



Industrialization: trends and transformations

Trade and industrialization have reinforced each other. At the international level, trade has allowed countries to specialize between industry and other sectors, between different branches of industry, and increasingly even between different stages in production. Trade has provided access to critical industrial inputs, including technology, for countries incapable of producing them. Expanded demand for exports has spurred technological development and industrial production. In turn, the advent of new industrial technologies has shaped the pattern of specialization and hence the pattern of trade.

At the national level, domestic trade has allowed specialization between economic sectors and within industry. Again, new technologies and industrial progress have altered the internal pattern of specialization and trade. In the other direction, increased domestic trade has provided the demand to stimulate the introduction of new technologies and further industrialization.

The first two parts of this chapter trace some key developments in technology, international specialization, and international trade. Together, these have led to today's integrated system of global trade and industrial production. This historical review highlights the influence of government policies toward trade and ends by discussing the performance of developing countries in this global system since the 1960s. The third part of the chapter discusses the changes in economic structure that have typically resulted from the interaction of technology, specialization, and trade over the course of industrialization. The fourth part discusses the factors that appear to have contributed to the more successful industrialization experi-

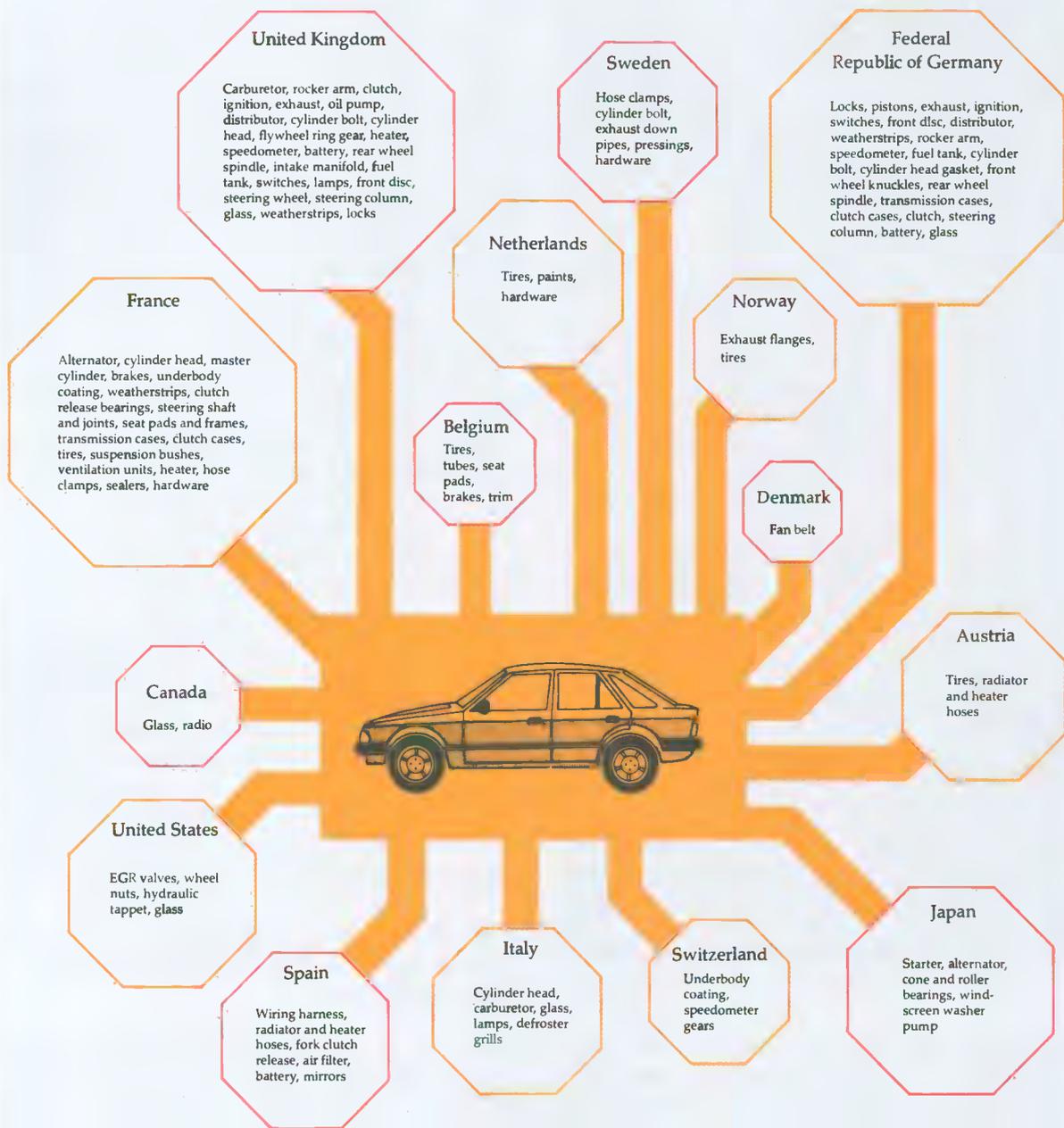
ences in the period before World War II. The chapter serves as historical background for the analyses of industrialization since World War II in later chapters. Although industry, broadly defined, includes mining, construction, electricity, gas, and water, in addition to manufacturing, this chapter focuses more on manufacturing—the most dynamic and usually the largest industrial subsector.

Global industrialization in historical perspective

International specialization has evolved beyond the old pattern by which industrialized countries exported manufactures to the developing countries in exchange for primary commodities. Today, some of the world's most successful exporters of manufactures are developing countries; many of their exports go to industrialized countries, from which they in turn import manufactures. Among industrialized countries, this two-way trade in manufactures—intraindustry trade as it is commonly called—has reached the point where comparisons of comparative advantage are meaningful only at the level of finely disaggregated product categories. Much of this intraindustry trade reflects the specialization that has accompanied industrialization. Production of a single good now commonly spans several countries, with each country in this "global factory" performing tasks in which it has a cost advantage (see Figure 3.1).

Some of these changes in international specialization and trade are no doubt responses to government policy. But, on the whole, they reflect the natural economic processes that have shaped industrialization from the start.

Figure 3.1 Global manufacturing: the component network for the Ford Escort (Europe)



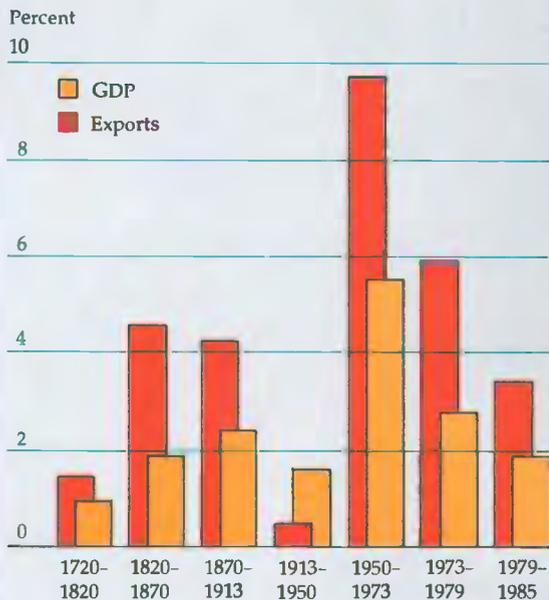
Note: Final assembly takes place in Halewood (United Kingdom) and Saarlouis (Federal Republic of Germany).
 Source: Dicken 1986, figure 9.9, p. 304.

***The rise of modern industrialization:
 the mid-1700s to 1820***

Although historians differ on details, the consensus is that industrialization began in Britain around

the middle of the eighteenth century. Innovations in the spinning and weaving of cotton greatly boosted productivity; cotton output increased a hundredfold from about 1760 to 1827, and cotton textiles overtook wool manufacturing to become

Figure 3.2 Historical trends in the growth of real GDP and exports in selected countries, 1720–1985



Note: Accurate historical data for world exports and GDP are difficult to obtain, so the chart shows average growth rates for six major industrial countries: France, Germany, Italy, Japan, the United Kingdom, and the United States. For exports, the growth rate for 1720–1820 includes only France and the United Kingdom; the average for 1820–70 includes France, Germany, the United Kingdom, and the United States. The GDP growth rates have the same coverage, except that the first period is 1700–1820 instead of 1720–1820, and the United States is excluded from both the first and second periods. More comprehensive world data are provided for the period since World War II in Figure 3.3.
Source: For 1720–1979: Maddison 1982, tables 3.2 and 3.7. For 1979–85: for GDP, World Bank data; for exports, IMF, *International Financial Statistics*.

the leading manufacturing product. Most of this growth may be attributed to specialization combined with simple modifications to existing processes. Adam Smith, writing *The Wealth of Nations* in the 1770s, emphasized specialization and the division of labor, not the introduction of machines, as the basis for higher productivity. The innovation that allowed coal to be used in smelting iron and James Watt's improvement of the Newcomen steam engine between 1776 and 1781 were milestones in the development of industrial machinery. But it took several decades for these innovations to be incorporated into production on a wide scale and to make the factory the symbol of manufacturing industry.

These innovations are now generally thought to have sparked the Industrial Revolution, but it is unlikely that people at that time would have regarded them as revolutionary. Output in British agriculture and handicrafts had been expanding for about 300 years. In contrast with continental Europe, Britain had eliminated internal customs barriers as well as most guild and state monopoly restrictions on production by the early 1700s. The bill of exchange, deposit banking, and insurance were well developed, and there had also been steady improvements in roads, rivers, and canals. Rising agricultural productivity had increased incomes and expanded the domestic market for other goods. The enclosure of common village lands had pushed labor from the farms and increased the number of people who depended on the market for food.

Throughout the period, domestic trade boomed, and an additional boost in demand came from increasing foreign trade. The expansion of demand gave impetus, within the relatively free enterprise environment that prevailed, to a series of innovations in production. An important pre-Industrial Revolution example was the putting-out system in textiles. Merchant-entrepreneurs supplied materials to textile weavers in the villages, bought back the finished cloth, and sold it to domestic consumers or to export merchants. Ultimately, as the growth of demand for manufactures exceeded the growth of the labor force, the specialization and labor-saving inventions that are generally acknowledged to have constituted the first industrial revolution followed.

The transport revolutions, the spread of industrialization, and the emergence of a global market: 1820 to 1870

After the innovations in cotton textiles, iron smelting, and the steam engine, industrialization centered on steel, railways, and steamships from about 1820 to 1870. Railways integrated national markets and stimulated demand for iron and steel. With steel and steam power, bigger and more reliable ships could be built. Freight costs dropped, which enabled such previously remote areas as the American Midwest to produce bulky agricultural products for distant markets in Europe. Belgium, France, Germany, and the United States began to industrialize in this period. Europe, the United States, Canada, Argentina, and Australia were linked by international trade in agricultural produce, raw materials, and manufactured products.

The spread of industrialization to the European continent was facilitated by important institutional reforms and the removal of many of the restrictions that had hindered domestic commerce. By 1820, Europe had emerged from the French Revolution and the Napoleonic wars that followed it. In France, tariffs and tolls on domestic trade, as well as guild restrictions on the choice of occupation, were abolished immediately after the Revolution. These reforms were soon followed by a standardized system of weights and measures (the metric system) and new legal codes protecting property rights. The Napoleonic wars helped diffuse this wave of liberalism and reform to other parts of Europe—Belgium, the Netherlands, Switzerland, Italy, and much of Germany. In Germany, after years of effort, barriers to domestic trade were greatly reduced in 1834 by the creation of the Zollverein, a customs union among the different German states.

The United Kingdom, the United States, and many of the European countries also adopted more liberal external trade policies between 1820 and 1870. Initially, the United Kingdom, the leader in industrial technology, prohibited exports of machinery and the emigration of skilled workers. But British entrepreneurs and craftsmen could be found in Belgium, France, and other European countries, often using smuggled machinery to produce textiles and engineering products. Realizing the futility of the prohibition, the United Kingdom removed the legal barriers against emigration of skilled workers (in 1825) and against exports of machinery (in 1842). Thereafter, British entrepreneurs, workers, and financiers helped to develop railways and coal mining in Europe and elsewhere. Subsequently, the United Kingdom abolished the Navigation Acts, which had restricted international shipping; and with the repeal of the restrictions on grain imports (the Corn Laws) in 1846, it moved to free trade. Protective tariffs were replaced with revenue tariffs, which were gradually reduced to an average of 5.8 percent by 1880.

The United States began a series of tariff reductions in 1840, and by 1857 most rates were at or below 24 percent. But an increasing need for government revenue, especially during the Civil War, led to several tariff increases. After the Civil War ended in 1865, tariff increases continued for protection purposes.

France embarked on a policy of reducing tariffs and eliminating import prohibitions around 1852, which culminated in the Cobden-Chevalier free trade treaty of 1860 between France and the United

Kingdom. This treaty liberated French industrial development from reliance on expensive domestic coal and iron. French industry and railways, which now had access to cheaper and better coal, iron, and steel—the basic industrial raw materials of that era—were able to develop rapidly. In Germany, the import duties levied by the Zollverein in 1834 were much lower than those in other European countries at the time. Duties on manufactured imports, for example, were about 10 percent in Germany. But these were steadily increased in the 1840s. The Cobden-Chevalier treaty between France and the United Kingdom and agitation by German free traders prompted a series of tariff reductions in Germany in the 1860s. By 1873 all duties levied for protective purposes had been removed in favor of moderate duties levied for revenue purposes.

Economic liberalism between 1820 and 1870, together with the transport revolutions wrought by railways and steamships, boosted world output and international trade (see Figure 3.2). Still, more than three quarters of the world's industrial production in 1870 was accounted for by four countries: the United Kingdom (about 32 percent), the United States (about 23 percent), Germany (about 13 percent), and France (about 10 percent).

The second industrial revolution and the waning of liberalism: 1870 to 1913

The next forty-three years—1870 to 1913—saw major advances in science and technology. The invention of the Gilchrist-Thomas process, which allowed steel to be made from iron ore of high phosphorus content, propelled the industrial development of countries with extensive deposits of phosphoric ores, such as Germany and Sweden. Other innovations in this period—electricity, refrigeration, organic chemicals, the internal combustion engine, the transatlantic telegraph, and the radio—are commonly regarded as the basis of a "second industrial revolution." Some of them reinforced the trend toward greater physical integration of world markets: refrigeration, for example, made it possible to ship frozen meat from Australia to London by the 1880s.

This second revolution differed from the earlier one in two important ways. Technological advances became more dependent on scientific research that was systematically organized in firms and universities for commercial application. Germany, later joined by the United States, led the way. Also, for the first time, industrial growth in the industrialized countries became partly depen-

dent on supplies from elsewhere: raw materials needed by the new technologies (for example, bauxite, petroleum, and rubber) and ingredients for new alloys (for example, tungsten, nickel, and chromium) now had to be supplemented with supplies from outside the group of industrialized countries. As a result, many countries were ushered into global industrialization as suppliers of industrial raw materials. Since many of these products had no economic value until the new technologies created demand for them, people in these areas were now presented with additional income opportunities. But along with these income opportunities came colonization for many of the new suppliers in Africa and Asia. This historical link between participation in international trade and colonization influenced the choice of industrialization and trade strategies in many of the former colonies after World War II.

Despite advances in technology, output in the industrialized countries grew only slightly faster than it had between 1820 and 1870, and the growth rate of exports fell (Figure 3.2). One reason for this was the onset of protectionism in the late 1870s. The United States had increased tariffs to help finance its Civil War. After the war the tariffs were maintained and even increased to protect both agriculture and industry. In Germany, where tariffs on most imports had been abolished by 1877, agricultural producers complaining of "cheap" wheat from America and iron and steel producers facing declining prices caused free trade to be abandoned in 1879. Protectionist forces in France quickly followed Germany's example, led again by farmers complaining about imports of cheap American wheat. Other countries did the same, which led to a series of tariff wars in Europe.

A number of countries joined the "industrial league" between 1870 and 1913, including Russia and Japan. The state played a more active role in the industrialization of these two countries, particularly in the development of infrastructure, than it did in the countries that had industrialized earlier. Nevertheless, the experience of Russia and Japan paralleled Western Europe's in some respects. Both countries embarked on major reforms that removed restrictions on domestic markets and helped spur domestic commerce. Serfdom was abolished in Russia in 1861, and judicial, administrative, tax, and monetary reforms followed in the late 1860s. In the mid-1880s the domestic market was integrated by the expansion of the railways.

Reforms in Japan were even more far-reaching. After more than 260 years in virtual autarky, Japan

was forced in the 1850s to open up to foreign trade. The country was compelled to sign a treaty that for years (1858-98) put a 5 percent ceiling on the tariffs that it could levy on imports. Partly in reaction to this, the old Tokugawa Shogunate that had ruled Japan for centuries was overthrown, the Meiji Emperor was restored in 1868 as head of a centralized state, and a series of reforms was begun. Guilds were eliminated, feudalism was abolished, and private property rights to land were established. People were now free to choose their trade or occupation: they could produce any crop or commodity and could buy and sell land freely. Taxation was reformed and made uniform across the country. Internal tolls on the movement of goods and restrictions on the movement of people were abolished; so too were prohibitions on the exports of rice, wheat, copper, and raw silk. These reforms are generally acknowledged to have been major catalysts in early Japanese industrialization.

The collapse of liberalism and of the global market: 1913 to 1950

Economic liberalism, waxing from 1820 to around 1870, and waning between 1870 and 1913, was practically moribund from 1913 to about 1950. During these years there were two world wars and frequent trade wars, the severest economic depression in history occurred, the socialist approach to industrialization emerged, and several countries that had previously served the world trading system as suppliers of primary products (Argentina and Brazil to name just two) adopted an industrialization strategy that emphasized import substitution behind high protective barriers.

Even within some of the major capitalist industrialized countries, the market lost ground. The cartelization of German industry, which had started around the last quarter of the nineteenth century, greatly intensified in the years between the two world wars. Industrial cartels started in the United States at about the same time as in Germany, but unlike in Germany were promptly outlawed. Nevertheless, a wave of mergers resulted in significant concentration in U.S. industry. International trade also became restricted as the industrialized countries adopted restrictive and predatory commercial policies around the Great Depression years of the 1930s. Tariff wars and quantitative restrictions became common. The United States passed the Smoot-Hawley Tariff Act, which created high protective tariffs. The United Kingdom and France retreated from multilateral

trade, each emphasizing trade within its colonial empire at the expense of outside countries. Germany created an elaborate mechanism of bilateral payments and exchange controls for its trade with central and southern Europe and with South America.

Although the period from 1913 to 1950 inherited many technological innovations from the earlier period of industrialization and contributed many of its own, their diffusion was delayed by the political and economic turmoil. The growth of output dropped, and there was an even greater fall in the growth of international trade (Figure 3.2).

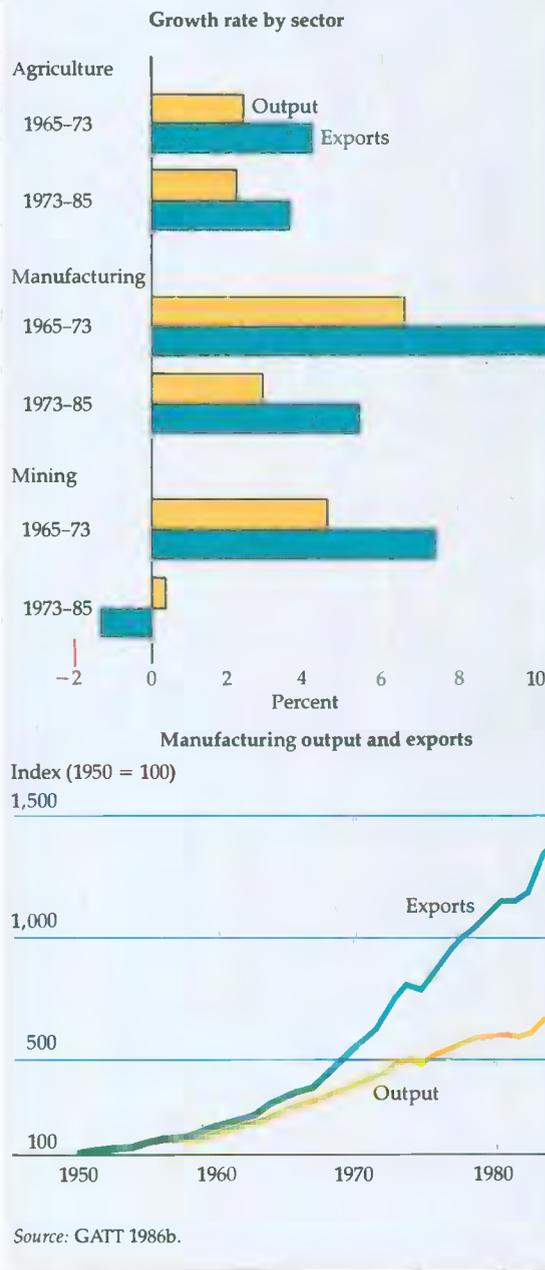
Global industrialization after World War II

By the mid-1950s postwar reconstruction was virtually complete, and the world economy entered a period of unprecedented output and trade expansion (Figure 3.2). Manufacturing led the way in both output and export growth (see Figure 3.3). As in the nineteenth century, exports grew faster than output.

Postwar growth in manufacturing was fueled by an explosion of new products, new technologies, liberalization of international trade, and increasing integration of the world economy. Assembly line production, the internal combustion engine and the automobile, electricity and the consumer durables that came with it—all of them predating the war—were given a push by the postwar release of postponed consumer spending. There were entirely new technological advances as well: synthetic materials, petrochemicals, nuclear energy, jet aircraft, and computers and electronic products (notably television). And great strides were made in telecommunications technologies, microelectronics, and robotics. The impact of microelectronics and robots on production processes is potentially so great that many observers believe the world is now on the threshold of a “third industrial revolution.”

As before, some of the new technologies assisted the physical integration of world markets. The jet aircraft cut travel time. Telecommunications made it easier for multinational corporations to coordinate subsidiaries in different countries. The associated electronic media helped shape a world market with increasingly similar consumer tastes. Trade liberalization among industrialized market economies under the General Agreement on Tariffs and Trade (see Chapter 8) helped to create a global environment that was conducive to the development and diffusion of the new technologies.

Figure 3.3 Postwar growth in world output and exports



Three other developments marked the pattern of global industrialization in the postwar period. First, the appearance of a nonmarket alternative to industrialization in Eastern Europe and elsewhere (see Box 3.1); second, decolonization in Asia, Africa, and the Caribbean; and third, the rise of the multinational corporation to prominence in world production and trade in manufactures.

Box 3.1 Industrialization and trade in nonmarket economies

Industrialization in the Soviet Union and other nonmarket economies has evolved differently from the other cases reviewed in this chapter. These countries have suppressed market transactions domestically and have engaged in relatively little foreign trade, even among themselves. Spontaneous responses to economic incentives have contributed little to either technological change or specialization among economic units. The Central Plan prepared by the government has attempted to determine most economic activities. State control of the means of production has been a key feature of this economic system. The Soviet Union pioneered it in 1928, and after World War II the socialist countries of Eastern Europe and elsewhere adopted it.

Statistics on these economies are difficult to obtain. In addition, because relative prices in these economies do not reflect relative scarcities, data on GDP, total investment, domestic consumption, industrial output, and so forth—all of which must rely on relative prices for aggregation—are difficult to interpret. Nevertheless, it is quite clear that the Soviet Union and some of the nonmarket economies have made tremendous progress in industrialization, especially since World War II. According to calculations by Western economists, Soviet GNP grew at an average annual rate of 6.7 percent from 1929 to the mid-1950s; 6.1 percent in 1953–65; 5.3 percent in 1966–70; 3.8 percent in 1971–75; 2.7 percent in 1976–80; and 2.4 percent in 1981–85. In view of the statistical problems, these estimates are debatable. But, if they are reasonably accurate, they suggest that in the two decades following World War II (1950 to 1970), only Japan and Germany, among the industrial market economies, grew faster. Growth in the other nonmarket economies during this period was also rapid, although generally not so rapid as that in the Soviet Union and not sustained over such long periods.

Much of this growth occurred in industry. Government control of the means of production allowed these countries to channel large shares of output to investment in industry. The large investment efforts involved meant that in many of the countries consumption per capita had to be constrained by the state for long periods. Nevertheless, the heavy investments together with the large pools of labor available initially resulted in rapid industrial expansion.

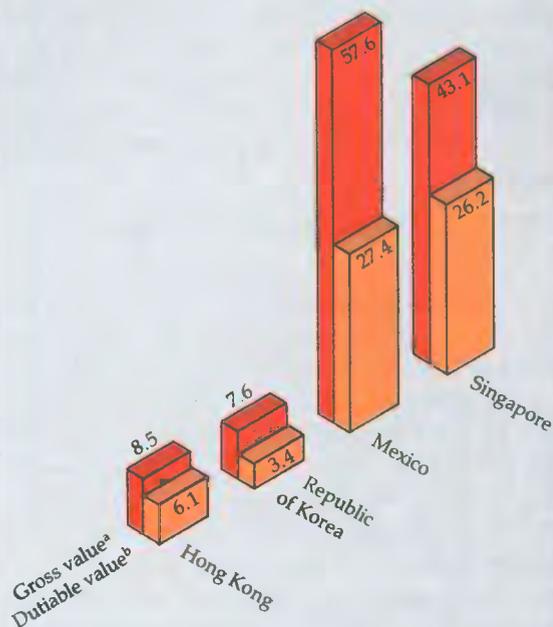
But the industrial sectors that appeared in these economies quickly lost dynamism, owing to the inherent rigidities in central planning. For instance, for most firms the Central Plan specifies what to produce, which inputs to use, where to obtain them, and where to send the outputs. Hence, most firms have had little liberty or incentive to innovate or diversify input sources (in-

cluding imports) so as to reduce costs. At the same time, however, each firm is generally assured of a market regardless of quality, since other firms are required by the plan to take its outputs and final consumers have no options. Hence, there is little incentive for most firms, especially those producing nonmilitary products, to improve upon their products, to maintain the goodwill of customers, or to develop new markets (including export markets).

Some Western experts claim that total factor productivity growth (see explanation in Box 3.3) in the Soviet Union has been negative since the mid-1970s. Given the difficulty of getting access to detailed and accurate data on the Soviet economy, however, this assessment of total productivity growth is not beyond dispute. What is beyond dispute is the fact that by the mid-1970s many economists and policymakers within the Soviet Union and other nonmarket economies had openly recognized the inefficiencies in their industrial sectors. Most of the countries then began opening up more to foreign trade with the industrial market economies, with technology acquisition the primary motive. Poland entered into a number of industrial cooperation agreements with Western firms (such as International Harvester). Other East European nonmarket economies, as well as China, entered into similar agreements, although in most cases more conservatively. The Soviet Union eventually also began increasing trade with the industrial market economies. Soviet imports from the industrial market economies expanded at about 17 percent a year in the first half of the 1970s. Some experts estimate that technological imports in the 1970s may have added about 0.5 percent a year to the Soviet industrial growth rate. Recently (1987) the Soviet Union adopted a policy that allows joint ventures with foreign firms inside the Soviet Union.

There are, however, potential problems with a policy of opening up more to foreign trade while still maintaining a rigid system of central planning. Increased imports ultimately require more exports to pay for them, and so domestic firms should have the flexibility to seek and respond quickly to export opportunities. Lack of such flexibility and also of a price system that reflects relative scarcity has already contributed to balance of payments difficulties in some of the nonmarket economies that have opened up their foreign trade, especially Poland. Several countries (for example, Hungary and China) are now trying to relax some of their restrictions on domestic market transactions in order to promote efficiency and innovation. These reforms are complicated and delicate, but the potential economic gains appear to be considerable.

Figure 3.4 Share of offshore assembly products in total manufactured imports by the United States from selected developing economies, 1973–85 (percent)



Note: Data are averages for the period. Manufactured products are defined here as Standard International Trade Classification (SITC) categories 5,6,7,8, and 9, less 68.
a. Total value of the finished product.
b. Gross value minus the value of material components that originated in the United States.
Source: U.S. International Trade Commission and United Nations.

Decolonization

Many of the countries emerging from colonialism in the postwar period chose an industrial development strategy that emphasized import substitution behind high government protection—similar to the strategy adopted by Argentina, Brazil, Turkey, and other independent developing countries in the 1930s. Several factors contributed to the appeal of this approach. First, during the turbulent years spanning the world wars, countries that had specialized as exporters of primary products found their access to export markets and to manufactured imports reduced. Their terms of trade fell drastically. This is what had prompted Argentina and others to take the protective import substitution course in the 1930s. In the first two decades after World War II, predictions of a secular decline in the

terms of trade against primary products were common, and many of the newly independent countries thought it sensible to shift quickly to industries. Second, many people in the new countries associated specialization in primary commodities with their previous colonial status. To them, independence called for breaking away from the colonial economic system. Many also believed that protection granted through government restrictions on imports had played a significant role in the early industrialization of Europe, North America, and Japan. In addition, inspired by the Soviet Union's rapid industrialization, several of the newly independent countries combined import substitution with government ownership, planning, and production. In these countries, governments sought to restrict domestic trade, unlike in Europe and Japan where early industrialization had been assisted by the easing of restrictions on domestic trade.

Countries pursuing the import substitution strategy typically started by producing final manufactures to replace imports. Many enjoyed initial bursts in the growth of manufacturing. But since production usually required imported intermediate and capital goods, sustained industrial growth depended on the expansion of exports to provide the necessary foreign exchange. Countries that made an early transition to export expansion, such as the Republic of Korea, sustained their industrial growth. Many others did not make the transition. They stayed in the protective import substitution phase and their industrial development was retarded.

Multinationals

Multinational corporations in manufacturing date back as far as the nineteenth century (Singer, a U.S. firm, established a factory in Glasgow in 1867 to manufacture sewing machines), and those in primary commodities date back even farther. But it is only since the 1960s that multinationals have become major actors in shaping world industrialization. Today, between 25 and 30 percent of the world's stock of foreign direct investment—the channel for multinationals' investments—is in developing countries; about 40 percent of this is in the manufacturing sector. Manufacturing multinationals have been attracted to some of the large developing countries, especially in Latin America, because of trade policies that restricted imports of final manufactures. But in many other countries, especially those in Southeast Asia, the attraction

has been the availability of semiskilled industrial labor at low cost. Some developing countries derive a significant part of their manufacturing exports from local subsidiaries of multinationals. Although data for recent years are not available, in the middle and late 1970s the share of multinationals in manufactured exports from Korea and Mexico was around 30 percent. In Brazil the share was more than 40 percent, and in Singapore more than 90 percent.

Multinationals have made it easier for some developing countries to begin exporting manufactures without going through an initial phase of import substitution. Some of these corporations have located in developing countries with the principal aim of producing in order to export to their home and other markets. Typically, this has occurred when the production processes have become routine and thus require large inputs of semiskilled labor. Locating in developing countries then allows the multinational firms to reduce labor costs.

Beginning in the late 1960s several multinationals began rationalizing their global production. Whereas before, most foreign subsidiaries had produced finished products, often with technological and intermediate inputs from the parent company, now all the subsidiaries were increasingly linked into a unified production process. Each performed only those aspects of the manufacturing process in which it had a comparative advantage. New subsidiaries were in some cases set up in developing countries to perform the labor-intensive activities. This system is not always confined to transactions among subsidiaries of the same multinational. Sometimes the arrangements are between locally owned companies and foreign-owned companies. The foreign-owned companies are not always multinationals, and sometimes they may not even be based in the domestic economy. The arrangement is known as international subcontracting. Sometimes the terms "offshore assembly" and "sourcing" are used. Figure 3.4 shows the share of offshore assembly products in total manufactured imports by the United States from four developing economies. Exemption from duties of the value of U.S. components in the offshore assembly imports has encouraged U.S. firms to use this arrangement. Similar arrangements occur between manufacturing firms in other industrialized countries and producers in developing countries.

An important form of subcontracting, especially in textiles, is an arrangement whereby firms based in the industrialized countries provide design

specifications to producers in developing countries, purchase the finished products, then sell them at home and abroad. This is akin to the putting-out system in textiles which was adopted in preindustrial England. With modern transport and communications, it probably is no more difficult for today's merchants to organize a putting-out system between New York and Hong Kong, or between Tokyo and Seoul, than it was for the early English merchants to organize their putting-out system between London and the surrounding villages.

Postwar performance of developing countries

As a group, the developing countries still have only a small share in world manufacturing output, but their output and exports of manufactures have nonetheless grown more rapidly than those of the industrial countries since the 1960s (see Tables 3.1 and 3.2). No developing economy figured among the world's top thirty exporters of manufactured products in 1965. Twenty years later Hong Kong and the Republic of Korea were among the top fifteen, with export shares close to those of Sweden and Switzerland. Singapore and Brazil were among the top twenty, with export shares close to those of Denmark and Finland. Although this performance occurred during a period of unprecedented real growth in world output and trade in manufactured products, it is remarkable that developing countries sustained their progress even when the world economy slowed after 1973. Moreover, manufactured exports from developing countries have become more sophisticated (see Table 3.3). Developing countries have diversified from traditional labor-intensive products (such as textiles) or those based on natural resources (such as crude petrochemicals, cork, and paper) to chemicals and engineering products.

There are now fears that microelectronics and robotics will reduce the labor-cost advantage which the developing countries have exploited to expand their role in world manufacturing. Similar fears about the effects of machinery on employment in earlier times proved unfounded. Increasing mechanization displaced some workers, but it also introduced new opportunities that led in the long run to higher employment. The same could be true of the long-run impact of microelectronics and robotics on industrialization in developing countries. Box 3.2 discusses the effect of technological change in textiles and clothing—two industries that are of special importance to industrialization in developing countries.

Table 3.1 Shares of production and exports of manufactures by country group, 1965, 1973, and 1985
(percent)

Country group	Share in production			Share in exports		
	1965	1973	1985	1965	1973	1985
Industrial market economies	85.4	83.9	81.6	92.5	90.0	82.3
Developing countries	14.5	16.0	18.1	7.3	9.9	17.4
Low-income	7.5	7.0	6.9	2.3	1.8	2.1
Middle-income	7.0	9.0	11.2	5.0	8.1	15.3
High-income oil exporters	0.1	0.1	0.3	0.2	0.1	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 3.2 Growth in production and exports of manufactures by country group, 1965–73, 1973–85, and 1965–85
(percent)

Country group	Growth in production			Growth in exports		
	1965–73	1973–85	1965–85	1965–73	1973–85	1965–85
Industrial market economies	5.3	3.0	3.8	10.6	4.4	6.8
Developing countries	9.0	6.0	7.2	11.6	12.3	12.2
Low-income	8.9	7.9	7.5	2.4	8.7	6.0
Middle-income	9.1	5.0	6.6	14.9	12.9	13.8
High-income oil exporters	10.6	7.5 ^a	8.4 ^a	16.2	11.5	16.0
Total	5.8	3.5	4.5	10.7	5.3	7.4

a. End period is 1984 instead of 1985.

Table 3.3 Structure of manufactured exports from developing countries, 1970–84

Description	Share of developing countries' exports ^a		Growth rate ^b
	1970	1984	1970–84
<i>Traditional manufactured exports</i>			
Labor-intensive			
Textiles and apparel (84 and 65)	31.3	24.8	11.8
Footwear (85)	1.8	2.9	18.2
Other labor-intensive (61 and 83)	2.9	2.3	11.6
Total	36.0	30.0	12.4
Resource-based			
Wood and cork (63)	3.6	1.5	6.9
Paper manufactures (64)	0.8	1.1	17.6
Other resource-based (52 and 56)	0.8	0.9	14.5
Total	5.2	3.5	12.2
<i>Nontraditional manufactured exports^c</i>			
Electrical machinery (72)	16.1	16.7	14.1
Chemicals (51)	8.3	9.9	15.3
Nonelectrical machinery (71)	4.2	8.7	20.1
Transport equipment (73)	2.6	5.2	20.0
Iron and steel (67)	6.2	6.5	14.2
Other nontraditional ^d	21.4	19.5	12.9
Total	58.8	66.5	15.1
<i>Total</i>	100.0	100.0	14.0

Note: Figures in parentheses are the SITC categories for the respective product group.

a. Developing countries' exports of the listed product as a share of developing countries' total exports of manufactured products defined as SITC categories 5, 6, 7, and 8, less 68.

b. The rate of growth of developing countries' exports of the listed product during 1970–84 in constant dollars.

c. Total manufacturing exports less traditional manufactured exports.

d. Rest of nontraditional exports.

Source: Murray (background paper).

Box 3.2 Technical change and comparative advantage: the case of textiles and clothing

Developing countries that have embarked on a path of efficient industrialization have often done so partly through the export of simple, labor-intensive manufactures, in particular clothing and textiles, to industrial market economies. But rapid technical change in such industries has led to a new form of export pessimism.

Surprisingly, perhaps, the textile industry—not normally considered a leading industry—has consistently registered higher-than-average labor productivity gains in the industrial market economies in recent decades. These gains have been brought about by a series of labor-saving innovations since World War II: the rationalization of production in more specialized factories, dramatically higher speeds in spinning, weaving, and knitting (helped in part by the growing use of synthetic fibers), and the introduction of radical, new techniques (open-end spinning, shuttleless weaving, non-woven fabrics, tufted carpets, and so on). In the 1960s many textile industrialists predicted a sharp reversal of comparative advantage in favor of the advanced industrialized countries.

These predictions turned out to be not entirely right, but not entirely wrong. By and large, innovations in textiles did succeed in halting the further loss of comparative advantage in the high-wage industrialized countries—by means of a substantial reduction in labor content. The textile industries of Germany, Italy, and the United States are, unlike their clothing industries, broadly competitive (although they still cling to protection). The reversal in comparative advantage was incomplete for several reasons. Firms—especially in Europe—found that the market would not allow them to produce standardized textiles on the scale that would justify the most capital-intensive equipment. In addition, the wage gap between the industrial market

economies and the developing economies remained so large that a broad range of techniques could exist side by side.

The clothing industry was never able to make similar strides in productivity because of the inherent obstacles to automating the functions of a machinist manipulating a soft, limp fabric. But thanks to the promise of microelectronics, clothing industrialists are now beginning to echo the textile industrialists of the 1960s.

A recent study sought to assess the likely impact of microelectronics on developing countries' comparative advantage in clothing (Hoffman 1985). This study found signs of an increasing rate of innovations in clothing machinery, most of them based on microelectronics. Recent innovations promised substantial savings in material and labor costs, as well as other advantages (such as time saving) in the preassembly phase of production (when fabrics are cut). In the assembly (or sewing) phase—which accounts for a significantly larger share of total costs than preassembly—productivity gains from microelectronics were also possible, but on a less dramatic scale. The productivity gains in both stages required costly capital investment, a minimum scale of efficient operation larger than that of the normal size of firm in this industry, increasing managerial sophistication, and—in some cases—a loss of flexibility. The study judged that, given the problems in adopting the new technology, its rate of diffusion would be slow in the coming decade, and the new technologies might not reach their maximum impact until the first years of the next century. The study concluded that protection by the industrial countries would remain the more immediate threat to developing countries' exports.

Not all of the developing countries have progressed at the same rate, however. Some have done far better than others. Figure 3.5 compares production and exports of manufactures for forty-three economies before and after 1973. Because of differences in the degree of distortion in exchange rates and in relative sectoral prices, comparisons based on the dollar value of manufactured production mean little. Export shares are more revealing. By 1985, the forty-three economies accounted for two-thirds of manufactured exports from developing countries; the first fifteen alone accounted for about 60 percent. Chapters 4 through 7 attempt to explain why recent performance has varied so widely from country to country. The rest of this chapter discusses the economic processes that

have been common to most industrializations and tries to draw some lessons from the period before World War II.

Industrialization and structural change

Typically, the share of manufacturing in GDP has risen in the early phase of industrialization. After a time, however, it has tended to fall, while the basic underlying forces of industrialization—technological change, specialization, and trade—have continued to propel output per capita upward. Thus, for most countries, the ratio of (a) the share of manufacturing (or of industry) in GDP to (b) GDP per capita follows an inverted U as industrialization proceeds (see Figure 3.6). This same

relationship emerges, although not as clearly, when the ratio is compared across different countries at a single point in time (see Figure 3.7). The share of services has also tended to rise over time; its upward trend lasts longer than that of manufacturing. Agriculture's share in output gradually declines to accommodate the increased share of in-

dustry and services. Similar trends occur in the sectoral distribution of employment.

Initial discussion of these long-term trends (Colin Clark in 1940 and Simon Kuznets in the 1950s and 1960s) were confined mainly to the industrialized countries. Since then, a number of scholars, notably Hollis Chenery, have studied

Figure 3.5 Indicators of industrial performance of developing economies

1973 Ranking ^a	1966-73			1985 Ranking ^a	1973-85			Change in share of manufactured exports from 1973 to 1985 ^c
	Growth in manufacturing value added	Growth in manufactured exports	Share of manufactured exports (1973) ^b		Growth in manufacturing value added	Growth in manufactured exports	Share of manufactured exports (1985) ^b	
1. Hong Kong	■	■	■	1. Hong Kong	■	■	■	-
2. Republic of Korea	■	■	■	2. Republic of Korea	■	■	■	+
3. Yugoslavia	■	■	■	3. Singapore	■	■	■	+
4. Singapore	■	■	■	4. Brazil	■	■	■	+
5. India	■	■	■	5. Yugoslavia	■	■	■	-
6. Brazil	■	■	■	6. India	■	■	■	-
7. Mexico	■	■	■	7. Malaysia	■	■	■	+
8. Argentina	■	■	■	8. Mexico	■	■	■	-
9. Pakistan	■	■	■	9. Turkey	■	■	■	+
10. Greece	■	■	■	10. Philippines	■	■	■	+
11. Malaysia	■	■	■	11. Thailand	■	■	■	+
12. Thailand	■	■	■	12. Indonesia	■	■	■	+
13. Colombia	■	■	■	13. Greece	■	■	■	-
14. Philippines	■	■	■	14. Pakistan	■	■	■	-
15. Egypt	■	■	■	15. Argentina	■	■	■	-
16. Turkey	■	■	■	16. Morocco	■	■	■	+
17. Jamaica	■	■	■	17. Tunisia	■	■	■	+
18. Morocco	■	■	■	18. Colombia	■	■	■	-
19. Zimbabwe	■	■	■	19. Egypt	■	■	■	-
20. Guatemala	■	■	■	20. Peru	■	■	■	+
21. El Salvador	■	■	■	21. Sri Lanka	■	■	■	+
22. Dominican Republic	■	■	■	22. Botswana	■	■	■	+
23. Tunisia	■	■	■	23. Venezuela	■	■	■	-
24. Sierra Leone	■	■	■	24. Zimbabwe	■	■	■	-
25. Costa Rica	■	■	■	25. Jamaica	■	■	■	-
26. Venezuela	■	■	■	26. Trinidad and Tobago	■	■	■	-
27. Zaire	■	■	■	27. Uruguay	■	■	■	-
28. Trinidad and Tobago	■	■	■	28. Costa Rica	■	■	■	-
29. Côte d'Ivoire	■	■	■	29. Chile	■	■	■	+
30. Indonesia	■	■	■	30. Guatemala	■	■	■	-
31. Algeria	■	■	■	31. Cyprus	■	■	■	+
32. Kenya	■	■	■	32. Côte d'Ivoire	■	■	■	-
33. Uruguay	■	■	■	33. Dominican Republic	■	■	■	-
34. Nigeria	■	■	■	34. El Salvador	■	■	■	-
35. Tanzania	■	■	■	35. Kenya	■	■	■	-
36. Sri Lanka	■	■	■	36. Cameroon	■	■	■	-
37. Chile	■	■	■	37. Senegal	■	■	■	-
38. Senegal	■	■	■	38. Zaire	■	■	■	-
39. Ghana	■	■	■	39. Algeria	■	■	■	-
40. Cyprus	■	■	■	40. Sierra Leone	■	■	■	-
41. Cameroon	■	■	■	41. Tanzania	■	■	■	-
42. Peru	■	■	■	42. Nigeria	■	■	■	-
43. Botswana	■	■	■	43. Ghana	■	■	■	-

a. Based on the share in manufactured exports from developing economies.

b. Share of manufactured exports from developing economies.

c. The + sign indicates that the share in 1985 is greater than in 1973, and the - symbol indicates that the share in 1985 is smaller than in 1973.

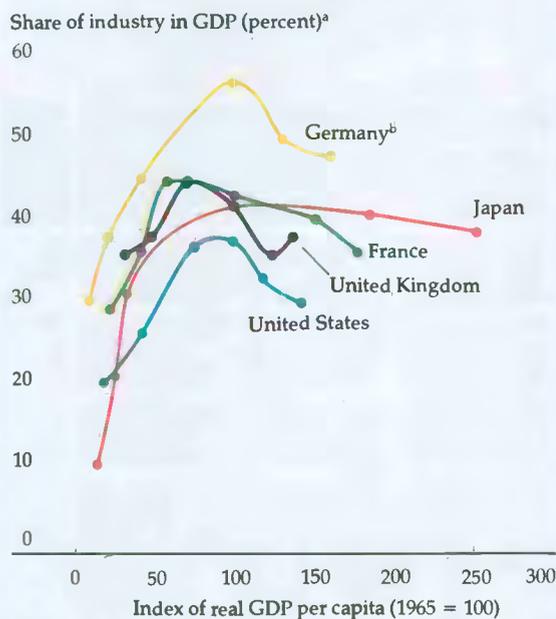
Growth rates (percent)

- equal to or more than 15.0
- 10.0 to less than 15.0
- 7.5 to less than 10.0
- 5.0 to less than 7.5
- 0.0 to less than 5.0
- less than 0.0

Export share (percent)

- equal to or more than 10.0
- 5.0 to less than 10.0
- 2.5 to less than 5.0
- 0.5 to less than 2.5
- 0.2 to less than 0.5
- less than 0.2

Figure 3.6 Historical relationship between GDP per capita and the share of industry in GDP in selected industrial countries, 1870–1984



Note: The six data points shown for each country represent the following approximate time periods: (from left to right) 1870, 1913, 1950, 1965, 1975, and 1984.

a. Industry includes manufacturing, mining, and construction.

b. Data for 1950 onward refer to the Federal Republic of Germany.

Source: Kuznets 1957, appendix table 2; Maddison 1982, tables A4 and B2; and World Bank data.

post-World War II trends in developing countries, extending the analyses to trends within industry (see Box 3.3.). The economic explanations behind the long-term trends rest, on the supply side, on technological change and its differential impacts on economic sectors, the induced specializations, and the resulting trade and flow of resources among and within sectors. On the demand side, the pattern of consumption changes with income growth, and this induces changes in the structure of production.

In the early phases of industrialization, greater use of machinery, especially in manufacturing, increases labor productivity and output. As industrialization continues, further increases in labor productivity reduce the growth of industry's demand for labor. In the early phases, high growth of employment in industry is made possible by low

growth in agricultural employment; in the later phases, high growth of employment in services is made possible by lower growth in industrial and agricultural employment.

Agricultural productivity and industrialization

Agriculture's reduced share in GDP has, in many countries, coincided with higher agricultural output and productivity. Britain experienced large increases in agricultural productivity in the second half of the eighteenth century, before its industrial revolution. Europe and North America went through a similar process later. Japan substantially increased its agricultural yields around the second half of the 1800s.

Increasing agricultural productivity facilitates industrialization in at least four ways:

- Higher rural incomes raise the demand for manufactures along with the demand for other goods. Moreover, because the share of food in total expenditure tends to decline as income rises, rising rural incomes also lead to a larger *proportion* of incomes being spent on manufactures.

- Rising agricultural productivity increases the supply of agricultural raw materials for industry.

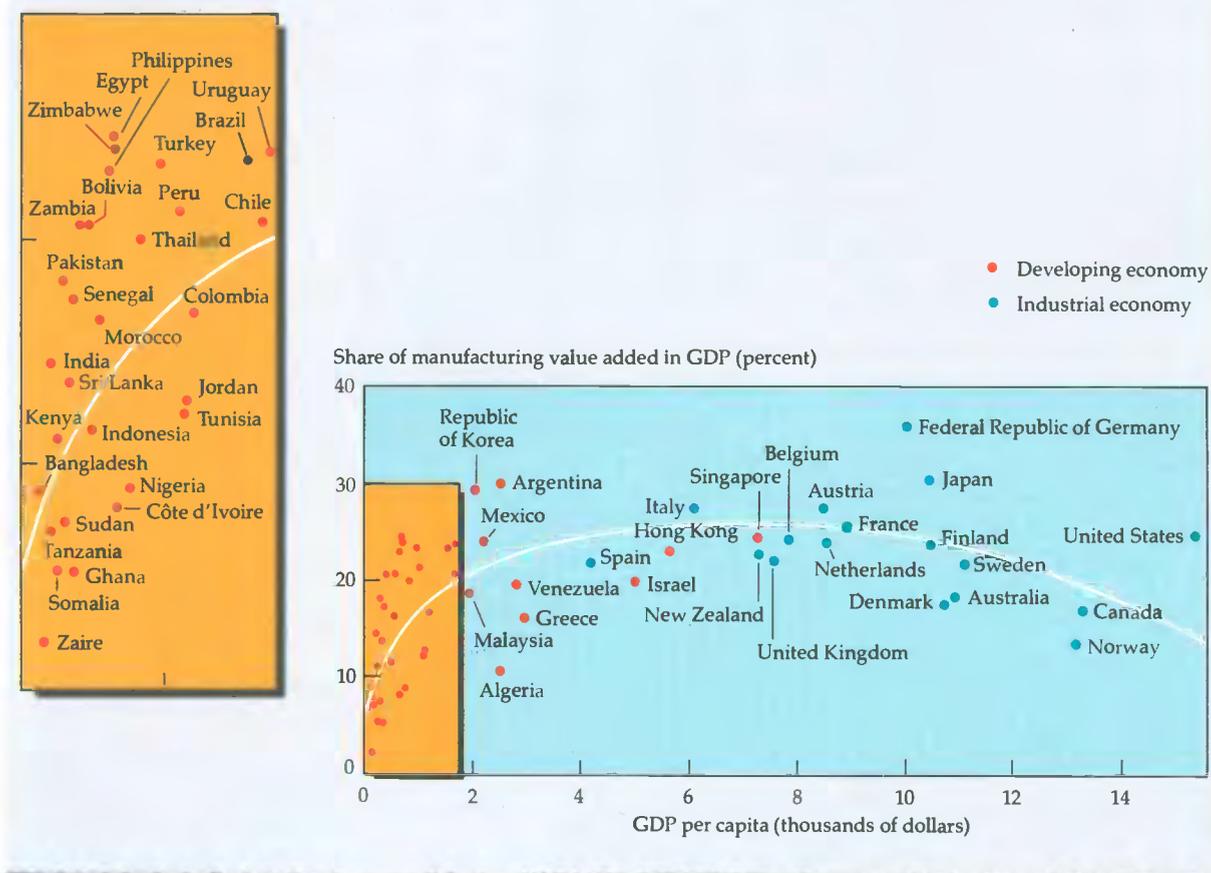
- Additional foreign exchange made possible by increased agricultural exports can be used to import inputs for industry. Higher farm incomes from increased agricultural productivity can also generate additional savings, which can then be made available for investment in industry. Japan's success in its transition to rapid industrial growth in the early twentieth century was partly due to its success in mobilizing agricultural savings. Agriculture financed 27 percent of nonagricultural investment from 1888 to 1902, and 23 percent from 1903 to 1922. In the earlier period two-thirds of the investment was channeled through the public sector, courtesy of the land tax. In the later period this share fell to a quarter (the private sector accounted for the rest).

- Rising farm productivity initially allows new entrants to the labor force to be employed outside agriculture. Later, it allows labor to be released from agriculture and to be fed without sharp rises in domestic food prices or recourse to large and unsustainable imports of food.

The service sector and industrialization

Growth in the share of services tends to persist longer than growth in the share of manufacturing as industrialization proceeds. Much of the growth

Figure 3.7 Relationship between GDP per capita and the share of manufacturing value added in GDP in selected economies, 1984



in the share of services reflects the increasing specialization and urbanization that come with industrialization. First, the factory—the symbol of industrialization—requires a vast, but less visible service infrastructure to function effectively. Transportation, distribution, communications, finance, and insurance, to name just a few, are all services that have to expand to facilitate industrial growth. Second, some services (for example, cleaning, information processing, advertising, and so forth) that previously were performed in-house by industrial firms have progressively been contracted to firms in the service sector. Third, just as the higher income demand elasticity for manufactures (compared with agricultural products) spurs the rapid growth of manufacturing output in the early phases of industrialization, so the higher income demand elasticity for services (compared with manufactures) encourages the growth of services

in later phases of industrialization. Fourth, increasing labor demand leads to the commercialization of domestic services, as housewives and other domestic workers join the formal labor force. Activities that previously fell outside the statistics thus begin to boost the recorded output of services. Fifth, urbanization, which accompanies industrialization, requires additional services: police, sanitation, city administration, and so forth.

Since service occupations, on the whole, are less amenable to automation, an increase in the value of service output would normally require more labor input than an increase of equal value in the output of industry. This explains why the share of services in employment rises faster than the share of services in GDP.

These factors account for the shift toward services within the individual economy. Growing integration in the world economy has added

Box 3.3 Statistical studies of economic growth and industrialization

Statistical studies of economic growth fall into two broad categories. One category extends the celebrated Clark-Kuznets studies to a large number of industrial and developing countries. The aim is to describe standard patterns of growth in economic sectors and across different branches of manufacturing. Another category tries to account for the different sources of economic growth and to isolate the contribution of rising productivity.

The studies that seek to establish standard patterns focus on income per capita. They postulate that as consumers' incomes increase, their demands shift from

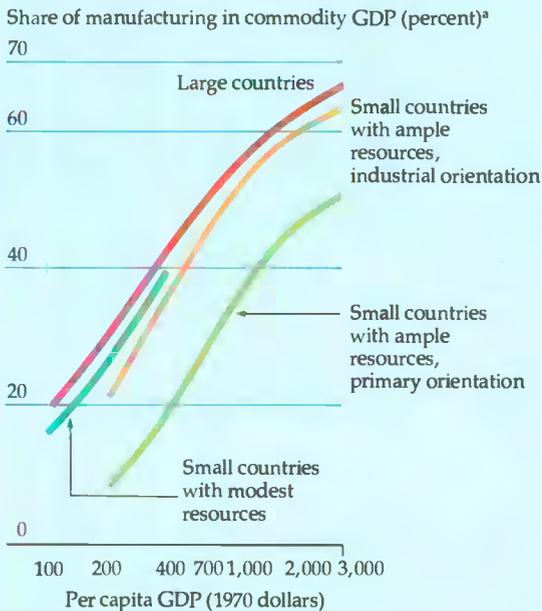
mostly food products, first to industrial products and then to services and leisure. In response to these demand changes, the share of agriculture in production is expected to fall, the share of industry to rise, and later the share of services to rise. In addition to income per capita, many of the studies also examine the role of population size and the endowment of natural resources (or the availability of foreign resources). Strictly speaking, the structural features, such as the share of manufacturing in GDP, and the principal "explanatory" variable, income per capita, are joint outcomes of underlying economic processes that are not explained in the statistical model. Hence, no causality can be inferred. Nevertheless, the standard patterns produced by these studies provide useful statistical benchmarks for inquiries into a very complex process (see Box figure 3.3A).

Some studies attempt to provide similar standard patterns for the various branches of manufacturing. For instance, it is postulated that at low per capita incomes, demand for manufactures is concentrated on food and other light manufactures, but as per capita incomes increase, demand shifts to consumer durables and other heavy manufactures. The demand stimulus thus provided is supposed to be translated into production, in part with the help of higher savings made possible by the higher per capita incomes. While all this may be true in general, rapid change in industrial technology and in international specialization reduces the relevance for policy of statistical patterns at the detailed level of industrial subsectors.

The studies that seek to account for the sources of growth start from the premise that countries can grow either through the accumulation of factor inputs (extensive growth) or through the more productive use of inputs (intensive growth). For fast growth, sustained through time, both are necessary. Rapid growth rates can usually be achieved with expansion in factor inputs at early stages of industrialization, but with time it becomes more difficult to expand factor inputs, especially labor, and efficiency in the use of all economic resources becomes critical to further growth in GDP. Total factor productivity growth is a concept that tries to capture productivity growth in the use of all physical inputs. It is usually derived as a residual, after subtracting the contribution attributable to growth in the use of labor, land, and capital from GDP growth. Since land grows slowly, if at all, in most countries, a good approximation is the residual obtained after subtracting the contributions of labor and capital growth from GDP growth. Box figure 3.3B shows estimates of the growth rates of real GDP, total factor (capital and labor) inputs, and total factor productivity.

The estimates were obtained by examining the growth of countries at different levels of industrialization for the period 1960-75. Changes in the quality of capital and labor that occur over time have been taken into account in deriving the estimates for each country. Differences in the stage of industrialization may account for some of the differences in performance among the countries shown. Nevertheless, the general

Box figure 3.3A Per capita GDP and the share of manufacturing



Note: A country was classified as large if its population in 1970 was 20 million or more; otherwise, it was classified as small. A small country was classified as having modest resources if its average per capita production of primaries (defined as GDP less services and manufacturing) in 1960-73 was less than \$84 (in 1970 prices); otherwise, it was classified as having ample resources. A small country with ample resources was classified as having an industrial orientation if in most years during the period 1969-73 its value added in manufacturing was above the regression plane that predicts manufacturing value added using per capita GDP and population (for small countries with ample resources); if in most years the actual manufacturing value added was below the regression plane, the country was classified as having a primary orientation.

The horizontal axis is in log scale. The curves are plots of a logistic function with the population variable held constant at the average value for each group. The number of observations at higher income levels was insufficient to extend the curve for small countries with modest resources beyond \$400 per capita income.

a. Commodity GDP is GDP minus the value of services.

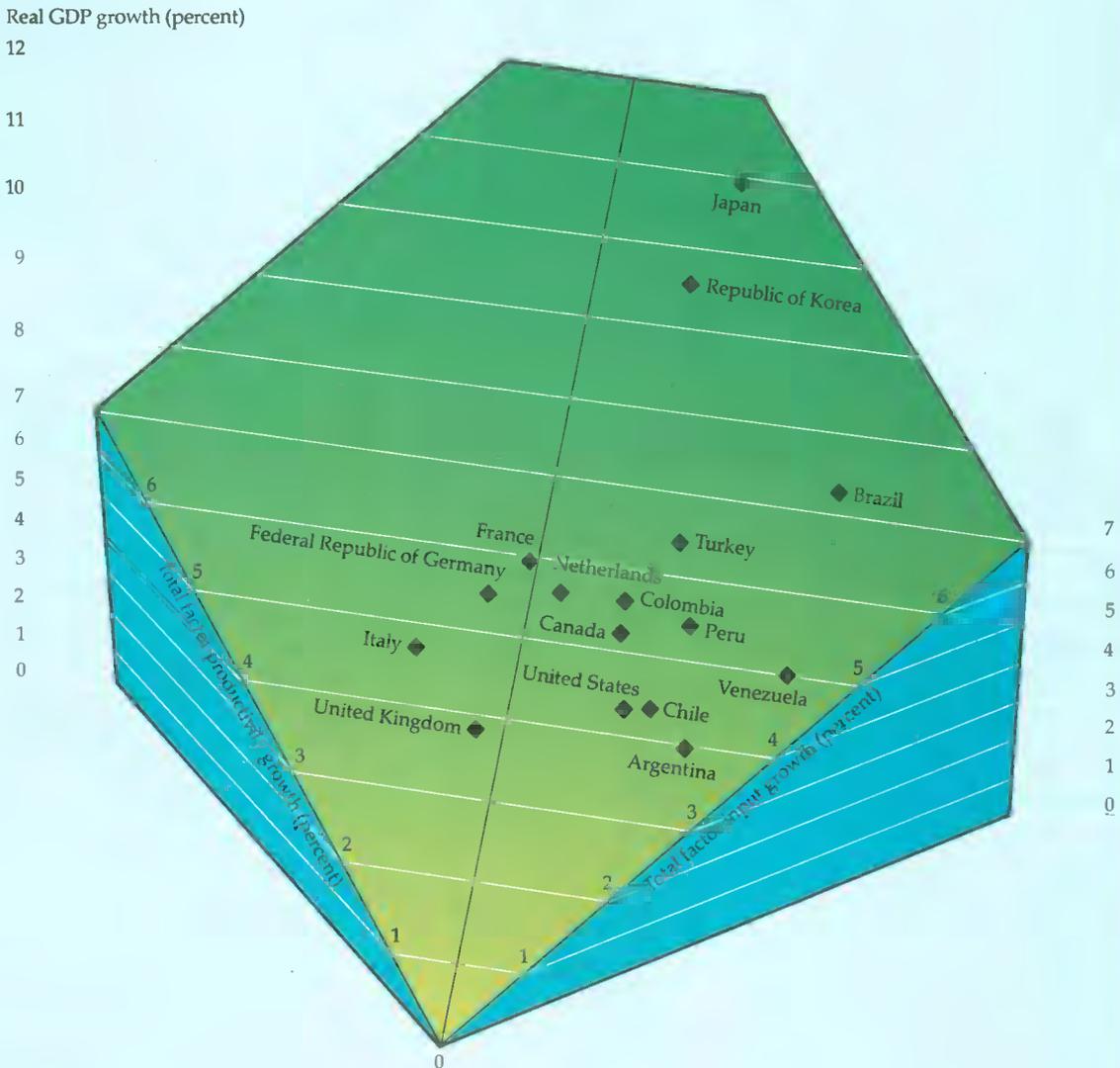
Source: UNIDO 1979, figure VI, p. 47, and Annex I.

picture conveyed by the figure is valid. Japan and the Republic of Korea have achieved high GDP growth rates through higher growth rates in both factor inputs and factor productivity. In contrast, the high GDP growth rates of Brazil and Venezuela have been based mainly on the growth of factor inputs. Furthermore, the figure shows that although factor inputs grew at about the same rate in Argentina and Colombia, the latter's real GDP growth was about 2 percent higher

than Argentina's—the result of differences in productivity growth.

Like the patterns-of-growth approach, the sources-of-growth approach does not provide *explanations*; rather it provides a useful way of viewing the outcome of the complex process of economic growth. Some recent studies (Chenery, Robinson, and Syrquin 1986) have attempted to encompass the two methodologies within a single framework.

Box figure 3.3B Total factor productivity and real GDP growth in selected countries, 1960–75



Note: Real GDP growth is the sum of the contributions from total factor input growth and total factor productivity growth. The closer a point is to the total factor productivity growth axis, the greater the relative contribution of productivity to real GDP growth. As one moves horizontally toward the total factor input growth axis, the relative contribution of productivity to real GDP growth falls and that of factor inputs rises.
Source: Adapted from Chenery, Robinson, and Syrquin 1986, figure 2-2.

an international dimension. Several developing countries (for example, Brazil, Mexico, the Republic of Korea, and Singapore) have been able to supply the relatively labor-scarce industrialized countries with labor-intensive manufactures at lower prices. Although the industrialized countries have sometimes tried to resist this trend, they have also adjusted to it, partly by increasing their exports of services such as banking, insurance, engineering, computer software, and marketing.

Structural change within manufacturing

World industrialization initially centered on textiles, later moved to iron, steel, and engineering products based on steel, then to chemicals, electrical products, and, finally, to today's electronic and microelectronic products. Most of the countries that industrialized before World War II followed this product sequence, at least as far as electrical products. Is this pattern of change within the single sector of manufacturing as inevitable as the one by which agriculture first gives way to manufacturing and then manufacturing itself gives way to services?

Textiles are preeminent in the early phase of industrialization mainly because clothing is a good for which there is growing demand in countries with low, but rising, income levels. In addition, most countries have a long history of textile production by artisans. Moreover, until quite recently, textiles technologies have been simple and stable. All in all, then, it was natural for most countries to begin industrializing by producing textiles (Box 3.2). The same factors also explain the early importance of leather goods, food processing, furniture, ceramics, building materials, and household utensils.

By the time most of today's developing countries started to industrialize (in the postwar period), the choice of products and processes in manufacturing was much wider and the world much more integrated. Countries could choose not to follow the product sequence that had occurred in the prewar period. For example, it was possible to create an engineering industry without producing iron and steel and to produce chemicals without refining petroleum. Nonetheless, some developing countries, emulating the previous generation of industrializers, built steel mills, refineries, factories producing consumer durables, and other heavy (or "late") industries. Some of these enterprises survive only with the aid of high protective barriers.

As the industrialized countries moved from tex-

tiles to heavier industries, they had to rely on bigger plants to reap economies of scale. This too is changing. It is now profitable to produce steel in mills with a capacity of around half a million tons; in the old integrated steel mills, plants of less than 2 million tons were inefficient. In the microelectronics industry, efficient plants can be much smaller than in the older branches of manufacturing.

Lessons from industrialization experiences before World War II

What are the lessons to be drawn from the experiences of countries which have followed a successful path to industrialization? This section examines five of the most important issues: the initial conditions—country size, population size, and resource endowment; policies toward domestic and foreign trade; education; transportation and communications infrastructure; and the institutional and macroeconomic background.

Initial conditions

A country with a large domestic market is in a better position to establish industrial plants that take advantage of economies of scale. Since distance between countries in many cases confers natural protection to domestic firms, everything else being equal, a country with a larger domestic market can begin industrializing earlier than one with a smaller domestic market. A large geographical size and a large population can, together, produce a large domestic market, unless agricultural productivity is exceptionally low. Hence, a large country with a large population can industrialize earlier. But this has not always been the case.

Although the United Kingdom is a small country, its growing agricultural productivity in the early 1700s supported an increasing population and provided an expanded domestic market that helped spur the Industrial Revolution. Japan, a small country with a relatively large population, went through a similar process. Switzerland has industrialized successfully despite its smallness in size and population. By contrast, Australia and Argentina are both large countries. In the late nineteenth and early twentieth centuries, their populations were expanding. In 1895, the per capita income of Argentina was as high as that of Germany, Holland, and Belgium; Australia's was higher, exceeding that of the United States. Yet neither country industrialized in the nineteenth

century, and neither is among today's major industrial countries.

A rich endowment of natural resources may provide a country with the financial means to import foreign technology and with the high incomes to support a large domestic market for industrial products. But several of the countries that became rich from natural resources were slow to industrialize. In the sixteenth century, Spain was the richest country in Europe, thanks mainly to the mineral resources of South America. But Spain did not initiate the Industrial Revolution, and the great surge in industrialization in eighteenth- and nineteenth-century Europe largely passed it by.

Domestic and foreign trade policies

Many of the countries that industrialized successfully in the nineteenth century first acquired technology through imports, then rapidly moved to producing manufactures for export. Policies that allowed opportunities on foreign markets to be communicated to domestic producers, that allowed domestic resources to move freely in response to the opportunities, and that complemented existing resources through education, training, and infrastructure all contributed to the success.

Unrestricted domestic trade was a precursor of Britain's industrial revolution. Many other European countries and Japan began their industrialization with reforms that liberalized their domestic trade. Foreign trade policies, however, were inconsistent. Episodes of free trade—such as those in the United Kingdom after 1846, in France during the 1860s, in Germany in the 1830s and 1860s, and in the United States during the 1840s and 1850s—were mixed with periods of restrictions on trade. The aims of foreign trade policy varied widely, too. In some cases foreign trade restrictions arose from a desire to protect domestic industry. Examples include British restrictions on machinery exports until 1842 and tariff increases in Germany in the 1840s and in the United States after the Civil War. At other times, import restrictions were prompted by the desire to protect agriculture. This was the motivation behind Britain's Corn Laws, the increases in German and French tariffs in the 1870s, and the Smoot-Hawley tariffs in the United States in 1930. In Germany, France, and the United States, however, the tariffs were also extended to cover manufactured imports. In other cases, import restrictions were adopted with the balance of payments in mind.

It is unclear how these shifts of foreign trade policy—liberal followed by protectionist, and vice versa—shaped industrialization before World War II. Domestic markets were generally competitive, so inefficiencies arising from protectionism may have been reduced, particularly in countries with large internal markets such as Germany and the United States. What is clear is that imports were the main channel of new technology in the initial stages of industrialization in each country except the United Kingdom. Furthermore, exports provided a powerful demand stimulus; the countries whose exports grew rapidly achieved the fastest overall economic growth.

Education, skills formation, and technology adaptation

The transition from a primarily agricultural and trading economy to an industrial economy has required, at least in the initial stages, an increase in the skills of the labor force. To use foreign technology effectively, producers must examine the choices available, make intelligent selections, and adapt them to local conditions (see Box 3.4). All of this calls for education.

More than general education is required, but high achievements at the frontiers of science are not. Science played a minor role in the first industrial revolution in Britain. Scientific excellence played an important role in Germany's rise to industrial prominence in the nineteenth century, but its system of polytechnical institutes, which taught basic industrial skills, probably mattered more. The United States and Japan both rose to world industrial leadership by copying and modifying foreign technologies. (Until the early 1900s the United States trailed behind the United Kingdom, France, and Germany in major scientific discoveries, but not in practical innovations and inventions.)

State support for technical education made significant contributions to French and German industrialization. The United States broadly emulated the German system of technical education. In addition, its government established a system of financial support for research in universities. Private industry also maintained research laboratories that sometimes received public support. Although some of these laboratories conducted original research, one of their main tasks has been to spot innovations elsewhere and provide the expertise that makes rapid imitation possible. Japan has also shown a strong and continuing commitment to education. By 1870 it had achieved a literacy rate that

Box 3.4 Technology acquisition and adaptation: the experiences of Japan and the United States

In a variety of ways the Japanese deliberately adapted Western technology to preserve scarce capital resources and use abundant labor. In textiles, for example, they purchased older, secondhand machines often discarded as obsolete by the Lancashire mills. Once installed, the machines were operated at high speeds and for longer hours than was the prevailing practice in the United Kingdom or the United States. Greater quantities of labor were lavished in servicing the machines and maintaining them in a decent state of repair. When the Japanese eventually reached the point of building their own textile machines, they substituted wood for iron wherever possible. They also introduced cheaper raw materials into production, as in the case of cotton spinning, and added more labor to each spinning machine to handle the increased frequency of broken threads. They also employed ring-spinning technology when virtually every other textile giant, apart from the United States and Brazil, was using mule-spinning machines. When continued improvements in ring-spinning technology and changes in global factor prices made ring spinning the dominant technology in the world, Japan was well positioned to increase its market share (Rosenberg, background paper; Saxonhouse 1985).

It is noteworthy that Japan at first did not understand

the need to adapt foreign technology to domestic circumstances. Dutch water control technology, for instance, was introduced without considering that, in addition to tidal forces, mountain runoff was a major source of flooding. Similarly, the Japanese government in 1871 imported a vast mechanized silk-reeling plant from France. Although it was intended as a model factory, private business discovered that it could not profitably operate such capital-intensive plants.

The United States' earlier adaptation of technology in the nineteenth century was very different from that of Japan, but as successful. Endowed with an abundance of natural resources, but with a scarcity of labor, the United States adapted its technology accordingly. Technology imported from Britain was adapted, whenever possible, to the extensive exploitation of natural resources. For example, although the United States had a later industrial start than Britain, it quickly established a worldwide leadership in the design, production, and use of woodworking machinery. It was characteristic of these machines that they were wasteful of wood, which was abundant in the United States.

These examples show that, ultimately, "appropriate" technology is what a country creates for itself, using all the means available to it—including "inappropriate" foreign technology—efficiently.

compared favorably with those in Western Europe. Today, industrial research is carried out mostly within private firms, but in the early period of industrialization the government helped to promote technological change, for example by setting up demonstration factories which were later sold to the private sector.

Transportation and communications networks

One of the better known aspects of nineteenth-century industrialization is the importance of railways. Transportation and communications networks integrated and expanded domestic markets and increased their efficiency. They also integrated domestic markets into the global economy, making it easier for exporters to compete. But transportation and communications networks are capital-intensive, and therefore expensive, especially during the early stages of industrialization. Except for Britain, governments of countries industrializing in the nineteenth century helped to finance the construction of transportation and communications networks. In some countries, such as Ger-

many, Italy, and Japan, the financing was often direct. In others, it was indirect—for instance, land grants (as in the United States) and guarantees of debt issues of private companies (as in France).

Stable institutional and macroeconomic environment

Laws and institutions that allow markets to function efficiently—property rights, standardized weights and measures, patent laws and so forth—have helped to promote rapid and efficient industrialization. Laws and institutions should provide a stable environment that promotes long-term investments and risk taking. Yet they should also be flexible enough to allow institutional innovations. For example, faced with the problem of financing the capital-intensive railway system in the early 1800s, Britain lifted its earlier prohibition on the formation of joint-stock companies. Late industrializing countries in Europe, particularly Germany, pioneered such innovations as the joint-stock bank and the investment bank in the second half of the 1800s, and the United States devised the modern corporation in the 1920s. Such flexibility greatly

assisted industrialization.

Industrialization requires large investments in machines and infrastructure, especially in its early stages. Moreover, one of the most important means by which technological innovations have been incorporated in production has been investment in new machines. Macroeconomic policies in the countries industrializing in the nineteenth century encouraged domestic savings and thus provided the funds required for investment. They also made foreigners, especially the British and the French, willing to provide loans and direct investments.

Conclusion

Initial conditions of size, population, and natural resources may influence the timing and pattern of

early industrialization, but further progress along the path is greatly influenced by government policy. Provision of infrastructure and education has been important. A stable institutional and macroeconomic environment and domestic and foreign trade policies which allowed producers and factors of production to respond to incentives have been crucial. Much has changed since World War II, but the essence of industrialization is as it was before: the interaction of technological change, specialization, and trade. Some of the policies that proved successful in the years before World War II may not be applicable today. But the key to success is still to choose policies that allow economies to utilize this interaction fully to their advantage. The chapters that follow discuss what this means for today's developing countries.