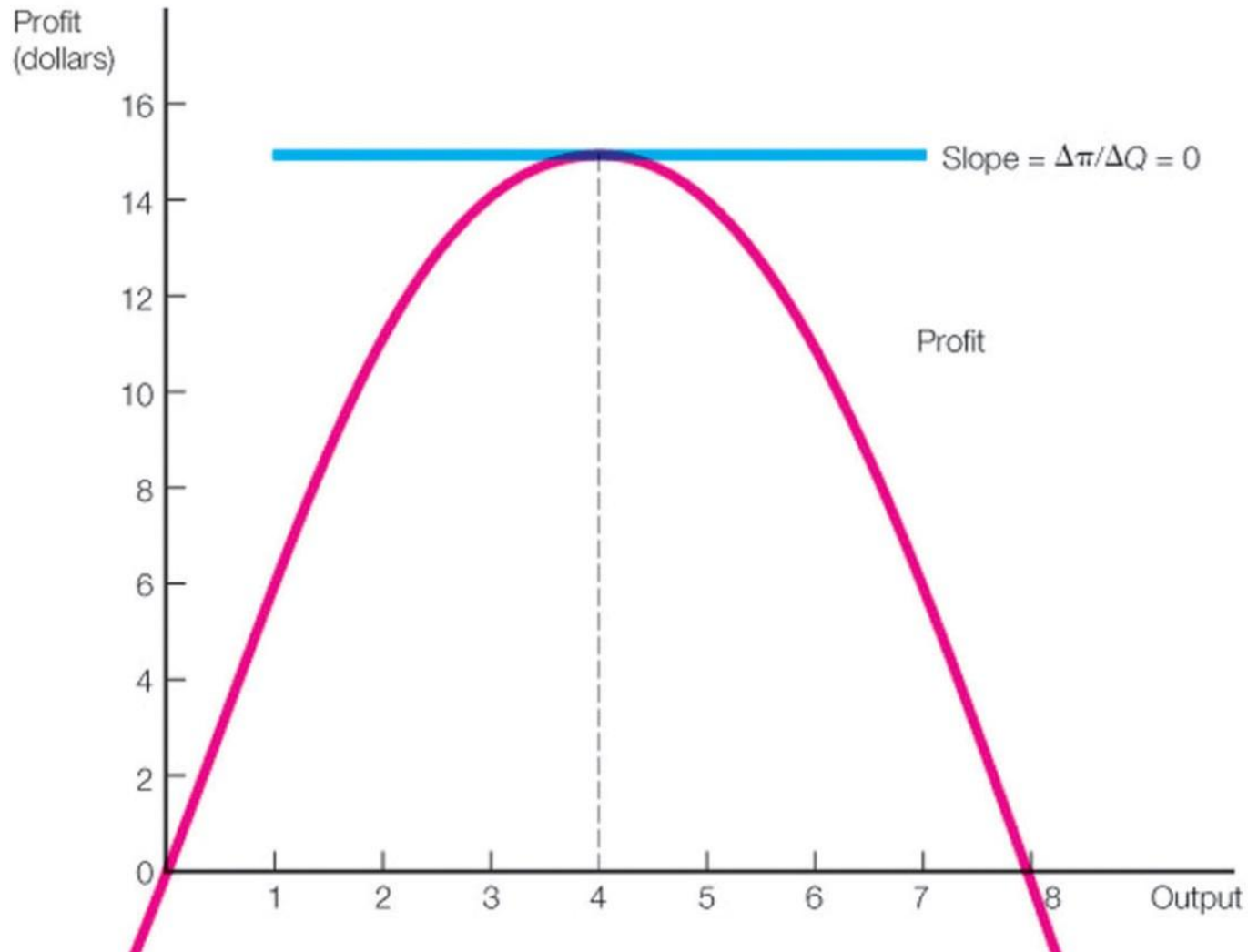


Figure 6.4. *MR* and *MC* of a Perfectly Competitive Firm

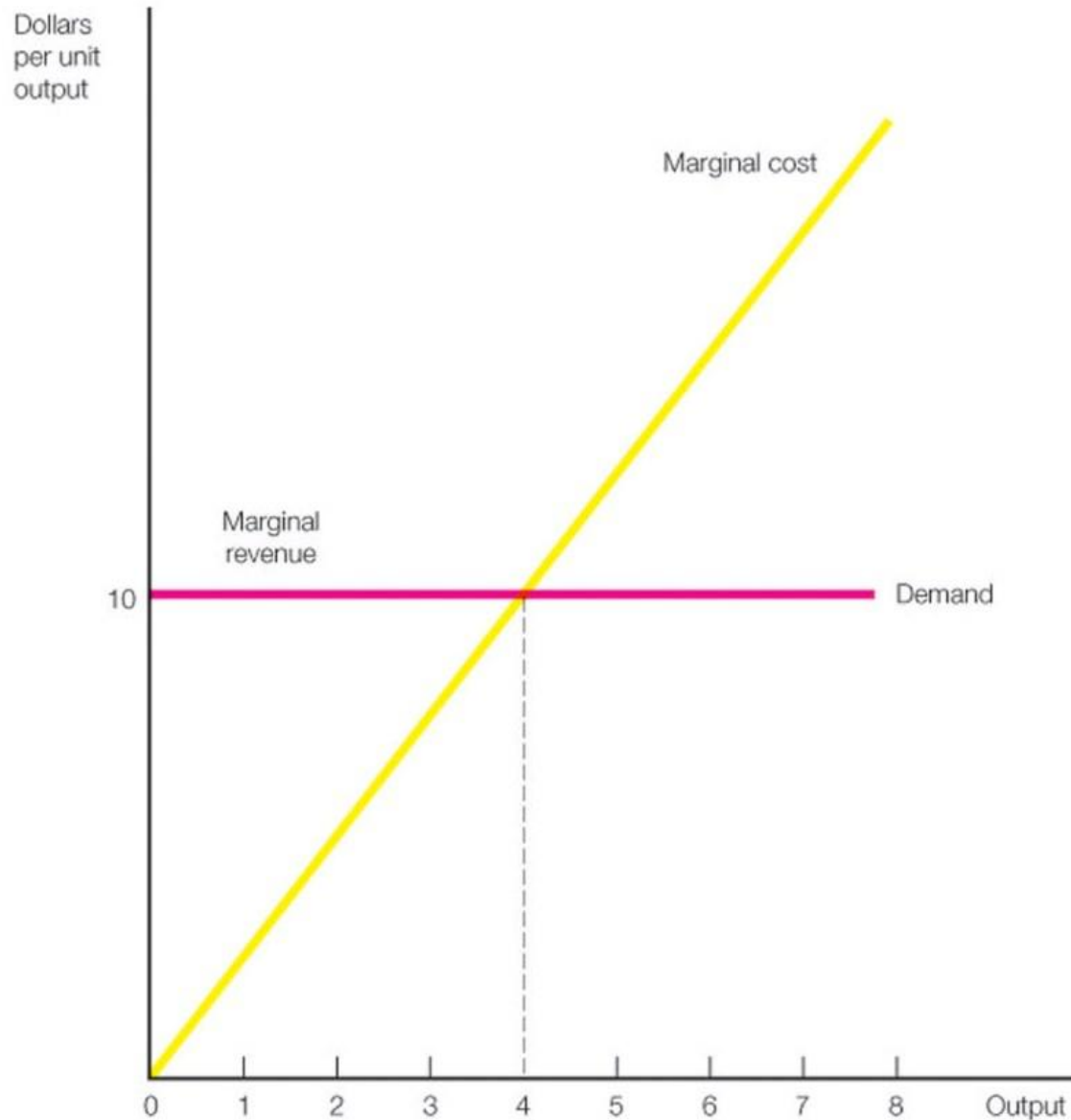
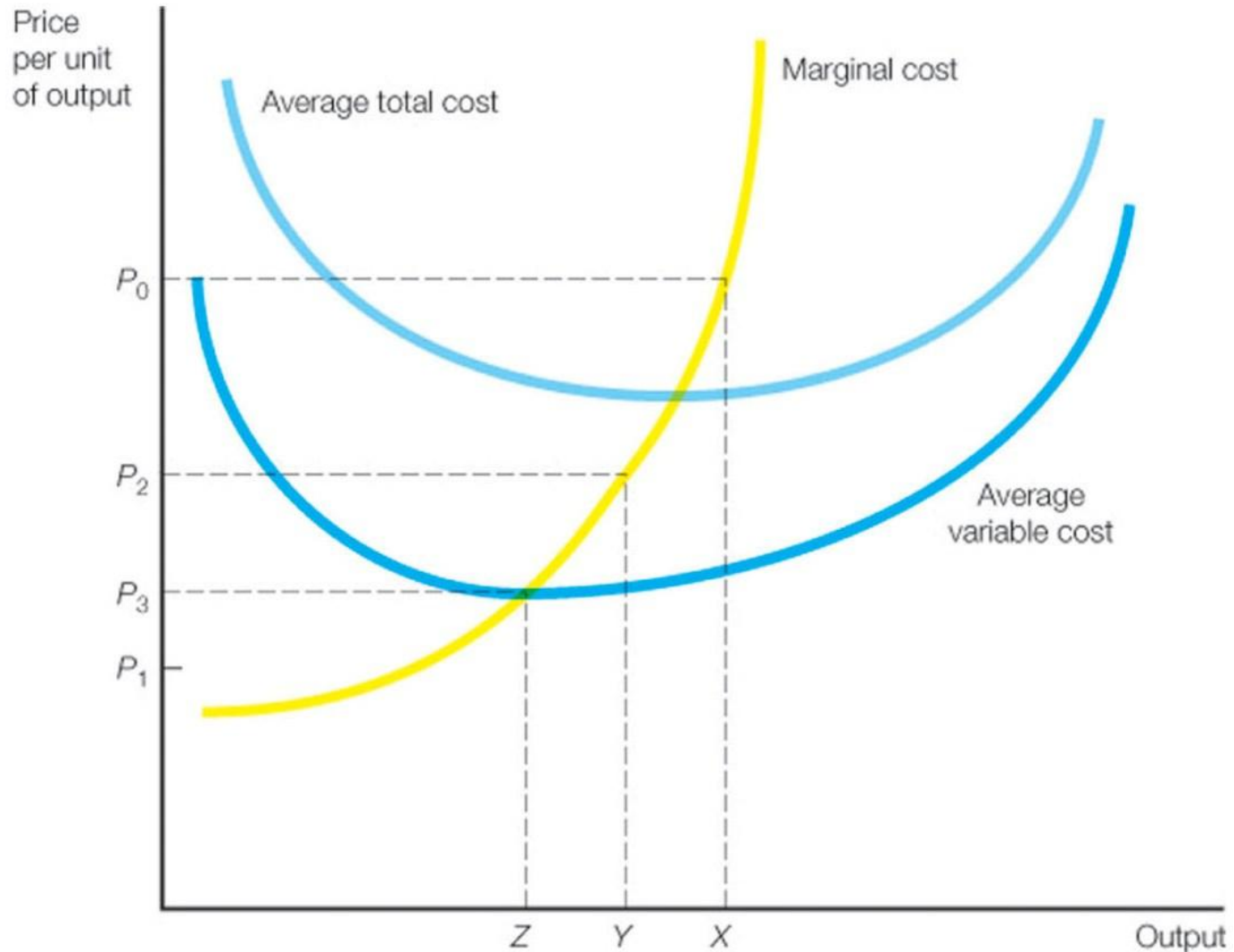


Figure 6.5. Short-Run Average and Marginal Cost Curves



The Kadda Company (Numerical Example)

$$TC = 800 + 6Q + 2Q^2$$

$$MC = \frac{dTC}{dQ} = 6 + 4Q = 30 = P \Rightarrow Q^* = 6.$$

$$AVC = (6Q + 2Q^2) / Q = 6 + 2Q = 18.$$

Since $P = \$30 > AVC$, it is worthwhile producing since $\pi = 30Q - 800 - 6Q - 2Q^2 = 24Q - 800 - 2Q^2 = 144 - 872 = -\728 (otherwise you lose \$800).

The $MRP = MRE$ rule

To maximize profit, the firm should utilize the amount of input Y where the marginal revenue product equals the marginal expenditure:

$$MRP_Y = \frac{dTR}{dQ} \frac{dQ}{dY} = \frac{dTC}{dQ} \frac{dQ}{dY} = ME_Y$$

$$\Rightarrow MR = \frac{dTR}{dQ} = \frac{dTC}{dQ} = MC!$$

Class Problem 6.1

- Crude oil is carried by pipelines from oil fields and storage areas over hundreds of miles to urban and industrial centers. Output is the amount of oil carried per day, and the two principal inputs are pipeline diameter and the horsepower applied to the oil carried. Suppose that an oil company estimates that throughput per day in its pipeline is given by

$$Q = 286H^{0.37},$$

where H is horsepower usage, which costs \$30 per unit, and throughput has a marginal revenue of \$2 per unit. Use the $MRP = MRE$ rule to figure out the profit maximizing level of horsepower usage for this company.

Market Equilibrium

- In the short run, output will occur where $MR = MC$, and revenue is greater than variable cost.
 - Above-normal short-run profits are possible; e.g., one firm may have lower costs than its rivals.
- However, if markets are competitively structured, then long-run economic profits get quickly dissipated.
 - Suppose such profits exist; then new firms will enter the market (since there are no entry barriers), output will increase, and price will fall until zero economic profits are earned.

Market Equilibrium

- Long-run market equilibrium in perfectly competitive markets is characterized by:
 - Market demand equals market supply.
 - No consumer wishes to change the amount of goods or services she is buying.
 - Incumbent firms have no interest in changing their production decisions; no further market entry or exit, and firms produce at the point of the minimum average total cost on their long-run average cost curves.