CHAPTER 7

External Economies of Scale and the International Location of Production

In Chapter 3 we pointed out that there are two reasons why countries specialize and trade. First, countries differ either in their resources or in their technology and specialize in the things they do relatively well; second, economies of scale (or increasing returns) make it advantageous for each country to specialize in the production of only a limited range of goods and services. The past four chapters considered models in which all trade is based on comparative advantage; that is, differences between countries are the only reason for trade. This chapter introduces the role of economies of scale.

The analysis of trade based on economies of scale presents certain problems that we have avoided so far. Up to now we have assumed that markets are perfectly competitive, so that all monopoly profits are always competed away. When there are increasing returns, however, large firms may have an advantage over small ones, so that markets tend to be dominated by one firm (monopoly) or, more often, by a few firms (oligopoly). If this happens, our analysis of trade has to take into account the effects of imperfect competition.

However, economies of scale need not lead to imperfect competition if they take the form of *external* economies, which apply at the level of the industry rather than at the level of the individual firm. In this chapter we will focus on the role of such external economies of scale in trade, reserving the discussion of internal economies for the next chapter.

LEARNING GOALS

After reading this chapter, you will be able to:

- Recognize why international trade often occurs from increasing returns to scale.
- Understand the differences between internal and external economies of scale.
- Discuss the sources of external economies.
- Discuss the roles of external economies and knowledge spillovers in shaping comparative advantage and international trade patterns.

Economies of Scale and International Trade: An Overview

The models of comparative advantage already presented were based on the assumption of constant returns to scale. That is, we assumed that if inputs to an industry were doubled, industry output would double as well. In practice, however, many industries are characterized by **economies of scale** (also referred to as increasing returns), so that production is more efficient the larger the scale at which it takes place. Where there are economies of scale, doubling the inputs to an industry will more than double the industry's production.

A simple example can help convey the significance of economies of scale for international trade. Table 7-1 shows the relationship between input and output of a hypothetical industry. Widgets are produced using only one input, labor; the table shows how the amount of labor required depends on the number of widgets produced. To produce 10 widgets, for example, requires 15 hours of labor, while to produce 25 widgets requires 30 hours. The presence of economies of scale may be seen from the fact that doubling the input of labor from 15 to 30 more than doubles the industry's output—in fact, output increases by a factor of 2.5. Equivalently, the existence of economies of scale may be seen by looking at the average amount of labor used to produce each unit of output: If output is only 5 widgets, the average labor input per widget is 2 hours, while if output is 25 units, the average labor input falls to 1.2 hours.

We can use this example to see why economies of scale provide an incentive for international trade. Imagine a world consisting of two countries, the United States and Britain, both of which have the same technology for producing widgets. Suppose that each country initially produces 10 widgets. According to the table, this requires 15 hours of labor in each country, so in the world as a whole, 30 hours of labor produce 20 widgets. But now suppose that we concentrate world production of widgets in one country, say the United States, and let the United States employ 30 hours of labor in the widget industry. In a single country these 30 hours of labor can produce 25 widgets. So by concentrating production of widgets in the United States, the world economy can use the same amount of labor to produce 25 percent more widgets.

But where does the United States find the extra labor to produce widgets, and what happens to the labor that was employed in the British widget industry? To get the labor to expand its production of some goods, the United States must decrease or abandon the production of others; these goods will then be produced in Britain instead, using the labor formerly employed in the industries whose production has expanded in the United States. Imagine that there are many goods subject to economies of scale in production, and give them numbers 1, 2, 3, ... To take advantage of economies of scale, each of the countries must concentrate on producing only a limited number of goods. Thus, for example, the United States might produce goods 1, 3, 5, and so on, while Britain produces 2, 4, 6, and so on. If each country produces only some of the goods, then each good can be produced

TABLE 7-1 Relationship of Input to Output for a Hypothetical Industry

Output	Total Labor Input	Average Labor Input
5	10	2
10	15	1.5
15	20	1.333333
20	25	1.25
25	30	1.2
30	35	1.166667

at a larger scale than would be the case if each country tried to produce everything. As a result, the world economy can produce more of each good.

How does international trade enter the story? Consumers in each country will still want to consume a variety of goods. Suppose that industry 1 ends up in the United States and industry 2 ends up in Britain; then American consumers of good 2 will have to buy goods imported from Britain, while British consumers of good 1 will have to import it from the United States. International trade plays a crucial role: It makes it possible for each country to produce a restricted range of goods and to take advantage of economies of scale without sacrificing variety in consumption. Indeed, as we will see in Chapter 8, international trade typically leads to an increase in the variety of goods available.

Our example, then, suggests how mutually beneficial trade can arise as a result of economies of scale. Each country specializes in producing a limited range of products, which enables it to produce these goods more efficiently than if it tried to produce everything for itself; these specialized economies then trade with each other to be able to consume the full range of goods.

Unfortunately, to go from this suggestive story to an explicit model of trade based on economies of scale is not that simple. The reason is that economies of scale may lead to a market structure other than that of perfect competition, and we need to be careful about analyzing this market structure.

Economies of Scale and Market Structure

In the example in Table 7-1, we represented economies of scale by assuming that the labor input per unit of production is smaller the more units produced; this implies that at a given wage rate per hour, the average cost of production falls as output rises. We did not say how this production increase was achieved—whether existing firms simply produced more, or whether there was instead an increase in the number of firms. To analyze the effects of economies of scale on market structure, however, one must be clear about what kind of production increase is necessary to reduce average cost. **External economies of scale** occur when the cost per unit depends on the size of the industry but not necessarily on the size of any one firm. **Internal economies of scale** occur when the cost per unit depends on the size of an individual firm but not necessarily on that of the industry.

The distinction between external and internal economies can be illustrated with a hypothetical example. Imagine an industry that initially consists of 10 firms, each producing 100 widgets, for a total industry production of 1,000 widgets. Now consider two cases. First, suppose the industry were to double in size, so that it now consists of 20 firms, each one still producing 100 widgets. It is possible that the costs of each firm will fall as a result of the increased size of the industry; for example, a bigger industry may allow more efficient provision of specialized services or machinery. If this is the case, the industry exhibits external economies of scale. That is, the efficiency of firms is increased by having a larger industry, even though each firm is the same size as before.

Second, suppose the industry's output is held constant at 1,000 widgets, but that the number of firms is cut in half so that each of the remaining five firms produces 200 widgets. If the costs of production fall in this case, then there are internal economies of scale: A firm is more efficient if its output is larger.

External and internal economies of scale have different implications for the structure of industries. An industry where economies of scale are purely external (that is, where there are no advantages to large firms) will typically consist of many small firms and be perfectly competitive. Internal economies of scale, by contrast, give large firms a cost advantage over small firms and lead to an imperfectly competitive market structure.

Both external and internal economies of scale are important causes of international trade. Because they have different implications for market structure, however, it is difficult to discuss both types of scale economy–based trade in the same model. We will therefore deal with them one at a time. In this chapter we focus on external economies, in the next on internal economies.

The Theory of External Economies

As we have already pointed out, not all scale economies apply at the level of the individual firm. For a variety of reasons, it is often the case that concentrating production of an industry in one or a few locations reduces the industry's costs even if the individual firms in the industry remain small. When economies of scale apply at the level of the industry rather than at the level of the individual firm, they are called *external economies.* The analysis of external economies goes back more than a century to the British economist Alfred Marshall, who was struck by the phenomenon of "industrial districts"—geographical concentrations of industry that could not be easily explained by natural resources. In Marshall's time, the most famous examples included such concentrations of industry as the cluster of cutlery manufacturers in Sheffield and the cluster of hosiery firms in Northampton.

There are many modern examples of industries where there seem to be powerful external economies. In the United States these examples include the semiconductor industry, concentrated in California's famous Silicon Valley; the investment banking industry, concentrated in New York; and the entertainment industry, concentrated in Hollywood. In the rising manufacturing industries of developing countries such as China, external economies are pervasive—for example, one town in China accounts for a large share of the world's underwear production; another produces nearly all of the world's cigarette lighters; yet another produces a third of the world's magnetic tape heads; and so on. External economies have also played a key role in India's emergence as a major exporter of information services, with a large part of this industry still clustered in and around the city of Bangalore.

Marshall argued that there are three main reasons why a cluster of firms may be more efficient than an individual firm in isolation: the ability of a cluster to support **specialized suppliers;** the way that a geographically concentrated industry allows **labor market pooling;** and the way that a geographically concentrated industry helps foster **knowledge spillovers**. These same factors continue to be valid today.

Specialized Suppliers

In many industries, the production of goods and services—and to an even greater extent, the development of new products—requires the use of specialized equipment or support services; yet an individual company does not provide a large enough market for these services to keep the suppliers in business. A localized industrial cluster can solve this problem by bringing together many firms that collectively provide a large enough market to support a wide range of specialized suppliers. This phenomenon has been extensively documented in Silicon Valley: A 1994 study recounts how, as the local industry grew, "engineers left established semiconductor companies to start firms that manufactured capital goods such as diffusion ovens, step-and-repeat cameras, and testers, and materials and components such as photomasks, testing jigs, and specialized chemicals.... This independent equipment sector promoted the continuing formation of semiconductor firms by freeing individual producers from the expense of developing capital equipment internally and by spreading the

costs of development. It also reinforced the tendency toward industrial localization, as most of these specialized inputs were not available elsewhere in the country."[1]

As the quote suggests, the availability of this dense network of specialized suppliers has given high-technology firms in Silicon Valley some considerable advantages over firms elsewhere. Key inputs are cheaper and more easily available because there are many firms competing to provide them, and firms can concentrate on what they do best, contracting out other aspects of their business. For example, some Silicon Valley firms that specialize in providing highly sophisticated computer chips for particular customers have chosen to become "fabless," that is, they do not have any factories in which chips can be fabricated. Instead, they concentrate on designing the chips, and then hire another firm to actually fabricate them.

A company that tried to enter the industry in another location—for example, in a country that did not have a comparable industrial cluster—would be at an immediate disadvantage because it would lack easy access to Silicon Valley's suppliers and would either have to provide them for itself or be faced with the task of trying to deal with Silicon Valley–based suppliers at long distance.

Labor Market Pooling

A second source of external economies is the way that a cluster of firms can create a pooled market for workers with highly specialized skills. Such a pooled market is to the advantage of both the producers and the workers, as the producers are less likely to suffer from labor shortages and the workers are less likely to become unemployed.

The point can best be made with a simplified example. Imagine that there are two companies that both use the same kind of specialized labor, say, two film studios that make use of experts in computer animation. Both employers are, however, uncertain about how many workers they will want to hire: If demand for their product is high, both companies will want to hire 150 workers, but if it is low, they will want to hire only 50. Suppose also that there are 200 workers with this special skill. Now compare two situations: one with both firms and all 200 workers in the same city, the other with the firms, each with 100 workers, in two different cities. It is straightforward to show that both the workers and their employers are better off if everyone is in the same place.

First, consider the situation from the point of view of the companies. If they are in different locations, whenever one of the companies is doing well, it will be confronted with a labor shortage: It will want to hire 150 workers, but only 100 will be available. If the firms are near each other, however, it is at least possible that one will be doing well when the other is doing badly, so both firms may be able to hire as many workers as they want. By locating near each other, the companies increase the likelihood that they will be able to take advantage of business opportunities.

From the workers' point of view, having the industry concentrated in one location is also an advantage. If the industry is divided between two cities, then whenever one of the firms has a low demand for workers, the result will be unemployment: The firm will be willing to hire only 50 of the 100 workers who live nearby. But if the industry is concentrated in a single city, low labor demand from one firm will at least sometimes be offset by high demand from the other. As a result, workers will have a lower risk of unemployment.

Again, these advantages have been documented for Silicon Valley, where it is common both for companies to expand rapidly and for workers to change employers. The same study of Silicon Valley that was quoted previously notes that the concentration of firms in

[1] See p. 40 of the book by Saxenian listed in Further Readings.

a single location makes it easy to switch employers. One engineer is quoted as saying that "it wasn't that big a catastrophe to quit your job on Friday and have another job on Monday. . . . You didn't even necessarily have to tell your wife. You just drove off in another direction on Monday morning."[2] This flexibility makes Silicon Valley an attractive location both for highly skilled workers and for the companies that employ them.

Knowledge Spillovers

It is by now a cliché that in the modern economy, knowledge is at least as important an input as are factors of production like labor, capital, and raw materials. This is especially true in highly innovative industries, where being even a few months behind the cutting edge in production techniques or product design can put a company at a major disadvantage.

But where does the specialized knowledge that is crucial to success in innovative industries come from? Companies can acquire technology through their own research and development efforts. They can also try to learn from competitors by studying their products and, in some cases, by taking them apart to "reverse engineer" their design and manufacture. An important source of technical know-how, however, is the informal exchange of information and ideas that takes place at a personal level. And this kind of informal diffusion of knowledge often seems to take place most effectively when an industry is concentrated in a fairly small area, so that employees of different companies mix socially and talk freely about technical issues.

Marshall described this process memorably when he wrote that in a district with many firms in the same industry, "The mysteries of the trade become no mystery, but are as it were in the air. . . . Good work is rightly appreciated, inventions and improvements in machinery, in processes and the general organization of the business have their merits promptly discussed: If one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas."[3]

A journalist described how these knowledge spillovers worked during the rise of Silicon Valley (and also gave an excellent sense of the amount of specialized knowledge involved in the industry) as follows: "Every year there was some place, the Wagon Wheel, Chez Yvonne, Rickey's, the Roundhouse, where members of this esoteric fraternity, the young men and women of the semiconductor industry, would head after work to have a drink and gossip and trade war stories about phase jitters, phantom circuits, bubble memories, pulse trains, bounceless contacts, burst modes, leapfrog tests, p-n junctions, sleeping sickness modes, slow-death episodes, RAMs, NAKs, MOSes, PCMs, PROMs, PROM blowers, PROM blasters, and teramagnitudes. . . ."[4] This kind of informal information flow means that it is easier for companies in the Silicon Valley area to stay near the technological frontier than it is for companies elsewhere; indeed, many multinational firms have established research centers and even factories in Silicon Valley simply in order to keep up with the latest technology.

External Economies and Market Equilibrium

As we've just seen, a geographically concentrated industry is able to support specialized suppliers, provide a pooled labor market, and facilitate knowledge spillovers in a way that a geographically dispersed industry cannot. But the strength of these economies presumably depends on the industry's size: Other things equal, a bigger industry will generate stronger external economies. What does this say about the determination of output and prices?

[2] Saxenian, p. 35.

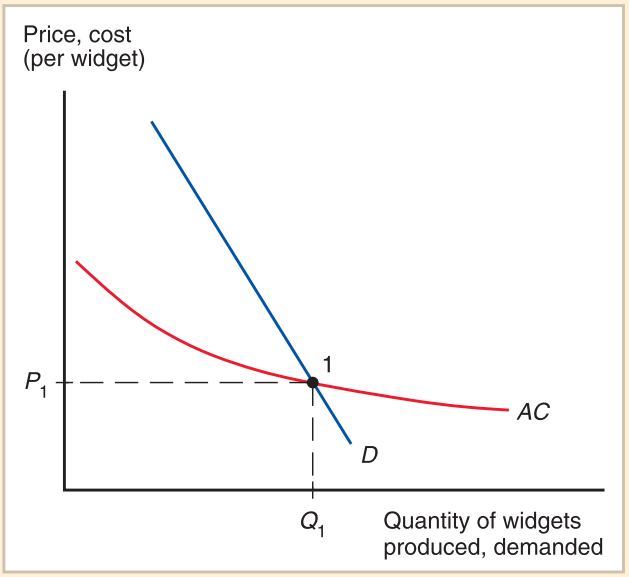
[3] Alfred Marshall, *Principles of Economics* (London: MacMillan, 1920).

[4] Tom Wolfe, quoted in Saxenian, p. 33.

Figure 7-1

External Economies and Market Equilibrium

When there are external economies of scale, the average cost of producing a good falls as the quantity produced rises. Given competition among many producers, the downward-sloping average cost curve *AC* can be interpreted as a *forward-falling supply curve*. As in ordinary supply-and-demand analysis, market equilibrium is at point 1, where the supply curve intersects the demand curve, *D*. The equilibrium level of output is Q_1, the equilibrium price P_1.



While the details of external economies in practice are often quite subtle and complex (as the example of Silicon Valley shows), it can be useful to abstract from the details and represent external economies simply by assuming that the larger the industry, the lower the industry's costs. If we ignore international trade for the moment, then market equilibrium can be represented with a supply-and-demand diagram like Figure 7-1, which illustrates the market for widgets. In an ordinary picture of market equilibrium, the demand curve is downward sloping, while the supply curve is upward sloping. In the presence of external economies of scale, however, there is a **forward-falling supply curve:** the larger the industry's output, the lower the price at which firms are willing to sell, because their **average cost of production** falls as industry output rises.

In the absence of international trade, the unusual slope of the supply curve in Figure 7-1 doesn't seem to matter much. As in a conventional supply-and-demand analysis, the equilibrium price, P_1, and output, Q_1, are determined by the intersection of the demand curve and the supply curve. As we'll see next, however, external economies of scale make a huge difference to our view of the causes and effects of international trade.

External Economies and International Trade

External economies drive a lot of trade both within and between countries. For example, New York exports financial services to the rest of the United States, largely because external economies in the investment industry have led to a concentration of financial firms in Manhattan. Similarly, Britain exports financial services to the rest of Europe, largely because those same external economies have led to a concentration of financial firms in London. But what are the implications of this kind of trade? We'll look first at the effects of trade on output and prices; then at the determinants of the pattern of trade; and finally at the effects of trade on welfare.

External Economies, Output, and Prices

Imagine, for a moment, that we live in a world in which it is impossible to trade buttons across national borders. Assume, also, that there are just two countries in this world,

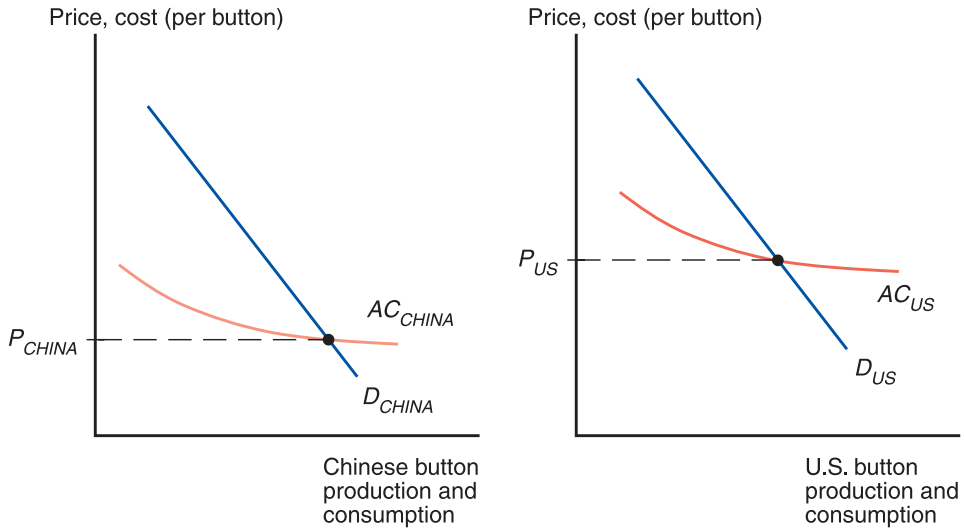


Figure 7-2

External Economies Before Trade

In the absence of trade, the price of buttons in China, P_{CHINA}, is lower than the price of buttons in the United States, P_{US}.

China and the United States. Finally, assume that production of buttons is subject to external economies of scale, which lead to a forward-falling supply curve for buttons in each country. (As the box on page 147 shows, this is actually true of the button industry.)

In that case, equilibrium in the world button industry would look like the situation shown in Figure 7-2.[5] In both China and the United States, equilibrium prices and output would be at the point where the domestic supply curve intersects the domestic demand curve. In the case shown in Figure 7-2, Chinese button prices in the absence of trade would be lower than U.S. button prices.

Now suppose that we open up the potential for trade in buttons. What will happen?

It seems clear that the Chinese button industry will expand, while the U.S. button industry will contract. And this process will feed on itself: As the Chinese industry's output rises, its costs will fall further; as the U.S. industry's output falls, its costs will rise. In the end, we can expect all button production to be concentrated in China.

The effects of this concentration are illustrated in Figure 7-3. Before the opening of trade, China supplied only its own domestic button market. After trade, it supplies the world market, producing buttons for both Chinese and U.S. consumers.

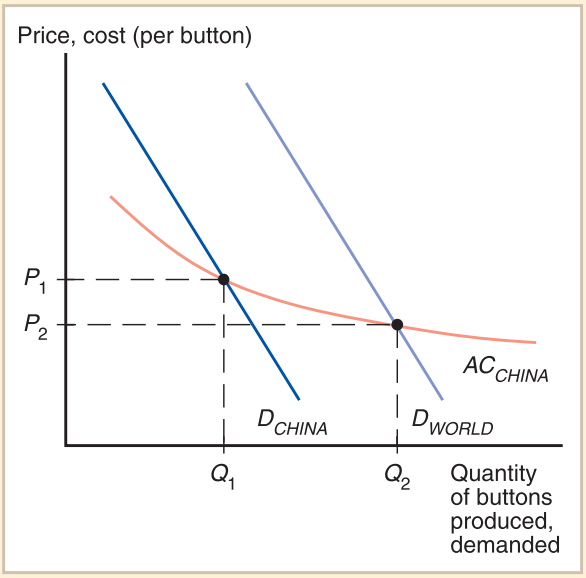
Notice the effects of this concentration of production on prices. Because China's supply curve is forward-falling, increased production as a result of trade leads to a button price that is lower than the price before trade. And bear in mind that Chinese button prices were lower than American button prices before trade. What this tells us is that trade leads to button prices that are lower than the prices in *either* country before trade.

[5] In this exposition, we focus for simplicity on *partial equilibrium* in the market for buttons, rather than on general equilibrium in the economy as a whole. It is possible, but much more complicated, to carry out the same analysis in terms of general equilibrium.

Figure 7-3

Trade and Prices

When trade is opened, China ends up producing buttons for the world market, which consists both of its own domestic market and of the U.S. market. Output rises from Q_1 to Q_2, leading to a fall in the price of buttons from P_1 to P_2, which is lower than the price of buttons in either country before trade.



This is very different from the implications of models without increasing returns. In the standard trade model, as developed in Chapter 6, relative prices converge as a result of trade. If cloth is relatively cheap in Home and relatively expensive in Foreign before trade opens, the effect of trade will be to raise cloth prices in Home and reduce them in Foreign. In our button example, by contrast, the effect of trade is to reduce prices everywhere. The reason for this difference is that when there are external economies of scale, international trade makes it possible to concentrate world production in a single location, and therefore to reduce costs by reaping the benefits of even stronger external economies.

External Economies and the Pattern of Trade

In our example of world trade in buttons, we simply assumed that the Chinese industry started out with lower production costs than the American industry. What might lead to such an initial advantage?

One possibility is comparative advantage—underlying differences in technology and resources. For example, there's a good reason that Silicon Valley is in California, rather than in Mexico. High-technology industries require a highly skilled work force, and such a work force is much easier to find in the United States, where 40 percent of the working-age population is college-educated, than in Mexico, where the number is below 16 percent. Similarly, there's a good reason that world button production is concentrated in China, rather than in Germany. Button production is a labor-intensive industry, which is best conducted in a country where the average manufacturing worker earns less than a dollar an hour rather than in a country where hourly compensation is among the highest in the world.

However, in industries characterized by external economies of scale, comparative advantage usually provides only a partial explanation of the pattern of trade. It was probably inevitable that most of the world's buttons would be made in a relatively low-wage country, but it's not clear that this country necessarily had to be China, and it certainly wasn't necessary that production be concentrated in any particular location within China.

So what does determine the pattern of specialization and trade in industries with external economies of scale? The answer, often, is historical contingency: Something gives a particular location an initial advantage in a particular industry, and this advantage gets

"locked in" by external economies of scale even after the circumstances that created the initial advantage are no longer relevant. The financial centers in London and New York are clear examples. London became Europe's dominant financial center in the 19th century, when Britain was the world's leading economy and the center of a world-spanning empire. It has retained that role even though the empire is long gone and modern Britain is only a middle-sized economic power. New York became America's financial center thanks to the Erie Canal, which made it the nation's leading port. It has retained that role even though the canal currently is used mainly by recreational boats.

Often sheer accident plays a key role in creating an industrial concentration. Geographers like to tell the tale of how a tufted bedspread, crafted as a wedding gift by a 19th-century teenager, gave rise to the cluster of carpet manufacturers around Dalton, Georgia. Silicon Valley's existence may owe a lot to the fact that a couple of Stanford graduates named Hewlett and Packard decided to start a business in a garage in that area. Bangalore might not be what it is today if vagaries of local politics had not led Texas Instruments to choose, back in 1984, to locate an investment project there rather than in another Indian city.

One consequence of the role of history in determining industrial location is that industries aren't always located in the "right" place: Once a country has established an advantage in an industry, it may retain that advantage even if some other country could potentially produce the goods more cheaply.

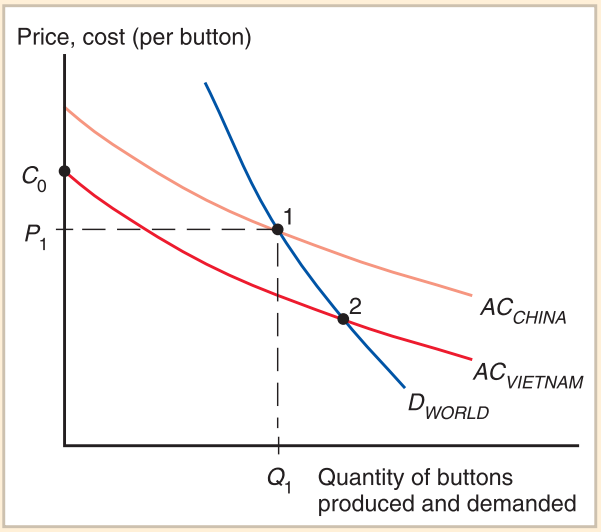
Figure 7-4, which shows the cost of producing buttons as a function of the number of buttons produced annually, illustrates this point. Two countries are shown: China and Vietnam. The Chinese cost of producing a button is shown as AC_{CHINA}, the Vietnamese cost as $AC_{VIETNAM}$. D_{WORLD} represents the world demand for buttons, which we assume can be satisfied either by China or by Vietnam.

Suppose that the economies of scale in button production are entirely external to firms, and that since there are no economies of scale at the level of the firm, the button industry in each country consists of many small, perfectly competitive firms. Competition therefore drives the price of buttons down to its average cost.

Figure 7-4

The Importance of Established Advantage

The average cost curve for Vietnam, $AC_{VIETNAM}$, lies below the average cost curve for China, AC_{CHINA}. Thus Vietnam could potentially supply the world market more cheaply than China. If the Chinese industry gets established first, however, it may be able to sell buttons at the price P_1, which is below the cost C_0 that an individual Vietnamese firm would face if it began production on its own. So a pattern of specialization established by historical accident may persist even when new producers could potentially have lower costs.



Holding the World Together

If you are reading this while fully clothed, the odds are that crucial parts of your outfit—specifically, the parts that protect you from a wardrobe malfunction—came from the Chinese town of Qiaotou, which produces 60 percent of the world's buttons and a large proportion of its zippers, too.

The Qiaotou fastener industry fits the classic pattern of geographical concentration driven by external economies of scale. The industry's origins lie in historical accident: In 1980 three brothers spotted some discarded buttons in the street, retrieved and sold them, then realized there was money to be made in the button business. There clearly aren't strong internal economies of scale: The town's button and zipper production is carried out by hundreds of small, family-owned firms. Yet there are clearly advantages to each of these small producers in operating in close proximity to the others.

Qiaotou isn't unique. As a fascinating article on the town's industry* put it, in China, "many small towns, not even worthy of a speck on most maps, have also become world-beaters by focusing on labour-intensive niches.... Start at the toothbrush town of Hang Ji, pass the tie mecca of Sheng Zhou, head east to the home of cheap cigarette lighters in Zhang Qi, slip down the coast to the giant shoe factories of Wen Ling, then move back inland to Yiwu, which not only makes more socks than anywhere else on earth, but also sells almost everything under the sun."

At a broad level, China's role as a huge exporter of labor-intensive products reflects comparative advantage: China is clearly labor-abundant compared with advanced economies. Many of those labor-intensive goods, however, are produced by highly localized industries, which benefit strongly from external economies of scale.

*"The Tiger's Teeth," *The Guardian*, May 25, 2005.

We assume that the Vietnamese cost curve lies below the Chinese curve because, say, Vietnamese wages are lower than Chinese wages. This means that at any given level of production, Vietnam could manufacture buttons more cheaply than China. One might hope that this would always imply that Vietnam will in fact supply the world market. Unfortunately, this need not be the case. Suppose that China, for historical reasons, establishes its button industry first. Then, initially, world button equilibrium will be established at point 1 in Figure 7-4, with Chinese production of Q_1 units per year and a price of P_1. Now introduce the possibility of Vietnamese production. If Vietnam could take over the world market, the equilibrium would move to point 2. However, if there is no initial Vietnamese production $(Q = 0)$, any individual Vietnamese firm considering manufacture of buttons will face a cost of production of C_0. As we have drawn it, this cost is above the price at which the established Chinese industry can produce buttons. So although the Vietnamese industry could potentially make buttons more cheaply than China's industry, China's head start enables it to hold on to the industry.

As this example shows, external economies potentially give a strong role to historical accident in determining who produces what, and may allow established patterns of specialization to persist even when they run counter to comparative advantage.

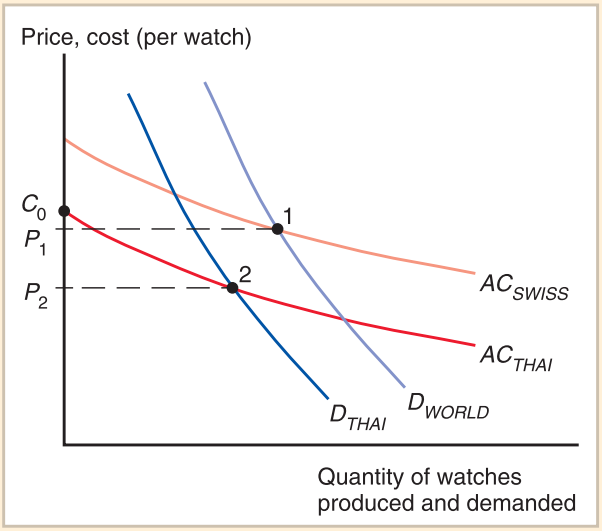
Trade and Welfare with External Economies

In general, we can presume that external economies of scale lead to gains from trade over and above those from comparative advantage. The world is more efficient and thus richer because international trade allows nations to specialize in different industries and thus reap the gains from external economies as well as from comparative advantage.

Figure 7-5

External Economies and Losses from Trade

When there are external economies, trade can potentially leave a country worse off than it would be in the absence of trade. In this example, Thailand imports watches from Switzerland, which is able to supply the world market (D_{WORLD}) at a price (P_1) low enough to block entry by Thai producers, who must initially produce the watches at cost C_0. Yet if Thailand were to block all trade in watches, it would be able to supply its domestic market (D_{THAI}) at the lower price, P_2.



However, there are a few possible qualifications to this presumption. As we saw in Figure 7-4, the importance of established advantage means that there is no guarantee that the right country will produce a good subject to external economies. In fact, it is possible that trade based on external economies may actually leave a country worse off than it would have been in the absence of trade.

An example of how a country can actually be worse off with trade than without is shown in Figure 7-5. In this example, we imagine that Thailand and Switzerland could both manufacture watches, that Thailand could make them more cheaply, but that Switzerland has gotten there first. D_{WORLD} is the world demand for watches, and, given that Switzerland produces the watches, the equilibrium is at point 1. However, we now add to the figure the Thai demand for watches, D_{THAI}. If no trade in watches were allowed and Thailand were forced to be self-sufficient, then the Thai equilibrium would be at point 2. Because of its lower average cost curve, the price of Thai-made watches at point 2, P_2, is actually lower than the price of Swiss-made watches at point 1, P_1.

We have presented a situation in which the price of a good that Thailand imports would actually be lower if there were no trade and the country were forced to produce the good for itself. Clearly in this situation, trade leaves the country worse off than it would be in the absence of trade.

There is an incentive in this case for Thailand to protect its potential watch industry from foreign competition. Before concluding that this justifies protectionism, however, we should note that in practice, identifying cases like that shown in Figure 7-5 is far from easy. Indeed, as we will emphasize in Chapters 10 and 11, the difficulty of identifying external economies in practice is one of the main arguments against activist government policies toward trade.

It is also worth pointing out that while external economies can sometimes lead to disadvantageous patterns of specialization and trade, it's virtually certain that it is still to the benefit of the *world* economy to take advantage of the gains from concentrating industries. Canada might be better off if Silicon Valley were near Toronto instead of San Francisco; Germany might be better off if the City (London's financial district, which, along with Wall Street, dominates world financial markets) could be moved to Frankfurt. But overall, it's better for the world that each of these industries be concentrated *somewhere*.

Dynamic Increasing Returns

Some of the most important external economies probably arise from the accumulation of knowledge. When an individual firm improves its products or production techniques through experience, other firms are likely to imitate the firm and benefit from its knowledge. This spillover of knowledge gives rise to a situation in which the production costs of individual firms fall as the industry as a whole accumulates experience.

Notice that external economies arising from the accumulation of knowledge differ somewhat from the external economies considered so far, in which industry costs depend on current output. In this alternative situation, industry costs depend on experience, usually measured by the cumulative output of the industry to date. For example, the cost of producing a ton of steel might depend negatively on the total number of tons of steel produced by a country since the industry began. This kind of relationship is often summarized by a **learning curve** that relates unit cost to cumulative output. Such learning curves are illustrated in Figure 7-6. They are downward sloping because of the effect on costs of the experience gained through production. When costs fall with cumulative production over time rather than with the current rate of production, this is referred to as a case of **dynamic increasing returns**.

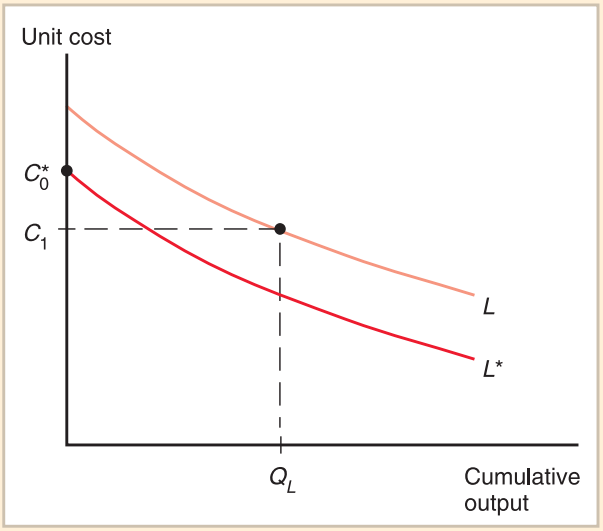
Like ordinary external economies, dynamic external economies can lock in an initial advantage or head start in an industry. In Figure 7-6, the learning curve L is that of a country that pioneered an industry, while L^* is that of a country that has lower input costs—say, lower wages—but less production experience. Provided that the first country has a sufficiently large head start, the potentially lower costs of the second country may not allow that second country to enter the market. For example, suppose the first country has a cumulative output of Q_L units, giving it a unit cost of C_1, while the second country has never produced the good. Then the second country will have an initial start-up cost, C_0^*, that is higher than the current unit cost, C_1, of the established industry.

Dynamic scale economies, like external economies at a point in time, potentially justify protectionism. Suppose that a country could have low enough costs to produce a good for export if it had more production experience, but that given the current lack of experience, the good cannot be produced competitively. Such a country might increase its long-term welfare either by encouraging the production of the good by a subsidy or by protecting it from foreign competition until the industry can stand on its own feet. The argument for

Figure 7-6

The Learning Curve

The learning curve shows that unit cost is lower the greater the cumulative output of a country's industry to date. A country that has extensive experience in an industry (L) may have lower unit cost than a country with little or no experience, even if that second country's learning curve (L^*) is lower—for example, because of lower wages.



temporary protection of industries to enable them to gain experience is known as the **infant industry argument;** this argument has played an important role in debates over the role of trade policy in economic development. We will discuss the infant industry argument at greater length in Chapter 10, but for now we simply note that situations like that illustrated in Figure 7-6 are just as hard to identify in practice as those involving nondynamic increasing returns.

Interregional Trade and Economic Geography

External economies play an important role in shaping the pattern of international trade, but they are even more decisive in shaping the pattern of **interregional trade**—trade that takes place between regions *within* countries.

To understand the role of external economies in interregional trade, we first need to discuss the nature of regional economics—that is, how the economies of regions within a nation fit into the national economy. Studies of the location of U.S. industries suggest that more than 60 percent of U.S. workers are employed by industries whose output is nontradable even within the United States—that is, that must be supplied locally. Table 7-2 shows some examples of tradable and nontradable industries. Thus, motion pictures made in Hollywood are shown across the country, and indeed around the world, but newspapers are mainly read in their home cities. Wall Street trades stocks and makes deals for clients across the United States, but savings banks mainly serve local depositors. Scientists at the National Institutes of Health develop medical knowledge that is applied across the whole country, but the veterinarian who figures out why your pet is sick has to be near your home.

As you might expect, the share of nontradable industries in employment is pretty much the same across the United States. For example, restaurants employ about 5 percent of the work force in every major U.S. city. On the other hand, tradable industries vary greatly in importance across regions. Manhattan accounts for only about 2 percent of America's total employment, but it accounts for a quarter of those employed in trading stocks and bonds and about one-seventh of employment in the advertising industry.

But what determines the location of tradable industries? In some cases, natural resources play a key role—for example, Houston is a center for the oil industry because east Texas is where the oil is. However, factors of production such as labor and capital play a less decisive role in interregional trade than in international trade, for the simple reason that such factors are highly mobile within countries. As a result, factors tend to move to where the industries are rather than the other way around. For example, California's Silicon Valley, near San Francisco, has a very highly educated labor force, with a high concentration of engineers and computer experts. That's not

TABLE 7-2 Some Examples of Tradable and Nontradable Industries

Tradable Industries	Nontradable Industries
Motion pictures	Newspaper publishers
Securities, commodities, etc.	Savings institutions
Scientific research	Veterinary services

Source: J. Bradford Jensen and Lori. G. Kletzer, "Tradable Services: Understanding the Scope and Impact of Services Outsourcing," in Lael Brainard and Susan M. Collins, eds., *Brookings Trade Forum 2005: Offshoring White Collar Work* (Washington, D.C.: Brookings Institution, 2005), pp. 75–116.