5

Production and Cost

Why is packet switching used for the Internet rather than circuit networks? What are economies of scale, and how do they provide the United States with a competitive advantage in producing movies and many other cultural or entertainment goods? What are the implications of economies of scale for trade disputes such as that between Canada and the United States over so-called split-run productions of U.S. magazines? Why is international coproduction of television programs and feature films growing in importance? Why do most studios produce both movies and television programs? Why are there so many entertainment industry mergers, such as Disney's acquisitions of Miramax and ABC, AT&T's acquisition of the cable company TCI, AOL's merger with Time Warner, and Bell Canada's (BCE's) acquisition of the CTV television network and the Toronto *Globe and Mail?* As we will see in this chapter, these and other communication questions can be answered through an understanding of how cost varies with output. We have to know how varying the level of factor inputs affects output and what determines the optimal combination of inputs.

We assume the objective of firms is to maximize profit. For profits to be maximized, the total cost of producing the selected output of the good must be minimized. That is, the production must be *economically efficient;* there must be no other method available that is capable of producing the output for a smaller total value (cost) of inputs. Total cost depends on the number of each factor employed and the price per unit that the firm has to pay.

5.1 Short Run, Long Run, and Very Long Run

Production opportunities—ways of combining inputs to change output—differ according to the length of time considered. The quantities of some inputs can be changed very rapidly, whereas a considerable time is needed to change others. For example, energy use can be changed by the turn of a switch, whereas building a plant or installing machinery is likely to take months or even years.

The *short run* is defined as a time period insufficient to change the input level of items such as capital equipment and plant. Such capacity factors are *fixed* in the short run. However, quantities of inputs such as labor and raw materials can be changed and are thus *variable* factors even in the short run.

The *long run* is a period of sufficient length that all factors of production are variable, but the basic technology of production is given.

The *very long run* is a period during which the technological possibilities available to the firm may also change.

5.2 Production in the Short Run

A *production function* shows the maximum quantity of a product that can be produced in a time period for each set of alternative inputs. In the short run, the production function is governed by the *Law of Diminishing Returns*. This law states that after a certain level of input of the variable factor, each additional unit of the variable factor, employed in conjunction with a fixed quantity of another factor, adds less to total product than the previous unit. (In production theory, economists use the word "product" to mean "output"; the words are used interchangeably).

The law is stated as if there were only two factors, one variable and the other fixed, but this is a simplification; the law applies for any number of variable and fixed factors. Also, note the similarity between the Law of Diminishing Returns and the Law of Diminishing Marginal Utility.

If it were not for the Law of Diminishing Returns, all the wheat sold in the world could be produced on one acre of land (fixed factor) if enough labor and fertilizer (variable factors) were employed.

To illustrate the Law of Diminishing Returns, consider the Small DVD Company, which produces DVD-R discs. With capital

Table 5.1 Small DVD Company's Short-Run Production Function

Labor input	0	1	2	3	4	5
Total product	0	2	10	20	25	26
Marginal product	0	2	8	10	5	1
Average product	0	2	5	6.67	6.25	5.2

equipment fixed at one machine, suppose the total product or output per hour for various levels of labor input (the variable factor) is shown in row 2 of Table 5.1.

The machine is designed to be operated by three people and to produce 20 units of output per hour. When only one person is employed, that person finds it almost impossible to perform all the tasks necessary to run the machine and is consequently only able to produce 2 units per hour. Adding a second person increases total product to 10 units. The two people are able to get the machine operating about half of the time. With a third person added, operating the machine goes fairly smoothly. A fourth person is useful to give the others a break, and total product is 25. With a fifth person, each can take longer breaks, but total product increases very little, to 26.

Marginal product is defined as the addition to total product from employing one more unit of the variable factor. Marginal product is shown in row 3 of Table 5.1. For example, adding a fourth worker would increase total product from 20 to 25, so the marginal product is 5.

Average product (row 4) is total product divided by the number of units of the variable factor employed.

5.3 Costs in the Short Run

Cost functions indicate how the minimum cost of producing varies with cost. We will start by defining various cost concepts.

Total Variable Cost (TVC) is the total cost associated with employing the variable factors. For example, referring to Table 5.1, the total variable cost of producing 25 units of output would be the cost of employing four units of labor. If the wage rate paid is $10 per hour, then the total variable cost is $40. This is shown in Table 5.2. To produce 26 units, five people have to be employed, so that the TVC is $50.

Table 5.2 Small DVD Company's Short-Run Costs

Labor input	0	1	2	3	4	5
Total output (Q)	0	2	10	20	25	26
TVC	0	10	20	30	40	50
TFC	20	20	20	20	20	20
TC	20	30	40	50	60	70
AVC		5.00	2.00	1.50	1.60	1.92
AFC		10.00	2.00	1.00	0.80	0.77
ATC		15.00	4.00	2.50	2.40	2.69
SMC		5.00	1.25	1.00	2.00	10.00

Note: AFC indicates average fixed cost; ATC, average total cost; AVC, average variable cost; SMC, short-run marginal cost; TC, total cost; TFC, total fixed cost; TVC, total variable cost.

Total Fixed Cost (TFC) is the cost associated with factors that are fixed in the short run. In our example, the machine is the fixed asset. If the machine has been obtained on a long-term lease at an hourly rate of $20, then TFC is $20 irrespective of output.

Total Cost (TC) is TVC + TFC, so the TC of producing 25 units of output is $40 + $20 = $60, and the TC of producing 26 units is $70.

Short-Run Marginal Cost (SMC) is the change in TC for a one-unit change in output. As the only component of TC varying with output is TVC, SMC can also be defined as the change in TVC associated with a one-unit change in output. For example, the SMC of the 26th unit of output is $10 as TC increases from $60 to $70 or as TVC increases from $40 to $50.

Average Variable Cost (AVC) is TVC/Q, where Q is the output. The AVC of producing 25 units is $40/25 = $1.60.

Average Fixed Cost (AFC) is TFC/Q. As TFC is constant, the larger Q is, the smaller the AFC will be. For example, the AFC for 2 units of output is $20/2 = $10.00, whereas for 25 units it is $0.80.

Average Total Cost (ATC) is AVC + AFC, or TC/Q. For an output of 25 units, it is $1.60 + $0.80 = $2.40.

The short-run costs for Small DVD Company are shown in Table 5.2. The amounts shown for SMC in Table 5.2 require explanation. We defined SMC as the change in TC or TVC for a one-unit change in output. But in the example, adding another person prior to the sixth person added more than one unit to the total output. If the

Small Company could hire people by the minute at a rate of 16.67 cents per minute ($10/60), then we could tell the true increase in cost of increasing output from 2 units to 3 units, 3 units to 4 units, and so on. If this is not possible, SMC can be approximated by $\Delta TC/\Delta Q$; that is, the change in total cost divided by the change in output. Thus the SMC of $1.25 shown for an output of 10 really represents an averaging of SMC for outputs from 2 to 10 units, which would increase TVC from $20 to $30 ($1.25 = $10/8).

Alternatively, SMC can be calculated as the wage rate or price paid for the variable factor, divided by the marginal product of the variable factor. For example, in Table 5.1, we can see that the second person employed had a marginal product of 8 units. Given a wage rate of $10, SMC is $10/8 = $1.25. This method of calculation makes it clear that SMC varies inversely with marginal product; thus the Law of Diminishing Returns entails increasing SMC.

Let us consider another example. Table 5.3 shows the short-run costs of the New Sound Company for producing up to 8 units of output per hour. Given the total variable costs shown in row 2 and the total fixed costs in row 3, the other costs have been calculated using the relationships presented earlier in this section. As SMC increases after an output of three units, we can infer that the Law of Diminishing Returns sets in after the input level associated with this output.

A relationship between SMC and AVC and between SMC and ATC should be noted. SMC equals AVC where AVC is at a minimum. SMC for the fourth unit is $70. This is equal to the AVC at

Table 5.3 New Sound Company's Short-Run Costs

Output	0	1	2	3	4	5	6	7	8
TVC	0	90	160	210	280	370	490	690	1,010
TFC	540	540	540	540	540	540	540	540	540
TC	540	630	700	750	820	910	1,030	1,230	1,550
AVC		90	80	70	70	74	82	99	126
AFC		540	270	180	135	108	90	77	68
ATC		630	350	250	205	182	172	176	194
SMC		90	70	50	70	90	120	200	320

Note: AFC indicates average fixed cost; ATC, average total cost; AVC, average variable cost; SMC, short-run marginal cost; TC, total cost; TFC, total fixed cost; TVC, total variable cost.

three units. Hence, adding the fourth unit leaves AVC unchanged. Whenever SMC is less than AVC, AVC is falling. Whenever SMC is more than AVC, AVC is rising. Only if SMC = AVC will AVC be unchanged. Similarly, SMC equals ATC where ATC is at a minimum.

To illustrate the relationship between marginal and average, suppose you are a rock star part way through a North American tour. The crowds at your concerts steadily declined until your last concert, in Minneapolis, which was an improvement over the previous one. However, the crowd at your last concert was still less than your average crowd, as the average includes the large crowds at the beginning of the tour. Your next three concerts are in Vancouver, Portland, and Seattle. Assume the crowd in Vancouver (marginal) is higher than it was in Minneapolis but still lower than the average crowd at the end of the Minneapolis concert. As a consequence, the size of your average crowd decreases after inclusion of the Vancouver concert. Suppose the Portland crowd is greater than that at Vancouver and equal to the post-Vancouver average. The inclusion of the Portland concert will leave the average unaffected. If the Seattle crowd is greater than that in Portland, after the Seattle concert, the average will increase.

In Figure 5.1, we show the SMC, AVC, AFC, and ATC curves for the New Sound Company. Note that the SMC is drawn with the SMC for the fourth unit plotted midway between the third and fourth units because it applies to the increase from three to four and so on for the rest of this cost curve. SMC starts to increase after the Law of Diminishing Returns sets in when the fourth unit is added. Prior to that output, the New Sound Company exhibited increasing marginal product (decreasing marginal cost). This resulted in the U-shaped SMC curve shown and also explains the U-shape of the AVC and ATC curves. However, for some producers, the Law of Diminishing Returns sets in after the first unit of the variable factor is employed, which would mean that the SMC (and AVC) curves would not have a negatively sloped portion.

An Internet service provider (ISP) is the type of organization that would have to be very clear on the distinction between fixed and variable costs in the short run. ISPs need to invest in network infrastructure such as the installation of fiber optics, routers, and software. This large investment is a fixed cost in the short run; it does not vary with output. On the other hand, customer service and maintenance costs vary with usage.

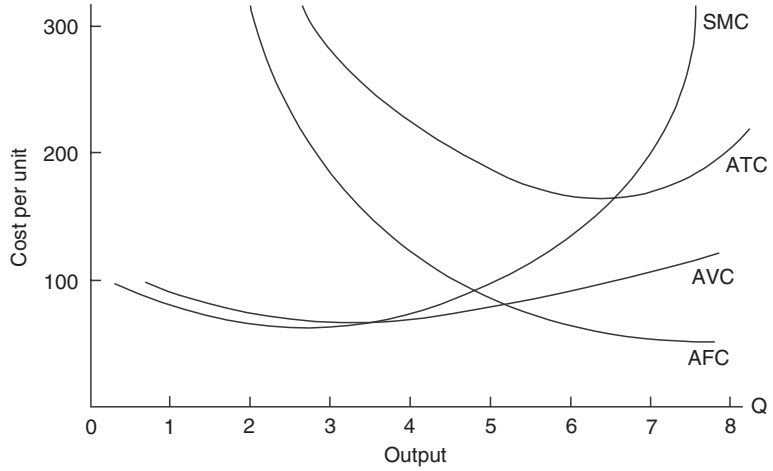

Figure 5.1 The Short-Run Cost Curves for the New Sound Company

Note: AFC indicates average fixed cost; ATC, average total cost; AVC, average variable cost; SMC, short-run marginal cost; Q, quantity (output).

5.4 Long-Run Production and Cost

The long run is a period of sufficient length that all factors of production are variable, but the basic technology of production is given.

5.4.1 The Choice of Factor Mix

The firm wishes to produce any given output at minimum cost or, equivalently, maximize output for any given level of total cost. This is achieved by employing an input mix such that the last dollar spent on each factor yields the same addition to total output. More formally:

$$MP_L/P_L = MP_K/P_K = \ldots$$

where MP_L is the marginal product of factor L (L could represent labor), MP_K is the marginal product of factor K (K could represent capital), P_L is the price of factor L, and P_K is the price of factor K.

This should look familiar. It is another example of the equimarginal principle.

A change in price of one factor will result in factor substitution. Suppose the price of input L increases. If employment levels of both

factors are not changed, then the last dollar spent on L will now yield less addition to total output than the last dollar spent on K. Hence the firm will substitute K for L until equality is reestablished. In other words, it will substitute the factor that is now relatively cheap for the one that is more expensive.

The recent increased volume of animation films, such as *The Prince of Egypt, A Bug's Life, Antz, The Hunchback of Notre Dame,* and *Finding Nemo* (aimed at adults as well as children), can be explained, at least in part, by the escalating salaries of top movie actors. The increase in the price of movie actor labor has resulted in a substitution of animation characters for movie stars.

As MacKie-Mason and Varian (1994, p. 81) explain, the Internet uses packet switching rather than circuit networks because of a fall in the price of switches and routers relative to lines. Packet switching uses many more switches and routers than circuit networks but economizes on the number of lines needed.

5.4.2 Returns to Scale and Production in the Long Run

The key long-run production concept is returns to scale. Returns to scale relate to the effect on output of an equal percentage increase in all inputs.

We have *constant returns to scale* if an X% increase in all inputs increases output by X%—if, for example, doubling all inputs exactly doubles output.

Increasing returns to scale apply if an X% increase in all inputs increases output by more than X%—if, for example, doubling all inputs more than doubles output. Increasing returns to scale are also called *economies of scale*. Possible reasons for increasing returns to scale include:

A. *Technical economies*. These arise because some capital equipment is not divisible. For example, assembly line production only becomes possible when the firm has achieved a certain size. A firm cannot use half an assembly line or a quarter of a robot. Production of most consumer electronics products would be subject to technical economies.

B. *Dimensional relations*. Capacity (output) of goods like oil tankers and beer vats increases more than external size. The capacity of a concert hall or stadium increases more than proportionally to the size of the parcel of land on which it is built.

C. *Specialization.* Increases in size permit greater specialization of factors of production. Specialization of labor on the factory floor enabled Ford to reduce the time needed to assemble a Model T from 14 hours to 93 minutes. Growth of firm size also facilitates specialization of managerial tasks. For example, suppose Jock runs a one-man desktop publishing business. Although he is very good at the production side of the job, he is poor at dealing with customers and finds this part of the job is taking up considerable time. If he hires Jill, who is experienced and successful in sales and customer relations, this would enable Jock to specialize on the production side. Doubling personnel and, as necessary, equipment could be expected to more than double output.

D. *Managerial economies.* Some managerial functions do not increase in proportion to output. For example, a movie studio that distributes 40 films a year does not need a distribution arm that is twice as big as one distributing 20. A publisher with 100 titles does not need twice the sales staff as a publisher with 50 titles. Similarly, research and development does not usually have to be increased in proportion to output.

Decreasing returns to scale apply if an X% increase in all inputs increases output by less than X%. Decreasing returns to scale are also known as *diseconomies of scale.* Problems of coordination and communication are often encountered with larger size. With increasing scale, a firm can grow more bureaucratic and lose the flexibility necessary to respond quickly to changes in the external environment. Fraser (1986) provides the example of IBM's failure to recognize the potential for PCs in the 1970s. To finally respond, IBM had to set up a separate division in 1980 and give it 1 year to create and market a PC. The danger of becoming inflexible should be borne in mind by the large media conglomerates such as AOL-Time Warner, Disney, and Newscorp.

5.4.3 Returns to Scale and Long-Run Costs

The returns to scale experienced by a firm determine how long-run average cost (LAC) and long-run marginal cost (LMC) vary with output. To illustrate this, suppose the Communications Corporation is currently producing 200 units of output per hour by employing 100 units of labor and 300 units of capital. The price of these factors is $20 per hour for labor and $25 per hour for capital. Thus the long-run total cost (LTC) of producing 200 units of output

is \$9500 (= 100 × \$20 + 300 × 25). The LAC of producing this output is LTC/Q = \$9500/200 = \$47.50. From this starting point, we will examine three scenarios (representing constant, increasing, and decreasing returns to scale) concerning the increase in output resulting from a 1% increase in labor from 100 to 101 and in capital from 300 to 303 units.

Suppose the 1% increase in inputs increases the output of the Communications Corporation from 200 units to 202 units per day. This represents a 1% increase in output. Hence the production function exhibits constant returns to scale. The LTC of producing the new output level is \$9595 (= 101 × \$20 + 303 × \$25). The LAC is \$9595/202 = \$47.50. Thus LAC is unchanged; it does not vary with output, and the cost curve is horizontal. LMC is the increase in LTC resulting from a one-unit change in output. If the increase in output is more than one unit, LMC is approximated by $\Delta LTC/\Delta Q$. The LTC of producing 202 units of output is \$9595, compared to \$9500 for 200 units. Hence the LMC is \$95/2 = \$47.50, the same as LAC.

If the 1% increase in all inputs increases the output of the Communications Corporation from 200 units to 204 units per day, this represents a 2% increase in output, and the production function will thus exhibit increasing returns to scale. The LAC is \$9595/204 = \$47.03. Thus LAC decreases. LMC is $\Delta LTC/\Delta Q$ = \$95/4 = \$23.75. LMC decreases also but at a faster rate than LAC.

Finally, if the 1% increase in all inputs increases the output of the Communications Corporation from 200 units to 201 units per day, this increase of 0.5% is less than proportional. Hence the production function exhibits decreasing returns to scale. The LAC is \$9595/201 = \$47.74. LAC increases with output. LTC increases from \$9500 for 200 units of output to \$9595 for one extra unit. Hence LMC is \$95. LMC increases and at a faster rate than LAC.

There is no reason to suppose that a production function exhibits the same returns to scale throughout the entire output range. Economies of scale, especially technical economies, are often exhausted after a certain output level is attained. Diseconomies of scale are usually found only at high levels of output. As a consequence, the LAC (and LMC) curve drawn in many textbooks is usually a shallow U shape, as in Figure 5.2, with increasing returns to scale at low output levels, decreasing returns to scale at high output levels, and an intermediate range with close to constant returns to scale. Note that decreasing returns to scale at high output levels, if in fact they occur, are not due to the Law of Diminishing Returns. Decreasing

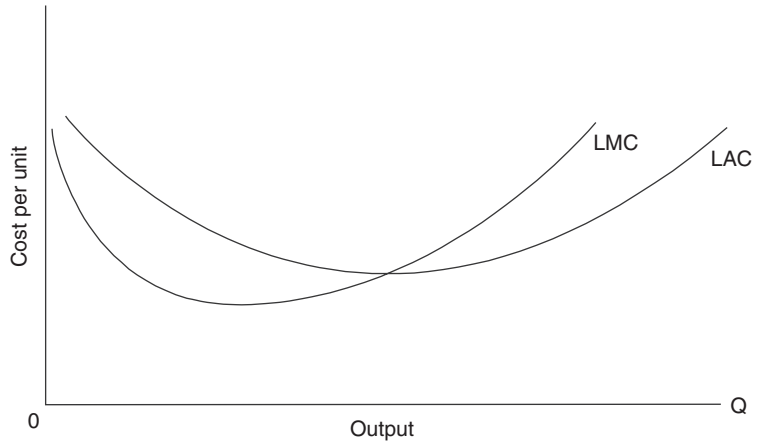

Figure 5.2 The U-Shaped, Long-Run Average Cost Curve

Note: LAC indicates long-run average cost; LMC, long-run marginal cost; Q, quantity (output).

returns to scale is a long-run concept in which all inputs can be increased in proportion, whereas the Law of Diminishing Returns is a short-run concept that applies where at least one factor is fixed.

Empirical studies estimating the cost functions of real companies suggest that an L-shaped LAC curve, as shown in Figure 5.3, is more common. Increasing returns to scale are found up to output Q*, with constant returns to scale thereafter. Output Q* is the *Minimum*

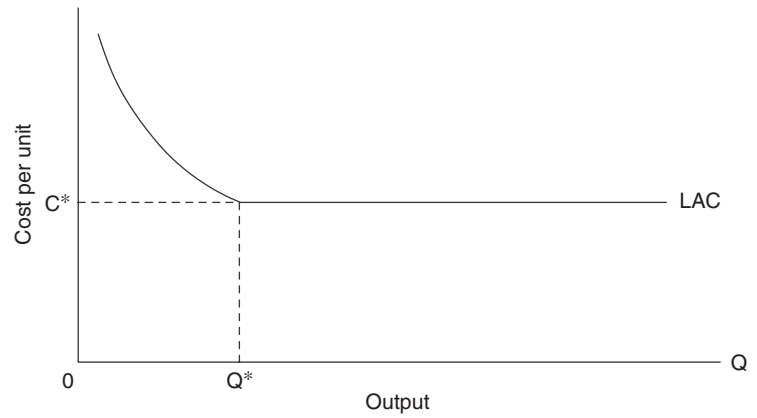

Figure 5.3 The L-Shaped, Long-Run Average Cost Curve

Note: LAC indicates long-run average cost; Q, quantity (output).

Efficient Scale, as any firm producing at a lower output will be at a cost disadvantage by producing at an average cost in excess of C*.

The relationship between average cost in the long run and in the short run is shown in Figure 5.4. The LAC curve shows the minimum average cost of producing any given output using the optimal combination of factors. A short-run ATC curve shows the average total cost of producing any given output in the most efficient manner when at least one factor is fixed. Different ATC curves (we have drawn three, but any number could be shown) can be drawn for different levels of the fixed factor. Each ATC curve is tangent to the LAC at the output level where the level of the fixed factor available is optimal. For any output above or below this, ATC > LAC because output can only be varied by adjusting the input of the variable input; in the short run, the firm will have too little of the fixed factor for larger outputs and too much for smaller outputs.

To illustrate, returning to our Communication Corporation example, let us assume that the current output is 200 units, made using the optimal mix of 100 units of labor and 300 units of capital, and assume that increasing returns to scale apply. As the quantity of capital (the factor fixed in the short run) is optimal for this output of 200 units, ATC = LAC = $47.50. As we saw, to increase output to 204 units in the long run, the firm increases labor input

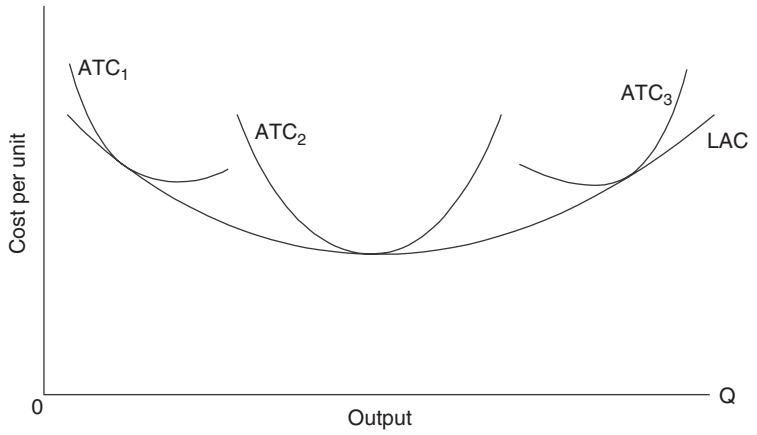

Figure 5.4 Relationship Between Average Cost in the Long Run and in the Short Run

Note: ATC_1, ATC_2, and ATC_3 indicate short-run average total cost curves for different levels of the fixed factor; LAC, longer-run average cost; Q, quantity (output).

by one unit and capital input by three units, and the LAC of this higher output level is $47.03. However, in the short run, capital input is fixed at 300 units, and output can only be increased to 204 by employing more labor. Suppose six more units of labor would be necessary. Short-run total cost becomes $9620 and ATC = $47.15. Thus, at the higher output level, ATC > LAC. The same applies to lower output levels. In the short run, a lower output level can only be achieved by employing less labor, in conjunction with too much capital. The ATC_1 curve drawn in Figure 5.4 is consistent with this example.

5.4.4 Returns to Scale in Media Goods

Many media goods exhibit increasing returns to scale. For telecommunication and cable companies, this follows from the indivisibility of the capital equipment used.

Economies of scale for entertainment and cultural goods arise from the unusual nature of the economics of their production. Production costs for an hour of U.S. drama (such as an episode of a U.S. network series) are usually quoted at $1 million or more. This is the cost of the first copy and must be borne even if only a single film or tape is made for one broadcast organization. Much of this cost can be regarded as akin to research and development, as it involves the creation of a new product. If another copy is made, so that exhibition rights can be sold to, say, the BBC in the United Kingdom, the marginal cost of this copy is the cost of replication and distribution. This may amount to around $100 (this is the price paid by the Caribbean island of Aruba, and it is unlikely that U.S. producers would be willing to sell at a price below marginal cost). If a third copy is produced for sale to CTV in Canada, the additional cost would again be around $100. This can be viewed as an extreme case of managerial scale economies, with expenditure on research and development being independent of output level. Huge economies of scale are experienced with an increase in output from one unit to two units, and constant returns to scale are experienced thereafter.

An implication is that the sale of additional copies of a television program is extremely attractive as the incremental cost is so low. Hoskins et al. (1997) report that sale of a typical hour of U.S. drama to the BBC in the United Kingdom takes place at a price of around $100,000 and to CTV in Canada at $60,000. (We consider a pricing strategy for selling TV programs in chapter 10). Thus exports

are very attractive and, indeed, worthwhile at any price above the marginal cost of supplying. This helps to explain why television programs are widely traded.

The returns to scale for movies, videos, videogames, compact disks, and DVD video and audio disks are essentially the same as for television programs. Large economies of scale, although the difference in cost between the first copy and subsequent copies is typically less, also occur in book, newspaper, and magazine publishing in print form. With digital downloading from the Internet available, or becoming available, for all these goods, the marginal cost of additional copies is fast approaching zero. This has resulted in a huge piracy problem for recorded music and is becoming an issue with movies. To counter this, the RIAA has instituted legal action targeting the makers, and very recently users, of share-swapping software. Napster Inc., in its original incarnation, was put out of business, and in September 2003, copyright infringement lawsuits were initiated against hundred of individual users.

Economies of scale also provide the background to the continuing trade dispute between Canada and the United States over Canadian attempts to protect its magazine industry from so-called split-run productions of U.S. magazines. U.S. magazines, even those with a small amount of added Canadian content, would enjoy a huge cost advantage over Canadian magazines because the cost of all or most of the content is, in effect, provided free to the copies sold in Canada. Canadian governments have feared that, without protection, the Canadian magazine industry would be decimated. Whether this presumed consequence is inevitable is open to debate, but successive Canadian governments have acted on this basis. Since 1965, Section 19 of the Canadian Income Tax Act has not permitted Canadian advertisers to claim the cost of advertising in foreign magazines as a tax-deductible expense. In 1993, *Sports Illustrated* tried to get around this by beaming a Canadian edition electronically across the border to a printing press in Ontario. The Canadian Parliament then passed a law imposing an 80% tax on the Canadian income of split-run publications not previously exempted (*Time* and *Reader's Digest* had been exempted under a grandfather clause.) The U.S. government argued that this was a restraint of trade, and in 1997 the Word Trade Organization agreed. Canada was about to counter with legislation that would make it illegal for Canadian companies to buy advertising space in split-run magazines when a compromise was reached in mid-1999.

The same returns to scale advantage, and potentially the same trade issue, apply to new media. Daniel Roseman, who served from 1988 to 1993 as Canada's negotiator on telecommunication and cultural services during the Uruguay Round of GATT, points out:

> The differences between Yahoo.com and Yahoo.ca are like the differences between *Time Magazine* and *Time Magazine Canada*. Yahoo.ca is a split-run in electronic format; there is an American core with some Canadian content and Web links added on . . . traditionally Canada's restrictions in the cultural industries have focused on control and manipulation of distribution channels, but such measures are becoming untenable. New technologies and applications make restrictive regulations unworkable; that is why no one is proposing [that] the prohibition on split-run magazines apply [to this situation]. (Roseman, 1999, p. A13)

An additional reason that no one is proposing a prohibition on split-run portals is that there is no well-established Canadian industry forming an effective lobby group.

5.4.5 International Coproductions and Returns to Scale

International coproduction has become an increasingly popular mode for producing television programs and films. It involves forming an alliance with one or more foreign partners to jointly develop and produce a program or film with attributes that make it attractive to audiences in more than one national market. In effect, the partners pool financial resources to share the high cost of the first copy of the program or film and then are able to produce additional copies for the other national market(s) at a very low marginal cost because of the huge economies of scale identified earlier. Surveys by Hoskins, McFadyen, and Finn (1999) of producers indicate that in most countries, the pooling of financial resources is by far the most important reason for choosing the international coproduction route.

5.4.6 Mergers and Returns to Scale

Mergers, unlike coproductions that are temporary alliances typically for just one television program or film, are permanent amalgamations of formerly distinct firms. Increasing returns to scale are an important motive for many mergers involving firms producing

the same class of product. For example, in 1987 (prior to its own acquisition by Sony), Columbia, a major Hollywood studio, merged with TriStar Pictures, an independent studio, and in 1998, Alliance and Atlantis, Canada's two largest studios, merged. Such mergers are designed to ensure sufficient market share to sustain a substantial, and costly, distribution structure.

5.4.7 Economies of Scope

Economies of scope exist if the total cost of producing two (or more) products within the same firm is less than producing them separately in two (or more) nonrelated firms.

Reasons for economies of scope are:

- The products are produced jointly. One may be essentially a by-product of the other.
- Factors of production are present that are shared by the processes used to make several different products.

When a movie is produced, there are many "by-products," or different windows of exhibition, that can be exploited. After cinema exhibition, the film can be produced in DVD and VHS video format for direct sale or rental to consumers, and it can be sold to individuals through pay per view and, later, to broadcast organizations for non–pay television exhibition. Revenues from DVD and video are typically larger than the box office from cinematic exhibition. Some films lend themselves to merchandising of items such as toys, games, and T-shirts, and film producers can sell the license for manufacturing these products. It is this license that can be thought of as the by-product. For example, Hasbro produces the Star Wars toys under license from Lucasfilm. Merchandising normally begins after exhibition of the movie has created a demand. However, merchandising of toys associated with the fourth Star Wars movie began in time for Christmas 1998, some 6 months before the movie opened in North America. Which product can be thought of as the "by-product" is becoming harder to distinguish. The first three Star Wars movies are reported to have resulted in merchandising sales far in excess of their box office, but a far smaller percentage of merchandise sales than gross box office revenue would flow back to the movie studio.

Most studios produce both feature films and television programs. Both products share labor with the same skills and use the same capital equipment and distribution infrastructure. There are economies

of scope from producing both of these products within the same company because of these shared inputs.

No doubt Matsushita (brand names include Panasonic, JVC, Technics, and Quasar) obtains cost savings from producing the whole range of television sets, VCRs, DVD players, stereo equipment, camcorders, and other consumer electronic hardware. The same distribution channels would apply, many of the component suppliers would be common and quantity discounts would be greater, and the production would involve some common labor and capital equipment. The diversified product line means that the company's fortunes are not tied to one product line. For example, if it only produced VCRs, a big drop in demand caused by customers switching to DVD players would hit the company hard. But if the company produces DVD players as well, many resources can easily be transferred from VCR to DVD player production.

Economies of scope are often the motive for mergers or joint ventures involving companies making different products, in some cases at different vertical levels of the same industry. Perhaps most typically, they involve mergers between software providers and distributors or exhibitors. Examples include the $10 billion acquisition of Paramount by Viacom, whose interests include cable systems and extensive international cable and satellite channels (e.g., MTV), and Disney's purchase of Miramax, the independent film distributor, and its $19 billion takeover of Capital Cities/ABC, a U.S. TV network. The $158 billion merger of AOL and Time Warner in 2000 was also of this type.

Some mergers have involved purchases by Japanese hardware producers of Hollywood producers. Sony Corporation acquired Columbia Pictures, and Matsushita acquired MCA (Universal). No doubt prominent in Sony's motives was a desire to ensure software for its own hardware standards; software shortages had contributed to Sony's Betamax video standard losing out to the rival VHS standard. When Matsushita acquired MCA (Universal) in 1990, Matsushita bought not only a Hollywood studio and its extensive film library but also MCA Records. Economies of scope probably exist between movies and music recordings, as the soundtracks of some films earn more revenue than that obtained from the box office.

Other acquisitions serve to expand the company's activities into other media that are competing for the advertising dollar or the consumers' entertainment dollar. Thus, Murdoch's News Corporation, traditionally in publishing, has expanded into television, notably

satellite TV channels such as BSkyB in the United Kingdom and Star TV, based in Hong Kong. In 1985, the corporation purchased a Hollywood studio, Twentieth Century Fox, for $575 million. To ensure a continuing source of very popular live sports television programming, Murdoch bought the Los Angeles Dodgers and, in September 1998, bid over £623 for Manchester United. (The takeover bid was blocked by the U.K. government in 1999.) *Time,* another entity that started life as a publishing company, although it had already spread into cable and satellite, acquired Warner Bros., the Hollywood studio, in 1990 for $14 billion to form Time-Warner. In 2000, the Canadian broadcaster CanWest Global Communications acquired most of Hollinger's Canadian newspapers.

Some recent merger activity is related to the convergence, resulting from digital technology, between television, cable, telecommunications, and computers. For example, convergence permits cable companies to offer local telephone services (about half of U.K. cable subscribers now use cable for local telephone services) and telecommunications companies to deliver video on demand and related television services. The ability to be able to offer a comprehensive bundle of services and to spread risks by not being totally committed to one method of distribution has sparked the merger interest between telecommunications companies and cable companies in the United States. Early in 1999, AT&T acquired Tele-Communications Inc. (TCI), a large cable TV company, for $55 billion. In May 1999, it outbid Comcast (a cable company) to purchase MediaOne Group, another large cable company, for $54 billion. With this purchase, AT&T became the biggest cable company in the United States. A Canadian example illustrating the effects of convergence between telecommunications, broadcasting, and computers is the year 2000 C$2.3 billion acquisition by BCE, Canada's largest telecommunications company, of CTV, Canada's largest private television network. BCE's primary motive seems to have been to obtain content for Sympatico, its Internet portal.

While economies of scope, often described by the buzzword "synergies," are the motive for many media mergers, it is not obvious that cost savings are always achieved. Obviously, Matsushita was disappointed with the results of its acquisition of MCA (Universal), as, after a few years, it sold 80% of its stake. With some mergers, not only do the expected synergies fail to occur, but merging different company cultures introduces new problems. The merger between AOL and Time Warner in 2000 to form

AOL–Time Warner Inc. is now widely regarded as unsuccessful, and the September 2003 decision to change the name back to Time Warner Inc. can be regarded as an acknowledgment of this.

5.4.8 Learning Curve

As companies gain experience making a product, they often learn on the job. For example, employees (both managerial and shop floor) gain familiarity and expertise in the task they are performing, and small design modifications may be made that facilitate production. Where such learning occurs, average cost decreases with cumulative output, as it is the cumulative output that is an indicator of the experience making the product. *The learning curve,* sometimes called *the experience curve,* thus relates average cost to cumulative output.

Figure 5.5 shows a learning curve. When cumulative output doubles from Q* to 2Q*, average cost decreases from AC_1 to AC_2. The learning progress ratio is AC_2/AC_1, so learning has taken place if this ratio is less than one. Empirical studies suggest a fairly typical ratio is around 0.80, indicating a reduction in average cost of approximately 20% as output is doubled. This will vary according to the nature of the product, however. The learning will be greatest, and the learning progress ratio least, for complex, sophisticated, labor-intensive products. For very simple manufactured products, learning may be minimal.

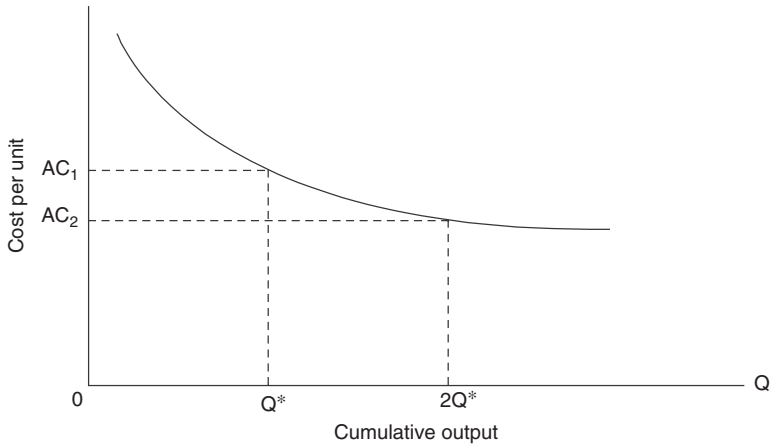

Figure 5.5 The Learning Curve

Note: AC indicates average cost; Q, cumulative output.

We would expect new media products, computer animation, and the development of computer games to be subject to considerable learning benefits. For example, Disney's movie *Dinosaur*, released in 2000, was the first time that the company meshed computer-generated images with film of real-life backgrounds and landscapes. Inevitably, the lessons the company learned from making this movie will decrease the cost of producing the next similar movie, and so on.

It is important to be clear about the distinction between the learning curve and increasing returns to scale. Suppose a company is producing 1000 units of a product per month and that by May 2001 it has been producing at this output rate for 2 years. The company's average cost at this time is $100. Returns to scale would determine the average cost of producing more or less than 1000 units in May 2001. For simplicity, we will assume constant returns to scale, so average cost would still be $100 if output in the month were 900 or 1100 units. By May 2003, cumulative output will have doubled from 24,000 units to 48,000 units. If we assume that the learning progress ratio is 0.70, then average cost in May 2003 will be $70. But, because of the constant returns to scale, if output in May 2003 is 900 or 1100 rather than 1000 units, average cost would still be $70. Between the two dates, learning would have caused the long-run average cost curve, relating average cost to the monthly output rate, to shift downwards by $30.

5.4.9 Transaction Costs and the Organization of Production

A transaction entails an exchange of a good or service. Many transactions take place in markets, but there are costs associated with finding someone to do business with, of reaching an agreement on price and terms, and of enforcing the resulting contract. These costs tend to be particularly high if both parties do not have easy and equal access to information concerning the transaction. Transactions also take place within organizations. These transactions involve costs too, but in some cases, the costs of coordination and enforcement may be less than for market transactions. Ronald Coase (1937) made transaction costs the basis for a theory explaining why firms exist and what transfers and activities take place within them.

Firms face "make or buy" decisions; that is, they produce within the firm or buy from an external supplier. For example, the success

of computer animation in the 1991 movie *Terminator 2: Judgment Day* and the development of user-friendly, reasonably priced software caused many animation studios and boutiques to conclude that their animation artists needed computer skills. The decision that arose was whether to provide skill training internally or buy such training in the form of college or other external courses or programs. Initially, most chose to train within the organization, but this has changed to a primary reliance on external training through a market transaction.

In the 1930s and early 1940s, the movie industry operated through large, vertically integrated studios in Hollywood employing industrial mass production methods similar to those employed by Henry Ford. Since 1945,

> Activities that had been within the studio framework gradually moved to the external market. Eventually, this meant the complete end of the "term contract," under which writers, actors, and skilled production people worked exclusively for one studio for a specified period of time. It was replaced by a film-to-film contract. (Christopherson & Storper, 1986, p. 309)

Studios now maintain a very lean operation, bringing together teams of specialists as needed to perform the various required production functions. Many expect the role of the studios to continue shrinking, with the studio slowly "assuming the role of a sort of super banker, marshalling resources, arraying projects and orchestrating the negotiations" (Bart, 1999).

The two examples cited both exhibited a move away from internal transactions to market transactions. This is typical of a more general trend in the economy that can be expected to continue as transactions costs associated with acquiring, processing, storing, and transmitting digital information progressively decline with the improvement in compression technologies and the expansion of Internet bandwidth. The substantial drop in transaction costs between buyers and sellers who are geographically separated can be expected to lead to a movement away from production centralized near important creative centers or distribution centers, such as Hollywood, to more widely scattered locations providing unique character or creative convenience, such as Queensland (Australia) or British Columbia (Canada). There is a potential for disintermediation (doing away with the use of a middle man) as producers and consumers are more able to

economically conduct transactions directly without the intervening role of distributors and exhibitors. Amazon.com and other virtual bookstores have already revolutionized book retailing. Napster and its successors have enabled people (illegally and legally) to share and download music in the MP3 format. Movies over the Internet are becoming a reality. Consumers with strong preferences are able to seek out the specific products or services they wish to acquire and complete a low-cost economic transaction, reducing the power of the traditional hierarchical distribution channel.

5.5 The Very Long Run

The *very long run* is a period during which the technological possibilities available to the firm change. This change can take the form of a new production technique or a new product. A change requires both invention and innovation. Invention is the act of creating something new. Innovation is development of the idea into a new production technique or new product that works and that can be produced at a cost which makes it viable. An example of invention is the realization that moving pictures could be captured and then transmitted over the air to a screen in people's homes and the theoretical underpinnings of how this could be achieved. An example of innovation is the development of cameras, transmission equipment, and television receivers that made this a reality.

The days of the accidental invention have largely passed. Most invention and innovation takes place in the research and development (R&D) departments of firms and government organizations and in research laboratories at universities. If universities are involved, it is usually at the invention stage. Research and development is very expensive and will only be undertaken by firms if it is likely to be profitable. The direction such research takes will reflect market signals in the form of current and expected factor and product prices. The R&D that went into the development of computer-generated imagery was primarily motivated by the creative limitations of "traditional" special-effects technology, but it was also influenced by the escalating cost of traditionally shot and edited special effects and stunts.

It is impossible to overemphasize the importance of technological change. This is illustrated by considering the products that we take

for granted now but that were not available in, say, 1950. There was no color TV, no cable TV, no direct-to-home satellite TV, no VCRs, no DVD players, no high-definition television, no camcorders, no cassette players, no compact disk players, no home computers, no video games, no cell phones, no modems, no Internet, and so on. These are all new products, but the development of new techniques has been just as important. Earlier in the chapter, we mentioned the introduction of computer animation. The Sony Handicam has transformed news reporting from the field, as well as some types of documentary shooting. One individual can act as reporter, producer, and cameraperson, whereas a few years ago a whole television crew would have been necessary. Robot cameras have similarly reduced staffing needs in news studios. Musical instrument digital interface technology, which eases the transfer of sounds to computers, is transforming the music industry. Recording quality that a few years ago could only be produced in a professional recording studio with $500,000 of equipment can now be produced in a home basement with a top of the line Macintosh computer and software packages for $10,000 or so (Waxer, 1998).

5.6 Summary

We assume that firms wish to maximize profits. This requires that production be economically efficient; that is, the method used produces any given output for the least possible total cost.

Production opportunities, ways of combining inputs to change output, differ according to the length of time considered. The short run is a period of insufficient length to change the input level of factors such as capital equipment and plant; these factors are called fixed factors. Production and cost in the short run is governed by the Law of Diminishing Returns, which states that after a certain level of input of the variable factor, each additional unit of the variable factor, employed in conjunction with a fixed quantity of another factor, adds less to total product or output than the previous unit. This law explains why short-run marginal cost, the change in total cost for a one-unit change in output, increases after a certain output level. Given the relationship between marginal and average costs, the law is also the reason for the increasing portion of the U-shaped average variable cost and average total cost curves usually drawn.

The long run is a period of sufficient length that all factors of production are variable, but the state of technology is given. In the long run, the factor mix selected will be that which results in the last dollar spent on each input yielding the same addition to total output. The optimal mix thus depends on relative factor prices, as well as factor productivity (indicated by the marginal product). It is the price of switches and routers relative to lines that explains why the Internet uses packet switching rather than circuit networks.

A key long-term concept is returns to scale. We have increasing returns to scale if an X% increase in all inputs increases output by more than X%, constant returns to scale if it increases output by X%, and decreasing returns to scale if it increases output by less than X%. The shape of the long-run average (and marginal) cost curve depends on the returns to scale. Most media goods exhibit increasing returns to scale (also known as economies of scale) because the cost of the second copy and additional copies is very much less than the cost of producing the first copy. This helps explain why the United States can sell television programs to foreign countries for as little as $100. This cost structure is fundamental in understanding the origins of the Canada–United States magazine trade dispute. Similarly, it provides a motive for coproduction of television programs and films. Mergers between companies making the same product, for example Columbia Pictures and TriStar Pictures, permit economies of scale to be realized.

Economies of scope exist if the total cost of producing two (or more) products within the same firm is less than producing them separately in two (or more) nonrelated firms. This occurs when products are jointly produced or where there are factors that are shared by the processes used to make different products. This explains why most studios produce both movies and television programs. Economies of scope provide a motive for many mergers, such as that between AT&T and TCI, between companies making different products.

A learning curve may apply in the long run. As the cumulative output of a company increases, on the job learning may occur, and average cost decreases as a consequence. Such learning benefits are no doubt significant for new media products, such as computer animation and the development of computer games.

A transaction (the exchange of a good or service) bears costs whether the transaction is made through the market or within an organization. We noted a general trend away from internal

transactions to market transactions. The Hollywood studios provide an example. The trend to market transactions is largely a result of the improvements in communications technology that have stimulated the movement of many business-to-business transactions to the Internet.

The very long run is a period during which the technological possibilities available to the firm change. Technological change results from invention, the act of creating something new, and innovation, the development of an idea into a new production technique or new product. A comparison of the consumer electronic products available now compared to what was available in 1950 illustrates the importance of technological change.