Perfect Competition

➢ WHAT IS A COMPETITIVE MARKET?

- A market with many buyers and sellers trading identical products so that each buyer and seller is a price taker.
- A competitive market, sometimes called a perfectly competitive market, has three characteristics:
    - There are many buyers and many sellers in the market.
    - The goods offered by the various sellers are largely the same.
    - Firms can freely enter or exit the market.
    - Everyone knows that everyone knows everything.

THE REVENUE OF A COMPETITIVE FIRM

- A firm in a competitive market tries to maximize profit (total revenue minus total cost).
- To keep matters concrete, let's consider a specific firm: the Vaca Family Dairy Farm. The Vaca Farm produces a quantity of milk, Q, and sells each unit at the market price, P. The farm's total revenue is $P \times Q$. For example, if a gallon of milk sells for $6 and the farm sells 1,000 gallons, its total revenue is $6,000.
- Because the Vaca Farm is small compared to the world market for milk, it takes the price as given by market conditions.

- Table 1 shows the revenue for the Vaca Family Dairy Farm. The first two columns show the amount of output the farm produces and the price at which it sells its output. The third column is the farm's total revenue. The table assumes that the price of milk is $6 a gallon, so total revenue is $6 times the number of gallons.

TABLE 1

Total, Average, and Marginal Revenue for a Competitive Firm

Quantity (Q)	Price (P)	Total Revenue ($TR = P \times Q$)	Average Revenue ($AR = TR / Q$)	Marginal Revenue ($MR = \Delta TR / \Delta Q$)
1 gallon	$6	$ 6	$6	
				$6
2	6	12	6	
				6
3	6	18	6	
				6
4	6	24	6	
				6
5	6	30	6	
				6
6	6	36	6	
				6
7	6	42	6	
				6
8	6	48	6	

- Just as the concepts of average and marginal were useful in the preceding chapter when analyzing costs, they are also useful when analyzing revenue. To see what these concepts tell us, consider these two questions:
- How much revenue does the farm receive for the typical gallon of milk?
- How much additional revenue does the farm receive if it increases production of milk by 1 gallon?
- The last two columns in Table 1 answer these questions.
- The fourth column in the table shows average revenue, which is total revenue, divided by the amount of output. Average revenue tells us how much revenue a firm receives for the typical unit sold.

- The fifth column shows marginal revenue, which is the change in total revenue from the sale of each additional unit of output. In Table 1, marginal revenue equals $6, the price of a gallon of milk. This result illustrates a lesson that applies only to competitive firms. Total revenue is P×Q, and P is fixed for a competitive firm. Therefore, when Q raises by 1 unit, total revenue rises by P dollars. For competitive firms, marginal revenue equals the price of the good.

➢ PROFIT MAXIMIZATION AND THE COMPETITIVE FIRM'S SUPPLY CURVE

- Let's begin our analysis of the firm's supply decision with the example in Table 2.

TABLE 2

Profit Maximization: A Numerical Example

Quantity (Q)	Total Revenue (TR)	Total Cost (TC)	Profit (TR – TC)	Marginal Revenue (MR = ΔTR / ΔQ)	Marginal Cost (MC = ΔTC /ΔQ)	Change in Profit (MR – MC)
0 gallons	$ 0	$ 3	–$3			
				$6	$2	$ 4
1	6	5	1			
				6	3	3
2	12	8	4			
				6	4	2
3	18	12	6			
				6	5	1
4	24	17	7			
				6	6	0
5	30	23	7			
				6	7	–1
6	36	30	6			
				6	8	–2
7	42	38	4			
				6	9	–3
8	48	47	1			

- The fourth column shows the farm's profit, which is computed by subtracting total cost from total revenue. If the farm produces nothing, it has

a loss of $3 (its fixed cost). If it produces 1 gallon, it has a profit of $1. If it produces 2 gallons, it has a profit of $4 and so on. Because the Vaca family's goal is to maximize profit, it chooses to produce the quantity of milk that makes profit as large as possible. In this example, profit is maximized when the farm produces 4 or 5 gallons of milk, for a profit of $7.

- There is another way to look at the Vaca Farm's decision: The Vaca finds the profit-maximizing quantity by comparing the marginal revenue and marginal cost from each unit produced. The fifth and sixth columns in Table 2 compute marginal revenue and marginal cost from the changes in total revenue and total cost, and the last column shows the change in profit for each additional gallon produced.
- The first gallon of milk the farm produces has marginal revenue of $6 and a marginal cost of $2; hence, producing that gallon increases profit by $4 (from –$3 to $1). The second gallon produced has marginal revenue of $6 and a marginal cost of $3, so that gallon increases profit by $3 (from $1 to $4).
- As long as marginal revenue exceeds marginal cost, increasing the quantity produced raises profit. Once the Vaca Farm has reached 5 gallons of milk, however, the situation changes. The sixth gallon would have marginal revenue of $6 and a marginal cost of $7, so producing it would reduce profit by $1 (from $7 to $6). As a result, the Vaca would not produce beyond 5 gallons.
- One of the Ten Principles of Economics in Chapter 1 is that rational people think at the margin. We now see how the Vaca Family Dairy Farm can apply this principle. If marginal revenue is greater than marginal cost—as it is at 1, 2, or 3 gallons—the Vaca should increase the production of milk because it

will put more money in their pockets (marginal revenue) than it takes out (marginal cost).

- If marginal revenue is less than marginal cost—as it is at 6, 7, or 8 gallons—the Vaca should decrease production. If the Vaca think at the margin and make incremental adjustments to the level of production, they are naturally led to produce the profit-maximizing quantity.

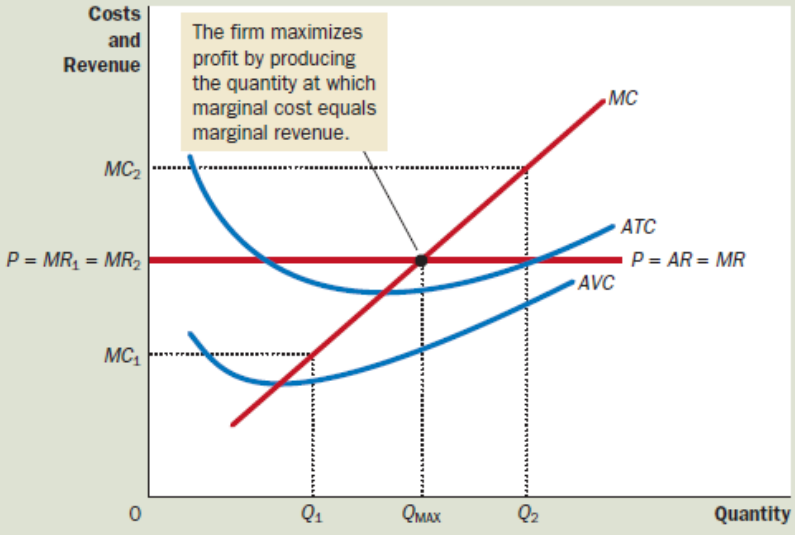
THE MARGINAL-COST CURVE AND THE FIRM'S SUPPLY DECISION

- To extend this analysis of profit maximization, consider the cost curves in Figure1.

1 FIGURE

Profit Maximization for a Competitive Firm

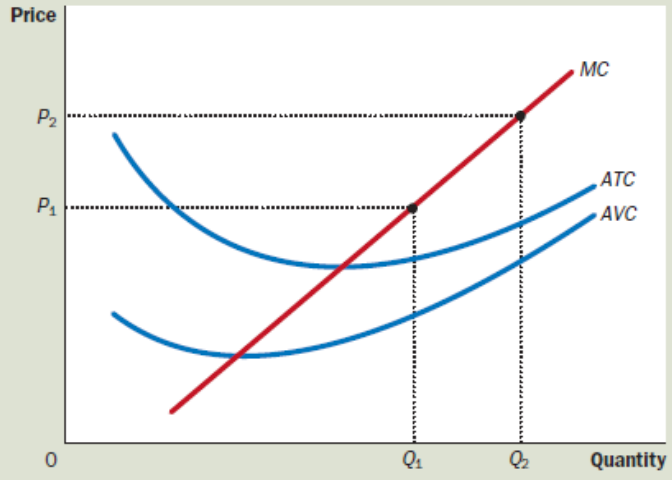
This figure shows the marginal-cost curve (*MC*), the average-total-cost curve (*ATC*), and the average-variable-cost curve (*AVC*). It also shows the market price (*P*), which equals marginal revenue (*MR*) and average revenue (*AR*). At the quantity Q_1, marginal revenue MR_1 exceeds marginal cost MC_1, so raising production increases profit. At the quantity Q_2, marginal cost MC_2 is above marginal revenue MR_2, so reducing production increases profit. The profit-maximizing quantity Q_{MAX} is found where the horizontal price line intersects the marginal-cost curve.



- These cost curves have the three features that, as we discussed in the previous chapter, are thought to describe most firms: The marginal-cost curve (MC) is upward sloping. The average-total-cost curve (ATC) is U-shaped. And the marginal-cost curve crosses the average-total-cost curve at the minimum of average total cost. The figure also shows a horizontal line at the market price (P). The price line is horizontal because the firm is a price taker: The price of the firm's output is the same regardless of the quantity that the firm decides to produce.
- Keep in mind that, for a competitive firm, the firm's price equals both its average revenue (AR) and its marginal revenue (MR).
- We can use Figure 1 to find the quantity of output that maximizes profit. Imagine that the firm is producing at Q1. At this level of output, marginal revenue is greater than marginal cost. That is, if the firm raised its level of production and sales by 1 unit, the additional revenue (MR1) would exceed the additional cost (MC1). Profit, which equals total revenue minus total cost, would increase. Hence, if marginal revenue is greater than marginal cost, as it is at Q1, the firm can increase profit by increasing production.
- A similar argument applies when output is at Q2. In this case, marginal cost is greater than marginal revenue. If the firm reduced production by 1 unit, the costs saved (MC2) would exceed the revenue lost (MR2). Therefore, if marginal revenue is less than marginal cost, as it is at Q2, the firm can increase profit by reducing production.
- Where do these marginal adjustments to production end? Regardless of whether the firm begins with production at a low level (such as Q1) or at a high level (such as Q2), the firm will eventually adjust production until the quantity produced reaches QMAX.

- This analysis yields three general rules for profit maximization:
- If marginal revenue is greater than marginal cost, the firm should increase its output.
- If marginal cost is greater than marginal revenue, the firm should decrease its output.
- At the profit-maximizing level of output, marginal revenue and marginal cost are exactly equal.
- Because a competitive firm is a price taker, its marginal revenue equals the market price. For any given price, the competitive firm's profit maximizing quantity of output is found by looking at the intersection of the price with the marginal-cost curve. In Figure 1, that quantity of output is QMAX. Suppose that the price prevailing in this market rises, perhaps because of an increase in market demand. Figure 2 shows how a competitive firm responds to the price increase.

FIGURE 2



Marginal Cost as the Competitive Firm's Supply Curve
An increase in the price from P_1 to P_2 leads to an increase in the firm's profit-maximizing quantity from Q_1 to Q_2. Because the marginal-cost curve shows the quantity supplied by the firm at any given price, it is the firm's supply curve.

- When the price is P1, the firm produces quantity Q1, the quantity that equates marginal cost to the price. When the price rises to P2, the firm finds that marginal revenue is now higher than marginal cost at the previous level

of output, so the firm increases production. The new profit-maximizing quantity is Q2, at which marginal cost equals the new higher price. In essence, because the firm's marginal-cost curve determines the quantity of the good the firm is willing to supply at any price, the marginal-cost curve is also the competitive firm's supply curve. There are, however, some caveats to that conclusion, which we examine next.

THE FIRM'S SHORT-RUN DECISION TO SHUT DOWN

- Here we should distinguish between a temporary shutdown of a firm and the permanent exit of a firm from the market.
- A shutdown refers to a short-run decision not to produce anything during a specific period of time because of current market conditions.
- Exit refers to a long-run decision to leave the market. The short-run and long-run decisions differ because most firms cannot avoid their fixed costs in the short run but can do so in the long run. That is, a firm that shuts down temporarily still has to pay its fixed costs, whereas a firm that exits the market does not have to pay any costs at all, fixed or variable.
- For example, consider the production decision that a farmer faces. The cost of the land is one of the farmer's fixed costs. If the farmer decides not to produce any crops one season, the land lies fallow, and he cannot recover this cost. When making the short-run decision whether to shut down for a season, the fixed cost of land is said to be a sunk cost. By contrast, if the farmer decides to leave farming altogether, he can sell the land. When making the long-run decision whether to exit the market, the cost of land is not sunk.

- **SUNK COST:** A cost that has already been committed and cannot be recovered.
- Now let's consider what determines a firm's shutdown decision. If the firm shuts down, it loses all revenue from the sale of its product. At the same time, it saves the variable costs of making its product (but must still pay the fixed costs).
- Thus, the firm shuts down if the revenue that it would get from producing is less than its variable costs of production.
- A small bit of mathematics can make this shutdown criterion more useful. If TR stands for total revenue and VC stands for variable costs, then the firm's decision can be written as

  Shut down if TR < VC.
- The firm shuts down if total revenue is less than variable cost. By dividing both sides of this inequality by the quantity Q, we can write it as

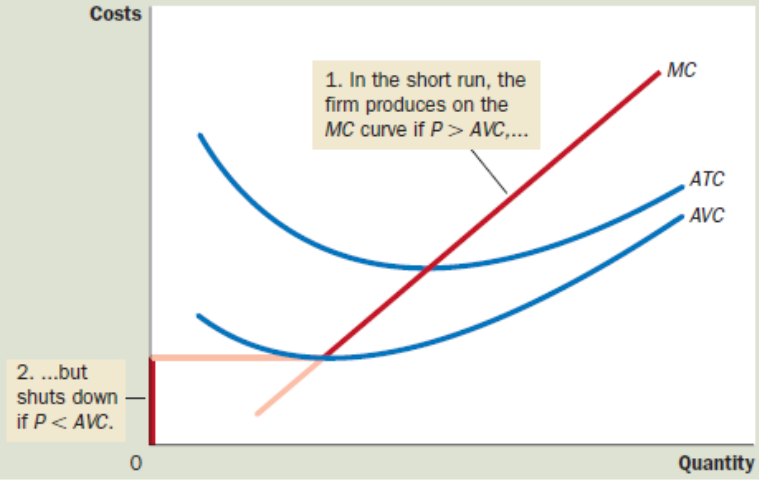
  Shut down if TR / Q < VC / Q.
- The left side of the inequality, TR / Q, is total revenue P × Q divided by quantity Q, which is average revenue, most simply expressed as the good's price, P. The right side of the inequality, VC / Q, is average variable cost, AVC. Therefore, the firm's shutdown criterion can be restated as

  Shut down if P < AVC.
- That is, a firm chooses to shut down if the price of the good is less than the average variable cost of production. This criterion is intuitive: When choosing to produce, the firm compares the price it receives for the typical unit to the average variable cost that it must incur to produce the typical unit. If the price doesn't cover the average variable cost, the firm is better off stopping production altogether. The firm will be losing money (since it still

has to pay fixed costs), but it would lose even more money staying open. The firm can reopen in the future if conditions change so that price exceeds average variable cost.

- If the firm produces anything, it produces the quantity at which marginal cost equals the price of the good. Yet if the price is less than average variable cost at that quantity, the firm is better off shutting down and not producing anything.

FIGURE 3



The Competitive Firm's Short-Run Supply Curve
In the short run, the competitive firm's supply curve is its marginal-cost curve (*MC*) above average variable cost (*AVC*). If the price falls below average variable cost, the firm is better off shutting down.

THE FIRM'S LONG-RUN DECISION TO EXIT OR ENTER A MARKET

- A firm's long-run decision to exit a market is similar to its shutdown decision. If the firm exits, it will again lose all revenue from the sale of its product, but now it will save not only its variable costs of production but also its fixed costs. Thus, the firm exits the market if the revenue it would get from producing is less than its total costs.

- We can again make this criterion more useful by writing it mathematically. If TR stands for total revenue, and TC stands for total cost, then the firm's exit criterion can be written as

  Exit if TR < TC.

- The firm exits if total revenue is less than total cost. By dividing both sides of this inequality by quantity Q, we can write it as

  Exit if TR / Q < TC / Q.

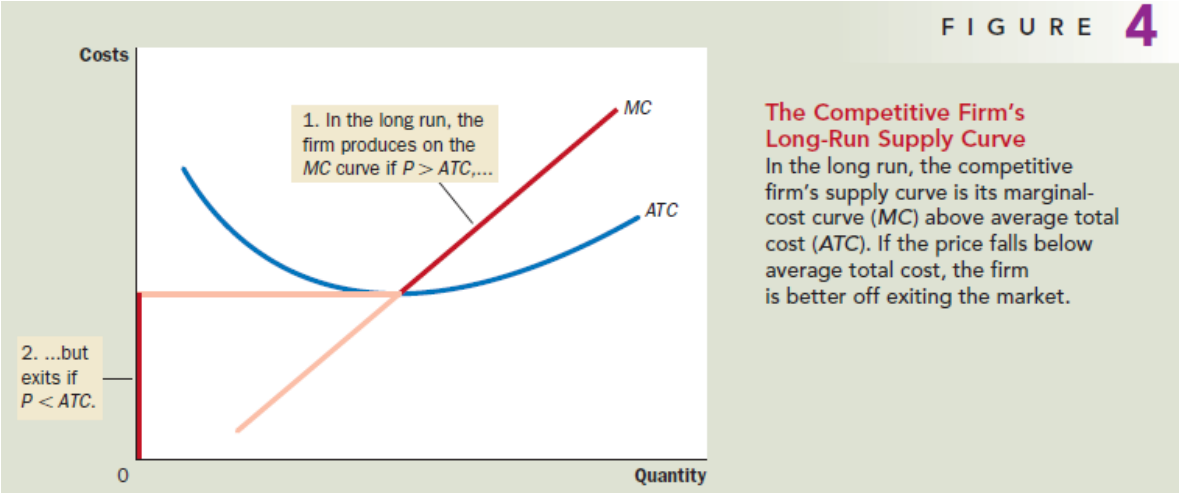
- We can simplify this further by noting that TR / Q is average revenue, which equals the price P, and that TC / Q is average total cost, ATC. Therefore, the firm's exit criterion is

  Exit if P < ATC.

- A parallel analysis applies to an entrepreneur who is considering starting a firm. The firm will enter the market if such an action would be profitable, which occurs if the price of the good exceeds the average total cost of production. The entry criterion is

  Enter if P > ATC.

- If the firm is in the market, it produces the quantity at which marginal cost equals the price of the good. Yet if the price is less than average total cost at that quantity, the firm chooses to exit (or not enter) the market. These results are illustrated in Figure 4. The competitive firm's long-run supply curve is the portion of its marginal-cost curve that lies above average total cost.



MEASURING PROFIT IN OUR GRAPH FOR THE COMPETITIVE FIRM

- As we analyze exit and entry, it is useful to be able to analyze the firm's profit in more detail. Recall that profit equals total revenue (TR) minus total cost (TC):

$$\text{Profit} = \text{TR} - \text{TC}.$$

- We can rewrite this definition by multiplying and dividing the right side by Q:

$$\text{Profit} = (\text{TR} / \text{Q} - \text{TC} / \text{Q}) \times \text{Q}.$$

  But note that TR / Q are average revenue, which is the price, P, and TC / Q is average total cost, ATC. Therefore,

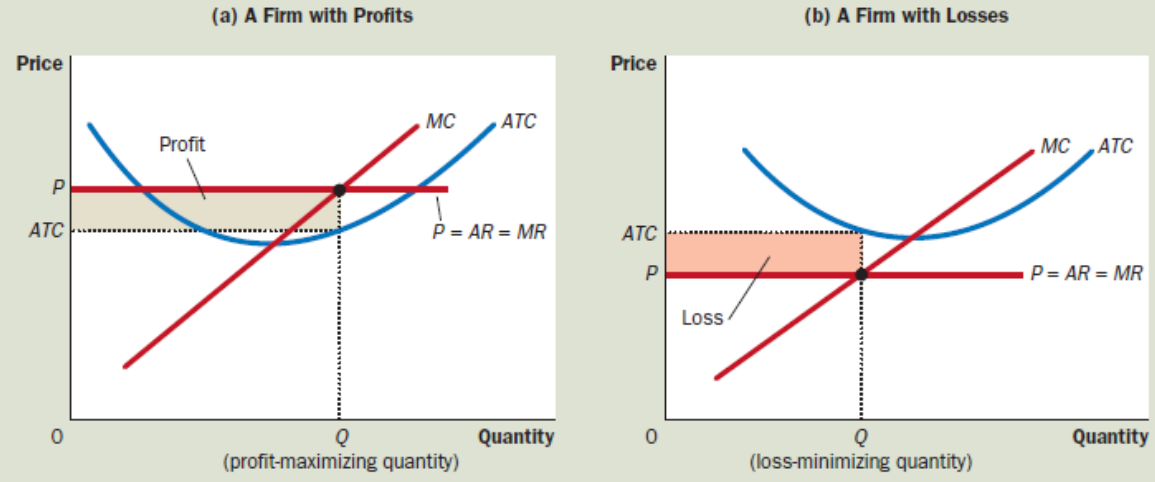
$$\text{Profit} = (\text{P} - \text{ATC}) \times \text{Q}.$$

- This way of expressing the firm's profit allows us to measure profit in our graphs.

5 FIGURE

Profit as the Area between Price and Average Total Cost

The area of the shaded box between price and average total cost represents the firm's profit. The height of this box is price minus average total cost ($P - ATC$), and the width of the box is the quantity of output (Q). In panel (a), price is above average total cost, so the firm has positive profit. In panel (b), price is less than average total cost, so the firm has losses.



- Panel (a) of Figure 5 shows a firm earning positive profit. As we have already discussed, the firm maximizes profit by producing the quantity at which price equals marginal cost. Now look at the shaded rectangle. The height of the rectangle is P – ATC, the difference between price and average total cost. The width of the rectangle is Q, the quantity produced. Therefore, the area of the rectangle is

  (P – ATC) × Q, which is the firm's profit.

- Similarly, panel (b) of this figure shows a firm with losses (negative profit). In this case, maximizing profit means minimizing losses, a task accomplished once again by producing the quantity at which price equals marginal cost. Now consider the shaded rectangle. The height of the rectangle is ATC – P, and the width is Q. The area is (ATC – P) × Q, which is the firm's loss. Because a firm in this situation is not making enough revenue to cover its average total cost, the firm would choose in the long run to exit the market.

THE SUPPLY CURVE IN A COMPETITIVE MARKET

- Now that we have examined the supply decision of a single firm, we can discuss the supply curve for a market. There are two cases to consider. First, we examine a market with a fixed number of firms. Second, we examine a market in which the number of firms can change as old firms exit the market and new firms enter.
- Both cases are important, for each applies over a specific time horizon. Over short periods of time, it is often difficult for firms to enter and exit, so the assumption of a fixed number of firms is appropriate. But over long periods of time, the number of firms can adjust to changing market conditions.

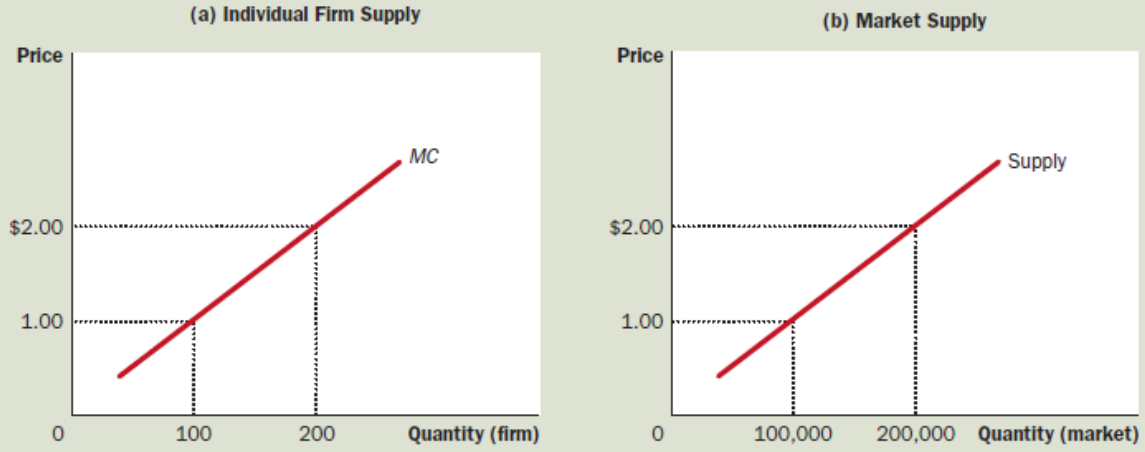
THE SHORT RUN: MARKET SUPPLY WITH A FIXED NUMBER OF FIRMS

- Consider first a market with 1,000 identical firms. For any given price, each firm supplies a quantity of output so that its marginal cost equals the price, as shown in panel (a) of Figure 6. That is, as long as price is above average variable cost, each firm's marginal-cost curve is its supply curve. The quantity of output supplied to the market equals the sum of the quantities supplied by each of the 1,000 individual firms. Thus, to derive the market supply curve, we add the quantity supplied by each firm in the market. As panel (b) of Figure 6 shows, because the firms are identical, the quantity supplied to the market is 1,000 times the quantity supplied by each firm.

In the short run, the number of firms in the market is fixed. As a result, the market supply curve, shown in panel (b), reflects the individual firms' marginal-cost curves, shown in panel (a). Here, in a market of 1,000 firms, the quantity of output supplied to the market is 1,000 times the quantity supplied by each firm.

FIGURE 6

Short-Run Market Supply



THE LONG RUN: MARKET SUPPLY WITH ENTRY AND EXIT

- Now consider what happens if firms are able to enter or exit the market. Let's suppose that everyone has access to the same technology for producing the good and access to the same markets to buy the inputs into production.
- Therefore, all firms and all potential firms have the same cost curves. Decisions about entry and exit in a market of this type depend on the incentives facing the owners of existing firms and the entrepreneurs who could start new firms.
- If firms already in the market are profitable, then new firms will have an incentive to enter the market. This entry will expand the number of firms, increase the quantity of the good supplied, and drive down prices and profits.

- Conversely, if firms in the market are making losses, then some existing firms will exit the market. Their exit will reduce the number of firms, decrease the quantity of the good supplied, and drive up prices and profits. At the end of this process of entry and exit, firms that remain in the market must be making zero economic profit.
- Recall that we can write a firm's profit as

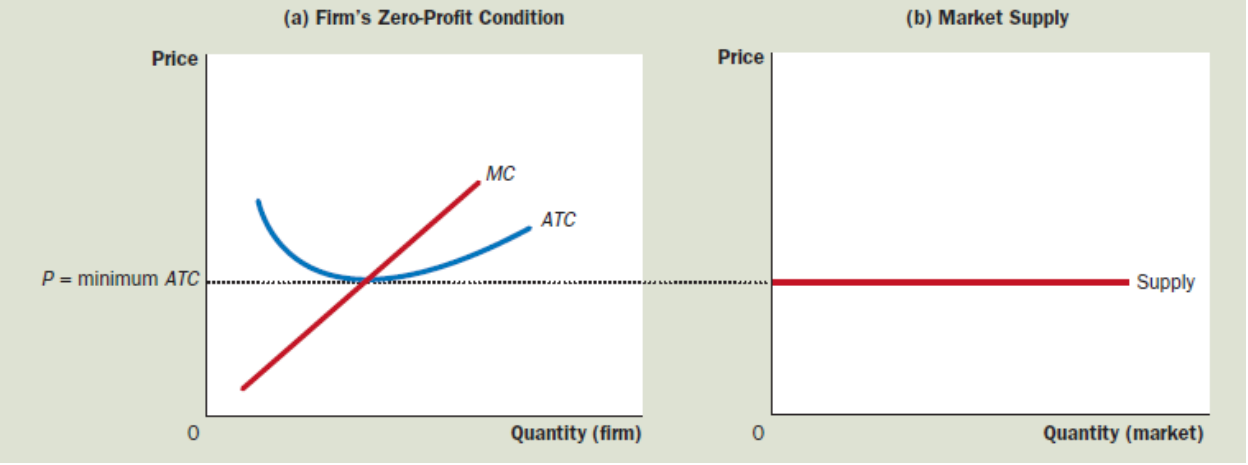
$$\text{Profit} = (P - ATC) \times Q.$$

- This equation shows that an operating firm has zero profit if and only if the price of the good equals the average total cost of producing that good. If price is above average total cost, profit is positive, which encourages new firms to enter. If price is less than average total cost, profit is negative, which encourages some firms to exit. The process of entry and exit ends only when price and average total cost are driven to equality.
- This analysis has a surprising implication. We noted earlier in the chapter that competitive firms maximize profits by choosing a quantity at which price equals marginal cost. We just noted that free entry and exit force price to equal average total cost. But if price is to equal both marginal cost and average total cost, these two measures of cost must equal each other. Marginal cost and average total cost are equal, however, only when the firm is operating at the minimum of average total cost. Recall from the preceding chapter that the level of production with lowest average total cost is called the firm's efficient scale. Therefore, in the long-run equilibrium of a competitive market with free entry and exit, firms must be operating at their efficient scale.

In the long run, firms will enter or exit the market until profit is driven to zero. As a result, price equals the minimum of average total cost, as shown in panel (a). The number of firms adjusts to ensure that all demand is satisfied at this price. The long-run market supply curve is horizontal at this price, as shown in panel (b).

FIGURE 7

Long-Run Market Supply



- Panel (a) of Figure 7 shows a firm in such a long-run equilibrium. In this figure, price P equals marginal cost MC, so the firm is profit-maximizing. Price also equals average total cost ATC, so profits are zero. New firms have no incentive to enter the market, and existing firms have no incentive to leave the market.
- From this analysis of firm behavior, we can determine the long-run supply curve for the market. In a market with free entry and exit, there is only one price consistent with zero profit—the minimum of average total cost. As a result, the long-run market supply curve must be horizontal at this price, as illustrated by the perfectly elastic supply curve in panel (b) of Figure 7.
- Any price above this level would generate profit, leading to entry and an increase in the total quantity supplied. Any price below this level would generate losses, leading to exit and a decrease in the total quantity supplied. Eventually, the number of firms in the market adjusts so that price equals the

minimum of average total cost, and there are enough firms to satisfy all the demand at this price.

WHY DO COMPETITIVE FIRMS STAY IN BUSINESS IF THEY MAKE ZERO PROFIT?

- At first, it might seem odd that competitive firms earn zero profit in the long run. After all, people start businesses to make a profit. If entry eventually drives profit to zero, there might seem to be little reason to stay in business.
- To understand the zero-profit condition more fully, recall that profit equals total revenue minus total cost and that total cost includes all the opportunity costs of the firm. In particular, total cost includes the time and money that the firm owners devote to the business. In the zero-profit equilibrium, the firm's revenue must compensate the owners for these opportunity costs.
- Consider an example. Suppose that, to start his farm, a farmer had to invest $1 million, which otherwise he could have deposited in a bank to earn $50,000 a year in interest. In addition, he had to give up another job that would have paid him $30,000 a year. Then the farmer's opportunity cost of farming includes both the interest he could have earned and the forgone wages—a total of $80,000. Even if his profit is driven to zero, his revenue from farming compensates him for these opportunity costs.
- Keep in mind that accountants and economists measure costs differently. That is, they measure costs that require an outflow of money from the firm, but they do not include the opportunity costs of production that do not involve an outflow of money. As a result, in the zero-profit equilibrium, economic profit is zero, but accounting profit is positive. Our farmer's accountant, for instance, would conclude that the farmer earned an

accounting profit of $80,000, which is enough to keep the farmer in business.