LEARNING MODULE

1

The Firm and Market Structures

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LEARNING OUTCOMES

Mastery	*The candidate should be able to:*
☐	determine and interpret breakeven and shutdown points of production, as well as how economies and diseconomies of scale affect costs under perfect and imperfect competition
☐	describe characteristics of perfect competition, monopolistic competition, oligopoly, and pure monopoly
☐	explain supply and demand relationships under monopolistic competition, including the optimal price and output for firms as well as pricing strategy
☐	explain supply and demand relationships under oligopoly, including the optimal price and output for firms as well as pricing strategy
☐	identify the type of market structure within which a firm operates and describe the use and limitations of concentration measures

INTRODUCTION

This learning module addresses several important concepts that extend the basic market model of demand and supply to the assessment of a firm's breakeven and shutdown points of production. Demand concepts covered include own-price elasticity of demand, cross-price elasticity of demand, and income elasticity of demand. Supply concepts covered include total, average, and marginal product of labor; total, variable, and marginal cost of labor; and total and marginal revenue. These concepts are used to calculate the breakeven and shutdown points of production.

This learning module surveys how economists classify market structures. We analyze distinctions between the different structures that are important for understanding demand and supply relations, optimal price and output, and the factors affecting long-run profitability. We also provide guidelines for identifying market structure in practice.

LEARNING MODULE OVERVIEW

- Firms under conditions of perfect competition have no pricing power and, therefore, face a perfectly horizontal demand curve at the market price. For firms under conditions of perfect competition, price is identical to marginal revenue (MR).
- Firms under conditions of imperfect competition face a negatively sloped demand curve and have pricing power. For firms under conditions of imperfect competition, MR is less than price.
- Economic profit equals total revenue (TR) minus total economic cost, whereas accounting profit equals TR minus total accounting cost.
- Economic cost considers the total opportunity cost of all factors of production.
- Opportunity cost is the next best alternative use of a resource forgone in making a decision.
- Maximum economic profit requires that (1) MR equals marginal cost (MC) and (2) MC not be falling with output.
- The breakeven point occurs when TR equals total cost (TC), otherwise stated as the output quantity at which average total cost (ATC) equals price.
- Shutdown occurs when a firm is better off not operating than continuing to operate.
- If all fixed costs are sunk costs, then shutdown occurs when the market price falls below the minimum average variable cost. After shutdown, the firm incurs only fixed costs and loses less money than it would operating at a price that does not cover variable costs.
- In the short run, it may be rational for a firm to continue to operate while earning negative economic profit if some unavoidable fixed costs are covered.
- Economies of scale is defined as decreasing long-run cost per unit as output increases. Diseconomies of scale is defined as increasing long-run cost per unit as output increases.
- Long-run ATC is the cost of production per unit of output under conditions in which all inputs are variable.
- Specialization efficiencies and bargaining power in input price can lead to economies of scale.
- Bureaucratic and communication breakdowns and bottlenecks that raise input prices can lead to diseconomies of scale.
- The minimum point on the long-run ATC curve defines the minimum efficient scale for the firm.
- Economic market structures can be grouped into four categories: perfect competition, monopolistic competition, oligopoly, and monopoly.

- The categories of economic market structures differ because of the following characteristics: The number of producers is many in perfect and monopolistic competition, few in oligopoly, and one in monopoly. The degree of product differentiation, the pricing power of the producer, the barriers to entry of new producers, and the level of nonprice competition (e.g., advertising) are all low in perfect competition, moderate in monopolistic competition, high in oligopoly, and generally highest in monopoly.
- A financial analyst must understand the characteristics of market structures to better forecast a firm's future profit stream.
- The optimal MR equals MC. Only in perfect competition, however, does the MR equal price. In the remaining structures, price generally exceeds MR because a firm can sell more units only by reducing the per unit price.
- The quantity sold is highest in perfect competition. The price in perfect competition is usually lowest, but this depends on factors such as demand elasticity and increasing returns to scale (which may reduce the producer's MC). Monopolists, oligopolists, and producers in monopolistic competition attempt to differentiate their products so that they can charge higher prices.
- Typically, monopolists sell a smaller quantity at a higher price. Investors may benefit from being shareholders of monopolistic firms that have large margins and substantial positive cash flows.
- In perfect competition, firms do not earn economic profit. The market will compensate for the rental of capital and of management services, but the lack of pricing power implies that there will be no extra margins.
- In the short run, firms in any market structure can have economic profits, the more competitive a market is and the lower the barriers to entry, the faster the extra profits will fade. In the long run, new entrants shrink margins and push the least efficient firms out of the market.
- Oligopoly is characterized by the importance of strategic behavior. Firms can change the price, quantity, quality, and advertisement of the product to gain an advantage over their competitors. Several types of equilibrium (e.g., Nash, Cournot, kinked demand curve) may occur that affect the likelihood of each of the incumbents (and potential entrants in the long run) having economic profits. Price wars may be started to force weaker competitors to abandon the market.
- Measuring market power is complicated. Ideally, econometric estimates of the elasticity of demand and supply should be computed. However, because of the lack of reliable data and the fact that elasticity changes over time (so that past data may not apply to the current situation), regulators and economists often use simpler measures. The concentration ratio is simple, but the Herfindahl-Hirschman index (HHI), with a little more computation required, often produces a better figure for decision making.

2 PROFIT MAXIMIZATION: PRODUCTION BREAKEVEN, SHUTDOWN AND ECONOMIES OF SCALE

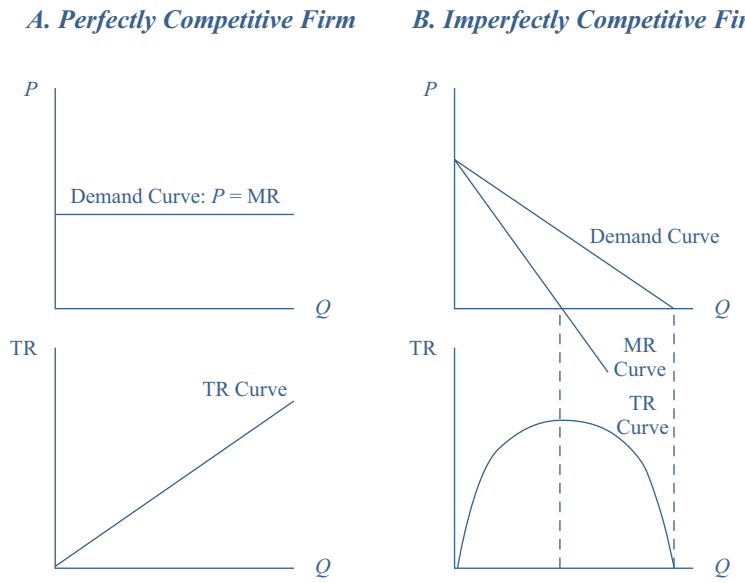
☐ determine and interpret breakeven and shutdown points of production, as well as how economies and diseconomies of scale affect costs under perfect and imperfect competition

Firms generally can be classified as operating in either a perfectly competitive or an imperfectly competitive environment. The difference between the two manifests in the slope of the demand curve facing the firm. If the environment of the firm is perfectly competitive, it must take the market price of its output as given, so it faces a perfectly elastic, horizontal demand curve. In this case, the firm's marginal revenue (MR) and the price of its product are identical. Additionally, the firm's **average revenue** (AR), or revenue per unit, is also equal to price per unit. A firm that faces a negatively sloped demand curve, however, must lower its price to sell an additional unit, so its MR is less than price (P).

These characteristics of MR are also applicable to the total revenue (TR) functions. Under conditions of perfect competition, TR (as always) is equal to price times quantity: TR = $(P)(Q)$. But under conditions of perfect competition, price is dictated by the market; the firm has no control over price. As the firm sells one more unit, its TR rises by the exact amount of price per unit.

Under conditions of imperfect competition, price is a variable under the firm's control, and therefore price is a function of quantity: $P = f(Q)$, and TR = $f(Q) \times Q$. For simplicity, suppose the firm is monopolistic and faces the market demand curve, which we will assume is linear and negatively sloped. Because the monopolist is the only seller, its TR is identical to the total expenditure of all buyers in the market. When price is reduced and quantity sold increases in this environment, a decrease in price initially increases total expenditure by buyers and TR to the firm because the decrease in price is outweighed by the increase in units sold. But as price continues to fall, the decrease in price overshadows the increase in quantity, and total expenditure (revenue) falls. We can now depict the demand and TR functions for firms under conditions of perfect and imperfect competition, as shown in Exhibit 1.

Exhibit 1: Demand and Total Revenue Functions for Firms under Conditions of Perfect and Imperfect Competition

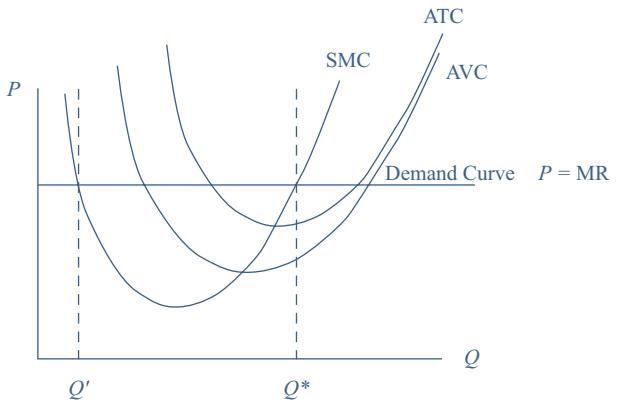


Panel A of Exhibit 1 depicts the demand curve (upper graph) and total revenue curve (lower graph) for the firm under conditions of perfect competition. Notice that the vertical axis in the upper graph is price per unit (e.g., GBP/bushel), whereas TR is measured on the vertical axis in the lower graph (e.g., GBP/week). The same is true for the respective axes in Panel B, which depicts the demand and total revenue curves for the monopolist. The TR curve for the firm under conditions of perfect competition is linear, with a slope equal to price per unit. The TR curve for the monopolist first rises (in the range where MR is positive and demand is elastic) and then falls (in the range where MR is negative and demand is inelastic) with output.

Profit-Maximization, Breakeven, and Shutdown Points of Production

We can now combine the firm's short-run TC curves with its TR curves to represent profit maximization in the cases of perfect competition and imperfect competition. Exhibit 2 shows both the AR and average cost curves in one graph for the firm under conditions of perfect competition.

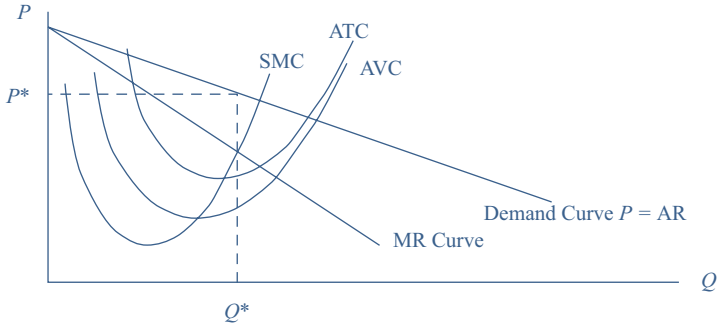
Exhibit 2: Demand and Average and Marginal Cost Curves for the Firm under Conditions of Perfect Competition



The firm is maximizing profit by producing Q^*, where price is equal to short-run marginal cost (SMC) and SMC is rising. Note at another output level, Q', where P = SMC, SMC is still falling, so this cannot be a profit-maximizing solution. If market price were to rise, the firm's demand and MR curve would simply shift upward, and the firm would reach a new profit-maximizing output level to the right of Q^*. If, however, market price were to fall, the firm's demand and MR curve would shift downward, resulting in a new and lower level of profit-maximizing output. As depicted, this firm is currently earning a positive economic profit because market price exceeds average total cost (ATC), at output level Q^*. This profit is possible in the short run, but in the long run, competitors would enter the market to capture some of those profits and would drive the market price down to a level equal to each firm's ATC.

Exhibit 3 depicts the cost and revenue curves for the monopolist that is facing a negatively sloped market demand curve. The MR and demand curves are not identical for this firm. But the profit-maximizing rule is still the same: Find the level of Q that equates SMC, to MR—in this case, Q^*. Once that level of output is determined, the optimal price to charge is given by the firm's demand curve at P^*. This monopolist is earning positive economic profit because its price exceeds its ATC. The barriers to entry that give this firm its monopolistic power mean that outside competitors would not be able to compete away this firm's profits.

Exhibit 3: Demand and Average and Marginal Cost Curves for the Monopolistic Firm



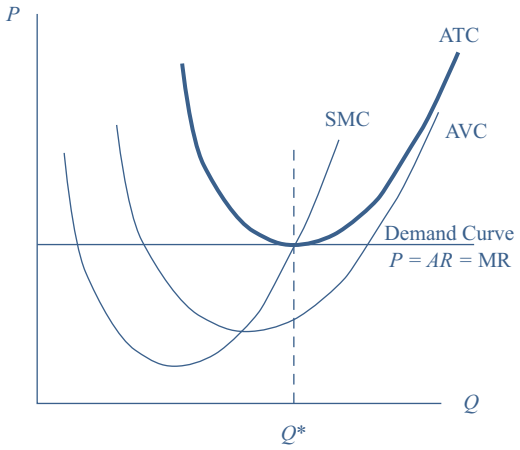
Breakeven Analysis and Shutdown Decision

A firm is said to break even if its TR is equal to its TC. It also can be said that a firm breaks even if its price (AR) is exactly equal to its ATC, which is true under conditions of perfect and imperfect competition. Of course, the goal of management is not just to breakeven but to maximize profit. However, perhaps the best the firm can do is cover all of its economic costs. Economic costs are the sum of total accounting costs and implicit opportunity costs. A firm whose revenue is equal to its economic costs is covering the opportunity cost of all of its factors of production, including capital. Economists would say that such a firm is earning normal profit, but not positive economic profit. It is earning a rate of return on capital just equal to the rate of return that an investor could expect to earn in an equivalently risky alternative investment (opportunity cost). Firms that are operating in a competitive environment with no barriers to entry from other competitors can expect, in the long run, to be unable to earn a positive economic profit; the excess rate of return would attract entrants who would produce more output and ultimately drive the market price down to the level at which each firm is, at best, just earning a normal profit. This situation, of course, does not imply that the firm is earning zero accounting profit.

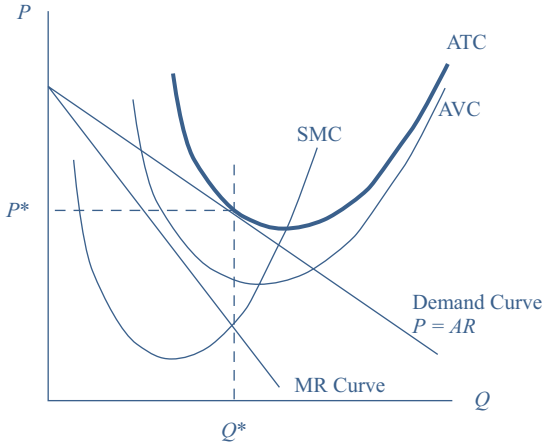
Exhibit 4 depicts the condition for both a firm under conditions of perfect competition (Panel A) and a monopolist (Panel B) in which the best each firm can do is to break even. Note that at the level of output at which SMC is equal to MR, price is equal to ATC. Hence, economic profit is zero, and the firms are breaking even.

Exhibit 4: Examples of Firms under Perfect Competition and Monopolistic Firms That Can, at Best, Break Even

A. Perfect Competition



B. Monopolist



The Shutdown Decision

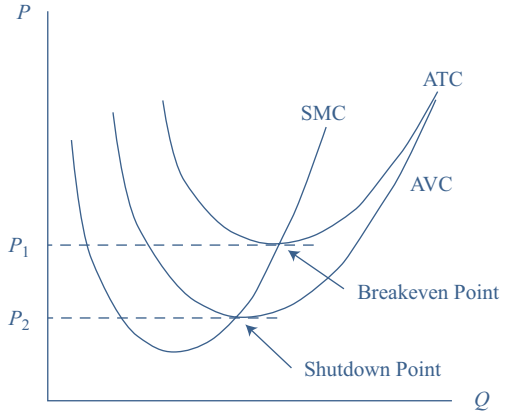
In the long run, if a firm cannot earn at least a zero economic profit, it will not operate because it is not covering the opportunity cost of all of its factors of production, labor, and capital. In the short run, however, a firm might find it advantageous to continue to operate even if it is not earning at least a zero economic profit. The discussion that follows addresses the decision to continue to operate and earn negative profit or shut down operations.

Recall that typically some or all of a firm's fixed costs are incurred regardless of whether the firm operates. The firm might have a lease on its building that it cannot avoid paying until the lease expires. In that case, the lease payment is a sunk cost: It cannot be avoided, no matter what the firm does. Sunk costs must be ignored in the decision to continue to operate in the short run. As long as the firm's revenues cover

at least its variable cost, the firm is better off continuing to operate. If price is greater than average variable cost (AVC), the firm is covering not only all of its variable cost but also a portion of fixed cost.

In the long run, unless market price increases, this firm would exit the industry. But in the short run, it will continue to operate at a loss. Exhibit 5 depicts a firm under conditions of perfect competition facing three alternative market price ranges for its output. At any price above P_1, the firm can earn a positive profit and clearly should continue to operate. At a price below P_2, the minimum AVC, the firm could not even cover its variable cost and should shut down. At prices between P_2 and P_1, the firm should continue to operate in the short run because it is able to cover all of its variable cost and contribute something toward its unavoidable fixed costs. Economists refer to the minimum AVC point as the **shutdown point** and the minimum ATC point as the **breakeven point**.

Exhibit 5: A Firm under Conditions of Perfect Competition Will Choose to Shut Down If Market Price Is Less Than Minimum AVC



EXAMPLE 1

Breakeven Analysis and Profit Maximization When the Firm Faces a Negatively Sloped Demand Curve under Imperfect Competition

Revenue and cost information for a future period including all opportunity costs is presented in Exhibit 6 for WR International, a newly formed corporation that engages in the manufacturing of low-cost, prefabricated dwelling units for urban housing markets in emerging economies. (Note that quantity increments are in blocks of 10 for a 250 change in price.) The firm has few competitors in a market setting of imperfect competition.

Exhibit 6: Revenue and Cost Information for WR International

Quantity (*Q*)	Price (*P*)	Total Revenue (*TR*)	Total Cost (*TC*)[a]	Profit
0	10,000	0	100,000	–100,000
10	9,750	97,500	170,000	–72,500

Quantity (*Q*)	Price (*P*)	Total Revenue (*TR*)	Total Cost (*TC*)[a]	Profit
20	9,500	190,000	240,000	–50,000
30	9,250	277,500	300,000	–22,500
40	9,000	360,000	360,000	0
50	8,750	437,500	420,000	17,500
60	8,500	510,000	480,000	30,000
70	8,250	577,500	550,000	27,500
80	8,000	640,000	640,000	0
90	7,750	697,500	710,000	–12,500
100	7,500	750,000	800,000	–50,000

[a] *Includes all opportunity costs*

1. How many units must WR International sell to initially break even?

   Solution:

   WR International will initially break even at 40 units of production, where TR and TC equal 360,000.

2. Where is the region of profitability?

   Solution:

   The region of profitability will range from greater than 40 units to less than 80 units. Any production quantity of less than 40 units and any quantity greater than 80 units will result in an economic loss.

3. At what point will the firm maximize profit? At what points are there economic losses?

   Solution:

   Maximum profit of 30,000 will occur at 60 units. Lower profit will occur at any output level that is higher or lower than 60 units. From 0 units to less than 40 units and for quantities greater than 80 units, economic losses occur.

Given the relationships between TR, total variable costs (TVC), and total fixed costs (TFC), Exhibit 7 summarizes the decisions to operate, shut down production, or exit the market in both the short run and the long run. The firm must cover its variable cost to remain in business in the short run; if TR cannot cover TVC, the firm shuts down production to minimize loss. The loss would be equal to the amount of fixed cost. If TVC exceeds TR in the long run, the firm will exit the market to avoid the loss associated with fixed cost at zero production. By exiting the market, the firm's investors do not suffer the erosion of their equity capital from economic losses. When TR is enough to cover TVC but not all of TFC, the firm can continue to produce in the short run but will not be able to maintain financial solvency in the long run.

Exhibit 7: Short-Run and Long-Run Decisions to Operate or Not

Revenue–Cost Relationship	Short-Run Decision	Long-Term Decision
TR = TC	Stay in market	Stay in market
TR = TVC but < TC	Stay in market	Exit market
TR < TVC	Shut down production	Exit market

EXAMPLE 2

Shutdown Analysis

For the most recent financial reporting period, a London-based business has revenue of GBP2 million and TC of GBP2.5 million, which are or can be broken down into TFC of GBP1 million and TVC of GBP1.5 million. The net loss on the firm's income statement is reported as GBP500,000 (ignoring tax implications). In prior periods, the firm had reported profits on its operations.

1. What decision should the firm make regarding operations over the short term?

   Solution:

   In the short run, the firm is able to cover all of its TVC but only half of its GBP1 million in TFC. If the business ceases to operate, its loss would be GBP1 million, the amount of TFC, whereas the net loss by operating would be minimized at GBP500,000. The firm should attempt to operate by negotiating special arrangements with creditors to buy time to return operations back to profitability.

2. What decision should the firm make regarding operations over the long term?

   Solution:

   If the revenue shortfall is expected to persist over time, the firm should cease operations, liquidate assets, and pay debts to the extent possible. Any residual for shareholders would decrease the longer the firm is allowed to operate unprofitably.

3. Assume the same business scenario except that revenue is now GBP1.3 million, which creates a net loss of GBP1.2 million. What decision should the firm make regarding operations in this case?

   Solution:

   The firm would minimize loss at GBP1 million of TFC by shutting down. If the firm decided to continue to do business, the loss would increase to GBP1.2 million. Shareholders would save GBP200,000 in equity value by pursuing this option. Unquestionably, the business would have a rather short life expectancy if this loss situation were to continue.

When evaluating profitability, particularly of start-up firms and businesses using turnaround strategies, analysts should consider highlighting breakeven and shutdown points in their financial research. Identifying the unit sales levels at which the firm

enters or leaves the production range for profitability and at which the firm can no longer function as a viable business entity provides invaluable insight when making investment decisions.

Economies and Diseconomies of Scale with Short-Run and Long-Run Cost Analysis

Rational behavior dictates that the firm select an operating size or scale that maximizes profit over any time frame. The time frame that defines the short run and long run for any firm is based on the ability of the firm to adjust the quantities of the fixed resources it uses. The short run is the time period during which at least one of the factors of production, such as technology, physical capital, and plant size, is fixed. The long run is defined as the time period during which all factors of production are variable. Additionally, in the long run, firms can enter or exit the market based on decisions regarding profitability. The long run is often referred to as the "planning horizon" in which the firm can choose the short-run position or optimal operating size that maximizes profit over time. The firm is always operating in the short run but planning in the long run.

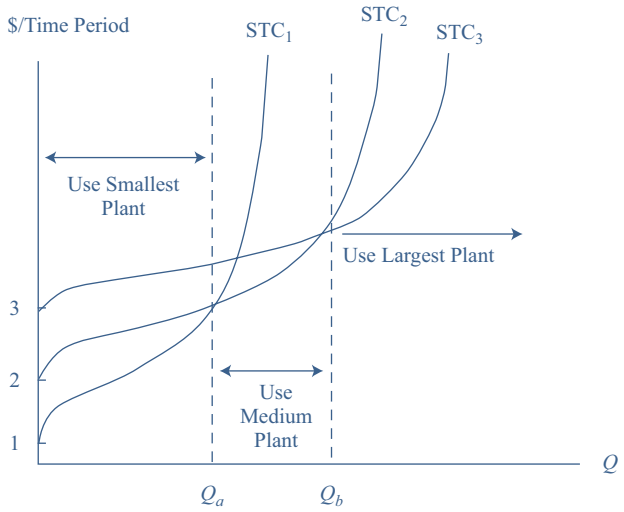
The time required for long-run adjustments varies by industry. For example, the long run for a small business using very little technology and physical capital may be less than a year, whereas for a capital-intensive firm, the long run may be more than a decade. Given enough time, however, all production factors are variable, which allows the firm to choose an operating size or plant capacity based on different technologies and physical capital. In this regard, costs and profits will differ between the short run and the long run.

Short- and Long-Run Cost Curves

Recall that when we addressed the short-run cost curves of the firm, we assumed that the capital input was held constant. That meant that the only way to vary output in the short run was to change the level of the variable input—in our case, labor. If the capital input—namely, plant and equipment—were to change, however, we would have an entirely new set of short-run cost curves, one for each level of capital input.

The short-run total cost includes all the inputs—labor and capital—the firm is using to produce output. For reasons discussed earlier, the typical short-run total cost (STC) curve might rise with output, first at a decreasing rate because of specialization economies and then at an increasing rate, reflecting the law of diminishing marginal returns to labor. TFC, the quantity of capital input multiplied by the rental rate on capital, determines the vertical intercept of the STC curve. At higher levels of fixed input, TFC is greater, but the production capacity of the firm is also greater. Exhibit 8 shows three different STC curves for the same technology but using three distinct levels of capital input—points 1, 2, and 3 on the vertical axis.

Exhibit 8: Short-Run Total Cost Curves for Various Plant Sizes



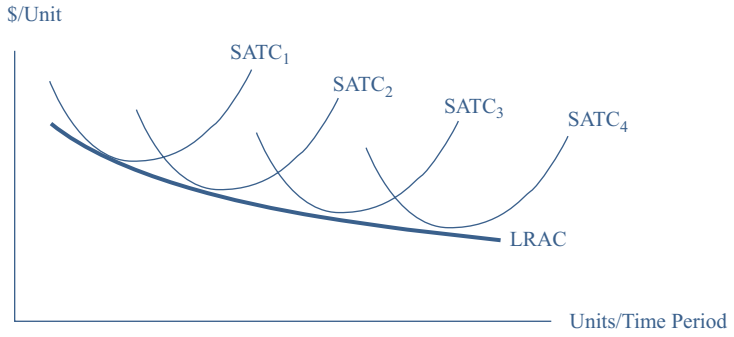
Plant Size 1 is the smallest and, of course, has the lowest fixed cost; hence, its STC_1 curve has the lowest vertical intercept. Note that STC_1 begins to rise more steeply with output, reflecting the lower plant capacity. Plant Size 3 is the largest of the three and reflects that size with both a higher fixed cost and a lower slope at any level of output. If a firm decided to produce an output between zero and Q_a, it would plan on building Plant Size 1 because for any output level in that range, its cost would be less than it would be for Plant Size 2 or 3. Accordingly, if the firm were planning to produce output greater than Q_b, it would choose Plant Size 3 because its cost for any of those levels of output would be lower than it would be for Plant Size 1 or 2. Of course, Plant Size 2 would be chosen for output levels between Q_a and Q_b. The long-run total cost curve is derived from the lowest level of STC for each level of output because in the long run, the firm is free to choose which plant size it will operate. This curve is called an "envelope curve." In essence, this curve envelopes—encompasses—all possible combinations of technology, plant size, and physical capital.

For each STC curve, there is also a corresponding **short-run average total cost** (SATC) curve and a corresponding **long-run average total cost** (LRAC) curve, the envelope curve of all possible short-run average total cost curves. The shape of the LRAC curve reflects an important concept called **economies of scale** and **diseconomies of scale**.

Defining Economies of Scale and Diseconomies of Scale

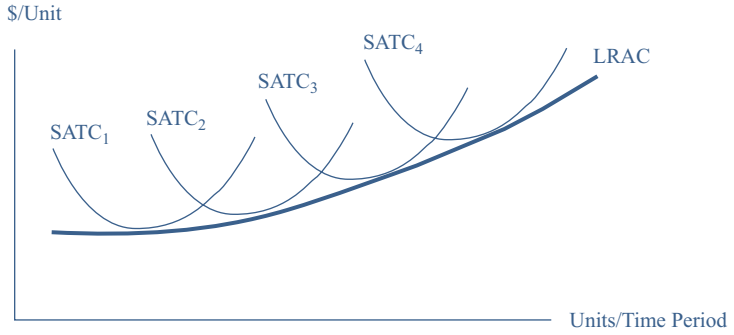
When a firm increases all of its inputs to increase its level of output (obviously, a long-run concept), it is said to *scale up* its production. *Scaling down* is the reverse—decreasing all of its inputs to produce less in the long run. Economies of scale occur if, as the firm increases its output, cost per unit of production falls. Graphically, this definition translates into an LRAC curve with a negative slope. Exhibit 9 depicts several SATC curves, one for each plant size, and the LRAC curve representing economies of scale.

Exhibit 9: Short-Run Average Total Cost Curves for Various Plant Sizes and Their Envelope Curve, LRAC: Economies of Scale



Diseconomies of scale occur if cost per unit rises as output increases. Graphically, diseconomies of scale translate into an LRAC curve with a positive slope. Exhibit 10 depicts several SATC curves, one for each plant size, and their envelope curve, the LRAC curve, representing diseconomies of scale.

Exhibit 10: Short-Run Average Total Cost Curves for Various Plant Sizes and Their Envelope Curve, LRAC: Diseconomies of Scale



As the firm grows in size, economies of scale and a lower ATC can result from the following factors:

- Achieving **increasing returns to scale** when a production process allows for increases in output that are proportionately larger than the increase in inputs.
- Having a division of labor and management in a large firm with numerous workers, which allows each worker to specialize in one task rather than perform many duties, as in the case of a small business (as such, workers in a large firm become more proficient at their jobs).
- Being able to afford more expensive, yet more efficient equipment and to adapt the latest in technology that increases productivity.
- Effectively reducing waste and lowering costs through marketable by-products, less energy consumption, and enhanced quality control.
- Making better use of market information and knowledge for more effective managerial decision making.

- Obtaining discounted prices on resources when buying in larger quantities.

A classic example of a business that realizes economies of scale through greater physical capital investment is an electric utility. By expanding output capacity to accommodate a larger customer base, the utility company's per-unit cost will decline. Economies of scale help explain why electric utilities have naturally evolved from localized entities to regional and multiregional enterprises. Walmart is an example of a business that has used its bulk purchasing power to obtain deep discounts from suppliers to keep costs and prices low. Walmart also uses the latest technology to monitor point-of-sale transactions to gather timely market information to respond to changes in customer buying behavior, which leads to economies of scale through lower distribution and inventory costs.

Factors that can lead to diseconomies of scale, inefficiencies, and rising costs when a firm increases in size include the following:

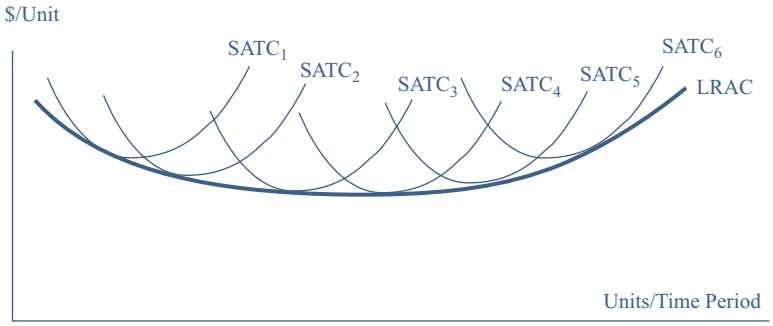
- Realizing **decreasing returns to scale** when a production process leads to increases in output that are proportionately smaller than the increase in inputs.
- Being so large that it cannot be properly managed.
- Overlapping and duplicating business functions and product lines.
- Experiencing higher resource prices because of supply constraints when buying inputs in large quantities.

Before its restructuring, General Motors (GM) was an example of a business that had realized diseconomies of scale by becoming too large. Scale diseconomies occurred through product overlap and duplication (i.e., similar or identical automobile models), and the fixed cost for these models was not spread over a large volume of output. In 2009, GM decided to discontinue three brands (Saturn, Pontiac, and Hummer) and also to drop various low-volume product models that overlapped with others. GM had numerous manufacturing plants around the world and sold vehicles in more than a hundred countries. Given this geographic dispersion in production and sales, the company had communication and management coordination problems, which resulted in higher costs. In 2017, GM sold its European arm, Opel, to Groupe PSA, the maker of Peugeot and Citroën. GM also had significantly higher labor costs than its competitors. As the largest producer in the market, it had been a target of labor unions for higher compensation and benefits packages relative to other firms.

Economies and diseconomies of scale can occur at the same time; the impact on LRAC depends on which dominates. If economies of scale dominate, LRAC decreases with increases in output. The reverse holds true when diseconomies of scale prevail. LRAC may fall (economies of scale) over a range of output and then LRAC might remain constant over another range, which could be followed by a range over which diseconomies of scale prevail, as depicted in Exhibit 11.

The minimum point on the LRAC curve is referred to as the **minimum efficient scale**. The minimum efficient scale is the optimal firm size under perfect competition over the long run. Theoretically, perfect competition forces the firm to operate at the minimum point on the LRAC curve because the market price will be established at this level over the long run. If the firm is not operating at this least-cost point, its long-term viability will be threatened.

Exhibit 11: LRAC Can Exhibit Economies and Diseconomies of Scale



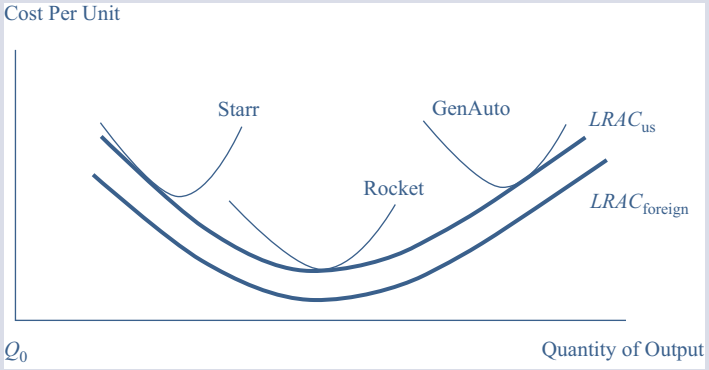
EXAMPLE 3

Long-Run Average Total Cost Curve

Exhibit 12 displays the long-run average total cost curve ($LRAC_{US}$) and the short-run average total cost curves for three hypothetical US-based automobile manufacturers—Starr Vehicles (Starr), Rocket Sports Cars (Rocket), and General Auto (GenAuto). The LRAC curve for foreign-owned automobile companies that compete in the US auto market ($LRAC_{foreign}$) is also indicated in the graph. (The market structure implicit in the exhibit is imperfect competition.)

1. To what extent are the cost relationships depicted in Exhibit 12 useful for an economic and financial analysis of the three US-based auto firms?

Exhibit 12: Long-Run Average Total Cost Curves for Three Auto Manufacturers



Solution:

First, it is observable that the foreign auto companies have a lower LRAC compared with that of the US automobile manufacturers. This competitive position places the US firms at a cost—and possibly, pricing—disadvantage in the market, with the potential to lose market share to the lower-cost foreign competitors. Second, only Rocket operates at the minimum point of the $LRAC_{US}$, whereas GenAuto is situated in the region of diseconomies of scale and Starr is positioned in the economies of scale portion of the curve. To become more efficient and competitive, GenAuto needs to downsize and restructure, which means moving down the $LRAC_{US}$ curve to a smaller

yet lower-cost production volume. In contrast, Starr has to grow in size to become more efficient and competitive by lowering per-unit costs. From a long-term investment prospective and given its cost advantage, Rocket has the potential to create more investment value relative to GenAuto and Starr. Over the long run, if GenAuto and Starr can lower their ATC, they will become more attractive to investors. But if any of the three US auto companies cannot match the cost competitiveness of the foreign firms, they may be driven from the market. In the long run, the lower-cost foreign automakers pose a severe competitive challenge to the survival of the US manufacturers and their ability to maintain and grow shareholders' wealth.

QUESTION SET

1. An agricultural firm operating in a perfectly competitive market supplies wheat to manufacturers of consumer food products and animal feeds. If the firm were able to expand its production and unit sales by 10%, the *most likely* result would be:

   A. a 10% increase in total revenue.

   B. a 10% increase in average revenue.

   C. a less than 10% increase in total revenue.

   Solution:

   A is correct. In a perfectly competitive market, an increase in supply by a single firm will not affect price. Therefore, an increase in units sold by the firm will be matched proportionately by an increase in revenue.

2. The marginal revenue per unit sold for a firm doing business under conditions of perfect competition will *most likely* be:

   A. equal to average revenue.

   B. less than average revenue.

   C. greater than average revenue.

   Solution:

   A is correct. Under perfect competition, a firm is a price taker at any quantity supplied to the market, and AR = MR = Price.

3. A profit maximum is *least likely* to occur when:

   A. average total cost is minimized.

   B. marginal revenue is equal to marginal cost.

   C. the difference between total revenue and total cost is maximized.

   Solution:

   A is correct. The quantity at which average total cost is minimized does not necessarily correspond to a profit maximum.

4. The short-term breakeven point of production for a firm operating under perfect competition will *most likely* occur when:

   A. price is equal to average total cost.

   B. marginal revenue is equal to marginal cost.

C. marginal revenue is equal to average variable costs.

Solution:

A is correct. Under perfect competition, price is equal to marginal revenue. A firm breaks even when marginal revenue equals average total cost.

3 INTRODUCTION TO MARKET STRUCTURES

☐ describe characteristics of perfect competition, monopolistic competition, oligopoly, and pure monopoly

Different market structures result in different sets of choices facing a firm's decision makers. Thus, an understanding of market structure is a powerful tool in analyzing issues, such as a firm's pricing of its products and, more broadly, its potential to increase profitability. In the long run, a firm's profitability will be determined by the forces associated with the market structure within which it operates. In a highly competitive market, long-run profits will be driven down by the forces of competition. In less competitive markets, large profits are possible even in the long run; in the short run, any outcome is possible. Therefore, understanding the forces behind the market structure will aid the financial analyst in determining firms' short- and long-term prospects.

Market structures address questions such as the following: What determines the degree of competition associated with each market structure? Given the degree of competition associated with each market structure, what decisions are left to the management team developing corporate strategy? How does a chosen pricing and output strategy evolve into specific decisions that affect the profitability of the firm? The answers to these questions are related to the forces of the market structure within which the firm operates.

Analysis of Market Structures

Traditionally, economists classify a market into one of four structures: perfect competition, monopolistic competition, oligopoly, and monopoly.

Economists define a market as a group of buyers and sellers that are aware of each other and can agree on a price for the exchange of goods and services. Although internet access has extended a number of markets worldwide, certain markets remain limited by geographic boundaries. For example, the internet search engine Google operates in a worldwide market. In contrast, the market for premixed cement is limited to the area within which a truck can deliver the mushy mix from the plant to a construction site before the compound becomes useless. Thomas L. Friedman's international best seller *The World Is Flat* challenges the concept of the geographic limitations of the market. If the service being provided by the seller can be digitized, its market expands worldwide. For example, a technician can scan your injury in a clinic in Switzerland. That radiographic image can be digitized and sent to a radiologist in India to be read. As a customer (i.e., patient), you may never know that part of the medical service provided to you was the result of a worldwide market.

Some markets are highly concentrated, with the majority of total sales coming from a small number of firms. For example, in the market for internet search, three firms controlled 98.9 percent of the US market (Google 63.5 percent, Microsoft 24 percent, and Oath (formerly Yahoo!) 11.4 percent) as of January 2018. Other markets

are fragmented, such as automobile repairs, in which small independent shops often dominate and large chains may or may not exist. New products can lead to market concentration. For example, Apple introduced its first digital audio player (iPod) in 2001 and despite the entry of competitors had a world market share of more than 70 percent among digital audio players in 2009.

THE IMPORTANCE OF MARKET STRUCTURE

Consider the evolution of television broadcasting. As the market environment for television broadcasting evolved, the market structure changed, resulting in a new set of challenges and choices. In the early days, viewers had only one choice: the "free" analog channels that were broadcast over the airwaves. Most countries had one channel, owned and run by the government. In the United States, some of the more populated markets were able to receive more channels because local channels were set up to cover a market with more potential viewers. By the 1970s, new technologies made it possible to broadcast by way of cable connectivity and the choices offered to consumers began to expand rapidly. Cable television challenged the "free" broadcast channels by offering more choice and a better-quality picture. The innovation was expensive for consumers and profitable for the cable companies. By the 1990s, a new alternative began to challenge the existing broadcast and cable systems: satellite television. Satellite providers offered a further expanded set of choices, albeit at a higher price, than the free broadcast and cable alternatives. In the early 2000s, satellite television providers lowered their pricing to compete directly with the cable providers.

Today, cable program providers, satellite television providers, and terrestrial digital broadcasters that offer premium and pay-per-view channels compete for customers who are increasingly finding content on the internet and on their mobile devices. Companies like Netflix, Apple, and Amazon offered alternative ways for consumers to access content. Over time, these companies had moved beyond the repackaging of existing shows to developing their own content, mirroring the evolution of cable channels, such as HBO and ESPN a decade earlier.

This is a simple illustration of the importance of market structure. As the market for television broadcasting became increasingly competitive, managers have had to make decisions regarding product packaging, pricing, advertising, and marketing to survive in the changing environment. In addition, mergers and acquisitions as a response to these competitive pressures have changed the essential structure of the industry.

Market structure can be broken down into four distinct categories: perfect competition, monopolistic competition, oligopoly, and monopoly.

We start with the most competitive environment, **perfect competition**. Unlike some economic concepts, perfect competition is not merely an ideal based on assumptions. Perfect competition is a reality—for example, in several commodities markets, in which sellers and buyers have a strictly homogeneous product and no single producer is large enough to influence market prices. Perfect competition's characteristics are well recognized and its long-run outcome is unavoidable. Profits under the conditions of perfect competition are driven to the required rate of return paid by the entrepreneur to borrow capital from investors (so-called normal profit or rental cost of capital). This does not mean that all perfectly competitive industries are doomed to extinction by a lack of profits. On the contrary, millions of businesses that do very well are living under the pressures of perfect competition.

Monopolistic competition is also highly competitive; however, it is considered a form of imperfect competition. Two economists, Edward H. Chamberlin (United States) and Joan Robinson (United Kingdom), identified this hybrid market and came

up with the term because this market structure not only has strong elements of competition but also some monopoly-like conditions. The competitive characteristic is a notably large number of firms, while the monopoly aspect is the result of product differentiation. That is, if the seller can convince consumers that its product is uniquely different from other, similar products, then the seller can exercise some degree of pricing power over the market. A good example is the brand loyalty associated with soft drinks such as Coca-Cola. Many of Coca-Cola's customers believe that their beverages are truly different from and better than all other soft drinks. The same is true for fashion creations and cosmetics.

The **oligopoly** market structure is based on a relatively small number of firms supplying the market. The small number of firms in the market means that each firm must consider what retaliatory strategies the other firms will pursue when prices and production levels change. Consider the pricing behavior of commercial airline companies. Pricing strategies and route scheduling are based on the expected reaction of the other carriers in similar markets. For any given route—say, from Paris, France, to Chennai, India—only a few carriers are in competition. If one of the carriers changes its pricing package, others likely will retaliate. Understanding the market structure of oligopoly markets can help identify a logical pattern of strategic price changes for the competing firms.

Finally, the least competitive market structure is the **monopoly**. In pure monopoly markets, no other good substitutes exist for the given product or service. A single seller, which, if allowed to operate without constraint, exercises considerable power over pricing and output decisions. In most market-based economies around the globe, pure monopolies are regulated by a governmental authority. The most common example of a regulated monopoly is the local electrical power provider. In most cases, the monopoly power provider is allowed to earn a normal return on its investment and prices are set by the regulatory authority to allow that return.

Factors That Determine Market Structure

The following five factors determine market structure:

1. The number and relative size of firms supplying the product;
2. The degree of product differentiation;
3. The power of the seller over pricing decisions;
4. The relative strength of the barriers to market entry and exit; and
5. The degree of non-price competition.

The number and relative size of firms in a market influence market structure. When many firms exist, the degree of competition increases. With fewer firms supplying a good or service, consumers are limited in their market choices. One extreme case is the monopoly market structure, with only one firm supplying a unique good or service. Another extreme is perfect competition, with many firms supplying a similar product. Finally, an example of relative size is the automobile industry, in which a small number of large international producers (e.g., Volkswagen and Toyota) are the leaders in the global market, and a number of small companies either have market power because they are niche players (e.g., Ferrari or McLaren) or have limited market power because of their narrow range of models or limited geographical presence (e.g., Mazda or Stellantis).

In the case of monopolistic competition, many firms are providing products to the market, as with perfect competition. However, one firm's product is differentiated in some way that makes it appear to be better than similar products from other firms. If a firm is successful in differentiating its product, this differentiation will provide pricing leverage. The more dissimilar the product appears, the more the market will

resemble the monopoly market structure. A firm can differentiate its product through aggressive advertising campaigns; frequent styling changes; the linking of its product with other complementary products; or a host of other methods.

When the market dictates the price based on aggregate supply and demand conditions, the individual firm has no control over pricing. The typical hog farmer in Nebraska and the milk producer in Bavaria are **price takers**. That is, they must accept whatever price the market dictates. This is the case under the market structure of perfect competition. In the case of monopolistic competition, the success of product differentiation determines the degree with which the firm can influence price. In the case of oligopoly, there are so few firms in the market that price control becomes possible. However, the small number of firms in an oligopoly market invites complex pricing strategies. Collusion, price leadership by dominant firms, and other pricing strategies can result.

The degree to which one market structure can evolve into another and the difference between potential short-run outcomes and long-run equilibrium conditions depend on the strength of the barriers to entry and the possibility that firms fail to recoup their original costs or lose money for an extended period of time and therefore are forced to exit the market. Barriers to entry can result from large capital investment requirements, as in the case of petroleum refining. Barriers may also result from patents, as in the case of some electronic products and drug formulas. Another entry consideration is the possibility of high exit costs. For example, plants that are specific to a special line of products, such as aluminum smelting plants, are non-redeployable, and exit costs would be high without a liquid market for the firm's assets. High exit costs deter entry and therefore also are considered barriers to entry. In the case of farming, the barriers to entry are low. Production of corn, soybeans, wheat, tomatoes, and other produce is an easy process to replicate; therefore, those are highly competitive markets.

Non-price competition dominates those market structures in which product differentiation is critical. Therefore, monopolistic competition relies on competitive strategies that may not include pricing changes. An example of non-price competition is product differentiation through marketing. In other circumstances, non-price competition may occur because the few firms in the market feel dependent on each other. Each firm fears retaliatory price changes that would reduce total revenue for all of the firms in the market. Because oligopoly industries have so few firms, each firm feels dependent on the pricing strategies of the others. Therefore, non-price competition becomes a dominant strategy.

Characteristics of Market Structure

Exhibit 13: Characteristics of Market Structure

Market Structure	Number of Sellers	Degree of Product Differentiation	Barriers to Entry	Pricing Power of Firm	Non-Price Competition
Perfect competition	Many	Homogeneous/ Standardized	Very Low	None	None
Monopolistic competition	Many	Differentiated	Low	Some	Advertising and Product Differentiation
Oligopoly	Few	Homogeneous/ Standardized	High	Some or Considerable	Advertising and Product Differentiation
Monopoly	One	Unique Product	Very High	Considerable	Advertising

From the perspective of the owners of the firm, the most desirable market structure is that with the most control over price, because this control can lead to large profits (Exhibit 13). Monopoly and oligopoly markets offer the greatest potential control over price; monopolistic competition offers less control. Firms operating under perfectly competitive market conditions have no control over price. From the consumers' perspective, the most desirable market structure is that with the greatest degree of competition because prices are generally lower. Thus, consumers would prefer as many goods and services as possible to be offered in competitive markets.

As often happens in economics, there is a trade-off. While perfect competition gives the largest quantity of a good at the lowest price, other market forms may spur more innovation. Specifically, firms may incur high costs in researching a new product, and they will incur such costs only if they expect to earn an attractive return on their research investment. This is the case often made for medical innovations, for example—the cost of clinical trials and experiments to create new medicines would bankrupt perfectly competitive firms but may be acceptable in an oligopoly market structure. Therefore, consumers can benefit from less-than-perfectly-competitive markets.

PORTER'S FIVE FORCES AND MARKET STRUCTURE

A financial analyst aiming to establish market conditions and consequent profitability of incumbent firms should start with the questions posed earlier: How many sellers are there? Is the product differentiated? Moreover, in the case of monopolies and quasi-monopolies, the analyst should evaluate the legislative and regulatory framework: Can the company set prices freely, or are there governmental controls? Finally, the analyst should consider the threat of competition from potential entrants.

This analysis is often summarized by students of corporate strategy as "Porter's five forces," named after Harvard Business School professor Michael E. Porter. His book, *Competitive Strategy*, presented a systematic analysis of the practice of market strategy. Porter identified the five forces as follows:

- Threat of entry;
- Power of suppliers;
- Power of buyers (customers);
- Threat of substitutes; and
- Rivalry among existing competitors.

It is easy to note the parallels between four of these five forces and the questions posed earlier. The only "orphan" is the power of suppliers, which is not at the core of the theoretical economic analysis of competition, but which has substantial weight in the practical analysis of competition and profitability.

Some stock analysts use the term "economic moat" to suggest that some of the factors protecting the profitability of a firm are similar to the moats (ditches full of water) that were used to protect some medieval castles. A deep moat means that there is little or no threat of entry by invaders (i.e., competitors). It also means that customers are locked in because of high switching costs.

QUESTION SET

1. A market structure characterized by many sellers with each having some pricing power and product differentiation is *best* described as:

   A. oligopoly.

   B. perfect competition.

   C. monopolistic competition.

   Solution:

   C is correct. Monopolistic competition is characterized by many sellers, differentiated products, and some pricing power.

2. A market structure with relatively few sellers of a homogeneous or standardized product is *best* described as:

   A. oligopoly.

   B. monopoly.

   C. perfect competition.

   Solution:

   A is correct. Few sellers of a homogeneous or standardized product characterizes an oligopoly.

MONOPOLISTIC COMPETITION 4

☐ explain supply and demand relationships under monopolistic competition, including the optimal price and output for firms as well as pricing strategy

Many market structures exhibit characteristics of strong competitive forces; however, other distinct non-competitive factors can also play important roles in the market. As the name implies, monopolistic competition is a hybrid market. *The most distinctive factor in monopolistic competition is product differentiation*. Recall the characteristics outlined earlier:

1. The market has a large number of potential buyers and sellers.
2. The products offered by each seller are close substitutes for the products offered by other firms, and each firm tries to make its product look different.
3. Entry into and exit from the market are possible with fairly low costs.
4. Firms have some pricing power.
5. Suppliers differentiate their products through advertising and other non-price strategies.

While the market is made up of many firms that compose the product group, each producer attempts to distinguish its product from that of the others. Product differentiation is accomplished in a variety of ways. For example, consider the wide variety of communication devices available today. Decades ago, when each communication

market was controlled by a regulated single seller (the telephone company), all telephones were alike. In today's deregulated market, the variety of physical styles and colors is extensive. All versions accomplish many of the same tasks.

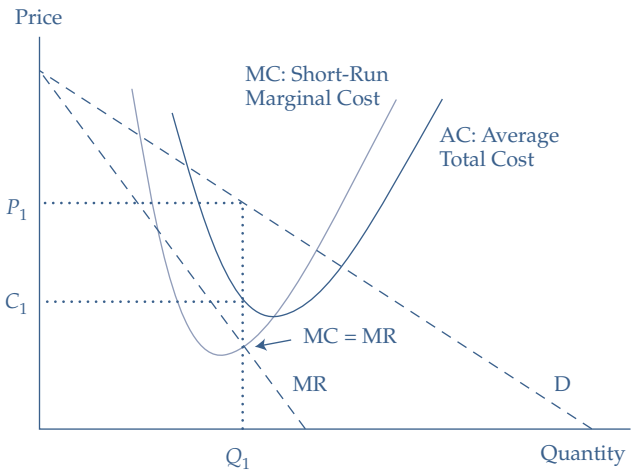
The communication device manufacturers and providers differentiate their products with different colors, styles, networks, bundled applications, conditional contracts, functionality, and more. Advertising is usually the avenue pursued to convince consumers that the goods in the product group are different. Successful advertising and trademark branding result in customer loyalty. A good example is the brand loyalty associated with Harley-Davidson motorcycles. Harley-Davidson's customers believe that their motorcycles are truly different from and better than all other motorcycles.

The extent to which the producer is successful in product differentiation determines pricing power in the market. Very successful differentiation results in a market structure that resembles the single-seller market (monopoly). Because of relatively low entry and exit costs, competition will, in the long run, drive prices and revenues down toward an equilibrium similar to perfect competition. Thus, the hybrid market displays characteristics found in both perfectly competitive and monopoly markets.

Demand Analysis in Monopolistically Competitive Markets

Because each good sold in the product group is somewhat different from the others, the demand curve for each firm in the monopolistic competition market structure is downward sloping to the right. Price and the quantity demanded are negatively related. Lowering the price will increase the quantity demanded and raising the price will decrease the quantity demanded. There will be ranges of prices within which demand is elastic and (lower) prices at which demand is inelastic. Exhibit 14 illustrates the demand, marginal revenue, and cost structures facing a monopolistically competitive firm in the short run.

Exhibit 14: Short-Run Equilibrium in Monopolistic Competition



In the short run, the profit-maximizing choice is the level of output at which MR = MC. Because the product is somewhat different from that of the competitors, the firm can charge the price determined by the demand curve. Therefore, in Exhibit 14, Q_1 is the ideal level of output and P_1 is the price consumers are willing to pay to acquire that quantity. Total revenue is the area of the rectangle $P_1 \times Q_1$.

Supply Analysis in Monopolistically Competitive Markets

In perfect competition, the firm's supply schedule is represented by the marginal cost schedule. In monopolistic competition, there is no well-defined supply function. The information used to determine the appropriate level of output is based on the intersection of MC and MR. However, the price that will be charged is based on the market demand schedule. The firm's supply curve should measure the quantity the firm is willing to supply at various prices. That information is not represented by either marginal cost or average cost.

Optimal Price and Output in Monopolistically Competitive Markets

In the short run, the profit-maximizing choice is the level of output at which MR = MC and total revenue is the area of the rectangle $P_1 \times Q_1$ shown in Exhibit 14.

The average cost of producing Q_1 units of the product is C_1, and the total cost is the area of the rectangle $C_1 \times Q_1$. The difference between TR and TC is economic profit. The profit relationship is described as follows:

$$\pi = TR - TC,$$

where π is total profit, TR is total revenue, and TC is total cost.

THE BENEFITS OF IMPERFECT COMPETITION

Is monopolistic competition indeed imperfect—that is, is it a bad thing? At first, one would say that it is an inefficient market structure because prices are higher and the quantity supplied is less than in perfect competition. At the same time, in the real world, we see more markets characterized by monopolistic competition than markets meeting the strict conditions of perfect competition. If monopolistic competition were that inefficient, one wonders, why would it be so common?

A part of the explanation goes back to Schumpeter. Firms try to differentiate their products to meet the needs of customers. Differentiation provides a profit incentive to innovate, experiment with new products and services, and potentially improve the standard of living.

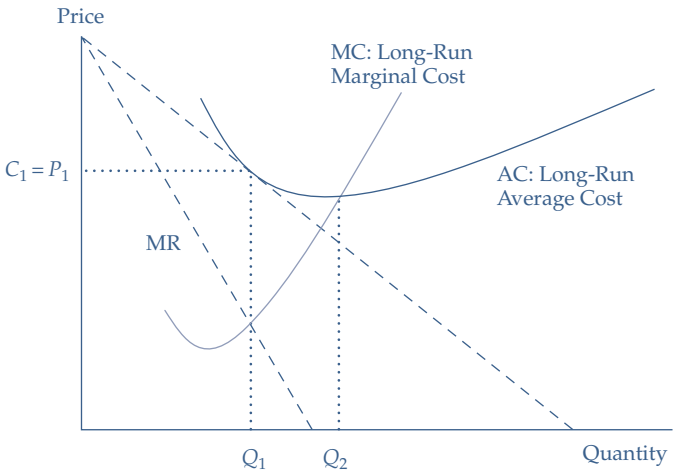
Moreover, because each customer has differing tastes and preferences, slight variations of each good or service are likely to capture the niche of the market that prefers them. An example is the market for candy, where one can find chocolate, licorice, mint, fruit, and many other flavors.

Another reason why monopolistic competition may be good is that people like variety. Traditional economic theories of international trade suggested that countries should buy products from other countries that they cannot produce domestically. Therefore, Norway should buy bananas from a tropical country and sell crude oil in exchange. But this is not the only kind of exchange that happens in reality: For example, Germany imports Honda, Subaru, and Toyota cars from Japan and sells Volkswagen, Porsche, Mercedes, and BMW cars to Japan. In theory, this should not occur because each of the countries produces good cars domestically and does not need to import them. The truth, however, is that consumers in both countries enjoy variety. Some Japanese drivers prefer to be at the steering wheel of a BMW; others like Hondas, and the same happens in Germany. Variety and product differentiation, therefore, are not necessarily bad things.

Long-Run Equilibrium in Monopolistic Competition

Because total cost includes all costs associated with production, including opportunity cost, economic profit is a signal to the market, and that signal will attract more competition. Just as with the perfectly competitive market structure, with relatively low entry costs, more firms will enter the market and lure some customers away from the firm making an economic profit. The loss of customers to new entrant firms will drive down the demand for all firms producing similar products. In the long run for the monopolistically competitive firm, economic profit will fall to zero. Exhibit 15 illustrates the condition of long-run equilibrium for monopolistic competition.

Exhibit 15: Long-Run Equilibrium in Monopolistic Competition



In long-run equilibrium, output is still optimal at the level at which MR = MC, which is Q_1 in Exhibit 15. Again, the price consumers are willing to pay for any amount of the product is determined from the demand curve. That price is P_1 for the quantity Q_1 in Exhibit 15, and total revenue is the area of the rectangle $P_1 \times Q_1$. Notice that unlike long-run equilibrium in perfect competition, in the market of monopolistic competition, the equilibrium position is at a higher level of average cost than the level of output that minimizes average cost. Average cost does not reach its minimum until output level Q_2 is achieved. Total cost in this long-run equilibrium position is the area of the rectangle $C_1 \times Q_1$. Economic profit is total revenue minus total cost. In Exhibit 15, economic profit is zero because total revenue equals total cost: $P_1 \times Q_1 = C_1 \times Q_1$.

In the hybrid market of monopolistic competition, zero economic profit in long-run equilibrium resembles perfect competition. However, the long-run level of output, Q_1, is less than Q_2, which corresponds to the minimum average cost of production and would be the long-run level of output in a perfectly competitive market. In addition, the economic cost in monopolistic competition includes some cost associated with product differentiation, such as advertising. In perfect competition, no costs are associated with advertising or marketing because all products are homogeneous. Prices are lower, but consumers may have little variety.

QUESTION SET

1. A company doing business in a monopolistically competitive market will *most likely* maximize profits when its output quantity is set such that:

   A. average cost is minimized.

   B. marginal revenue is equal to average cost.

   C. marginal revenue is equal to marginal cost.

   Solution:

   C is correct. The profit maximizing choice is the level of output at which marginal revenue equals marginal cost.

OLIGOPOLY

5

☐ explain supply and demand relationships under oligopoly, including the optimal price and output for firms as well as pricing strategy

Oligopoly and Pricing Strategies

An oligopoly market structure is characterized by only a few firms doing business in a relevant market. The products must all be similar and generally are substitutes for one another. In some oligopoly markets, the goods or services may be differentiated by marketing and strong brand recognition, as in the markets for breakfast cereals and for bottled or canned beverages. Other examples of oligopoly markets are made up of homogeneous products with little or no attempt at product differentiation, such as petroleum and cement. *The most distinctive characteristic of oligopoly markets is the small number of firms that dominate the market. There are so few firms in the relevant market that their pricing decisions are interdependent.* That is, each firm's pricing decision is based on the expected retaliation by the other firms. Recall the characteristics of oligopoly markets:

1. There are a small number of potential sellers.
2. The products offered by each seller are close substitutes for the products offered by other firms and may be differentiated by brand or homogeneous and unbranded.
3. Entry into the market is difficult, with fairly high costs and significant barriers to competition.
4. Firms typically have substantial pricing power.
5. Products are often highly differentiated through marketing, features, and other non-price strategies.

Because there are so few firms, each firm can have some degree of pricing power, which can result in substantial profits. Another by-product of the oligopoly market structure is the attractiveness of price collusion. Even without price collusion, a dominant firm may easily become the price maker in the market. Oligopoly markets

without collusion typically have the most sophisticated pricing strategies. Perhaps the most well-known oligopoly market with collusion is the Organization of the Petroleum Exporting Countries (OPEC) cartel, which seeks to control prices in the petroleum market by fostering agreements among oil-producing countries.

Demand Analysis and Pricing Strategies in Oligopoly Markets

Oligopoly markets' demand curves depend on the degree of pricing interdependence. In a market in which collusion is present, the aggregate market demand curve is divided by the individual production participants. Under non-colluding market conditions, each firm faces an individual demand curve. Furthermore, non-colluding oligopoly market demand characteristics depend on the pricing strategies adopted by the participating firms. The three basic pricing strategies are pricing interdependence, the Cournot assumption, and the Nash equilibrium.

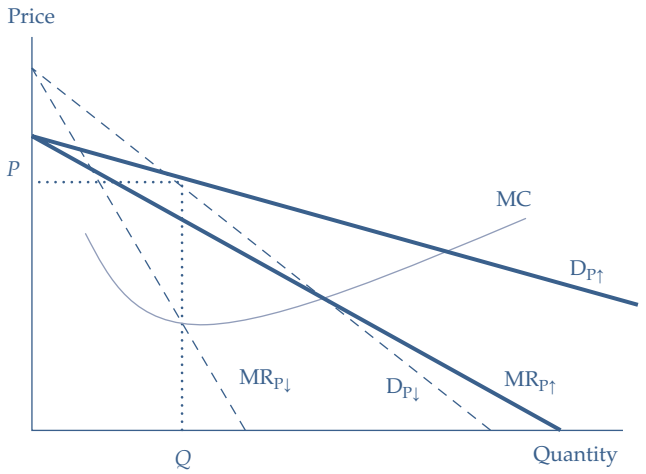
The first pricing strategy assumes pricing interdependence among the firms in the oligopoly. A good example of this situation is any market in which there are "price wars," such as the commercial airline industry. For example, flying out of their hubs in Atlanta, both Delta Air Lines and AirTran Airways jointly serve several cities. AirTran is a low-cost carrier and typically offers lower fares to destinations out of Atlanta. Delta tends to match the lower fares for those cities also served by AirTran when the departure and arrival times are similar to its own. When Delta offers service to the same cities at different time slots, however, Delta's ticket prices are higher.

The most common pricing strategy assumption in these price war markets is that competitors will match a price reduction and ignore a price increase. The logic is that by lowering its price to match a competitor's price reduction, the firm will not experience a reduction in customer demand. Conversely, by not matching the price increase, the firm stands to attract customers away from the firm that raised its prices. The oligopolist's demand relationship must represent the potential increase in market share when rivals' price increases are not matched and no significant change in market share when rivals' price decreases are matched.

Given a prevailing price, the price elasticity of demand will be much greater if the price is increased and less if the price is decreased. The firm's customers are more responsive to price increases because its rivals have lower prices. Alternatively, the firm's customers are less responsive to price decreases because its rivals will match its price change.

This implies that the oligopolistic firm faces two different demand structures: one associated with price increases and another relating to price reductions. Each demand function will have its own marginal revenue structure as well. Consider the demand and marginal revenue functions in Exhibit 16. The functions $D_{P\uparrow}$ and $MR_{P\uparrow}$ represent the demand and marginal revenue schedules associated with higher prices, whereas the functions $D_{P\downarrow}$ and $MR_{P\downarrow}$ represent the lower prices' demand and marginal revenue schedules. The two demand schedules intersect at the prevailing price (i.e., the price at which the price increase and price decrease are both equal to zero).

Exhibit 16: Kinked Demand Curve in Oligopoly Market



This oligopolistic pricing strategy results in a kinked demand curve, with the two segments representing the different competitor reactions to price changes. The kink in the demand curve also yields a discontinuous marginal revenue structure, with one part associated with the price increase segment of demand and the other relating to the price decrease segment. Therefore, the firm's overall demand equals the relevant portion of $D_{P\uparrow}$ and the relevant portion of $D_{P\downarrow}$. Exhibit 17 represents the firm's new demand and marginal revenue schedules. The firm's demand schedule shown in Exhibit 17 is segment $D_{P\uparrow}$ and $D_{P\downarrow}$, where overall demand $D = D_{P\uparrow} + D_{P\downarrow}$.

Exhibit 17: Kinked Demand Curve in Oligopoly Market

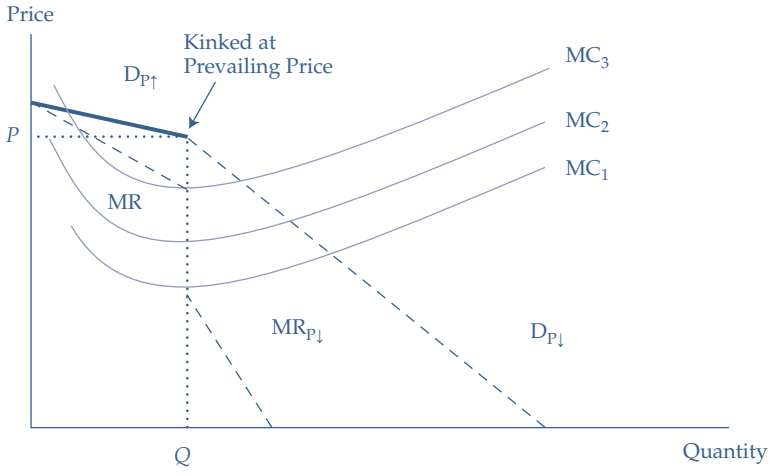


Exhibit 17 shows that a wide variety of cost structures are consistent with the prevailing price. If the firm has relatively low marginal costs, MC_1, the profit-maximizing pricing rule established earlier, MR = MC, still holds for the oligopoly firm. Marginal cost can rise to MC_2 and MC_3 before the firm's profitability is challenged. If the marginal

cost curve MC_2 passes through the gap in marginal revenue, the most profitable price and output combination remains unchanged at the prevailing price and original level of output.

Criticism of the kinked demand curve analysis focuses on its inability to determine what the prevailing price is from the outset. The kinked demand curve analysis helps explain why stable prices have been observed in oligopoly markets and therefore is a useful tool for analyzing such markets. However, because it cannot determine the original prevailing price, it is considered to be an incomplete pricing analysis.

The Cournot Assumption

The second pricing strategy was first developed by French economist Augustin Cournot in 1838. In the **Cournot assumption**, each firm determines its profit-maximizing production level by assuming that the other firms' output will not change. This assumption simplifies pricing strategy because there is no need to guess what the other firm will do to retaliate. It also provides a useful approach to analyzing real-world behavior in oligopoly markets. Take the most basic oligopoly market situation, a two-firm duopoly market. In equilibrium, neither firm has an incentive to change output, given the other firm's production level. Each firm attempts to maximize its own profits under the assumption that the other firm will continue producing the same level of output in the future. The Cournot strategy assumes that this pattern continues until each firm reaches its long-run equilibrium position. In long-run equilibrium, output and price are stable: No change in price or output will increase profits for either firm.

Consider this example of a duopoly market. Assume that the aggregate market demand has been estimated to as follows:

$$Q_D = 450 - P.$$

The supply function is represented by constant marginal cost MC = 30.

The Cournot strategy's solution can be found by setting $Q_D = q_1 + q_2$, where q_1 and q_2 represent the output levels of the two firms. Each firm seeks to maximize profit, and each firm believes the other firm will not change output as it changes its own output (i.e., Cournot's assumption). The firm will maximize profit where MR = MC. Rearranging the aggregate demand function in terms of price, we get:

$$P = 450 - Q_D = 450 - (q_1 + q_2), \text{ and } MC = 30.$$

Total revenue for each of the two firms is found by multiplying price and quantity:

$$TR_1 = Pq_1 = (450 - q_1 - q_2)q_1 = 450q_1 - q_1^2 - q_1q_2,$$

and

$$TR_2 = Pq_2 = (450 - q_1 - q_2)q_2 = 450q_2 - q_2q_1 - q_2^2.$$

Marginal revenue is defined as the change in total revenue, given a change in sales (q_1 or q_2). For the profit-maximizing output, set MR = MC, or

$$450 - 2q_1 - q_2 = 30,$$

and

$$450 - q_1 - 2q_2 = 30.$$

Then find the simultaneous equilibrium for the two firms by solving the two equations with two unknowns:

$$450 - 2q_1 - q_2 = 450 - q_1 - 2q_2.$$

Because $q_2 = q_1$ under Cournot's assumption, insert this solution into the demand function and solve as follows:

$$450 - 2q_1 - q_1 = 450 - 3q_1 = 30.$$

Therefore, $q_1 = 140$, $q_2 = 140$, and $Q = 280$.

The price is $P = 450 - 280 = 170$.

In the Cournot strategic pricing solution, the market equilibrium price will be 170, and the aggregate output will be 280 units. This result, known as the Cournot equilibrium, differs from the perfectly competitive market equilibrium because the perfectly competitive price will be lower and the perfectly competitive output will be higher. In general, non-competitive markets have higher prices and lower levels of output in equilibrium when compared with perfect competition. In competition, the equilibrium is reached when price equals marginal cost:

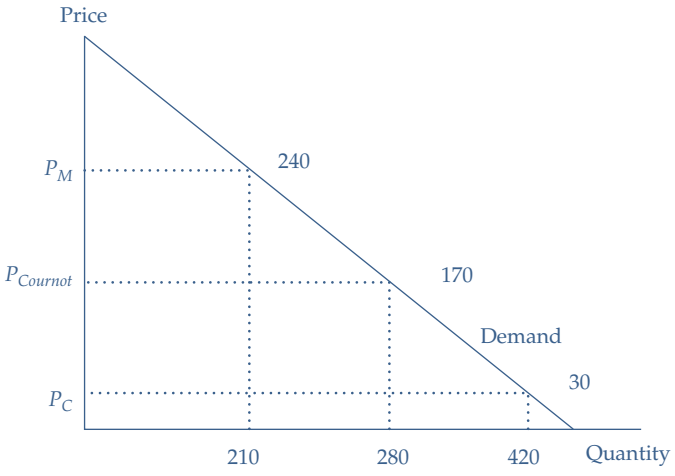
$P_C = MR_C = MC$, so $450 - Q = 30$,

where P_C is the competitive firm's equilibrium price.

$Q = 420$, and $P_C = 30$.

Exhibit 18 describes the oligopoly, competitive, and monopoly market equilibrium positions, where P_M is the monopoly optimum price, P_C is the competitive price, and $P_{Cournot}$ is the oligopoly price under the Cournot assumption.

Exhibit 18: Cournot Equilibrium in Duopoly Market



In the later discussion regarding monopoly market structure, equilibrium will be established where MR = MC. That solution is also shown in Exhibit 18. The monopoly firm's demand schedule is the aggregate market demand schedule. Therefore, the solution is

MR = MC.

For the market demand function, total revenue is $P \times Q = 450Q - Q^2$ and $MR = 450 - 2Q$; therefore,

$450 - 2Q = 30$ and $Q = 210$.

From the aggregate demand function, solve for price:

$P_M = 450 - 210 = 240$.

Note that the Cournot solution falls between the competitive equilibrium and the monopoly solution.

As the number of firms increases from two to three, from three to four, and so on, the output and price equilibrium positions move toward the competitive equilibrium solution. Historically, this result has been the theoretical basis for the antitrust policies established in the United States.

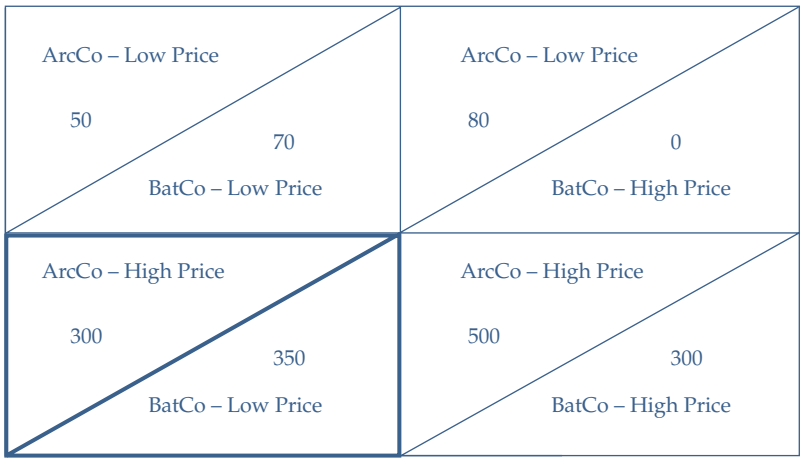
The Nash Equilibrium

The third pricing strategy is attributed to one of the 1994 Nobel Prize winners, John Nash, who first developed the general concepts. In the previous analysis, the concept of market equilibrium occurs when firms are achieving their optimum remuneration under the circumstances they face. In this optimum environment, the firm has no motive to change price or output level. Existing firms are earning a normal return (zero economic profit), leaving no motive for entry to or exit from the market. All of the firms in the market are producing at the output level at which price equals the average cost of production.

In **game theory** (the set of tools that decision makers use to consider responses by rival decision makers), the **Nash equilibrium** is present when two or more participants in a non-cooperative game have no incentive to deviate from their respective equilibrium strategies after they have considered and anticipated their opponent's rational choices or strategies. In the context of oligopoly markets, the Nash equilibrium is an equilibrium defined by the characteristic that none of the oligopolists can increase its profits by unilaterally changing its pricing strategy. The assumption is made that each participating firm does the best it can, given the reactions of its rivals. Each firm anticipates that the other firms will react to any change made by competitors by doing the best they can under the altered circumstances. The firms in the oligopoly market have interdependent actions. Their actions are non-cooperative, with each firm making decisions that maximize its own profits. The firms do not collude in an effort to maximize joint profits. The equilibrium is reached when all firms are doing the best they can, given the actions of their rivals.

Exhibit 19 illustrates the duopoly result from the Nash equilibrium. Assume there are two firms in the market, ArcCo and BatCo. ArcCo and BatCo can charge high prices or low prices for the product. The market outcomes are shown in Exhibit 19.

Exhibit 19: Nash Equilibrium in Duopoly Market



For example, the top left solution indicates that when both ArcCo and BatCo offer the product at low prices, ArcCo earns a profit of 50 and BatCo earns 70. The top right solution shows that if ArcCo offers the product at a low price, BatCo earns zero profits. The solution with the maximum joint profits is the lower right equilibrium, where both firms charge high prices for the product. Joint profits are 800 in this solution.

The Nash equilibrium, however, requires that each firm behaves in its own best interest. BatCo can improve its position by offering the product at low prices when ArcCo is charging high prices. In the lower left solution, BatCo maximizes its profits at 350. Although ArcCo can earn 500 in its best solution, it can do so only if BatCo also agrees to charge high prices. This option is clearly not in BatCo's best interest because it can increase its return from 300 to 350 by charging lower prices.

This scenario brings up the possibility of collusion. If ArcCo agrees to share at least 51 of its 500 when both companies are charging high prices, BatCo should also be willing to charge high prices. In general, such collusion is unlawful in most countries, but it remains a tempting alternative. Clearly, conditions in oligopolistic industries encourage collusion, with a small number of competitors and interdependent pricing behavior. Collusion is motivated by several factors: increased profits, reduced cash flow uncertainty, and improved opportunities to construct barriers to entry.

When collusive agreements are made openly and formally, the firms involved are called a **cartel**. In some cases, collusion is successful; other times, the forces of competition overpower collusive behavior. The following six major factors affect the chances of successful collusion:

1. *The number and size distribution of sellers.* Successful collusion is more likely if the number of firms is small or if one firm is dominant. Collusion becomes more difficult as the number of firms increases or if the few firms have similar market shares. When the firms have similar market shares, the competitive forces tend to overshadow the benefits of collusion.
2. *The similarity of the products.* When the products are homogeneous, collusion is more successful. The more differentiated the products, the less likely it is that collusion will succeed.
3. *Cost structure.* The more similar the firms' cost structures, the more likely it is that collusion will succeed.
4. *Order size and frequency.* Successful collusion is more likely when orders are frequent, received on a regular basis, and relatively small. Frequent small orders, received regularly, diminish the opportunities and rewards for cheating on the collusive agreement.
5. *The strength and severity of retaliation.* Oligopolists will be less likely to break the collusive agreement if the threat of retaliation by the other firms in the market is severe.
6. *The degree of external competition.* The main reason to enter into the formal collusion is to increase overall profitability of the market, and rising profits attract competition. For example, in 2016 the average extraction cost of a barrel of crude oil from Saudi Arabia was approximately $9, while the average cost from United States shale oil fields was roughly $23.50. The cost of extracting oil from the Canadian tar sands in 2016 was roughly $27 per barrel. It is more likely that crude oil producers in the gulf countries will successfully collude because of the similarity in their cost structures (roughly $9–$10 per barrel). If OPEC had held crude oil prices down below $30 per barrel, there would not have been a viable economic argument to develop US shale oil fields through fracking or expand extraction from Canada's tar

sands. OPEC's successful cartel raised crude oil prices to the point at which outside sources became economically possible and, in doing so, increased the competition the cartel faces.

Other possible oligopoly strategies are associated with decision making based on game theory. The Cournot equilibrium and the Nash equilibrium are examples of specific strategic games. A strategic game is any interdependent behavioral choice employed by individuals or groups that share a common goal (e.g., military units, sports teams, or business decision makers). Another prominent decision-making strategy in oligopolistic markets is the first-mover advantage in the **Stackelberg model**, named after the economist who first conceptualized the strategy. The important difference between the Cournot model and the Stackelberg model is that Cournot assumes that in a duopoly market, decision making is simultaneous, whereas Stackelberg assumes that decisions are made sequentially. In the Stackelberg model, the leader firm chooses its output first and then the follower firm chooses after observing the leader's output. It can be shown that the leader firm has a distinct advantage—that is, being a first mover. In the Stackelberg game, the leader can aggressively overproduce to force the follower to scale back its production or even punish or eliminate the weaker opponent. This approach is sometimes referred to as a "top dog" strategy. The leader earns more than in Cournot's simultaneous game, while the follower earns less. Many other strategic games are possible in oligopoly markets. The important conclusion is that the optimal strategy of the firm depends on what its adversary does. The price and marginal revenue the firm receives for its product depend on both its decisions and its adversary's decisions.

Oligopoly Markets: Optimal Price, Output, and Long-Run Equilibrium

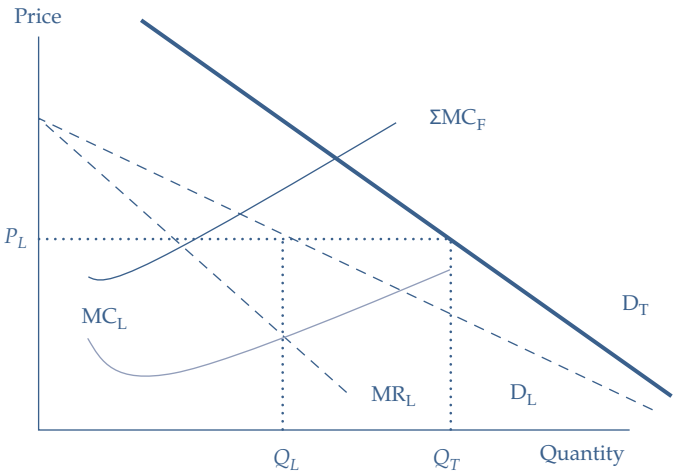
As in monopolistic competition, the oligopolist does not have a well-defined supply function. That is, there is no way to determine the oligopolist's optimal levels of output and price independent of demand conditions and competitor's strategies. However, the oligopolist still has a cost function that determines the optimal level of supply. Therefore, the profit-maximizing rule established earlier is still valid: The level of output that maximizes profit is where MR = MC. The price to charge is determined by what price consumers are willing to pay for that quantity of the product. Therefore, the equilibrium price comes from the demand curve, whereas the output level comes from the relationship between marginal revenue and marginal cost.

Consider an oligopoly market in which one of the firms is dominant and thus able to be the price leader. Dominant firms generally have 40 percent or greater market share. When one firm dominates an oligopoly market, it does so because it has greater capacity, has a lower cost structure, was first to market, or has greater customer loyalty than other firms in the market.

Assuming there is no collusion, the dominant firm becomes the price maker, and therefore its actions are similar to monopoly behavior in its segment of the market. The other firms in the market follow the pricing patterns of the dominant firm. Why wouldn't the price followers attempt to gain market share by undercutting the dominant firm's price? The most common explanation is that the dominant firm's supremacy often stems from a lower cost of production. Usually, the price followers would rather charge a price that is even higher than the dominant firm's price choice. If they attempt to undercut the dominant firm, the followers risk a price war with a lower-cost producer that can threaten their survival. Some believe that one explanation for the price leadership position of the dominant firm is simply convenience. Only one firm has to make the pricing decisions, and the others can simply follow its lead.

Exhibit 20 establishes the dominant firm's pricing decision. The dominant firm's demand schedule, D_L, is a substantial share of the total market demand, D_T. The low-cost position of the dominant firm is represented by its marginal cost, MC_L. The sum of the marginal costs of the price followers is established as ΣMC_F and represents a higher cost of production than that of the price leader.

Exhibit 20: Dominant Oligopolist's Price Leadership



An important reason why the total demand curve and the leader demand curve are not parallel is illustrated in Exhibit 20: The leader is the low-cost producer. Therefore, as price decreases, fewer of the smaller suppliers will be able to profitably remain in the market, and several will exit because thwey do not want to sell below cost. Therefore, the leader will have a larger market share as *P* decreases, which implies that Q_L increases at a low price, exactly as shown by a steeper D_T in the diagram.

The price leader identifies its profit-maximizing output where $MR_L = MC_L$, at output Q_L. This is the quantity it wants to supply; however, the price it will charge is determined by its segment of the total demand function, D_L. At price P_L, the dominant firm will supply quantity Q_L of total demand, D_T. The price followers will supply the difference to the market, $(Q_T - Q_L) = Q_F$. Therefore, neither the dominant firm nor the follower firms have a single functional relationship that determines the quantity supplied at various prices.

Optimal Price and Output in Oligopoly Markets

As this discussion shows, clearly no single optimum price and output analysis fits all oligopoly market situations. The interdependence among the few firms that make up the oligopoly market provides a complex set of pricing alternatives, depending on the circumstances in each market. In the case of the kinked demand curve, the optimum price is the prevailing price at the kink in the demand function. As noted, however, the kinked demand curve analysis does not provide insight into what established the prevailing price in the first place.

Perhaps the case of the dominant firm, with the other firms following the price leader, is the most obvious. In that case, the optimal price is determined at the output level where MR = MC. The profit-maximizing price is then determined by the output position of the segment of the demand function faced by the dominant firm. The price

followers have little incentive to change the leader's price. In the case of the Cournot assumption, each firm assumes that the other firms will not alter their output following the dominant firm's selection of its price and output level.

Therefore, again, the optimum price is determined by the output level where MR = MC. In the case of the Nash equilibrium, each firm will react to the circumstances it faces, maximizing its own profit. These adjustments continue until prices and levels of output are stable. Because of the interdependence, the individual firm's price and output level remain uncertain.

Factors Affecting Long-Run Equilibrium in Oligopoly Markets

Long-run economic profits are possible for firms operating in oligopoly markets. History has shown that, however, the market share of the dominant firm declines. Profits attract entry by other firms into the oligopoly market. Over time, the marginal costs of the entrant firms decrease because they adopt more efficient production techniques, the dominant firm's demand and marginal revenue shrink, and the profitability of the dominant firm declines. In the early 1900s, J.P. Morgan, Elbert Gary, Andrew Carnegie, and Charles M. Schwab created the United States Steel Corporation (US Steel). When it was first formed in 1901, US Steel controlled 66 percent of the market. By 1920, US Steel's market share had declined to 46 percent, and by 1925 its market share was 42 percent.

In the long run, optimal pricing strategy must include the reactions of rival firms. History has proven that pricing wars should be avoided because any gains in market share are temporary. Decreasing prices to drive away competitors lowers total revenue to all participants in the oligopoly market. Innovation may be a way—though sometimes an uneconomical one—to maintain market leadership.

OLIGOPOLIES: APPEARANCE VERSUS BEHAVIOR

When is an oligopoly not an oligopoly? There are two extreme cases of this situation. A normal oligopoly has a few firms producing a differentiated good, and this differentiation gives them pricing power.

At one end of the spectrum, we have the oligopoly with a credible threat of entry. In practice, if the oligopolists are producing a good or service that can be easily replicated, has limited economies of scale, and is not protected by brand recognition or patents, they will not be able to charge high prices. The easier it is for a new supplier to enter the market, the lower the margins. In practice, this oligopoly will behave very much like a perfectly competitive market.

At the opposite end of the spectrum, we have the case of the cartel. Here, the oligopolists collude and act as if they were a single firm. In practice, a very effective cartel enacts a cooperative strategy. Instead of going to a Nash equilibrium, the cartel participants go to the more lucrative (for them) cooperative equilibrium.

A cartel may be explicit (i.e., based on a contract) or implicit (based on signals). An example of signals in a duopoly would be that one of the firms reduces its prices and the other does not. Because the firm not cutting prices refuses to start a price war, the firm that cut prices may interpret this signal as a "suggestion" to raise prices to a higher level than before, so that profits may increase for both.

QUESTION SET

1. Oligopolistic pricing strategy *most likely* results in a demand curve that is:

   A. kinked.

   B. vertical.

   C. horizontal.

   Solution:

   A is correct. The oligopolist faces two different demand structures, one for price increases and another for price decreases. Competitors will lower prices to match a price reduction, but will not match a price increase. The result is a kinked demand curve.

2. Collusion is *less likely* in a market when:

   A. the product is homogeneous.

   B. companies have similar market shares.

   C. the cost structures of companies are similar.

   Solution:

   B is correct. When companies have similar market shares, competitive forces tend to outweigh the benefits of collusion.

3. In an industry composed of three companies, which are small-scale manufacturers of an easily replicable product unprotected by brand recognition or patents, the *most* representative model of company behavior is:

   A. oligopoly.

   B. perfect competition.

   C. monopolistic competition.

   Solution:

   B is correct. The credible threat of entry holds down prices and multiple incumbents are offering undifferentiated products.

4. Deep River Manufacturing is one of many companies in an industry that makes a food product. Deep River units are identical up to the point they are labeled. Deep River produces its labeled brand, which sells for $2.20 per unit, and "house brands" for seven different grocery chains, which sell for $2.00 per unit. Each grocery chain sells both the Deep River brand and its house brand. The *best* characterization of Deep River's market is:

   A. oligopoly.

   B. perfect competition.

   C. monopolistic competition.

   Solution:

   C is correct. There are many competitors in the market, but some product differentiation exists, as the price differential between Deep River's brand and the house brands indicates.

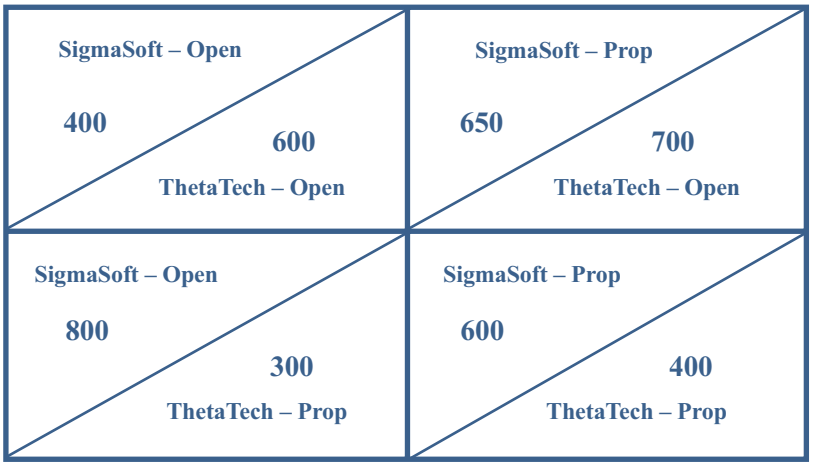
The following information relates to questions 5 & 6

SigmaSoft and ThetaTech are the dominant makers of computer system software. The market has two components: a large mass-market component in which demand is price sensitive, and a smaller performance-oriented component in which demand is much less price sensitive. SigmaSoft's product is considered to be technically superior. Each company can choose one of two strategies:

Open architecture (Open): Mass market focus allowing other software venders to develop products for its platform.

Proprietary (Prop): Allow only its own software applications to run on its platform.

5. Depending upon the strategy each company selects, their profits would be:



The Nash equilibrium for these companies is:

A. proprietary for SigmaSoft and proprietary for ThetaTech.

B. open architecture for SigmaSoft and proprietary for ThetaTech.

C. proprietary for SigmaSoft and open architecture for ThetaTech.

Solution:

C is correct. In the Nash model, each company considers the other's reaction in selecting its strategy. In equilibrium, neither company has an incentive to change its strategy. ThetaTech is better off with open architecture regardless of what SigmaSoft decides. Given this choice, SigmaSoft is better off with a proprietary platform. Neither company will change its decision unilaterally.

6 DETERMINING MARKET STRUCTURE

☐ identify the type of market structure within which a firm operates and describe the use and limitations of concentration measures

Monopoly markets and other situations in which companies have pricing power can be inefficient because producers constrain output to cause an increase in prices. Therefore, less of the good will be consumed, and it will be sold at a higher price, which is generally inefficient for the overall market. As a result, many countries have introduced competition law to regulate the degree of competition in many industries.

Market power in the real world is not always as clear as it is in textbook examples. Governments and regulators often have the difficult task of measuring market power and establishing whether a firm has a dominant position that may resemble a monopoly. A few historical examples of this are as follows:

1. In the 1990s, US regulators prosecuted agricultural corporation Archer Daniels Midland for conspiring with Japanese competitors to fix the price of lysine, an amino acid used as an animal feed additive. The antitrust action resulted in a settlement that involved more than US$100 million in fines paid by the cartel members.
2. In the 1970s, US antitrust authorities broke up the local telephone monopoly, leaving AT&T the long-distance business (and opening that business to competitors), and required AT&T to divest itself of the local telephone companies it owned. This antitrust decision brought competition, innovation, and lower prices to the US telephone market.
3. European regulators (specifically, the European Commission) have affected the mergers and monopoly positions of European corporations (as in the case of the companies Roche, Rhone-Poulenc, and BASF, which were at the center of a vitamin price-fixing case) as well as non-European companies (such as Intel) that do business in Europe. Moreover, the merger between the US company General Electric and the European company Honeywell was denied by the European Commission on grounds of excessive market concentration.

Quantifying excessive market concentration is difficult. Sometimes, regulators need to measure whether something that has not yet occurred might generate excessive market power. For example, a merger between two companies might allow the combined company to be a monopolist or quasi-monopolist in a certain market.

A financial analyst hearing news about a possible merger should always consider the impact of competition law (sometimes called antitrust law)—that is, whether a proposed merger may be blocked by regulators in the interest of preserving a competitive market.

Econometric Approaches

How should one measure market power? The theoretical answer is to estimate the elasticity of demand and supply in a market. If demand is very elastic, the market must be very close to perfect competition. If demand is rigid (inelastic), companies *may* have market power.

From the econometric point of view, this estimation requires some attention. The problem is that observed price and quantity are the equilibrium values of price and quantity and do not represent the value of either supply or demand. Technically, this is called the problem of endogeneity, in the sense that the equilibrium price and quantity are jointly determined by the interaction of demand and supply. Therefore, to have an appropriate estimation of demand and supply, we need to use a model with two equations: an equation of demanded quantity (as a function of price, income of the buyers, and other variables) and an equation of supplied quantity (as a function of price, production costs, and other variables). The estimated parameters will then allow us to compute elasticity.

Regression analysis is useful in computing elasticity but requires a large number of observations. Therefore, one may use a time-series approach and, for example, look at 20 years of quarterly sales data for a market. The market structure may have changed radically over those 20 years, however, and the estimated elasticity may not apply to the current situation. Moreover, the supply curve may change because of a merger among large competitors, and the estimation based on past data may not be informative regarding the future state of the market postmerger.

An alternative approach is a cross-sectional regression analysis. Instead of looking at total sales and average prices in a market over time (the time-series approach mentioned earlier), we can look at sales from different companies in the market during the same year, or even at single transactions from many buyers and companies. Clearly, this approach requires a substantial data-gathering effort, and therefore, this estimation method can be complicated. Moreover, different specifications of the explanatory variables (e.g., using total GDP rather than median household income or per-capita GDP to represent income) may lead to dramatically different estimates.

Simpler Measures

Trying to avoid these drawbacks, analysts often use simpler measures to estimate elasticity. The simplest measure is the concentration ratio, which is the sum of the market shares of the largest *N* firms. To compute this ratio, one would, for example, add the sales values of the largest 10 firms and divide this figure by total market sales. This number is always between 0 (perfect competition) and 100 percent (monopoly).

The main advantage of the concentration ratio is that it is simple to compute, as shown previously. The disadvantage is that it does not directly quantify market power. In other words, is a high concentration ratio a clear signal of monopoly power? A company may be the only incumbent in a market, but if the barriers to entry are low, the simple presence of a *potential* entrant may be sufficient to convince the incumbent to behave like a firm in perfect competition. For example, a sugar wholesaler may be the only one in a country, but the knowledge that other large wholesalers in the food industry might easily add imported sugar to their range of products should convince the sugar wholesaler to price its product as if it were in perfect competition.

Another disadvantage of the concentration ratio is that it tends to be unaffected by mergers among the top market incumbents. For example, if the largest and second-largest incumbents merge, the pricing power of the combined entity is likely to be larger than that of the two preexisting companies. But the concentration ratio may not change much.

CALCULATING THE CONCENTRATION RATIO

Suppose there are eight producers of a certain good in a market. The largest producer has 35 percent of the market, the second largest has 25 percent, the third has 20 percent, the fourth has 10 percent, and the remaining four have 2.5 percent each. If we computed the concentration ratio of the top three producers, it would be 35 + 25 + 20 = 80 percent, while the concentration ratio of the top four producers would be 35 + 25 + 20 + 10 = 90 percent.

If the two largest companies merged, the new concentration ratio for the top three producers would be 60 (the sum of the market shares of the merged companies) + 20 + 10 = 90 percent, and the concentration ratio for the four top producers would be 92.5 percent. Therefore, this merger affects the concentration ratio very mildly, even though it creates a substantial entity that controls 60 percent of the market.

For example, the effect of consolidation in the US retail gasoline market has resulted in increasing degrees of concentration. In 1992, the top four companies in the US retail gasoline market shared 33 percent of the market. By 2001, the top four companies controlled 78 percent of the market (Exxon Mobil 24 percent, Shell 20 percent, BP/Amoco/Arco 18 percent, and Chevron/Texaco 16 percent).

To avoid the known issues with concentration ratios, economists O. C. Herfindahl and A. O. Hirschman suggested an index in which the market shares of the top N companies are first squared and then added. If one firm controls the whole market (a monopoly), the Herfindahl–Hirschman index (HHI) equals 1. If there are M firms in the industry with equal market shares, then the HHI equals $(1/M)$. This provides a useful gauge for interpreting an HHI. For example, an HHI of 0.20 would be analogous to having the market shared equally by five firms.

The HHI for the top three companies in the example in the box above would be $0.35^2 + 0.25^2 + 0.20^2 = 0.225$ before the merger, whereas after the merger, it would be $0.60^2 + 0.20^2 + 0.10^2 = 0.410$, which is substantially higher than the initial 0.225. The HHI is widely used by competition regulators; however, just like the concentration ratio, the HHI does not take the possibility of entry into account, nor does it consider the elasticity of demand. Therefore, the HHI has limited use for a financial analyst trying to estimate the potential profitability of a company or group of companies.

EXAMPLE 4

The Herfindahl–Hirschman Index

1. Suppose a market has 10 suppliers, each of them with 10 percent of the market. What are the concentration ratio and the HHI of the top four firms?

   A. Concentration ratio 4 percent and HHI 40

   B. Concentration ratio 40 percent and HHI 0.4

   C. Concentration ratio 40 percent and HHI 0.04

   Solution:

   C is correct. The concentration ratio for the top four firms is 10 + 10 + 10 + 10 = 40 percent, and the HHI is $0.10^2 \times 4 = 0.01 \times 4 = 0.04$.

QUESTION SET

1. An analyst gathers the following market share data for an industry:

Company	Sales (in millions of euros)
ABC	300
Brown	250
Coral	200
Delta	150
Erie	100
All others	50

2. The industry's four-company concentration ratio is *closest* to:

   A. 71%.

B. 86%.

C. 95%.

Solution:

B is correct. The top four companies in the industry account for 86 percent of industry sales: (300 + 250 + 200 + 150)/(300 + 250 + 200 + 150 + 100 + 50) = 900/1050 = 86%.

The following information applies to questions 3 & 4

An analyst gathered the following market share data for an industry composed of five companies:

Company	Market Share (%)
Zeta	35
Yusef	25
Xenon	20
Waters	10
Vlastos	10

3. The industry's three-firm Herfindahl–Hirschman index is *closest* to:

A. 0.185.

B. 0.225.

C. 0.235.

Solution:

B is correct. The three-firm Herfindahl–Hirschman index is $0.35^2 + 0.25^2 + 0.20^2 = 0.225$.

4. One disadvantage of the Herfindahl–Hirschman index is that the index:

A. is difficult to compute.

B. fails to reflect low barriers to entry.

C. fails to reflect the effect of mergers in the industry.

Solution:

B is correct. The Herfindahl–Hirschman index does not reflect low barriers to entry that may restrict the market power of companies currently in the market.

PRACTICE PROBLEMS

1. The short-term shutdown point of production for a firm operating under perfect competition will *most likely* occur when:

   A. price is equal to average total cost.

   B. marginal revenue is equal to marginal cost.

   C. marginal revenue is equal to average variable costs.

2. Under conditions of perfect competition, a company will break even when market price is equal to the minimum point of the:

   A. average total cost curve.

   B. average variable cost curve.

   C. short-run marginal cost curve.

3. A company will shut down production in the short run if total revenue is less than total:

   A. fixed costs.

   B. variable costs.

   C. opportunity costs.

4. A company has total variable costs of $4 million and fixed costs of $3 million. Based on this information, the company will stay in the market in the long term if total revenue is at least:

   A. $3.0 million.

   B. $4.5 million.

   C. $7.0 million.

5. When total revenue is greater than total variable costs but less than total costs, in the short term, a firm will *most likely*:

   A. exit the market.

   B. stay in the market.

   C. shut down production.

6. Under conditions of perfect competition, in the long run, firms will *most likely* earn:

   A. normal profits.

   B. positive economic profits.

   C. negative economic profits.

7. A firm that increases its quantity produced without any change in per-unit cost is

experiencing:

A. economies of scale.

B. diseconomies of scale.

C. constant returns to scale.

8. A company is experiencing economies of scale when:

A. cost per unit increases as output increases.

B. it is operating at a point on the LRAC curve at which the slope is negative.

C. it is operating beyond the minimum point on the long-run average total cost curve.

9. Diseconomies of scale *most likely* result from:

A. specialization in the labor force.

B. overlap of business functions and product lines.

C. discounted prices on resources when buying in larger quantities.

10. A firm is operating beyond minimum efficient scale in a perfectly competitive industry. To maintain long-term viability, the *most likely* course of action for the firm is to:

A. operate at the current level of production.

B. increase its level of production to gain economies of scale.

C. decrease its level of production to the minimum point on the long-run average total cost curve.

11. Companies *most likely* have a well-defined supply function when the market structure is:

A. oligopoly.

B. perfect competition.

C. monopolistic competition.

12. Aquarius, Inc. is the dominant company and the price leader in its market. One of the other companies in the market attempts to gain market share by undercutting the price set by Aquarius. The market share of Aquarius will *most likely*:

A. increase.

B. decrease.

C. stay the same.

13. Over time, the market share of the dominant company in an oligopolistic market will *most likely*:

A. increase.

B. decrease.

C. remain the same.

SOLUTIONS

1. C is correct. The firm should shut down production when marginal revenue is less than or equal to average variable cost.

2. A is correct. A company is said to break even if its total revenue is equal to its total cost. Under conditions of perfect competition, a company will break even when market price is equal to the minimum point of the average total cost curve.

3. B is correct. A company will shut down production in the short run when total revenue is below total variable costs.

4. C is correct. A company will stay in the market in the long term if total revenue is equal to or greater than total cost. Because total costs are $7 million ($4 million variable costs and $3 million fixed costs), the company will stay in the market in the long term if total revenue equals at least $7 million.

5. B is correct. When total revenue is enough to cover variable costs but not total fixed costs in full, the firm can survive in the short run but would not be able to maintain financial solvency in the long run.

6. A is correct. Competition should drive prices down to long-run marginal cost, resulting in only normal profits being earned.

7. C is correct. Output increases in the same proportion as input increases occur at constant returns to scale.

8. B is correct. Economies of scale occur if, as the firm increases output, cost per unit of production falls. Graphically, this definition translates into an LRAC with a negative slope.

9. B is correct. As the firm increases output, diseconomies of scale and higher average total costs can result when business functions and product lines overlap or are duplicated.

10. C is correct. The firm operating at greater than long-run efficient scale is subject to diseconomies of scale. It should plan to decrease its level of production.

11. B is correct. A company in a perfectly competitive market must accept whatever price the market dictates. The marginal cost schedule of a company in a perfectly competitive market determines its supply function.

12. A is correct. As prices decrease, smaller companies will leave the market rather than sell below cost. The market share of Aquarius, the price leader, will increase.

13. B is correct. The dominant company's market share tends to decrease as profits attract entry by other companies.