Chapter 2
Competition as Market Regulator

■ Student Learning Goals

The three goals of this chapter are:

1. To present the basis for business firm decisions in ideally functioning competitive markets. This task begins with analysis of costs as the basis of firms' decisions, and understanding costs is a first goal.

2. To show how competitive markets function, we examine market supply and demand. Armed with knowledge of costs, firms' supplies can be understood as market supply, and adding consumer demands leads to market demand, supply and demand being the ingredients needed for a market to function. Seeing how it functions is the second goal of the chapter .

3. To show why competition is beneficial requires a definition of welfare, and understanding a useful way to represent welfare is the third goal.

■ Suggested Assignments

In addition to reading the chapter carefully, even though it will be review for students who have studied microeconomics, it is useful to have students work through several problems, and indeed to work through some problems in class (to help judge how well students understand the material).

■ Teaching Tips

Chapter 2 is a review that well prepared students may find boring. The instructor will have to judge how much emphasis to give it. It covers material that students should understand very well, because a market economy is background for every thing in the book.

Section 2.1, on the firm's production costs, is a brief treatment of very important material from microeconomics. Confined to examine costs only for the single product firm, the first subsection describes the total cost function, marginal cost, average cost, the short run and the long run, and economies of scale. The aim should be to uncover weaknesses in student understanding, and students should be urged to look for ideas that are confusing, so they can clarify their understanding of them. The second subsection examines the long run and short run more thoroughly, including entry as a long-run response to profitable opportunities. Sunk costs, which give an entrant pause because they prevent exit, and avoidable costs, which foster easier adjustments to change, are explained. Then the third subsection extends the cost ideas to multi-product firms. Some new ideas are needed for this extension. When some fixed costs are common to more than one product, economies of scale are no longer easily defined and new ideas are needed. The average incremental cost is introduced here to provide a measure in the multi-product firm that is comparable to economies of scale in the single product firm. Economies of multi-product operation (called economies of product scope) are also defined. The new ideas also yield a clear definition of cross subsidy.

Section 2.2 takes the supply implications of production costs in Section 2.1 and joins them with consumer demand in ideal competitive markets. First, the assumptions for a perfect form of competition are set out and how this ideal competition operates is then traced. This involves first identifying a short-run equilibrium, and then judging incentives it offers to firms for long-run adjustments. In Figure 2.3 the average variable cost curve, which is not shown, can be introduced in class to show how the firm's short-run supply curve lies above it. In ideal conditions, competition leads to a beneficial long-run equilibrium, which is described in Section 2.3.

Section 2.3 shows what is meant by a "beneficial" equilibrium by defining an idea of economic welfare. The idea depends on measures of consumer surplus and producer surplus, which can be combined into a measure of economic welfare. The section shows what is meant by efficiency and what it means to allocate resources efficiently. Risk and its effects on welfare (under diminishing marginal utility of income, which implies aversion to risk) are also examined.

■ Answers to End-of-Chapter Questions

1. (a) Average cost $= AC = C/Q = (10 + Q)/Q = 10/Q + 1$.

    (b) If cost is $C = 10 + Q$ and output is increased by one unit, Q rises by one, so cost will increase by one. Thus, marginal cost is one. (This result can be obtained directly using calculus. The derivative of C with respect to Q is $dC/dQ = 1$.)

    (c) $S_c = AC/MC = (10Q + 1)/1 = 10Q + 1 > 1$, indicating scale economies.

2. (a) Average cost for this case is $AC = (10 + q + q^2)/q = 10/q + 1 + q$.

    (b) Marginal cost for this case is the derivative of the total cost function, $MC = d(10 + q + q^2)/dq = 1 + 2q$.

    (c) An effective index of scale economies is $S_c = AC/MC = (10/q + 1 + q)/(1 + 2q)$.
        Scale economies exist when this ratio exceeds one. The ratio equals one when numerator equals denominator, which occurs when $q = \sqrt{10}$. Up to that value for q, $AC \geq MC$ and $Sc \geq 1$. When $q \leq \sqrt{10}$, $AC \leq MC$ and $Sc \leq 1$. The same conclusion can be reached by plotting the AC curve and inferring the location of the MC curve (when AC is falling with output, it must be true that $AC \geq MC$, and when AC is rising with output, it must be true that $AC \leq MC$).

    (d) If all firms have this same cost function, each can produce $q = \sqrt{10}$, where average cost will be at a minimum. With demand great enough to support many firms of this size, a competitive market can exist and function properly.
        Notice that at this output of $q = \sqrt{10}$, $AC = 10/q + 1 + q = q + 1 + q = 1 + 2q$, which also equals $MC (AC = MC$ where AC is at its minimum). If $q = \sqrt{10} = 3.16$, then $AC = 7.32$.

    (e) Suppose market demand is represented by $P = 10.4868 - 0.01Q$ where $Q = \Sigma q$ and any number of firms can produce according to the cost function described. A competitive equilibrium will occur where $P = AC$ or $P = 10.4868 - 0.01Q = 7.32$. Solving for Q yields market $Q = 3.1668/0.01 = 316.68$. With each firm at its minimum cost at $q = \sqrt{10}$, or $q \approx 3.16$, there will be about 100 firms at this equilibrium.

3. (a)

q	TC	AC	MC
7	219	31.3	
			25
8	244	30.5	
			27
9	271	30.1	
			29
10	300	30.0	
			31
11	331	30.1	
			33
12	364	30.3	

The minimum average cost is 30 and it occurs at a quantity of 10.

(b) As an approximation, look at the change in total cost when quantity increases from $q = 7$ ($TC = 219$) to $q = 8$ ($TC = 244$). That increase in total cost of 25 ($244 - 219 = 25$) is roughly the marginal cost in going from $q = 7$ to $q = 8$. It is not the exact marginal cost at $q = 8$, however. In going from $q = 8$ to $q = 9$, the same approximation makes marginal cost 27. In moving from $q = 7$ to $q = 9$ the two marginal costs are thus 25 and 27, so the marginal cost right at $q = 8$ may be an average of these two estimates, or 26. (This result can be obtained directly using calculus. The derivative of C with respect to q, which equals marginal cost, is $MC = 10 + 2q$. If $q = 8$, $MC = 26$.)

(c) In going from $q = 9$ to $q = 10$, total cost increases by 29 ($300 - 271$), indicating $MC = 29$ as an approximation. But because in going from $q = 10$ to $q = 11$ total cost increases by 31, we might expect the average of 29 and 31 to yield a better estimate: $MC = 30$. (Using calculus again, and substituting $q = 10$ into $MC = 10 + 2q$, we obtain $MC = 30$. This result of $MC = 30$ should be expected from $AC = 30$ at the minimum of the average cost curve, because when average cost is at its minimum value that value should equal marginal cost. The point of minimum average cost is where marginal cost and average cost intersect.)

4   (a) The cost function does not possess economies of scale because the marginal cost of Q_1 is constant at 15 and the marginal cost of Q_2 is constant at 15. The average incremental cost of Q_1(or Q_2, similarly) is also constant at $AIC_1 = [C(q_1, q_2) - C(0, q_2)]/q_1 = [15Q_1 + 15Q_2 - 15Q_2]/Q_1 = 15$.

(b) There are no economies of scope because a single firm could produce Q_1 or Q_2 at the same cost as a firm producing both goods. Setting Q_1 or Q_2 equal to zero in $TC = 15Q_1 + 15Q_2$ will yield the single-firm cost function and two firms such can have the same costs as the two-product firm.

(c) The average incremental cost for good Q_1 when $Q_1 = 10$ and $Q_2 = 10$ is $AIC_1 = [C(q_1, q_2) - C(0, q_2)]/q_1 = [10Q_1 + 10Q_2 - 10Q_2]/Q_1 = 10$.

5. (a) The presence of fixed cost in the total cost function, $C = 15 + 0.5q_1 + 0.3q_2$, suggests there may be economies of scale. Although the fixed cost could be offset by a q_i^2 (or higher level) term, which would make average cost rise at some output, there is no exponential term in this case. If q_1 and q_2 are both increased, average cost will decline. For example, let $0.625 q_1 + 0.375q_2 = q$, so $C = 15 + 1.25q$ and $AC = 15/q + 1.25$. Now as q increases it is clear that AC will decrease because q is in the denominator of average cost. (This result can be obtained directly using calculus. The derivative of average cost with respect to quantity is $dAC/dq = -15/q^2$, which is negative, indicating average cost decreases with quantity.)

(b) The test for economies of scope is whether $C(q_1, q_2)$ is less than $C(0, q_2) + C(q_1, 0)$. Substituting in the cost function, $C = 15 + 0.5q_1 + 0.3q_2$, we find

$$C = 15 + 0.5q_1 + 0.3q_2 < 15 + 0.5q_1 + 15 + 0.3q_2 = 30 + 0.5q_1 + 0.3q_2, \text{ or } 15 < 30,$$

which confirms that economies of scope are present.

(c) Both $C_1 = 10 + 0.5q_1$ and $C_2 = 10 + 0.3q_2$ possess economies of scale because the appropriate measure of average cost, $AC_1 = 10/q_1 + 0.5$ or $AC_2 = 10/q_2 + 0.3$, grows smaller as q_1 or q_2 grows larger. The cost functions cannot have economies of scope because each cost function applies to only one product.

(d) Because q_1 and q_2 can be produced more economically in one firm, we should not expect to see firms producing only one of the goods. *That is,* $C = 15 + 0.5q_1 + 0.3q_2$ is less than $C_1 + C_2 = 10 + 0.5q_1 + 10 + 0.3q_2 = 20 + 0.5q_1 + 0.3q_2$.

6. Each of four neighboring farmers is willing to pay at least $15,000 for an irrigation and flood control system. The most efficient arrangement for irrigating the four farms will be the single system that costs $44,000 for four farms, or $11,000 per farm. No other system allows a price for all four farms that averages as little as $11,000.

    The technology of irrigation and flood control does possess economies of scale up to three farms, as average cost is $15,000 for one farm, $12,500 for two farms, and $10,000 for three farms. But at three farms the economies stop, and diseconomies appear at four farms where average cost rises to $11,000.

7. Because the identical twins have exactly the same utility function, the richer twin will have a smaller gain in utility from an incremental $100 than the poorer twin. Answers to the questions follow from this observation. Thus, to give each twin the *same* gain in utility, the rich twin will have to receive the bigger share of the $100. On the other hand, if they wish to obtain the greatest gain in their aggregate, or combined, utility, the poorer twin—who will have a larger gain in utility from an incremental $100—should receive the bigger share.

8. Consider the consumer's and producer's surpluses presented in Figures 2.8 and 2.9. If the goal was to maximize consumer plus producer surplus from a transaction by simply setting a price in the market, the best price would be $P = MC$. That price will avoid the losses in welfare (shaded areas) in both figures. That makes $P = MC$ the ideal price. If a single consumer and a single producer bargain, they may not reach the ideal price of $P = MC$. We should expect them to do so, because that solution is best for both of them, bur bargaining strategies could get in the way.

9. (a) Equilibrium occurs where supply and demand intersect, or where $P = 10 - 0.01Q = 2 + 0.01Q$. Solving $10 - 0.01Q = 2 + 0.01Q$ for Q yields $Q = 400$, and substituting that value into either the demand or the supply function yields $P = 6$. (This solution may also be found graphically.)

    (b) Consumer surplus will be the area above price and below demand. This triangular area will have height of 4 (the demand price intercept 10 minus the price of 6) and length of the quantity, 40, so its area will be $\frac{1}{2}(4 \times 40)$, or 80. The producer surplus will also have a height of 4 (the price of 6 minus the supply curve intercept with demand of 2) and a length of 40, so it also equals 80. And total welfare $(CS + PS)$ will be 160.

    (c) There is no average cost information for the firms in the market and without that it is impossible to analyze the long-run equilibrium.

■ True or False and Explain

1. Firms in competitive markets must seek to maximize profit rather than a different goal.

    T. If a firm does not attempt to maximize profit it will earn less and fall by the wayside. Competition forces profit seeking as a means of survival.

2. Short-run marginal cost is always higher than long-run marginal costs.

    F. When output is low, below the output that minimizes average cost, short-run marginal cost is below long-run marginal cost because capacity is plentiful and the short-run measure does not include fixed cost.

3. The rent you pay a landlord is like a sunk cost.

    F. This would be true only if you had a very long lease, maybe for twenty years, and you could not break it. Leases seldom last more than a year, and after renting for a period such as a year the tenant can often break the lease by giving one-month's notice. Being able to stop the rent in one month would make the rent an avoidable cost.

4. Scale economies influence the number of firms in an industry.

    T. Yes, scale economies establish a size that is necessary for a firm to achieve competitive costs, and if that size is large relative to the size of the market there will be room in the market for only a few firms.

5. In a multi-product firm, having fixed costs that are common across many products complicates the estimation of costs.

    T. When costs are common across many products, meaning there is no proper basis for allocating them to products, it is hard to estimate product costs. Incremental costs and average incremental costs were conceived to solve this problem by offering a sensible basis for estimating product cost in a multi-product firm.

6. If prices are sustainable they are subsidy free.

    T. Sustainable prices survive. If a subsidy exists, one product must have a price higher than its costs, in order to provide the subsidy, and that product can not survive entry. So prices must be subsidy free to survive, or be sustainable.

7. In Figure 2.3, at the long-run equilibrium, the firm would chose an output of q^*.

    F. The firm would choose q_1 in the long-run, because that is where average cost is minimized.

8. In considering entry or exit, average cost is a crucial influence on the firm's decision.

    T. In the short run, the firm is already in a position in an industry, and marginal cost is important in its decision. But entry or exit are long-run decisions that depend on long-run measures, like average cost.

9. Because an economy serves consumers, welfare can be represented by consumer surplus alone.

    F. Consumers are also investors who receive profit, so a measure of welfare should include producers surplus also.

10. A person who has diminishing marginal utility (marginal utility is lower as the individual has more income) will want to gamble.

  F. Consider a fair gamble, such as the flip of fair coin to determine which person pays $10 to the other. A person who has diminishing marginal utility will see the utility of a possible gain of $10 from winning as lower than the utility of a possible loss of $10 from losing, and when you take a weighted average of those utilities (weights being ½ for winning and ½ for losing), the person will prefer the status quo and will reject the gamble.

11. In the long run, an entire industry will have the same cost function as the firms that operate in the industry.

  F. The industry is made up of a variable (in the long run) number of firms. So even though an individual firm may have a *U*-shaped cost curve, which reaches minimum cost at a certain output, the long-run industry cost curve can be a flat horizontal line as firms enter or exit at that minimum cost for each firm.

■ Discussion Question

*1. Name the six assumptions of perfect competition (the six assumptions are listed in Section 2.2) and consider possible effects when each of them is not met.

■ Supplementary Materials

To speak about social welfare requires some resolution of the income distribution question. Once an income distribution is specified, for example, Pareto ideas that are described—consumption efficiency, production efficiency, and overall economic efficiency—can be shown under reasonable assumptions to yield a *unique* Pareto optimum, a maximum of such economic welfare. Often the existing distribution of income is accepted. Practical measures of welfare, such as consumer surplus (which usually can be inferred from demand information) and producer surplus (which is related to cost and profit), can be derived if the existing distribution of income is accepted. These ideas are introduced in the chapter because they are valuable for evaluating prices and other policies in the absence of competition, and in interpreting a host of regulatory issues.

Defining Consumer Surplus

What if the demand curve does not meet the vertical axis because the quantity demanded never falls to zero (e.g., presumably one would always demand a positive amount of water)? Although *CS* is not as easily defined then, the *change* in consumer surplus can still be obtained, as the change from one price to another in Figure 2.1. The welfare effects of a change in price can thus be obtained even if demand never falls to zero, and the effect of such a change in price is often what is of interest in regulatory situations. For instance, the change in consumer surplus upon changing price from P_0 to P_1 is the area P_0abP_1 in Figure 2.1.

Defining Welfare

It is possible to argue that maximization of consumer surplus alone is a reasonable goal without including producer surplus (this argument sometimes has profit limited, say, to some fair return on assets, so there is no excessive profit or producer surplus). Such a position depends on how consumers and those receiving profit are to be weighted in a measure of welfare. The main reason for including producer surplus as part of welfare is that the shareholders who are receiving profits from firms are also consumers, so their welfare is an appropriate concern. And profit can benefit them. Since profit can be as valuable as consumer surplus, seeking to make their combined sum large is a common normative goal.

Consumer surplus evaluations can often be made from estimated demands for products or services. When profit is affected, it also should be included in assessing welfare effects, as producer surplus. A change in public utility price often involves profit as well as consumer surplus changes, for example, and profit has beneficial effects (or negative effects if profit is reduced) so effects on both should be estimated. Normally in competitive markets profit—or producer surplus—will be driven to zero, because positive economic profit invites entry until that profit is eliminated. But in government regulated markets, where entry is often prevented, it is possible for economic profit to persist as producer surplus, which is another reason to include it in the welfare measure.

Opportunity Cost

To use consumer surplus plus producer surplus ($CS + PS$) in evaluating a public action it is necessary to determine resource costs accurately. This is most easily done when any resources needed, say to build a bridge, can be drawn from many other industries, so the price in no one of them is seriously altered. Resources drawn from other markets at their market prices represent the marginal values consumers place on them in their other uses, and that is the appropriate opportunity cost. This normally expected case allows marginal costs of an action to be calculated in a straightforward way based on resource costs observed. A problem would arise if the necessary resource adjustment was so great that to increase output in this market, some other market in the economy would no longer exist. Then the lost consumer surplus from that collapsed market would have to be considered, in addition to resource costs at market prices.