

# 11

## **Empirical Evidence: The Persistence of Specialization in Industrialized Countries**

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There is no obvious way to test directly the models and analyses of the preceding chapters. Because history in a multiequilibrium world can select only one among the many candidate equilibria, none of the others will be more than potential outcomes that might have been, but in fact never were. There is of course no way that one can observe directly a state of affairs that was a possible prospect but that never actually occurred. Yet indirect tests of theoretical propositions are possible and legitimate. Their most common form takes predictions that emerge from a model under investigation, predictions different from those of alternative models, and seeks to determine whether these predictions are confirmed by reality. That is the approach adopted in this chapter, which focuses on trade patterns in manufactured goods.

Several of the previous chapters have emphasized the role of increasing internal returns to scale (IIRS) and learning-by-doing in the formation of comparative advantage. Here the word “internal” means that the effect occurs within an individual country in which production of the commodity in question takes place. The analysis in the preceding chapters suggests that economies of scale and/or high start-up costs lead different countries to specialize in different sets of products. A country that enters a new field or new product line early may be among a few countries able to dominate that line. It can do so by increasing production to the point at which costs are so low that potential additional competitors are unable to enter the field successfully (at least, without significant product or process innovation or sufficient support from their government). Even more important, a handicap to entry is the necessary accumulation of specialized knowledge that is acquired easily only by prior participation in the industry through “learning-by-doing” (see Arrow 1962). The resulting leadership

positions may persist for long periods of time. The identity of the industries in which a country specializes may depend on history and a variety of particular influences, some of them fortuitous such as the availability or unavailability of ancillary industries that can substantially facilitate a country's success in the production of some particular product or type of products. This all suggests that positions of national leadership are likely to persist for long periods of time and ensure relatively stable patterns of industry specialization, the prime result being retainability.

It is helpful to contrast this line of argument with that of the Heckscher-Ohlin model and its factor-price equalization implications. In that model, trade specialization is taken to depend on relative abundance of the different factors of production. In cases where the Heckscher-Ohlin model entails factor-price equalization, it yields very sharp predictions about cross-country patterns in labor and total factor productivity (TFP) in an industry. Specifically it implies that productivity will be the same in all countries. If this is so and factor prices (i.e., wages and profit rates) are equalized among countries, then the choice of the industries in which a country specializes can depend only on the relative abundance of its different factors—whether it has relatively more labor, capital, or land than its competitors.<sup>1</sup>

Earlier work by Dollar and Wolff (1993) reported a marked convergence of labor productivity, capital-labor ratios, and TFP in the aggregate among developed economies in the post-World War II. A similar convergence has occurred at the industry level, though it is weaker for capital intensity than for labor productivity or TFP. In such circumstances a Heckscher-Ohlin type of model predicts that convergence in aggregate capital-labor ratios should be accompanied by convergence in the production patterns of these countries.

This chapter investigates whether there has been movement toward convergence in production patterns among industrialized OECD countries between 1970 and 1993. A trend toward convergence in product lines would lend support to the Heckscher-Ohlin class of models. However, since it is found, instead, that there has been little or no convergence in patterns of specialization among these countries, despite the convergence in aggregate productivity and relative factor abundance, the results tend to lend support to the economies of scale models of this book. In other words, the results suggest that trade in manufactures is characterized by a considerable degree of retainability.

## 11.1 Convergence of Production Patterns?

The issue to be investigated is whether the industrial production patterns of developed countries have tended toward convergence. To investigate this issue, we use the 1994 OECD Structural Analysis (STAN) industrial database, which covers 1970 to 1993. STAN provides statistics on value added, measured in both current and 1985 local prices, for 33 manufacturing industries. The STAN database has relatively complete data on fourteen OECD countries—Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, the United Kingdom, and the United States.

For an indicator of specialization we chose the share of the total world production of a given commodity made in an individual country relative to its share of world GDP. We call this measure of relative production share “RELPSHR<sub>*i*</sub>”, an acronym that connotes the relative share of country *h* in the production of good *I*, valued in 1985 U.S. dollars.<sup>2</sup> The totals are made up of data from the fourteen STAN countries. RELPSHR is a fraction whose numerator is country *h*'s share of the total production of product *I* among the fourteen countries, while the denominator measures country *h*'s share of total GDP for these countries. Thus a value of RELPSHR greater than 1 means that country *h*'s share of the group's total production of product *I* is higher than its share of the total GDP of this group, and a value less than 1 means that the country's share of production is lower than its share of GDP. RELPSHR tells us in which product lines a country's production is concentrated, that is, in which goods it specializes. In general, for each country some values of RELPSHR for a country will be greater than 1, and some will be less than 1.<sup>3</sup>

We chose thirty-three industries at the lowest level of aggregation for which the requisite data were available. They are all three-digit ISIC (International Standard Industrial Classification) industries, with the exception of transport equipment, for which information is available at the four-digit level. We divided the industries into three technology groups based on their average R&D intensity<sup>4</sup> of production in the OECD countries in 1985: low-tech (in which R&D intensity was less than 0.5 times the mean), medium-tech (those with 0.5 to 1.5 times the mean R&D intensity), and high-tech (with more than 1.5 times the mean R&D intensity).

Our investigation revealed that in the earliest year studied, 1970, Germany accounted for 14 percent of total manufactures for this group

of countries, Japan 13 percent, and the United States 40 percent. In other words, these three countries together produced two-thirds of the total manufactures of the fourteen OECD countries. Germany's share of total manufacturing was considerably greater than its share of the fourteen-country GDP (14 percent vs. 9 percent), for a RELPSHR index of 1.48. Japan's share of manufactures was almost identical to its GDP share (13 percent), for a RELPSHR of 1.01. The U.S. manufacturing share was smaller (40 percent vs. 45 percent), yielding a RELPSHR value of 0.89 (table 11.1 reports these results).

Germany's production in 1970 was heavily specialized in beverages, petroleum refineries, petroleum and coal products, industrial chemicals, motor vehicles, electrical machinery, and professional goods and scientific instruments (all with values of RELPSHR exceeding 1.8). Japan in 1970 was particularly strong in plastics, glass and glass products, and other transport equipment (all values above 1.6). America's major specialization was aircraft (a value of 1.7).

In 1970 Germany led all countries in relative share of total manufacturing, in all the high-tech industries except aircraft, in motor vehicles, and in seven of the low-tech industries as well. Italy led in five industries, including textiles, wearing apparel, footwear, and motorcycles and bicycles. Japan was the leader in only one industry (food products), the United States in only one (aircraft), Belgium in three (including industrial chemicals), Sweden in one (wood products), Finland in one (paper and paper products), Norway in two (including shipbuilding), Australia in two (including railroad equipment), and Denmark, the Netherlands, and the United Kingdom each in one.

A little more than two decades later, both Germany's and America's share of total manufacturing production had declined by three percentage points, but Japan's had increased by a dramatic ten percentage points. In fact, by 1993, Japan's manufacturing output was more than double Germany's and over 60 percent of the level of the United States. By 1993 Japan had the highest value of RELPSHR in total manufacturing (an index of 1.27), Germany's RELPSHR score had fallen to 1.22, while the U.S. value remained at 0.89.

In 1993 Germany remained extremely specialized only in petroleum refineries and motor vehicles (values of RELPSHR exceeding 1.8), with the United States very specialized only in aircraft (a value of 1.76). Japan, though, was now highly specialized in a number of industries: iron and steel, shipbuilding, motor vehicles, motorcycles and bicycles, other transport equipment, and, especially, electrical machinery (all

values above 1.6). By 1993 Japan was the leading country in total manufacturing, and the leader in two high-tech industries (nonelectrical machinery and electrical machinery), as well as other manufactures. Italy led in eight industries; the United Kingdom and Germany in three; the Netherlands, Finland, Belgium, and Australia in two; and Sweden, France, Denmark, Canada, Norway, and the United States in just one apiece.

The last part of table 11.1 shows the correlation (and rank correlation) between the distribution of relative production shares among the three countries. What is striking is the low correlation among the three countries. In 1970, the correlation coefficient was 0.07 between Germany and the United States,  $-0.57$  between Japan and the United States, and  $-0.33$  between Germany and Japan. The rank correlations are similar. Between 1970 and 1993, the correlation coefficient (and the rank correlation) between Germany and the United States turned slightly negative and remained negative between Japan and the United States and between Germany and Japan, though its absolute value declined. Clearly, the three countries have specialized in distinctly different industries and there has been very little change over time in the dissimilarity of their patterns of specialization.

## 11.2 Trends in Cross-country Dispersion

We turned next to an investigation of what has happened to the cross-country dispersion in the RELPSHR measures. The last two columns of table 11.1 show the coefficient of variation among countries for each industry in 1970 and 1993. There was no clear trend over this period: Between 1970 and 1993 dispersion increased in 13 industries and decreased in 10 industries in the low-tech group, increased in 4 and fell in 1 in the medium-tech group, and rose in 1 but declined in 4 in the high-tech group. The biggest changes spanned the range of low-tech to high-tech industries: textiles (0.55 to 0.93), footwear (0.77 to 1.50), plastics (0.67 to 0.31), shipbuilding (1.06 to 0.62), electrical machinery (0.41 to 0.70), and professional goods (1.01 to 0.68). By 1993 the most specialized industries were tobacco products, textiles, leather products, footwear, pottery and china, motorcycles and bicycles, other transport equipment, and aircraft (all with coefficients of variation exceeding 0.9). The most diversified industries were food, beverages, printing and publishing, plastics, nonmetal products, metal products, other chemical products, and nonelectrical machinery (all with coefficients of

**Table 11.1**  
Relative production shares (RELPSHR) of Germany, Japan, and the U.S.; the OECD leader; and the coefficient of variation of RELPSHR among the 14 OECD countries, 1970 and 1993<sup>a</sup>

Industry	1970				1993				Coefficient of Variation <sup>b</sup>	
	GER	JPN	USA	Leader	GER	JPN	USA	Leader	1970	1993
<b>Total manufacturing</b>	1.48	1.01	0.89	GER	1.22	1.27	0.89	JPN	0.18	0.21
<b>Low-tech industries<sup>c</sup></b>										
Food	0.93	1.56	0.67	JPN	0.84	1.16	0.78	DNK	0.24	0.29
Beverages	2.15	1.51	0.44	GER	1.62	0.82	0.61	UK	0.37	0.39
Tobacco	2.62	0.18	1.12	GER	3.94	0.24	0.70	NET	0.81	1.05
Textiles	1.23	1.25	0.63	ITA	0.86	0.68	0.86	ITA	0.55	0.93
Wearing apparel	1.26	1.08	0.81	ITA	0.55	1.04	0.97	ITA	0.31	0.65
Leather and products	1.47	1.15	0.48	BEL	0.86	1.12	0.48	ITA	0.74	1.04
Footwear	1.30	0.25	0.74	ITA	0.68	0.27	0.39	ITA	0.77	1.50
Wood Products	0.94	0.81	1.08	SWE	0.86	0.59	1.23	SWE	0.61	0.56
Furniture and fixtures	1.84	1.21	0.71	GER	1.31	0.85	0.82	ITA	0.27	0.48
Paper and products	0.99	0.80	1.06	FIN	0.96	0.88	1.09	FIN	0.76	0.89
Printing and publishing	0.62	1.45	1.01	NOR	0.53	1.15	0.98	UK	0.34	0.27
Petroleum Refineries	2.98	0.47	0.67	GER	2.30	0.67	0.60	FRA	1.04	0.80
Petroleum and coal	2.37	0.39	1.10	GER	1.66	0.52	1.27	NET	0.77	0.63
Rubber Products	1.68	0.73	0.94	GER	0.94	1.12	0.95	ITA	0.44	0.41
Plastic Products	1.28	1.72	0.74	AUS	1.31	1.31	0.92	GER	0.67	0.31
Pottery and china	1.22	1.19	0.26	ITA	0.88	1.01	0.28	ITA	0.97	1.28
Glass and products	1.11	1.65	0.91	BEL	1.56	1.03	0.75	BEL	0.59	0.70
Nonmetal products	1.58	1.27	0.65	DNK	1.50	1.22	0.69	AUS	0.28	0.36
Iron and steel	1.67	1.28	1.00	GER	1.71	1.66	0.72	GER	0.51	0.44

Nonferrous metals	1.25	1.28	1.01	NOR	1.65	1.41	0.70	NOR	0.64	0.58
Metal products	1.63	0.76	0.85	ITA	1.69	1.02	0.89	GER	0.42	0.36
Shipbuilding <sup>a</sup>	0.54	1.26	0.77	NOR	0.72	1.73	0.71	FIN	1.06	0.62
Other manufactures	0.66	1.59	0.87	UK	0.40	2.46	0.71	JPN	0.67	0.83
<b>Medium-tech industries<sup>c</sup></b>										
Industrial Chemicals	2.07	0.89	0.84	BEL	1.49	0.96	0.88	BEL	0.52	0.72
Railroad Equipment <sup>h</sup>	0.43	0.48	0.44	AUS	0.54	0.71	0.49	AUS	0.86	0.67
Motor Vehicles <sup>h</sup>	1.83	1.38	0.85	GER	1.82	1.64	0.76	GER	0.61	0.75
Motorcycles and Bikes <sup>h</sup>	0.68	1.48	0.35	ITA	0.66	1.68	0.30	ITA	0.98	1.22
Other Transp. Equip <sup>h</sup>	1.15	2.07	0.00	NET	1.03	2.20	0.00	CAN	0.90	1.16
<b>High-tech industries<sup>c</sup></b>										
Chemical products <sup>d</sup>	1.57	0.85	1.09	GER	1.19	1.13	1.03	GER	0.36	0.29
Nonelectrical machinery <sup>e</sup>	1.74	0.93	0.86	GER	1.10	1.21	1.09	JPN	0.41	0.31
Electrical machinery <sup>f</sup>	1.86	0.19	1.11	GER	1.18	2.23	0.74	JPN	0.41	0.70
Aircraft <sup>h</sup>	0.30	0.11	1.66	USA	0.40	0.15	1.76	USA	0.96	0.91
Professional goods <sup>g</sup>	2.29	0.38	1.20	GER	1.35	0.66	1.34	UK	1.01	0.68

**Correlations in relative production shares between:**

Germany and the United States	1970	1993
Japan and the United States	0.07	-0.06
Germany and Japan	-0.57	-0.42
	-0.33	-0.23

Table 11.1 (continued)

Rank correlations in relative production shares between:	1970	1993
Germany and the United States	0.17	-0.01
Japan and the United States	-0.49	-0.28
Germany and Japan	-0.34	-0.09

a. Relative production share of country  $h$  in industry  $I$  defined as:

$$RELPSHR_{I, h} = \frac{Y_{I, h}^h / \sum_h Y_{I, h}^h}{GDP^h / \sum_h GDP^h}$$

where the aggregation over  $h$  is based on 14 OECD countries with pertinent data: Australia (AUS), Belgium (BEL), Canada (CAN), Denmark (DNK), Finland (FIN), France (FRA), Germany (GER), Italy (ITA), Japan (JPN), the Netherlands (NET), Norway (NOR), Sweden (SWE), the United Kingdom (UK), and the United States (USA).

- b. The coefficient of variation is defined as the ratio of the standard deviation to the (unweighted) mean.
- c. Division of industries into technology groups is based on the average R&D intensity of production of OECD countries in 1985, as follows: low-tech—less than 0.5 times the mean R&D intensity; medium-tech—from 0.5 to 1.5 the mean R&D intensity; and high-tech—over 1.5 the mean R&D intensity.
- d. Includes drugs and medicines and other chemicals.
- e. Includes office and computing machinery and machinery and equipment.
- f. Includes radio, TV and communication equipment and electrical apparatus.
- g. Includes scientific instruments.
- h. Calculations exclude Belgium.



variation less than 0.4). Here too both sets of industries run the gamut between low-tech and high-tech enterprises.

The finding that there was little change in the degree of specialization among manufacturing industries may be somewhat surprising in light of the evidence that aggregate measures of factor endowments (e.g., the capital-labor ratio for the entire economy) have become more similar in these advanced economies. On the other hand, the result is consistent with the finding that dispersion of productivity at the industry level remains high, and that there has been no strong trend toward cross-country convergence of industry-level productivity since the mid-1970s. It appears that countries are maintaining their specializations in different industries. Thus it is that aggregate productivity is converging among these countries, while at the same time industry-level productivity continues to diverge and production patterns are highly dispersed.

It is also striking that the specialization patterns of most countries persist over time. Table 11.2 shows correlation coefficients of the logarithm of RELPSHR values by industry within each country between 1970 and 1979 and between 1970 and 1993.<sup>5</sup> With only a few exceptions, these correlations remain very high over time. Between 1970 and 1979, the correlation coefficients are 0.88 or greater for all 14 countries, and between 1970 and 1993, they are 0.79 or higher for 10 of the 14 countries. The exceptions are Belgium, Japan, Sweden, and the United Kingdom (though, even for these four, the correlations exceed 0.60).

Rank correlations are also shown in table 11.2, and they are almost as strong for the period 1970 to 1979 as the correlations of LN(RELPSHR), exceeding 0.85 for all fourteen countries. However, rank correlations are weaker for the period 1970 to 1993 (exceeding 0.70 for ten countries), and fall in the range 0.58 to 0.69 for the other four countries (Finland, Japan, Sweden, and the United Kingdom). These results suggest that there was greater industrial restructuring in the 1980s than the 1970s.

Even though countries tend to retain the industries in which they specialize, over time it is still possible that they have become more alike in terms of the industrial composition of their output—that is, that they have moved closer to the average industrial composition of the fourteen countries used in the analysis here. This is a difficult issue to test formally. Table 11.2 (last two columns) uses the sum of squared values of LN(RELPSHR), where the summation is performed across industries

**Table 11.2**

Correlation over time in relative production shares (RELPSHR) by industry within country, 1970–1979 and 1970–1993, and the sum of squared values of RELPSHR, 1970 and 1993

Country	Correlation of the logarithm of relative production shares [LN(RELPSHR)]		Rank correlation of relative production shares (RELPSHR)		Summation of squared values of LN (RELPSHR)	
	1970–1979	1970–1993	1970–1979	1970–1993	1970	1993
Australia	0.97	0.85	0.94	0.73	31.9	31.2
Belgium <sup>a</sup>	0.88	0.75	0.86	0.73	22.5	20.6
Canada	0.98	0.93	0.95	0.85	42.9	41.8
Denmark	0.99	0.94	0.97	0.85	64.3	59.3
Finland	0.95	0.79	0.89	0.67	20.4	19.3
France	0.99	0.98	0.87	0.84	33.5	32.7
Germany	0.96	0.82	0.95	0.77	10.9	8.4
Italy	0.96	0.89	0.96	0.86	18.5	20.4
Japan	0.88	0.71	0.86	0.64	18.3	12.1
Netherlands	0.95	0.88	0.90	0.78	31.1	33.2
Norway	0.96	0.79	0.93	0.77	49.7	58.7
Sweden	0.95	0.64	0.92	0.58	13.1	18.6
United Kingdom	0.92	0.61	0.92	0.60	5.0	4.6
United States	0.98	0.95	0.93	0.70	20.4	21.2

Note: Correlations and sum of squared values are based on thirty-three industries unless otherwise indicated.

a. All industries except shipbuilding and repair, railroad equipment, motor vehicles, motorcycles and bicycles, other transport equipment, and aircraft.

within a country. This measure compares each country's relative industry production with the cross-country average relative production in a given industry.<sup>6</sup> If countries are becoming less specialized over time, then their production structure should be converging on the overall average of the countries, and this index should decline.

In 1970 Denmark was the most specialized country, according to this index, followed by Norway and Canada, and the United Kingdom was the least specialized. For our discussion, it is significant that these indexes remain relatively stable over time, with the notable exceptions of Japan (for which the index declines from 18.3 in 1970 to 12.1 in 1993), Norway (for which it rises from 49.7 to 58.7), and Sweden (from 13.4 to 18.6). However, what is most striking is that the total sum of squared values (summed across all countries) is almost identical in 1993 and 1970 (equaling approximately 382 in both years). This

result again indicates that the degree of industry specialization among these fourteen countries has remained virtually unchanged over this twenty-three-year time span.

### 11.3 Patterns of Country Leadership in Industrial Sectors

Let us consider, finally, the stability of leadership in the different industrial sectors (see table 11.3). Does a country that attains a position of leading supplier of some product tend to retain that status, as in the situation upon which the analysis of this book focuses? In seeking to determine the answer statistically, we must reduce as far as possible the distorting influence of business cycle fluctuations. We therefore classify a country as a leader if it has the highest value in RELPSHR in at least three out of five consecutive years (or two consecutive years at the beginning or end of the data series). Germany, for example, led in terms of relative production share in total manufacturing from 1970 to 1991, when it was overtaken by Japan.

The noteworthy conclusion is that there was considerable stability in leadership in terms of relative production shares among the individual industries. Of the 33 industries in table 11.2, in 16 industries there was no change in country leader throughout the entire period, and there was only one change of leadership in 14 industries. In furniture and fixtures and plastic products, there were 2 changes of leadership, while in nonmetal products, there were 5 changes. It is also noteworthy that Germany, Japan, and the United States led in the high-tech industries, while, as the analysis of the book may suggest, leadership in the medium-tech industries was more spread out, among Belgium, Australia, Germany, Italy, the Netherlands, and Canada. Moreover, among the more interesting changes is the takeover in leadership position by Japan from Germany in the two high-tech industries, nonelectrical machinery (e.g., computers) and electrical machinery (e.g., radio, televisions, and communication equipment). These results on the general stability of leadership in production shares are in accord with those of table 11.2, which show a very high correlation over time in industry RELPSHR within the countries.

### 11.4 Concluding Remarks

In 1970 the world's major industrialized countries tended to specialize in very different manufacturing industries. Among the three largest

**Table 11.3**

Leadership and leadership changes in relative production share (RELPSHR) for 29 manufacturing industries, 1970–1993

	Leader (years)
Total manufacturing	GER (1970–91), JPN (1992–93)
<i>Low-tech industries</i>	
Food	JPN (1970–78), DNK (1979–93)
Beverages	GER (1970–82), UK (1983–93)
Tobacco	GER (1970–88), NET (1989–93)
Textiles	ITA (1970–93)
Wearing apparel	ITA (1970–93)
Leather and products	BEL (1970–74), ITA (1975–93)
Footwear	ITA (1970–93)
Wood products	SWE (1970–93)
Furniture and fixtures	GER (1970–75), BEL (1976–79), ITA (1980–93)
Paper and products	FIN (1970–93)
Printing and publishing	NOR (1970–78), FIN (1979–93)
Petroleum refineries	GER (1970–71), FRA (1972–93)
Petroleum and coal products	NOR (1970–77), NET (1978–93)
Rubber products	GER (1970–87), ITA (1988–93)
Plastic products, nec	AUS (1970–81), JPN (1982–87), GER (1988–93)
Pottery, china, etc.	ITA (1970–93)
Glass and products	BEL (1970–93)
Nonmetal products, nec	DNK (1970–73), GER (1974–76), DNK (1977–79), GER (1980–84), FIN (1985–87), AUS (1989–93)
Iron and steel	GER (1970–93)
Nonferrous metals	NOR (1970–93)
Metal products	ITA (1970–77), GER (1978–93)
Shipbuilding and repair	NOR (1970–81), FIN (1982–93)
Other manufactures nec	UK (1970–80), JPN (1981–93)
<i>Medium-tech industries</i>	
Industrial chemicals	BEL (1970–93)
Railroad equipment	AUS (1970–93)
Motor vehicles	GER (1970–93)
Motorcycles and bicycles	ITA (1970–93)
Other transport equipment	NET (1970–72), CAN (1973–93)
<i>High-tech industries</i>	
Other chemical products	GER (1970–93)
Nonelectrical machinery	GER (1970–89), JPN (1990–93)
Electrical machinery	GER (1970–83), JPN (1984–93)
Aircraft	USA (1970–93)
Professional goods	GER (1970–93)

Note: A country is considered a leader if it has the highest value in at least three out of five consecutive years.

economies—Germany, Japan, and the United States—the correlations (and rank correlations) in production shares by industry in 1970 are either negative or close to zero. There are also very low correlations in production shares between the United States and the other eleven OECD countries studied in the analysis. Moreover there was no tendency over time toward greater similarity in industries of specialization among the fourteen countries. A comparison of the coefficient of variation in relative production shares measured across countries within industry shows, on net, little change in the degree of specialization among manufacturing industries.

Most countries retained their pattern of specialization between 1970 and 1993. Correlation coefficients of the logarithm of RELPSHR by industry between 1970 and 1979 and between 1970 and 1993 are quite high for almost all of the countries. It is also noteworthy that there was considerable stability in leadership in terms of relative production shares among the individual industries. Of the thirty-three industries in the analysis, in sixteen industries there was no change in the country that led throughout the entire period, and there was only one change of leadership in fourteen industries. The general stability over time in the industries in which a country specialized is confirmed by the overall sum of squared values of the logarithm of RELPSHR within each country, which is almost identical in 1970 and 1993.

The general stability over time in the industries in which each country specialized lends support to the relevance of the models of this book and tends to raise some doubts about the pertinence of the Heckscher-Ohlin class of models or (presumably) the static classical model with costless entry and constant or diminishing returns to scale. The revised trade model in this book stresses the advantages of initial leadership in an industry and the consequent cost reduction emanating from increased production volume. In contrast, the Heckscher-Ohlin models suggest that specialization among the advanced countries should become less marked over time if their relative factor abundance converges, as it has in reality. The coefficient of variation in the overall capital-labor ratio (computed from the OECD International Sectoral Database, or ISDB) among these fourteen countries fell from 0.28 in 1970 to 0.17 in 1992. Despite this growing similarity in relative factor abundance, these countries tended to remain specialized in the same industries in 1993 as in 1970.

If industry specialization is influenced by the technology-related assets owned by the firm or embodied in technical labor, then

investment in research and development and training of skilled labor are clearly important influences for the promotion of such specialization. And, if many of these assets really are industry specific, then it is likely that past history, as well as past and current government policy, will have a substantial effect on the kinds of assets accumulated and consequently on the industries that emerge as major producers. For instance, U.S. concentration of R&D in military-related industries clearly is a significant element in the explanation of the leading U.S. position in aircraft, large-scale computers, and advanced telecommunications. Japanese industrial policy, on the other hand, has directed R&D toward advanced consumer products such as automobiles and consumer electronics. Past history is also important for certain industries: Large German and U.S. firms that entered the chemical industry early continue to devote substantial resources to R&D in this industry and to maintain high production shares.

The bottom line of all this is that, according to the data, trade in manufactures shows patterns that we would expect of industries that are retainable—those dealt with in much of this book.

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# Global Trade and Conflicting National Interests

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