What Do Rich Countries Trade with Each Other? R&D and the Composition of U.S. and Swedish Trade *

"As the several nations of the world advance in wealth and population, the commercial intercourse between them must gradually become less important and beneficial ... until at length ... [it]... shall be confined to those peculiar articles, in the production of which the immutable circumstances of soil and climate give one country a permanent advantage over another" (Torrens, 1821).

"... we must learn to accommodate ourselves permanently to a smaller relative value of international trade ... [because] ... the scope for advantageous exchange between nations is narrowing" (Robertson, 1938).

Introduction

A long tradition in international economics explains comparative advantage by differences between countries in their stage of development. In the spirit of this tradition, it seemed natural to expect that universal development would eventualy undermine the basis for trade and reduce its importance. A similar concern has arisen in recent years in the most advanced countries about the impact of technological progress in the trading partners closely pursuing them in the technology races.

A counterweight to these apprehensions has been the line of argument that stresses the growth and importance of trade among

* We are indebted to Svenska Handelsbanken for research support and to two referees for helpful suggestions. This paper is part of the NBER's research program in International Studies. Any opinions expressed are those of the authors, and not necessarily those of the National Bureau or Economic Research or the sponsor.

highly developed countries, even though they appear much alike in their levels of education, technology, and per capita income. One of the earliest of these was Folke Hilgerdt's League of Nations historical study (1945), that pointed out that trade among industrialized countries had grown much faster than trade between those countries and developing countries. Another was Burenstam-Linder's volume (1961), that offered similarity of income levels and the corresponding similarity of tastes in a product world dominated by differentiated goods and economies of scale as an explanation of the volume and nature of trade, as an alternative to factor proportions theories.

We pursue this issue here by examining the composition of the total trade and the size and composition of the bilateral trade of two of the world's highest income and technologically most advanced countries, the United States and Sweden. In particular, we relate their bilateral trade to specialization based on the R&D intensity of various industries.

While Sweden's population and output are, of course, much smaller than those of the United States, its per capita output is one of the closest to that of the U.S. Among the European countries, for example, only Luxembourg and Norway enjoyed higher per capita output than Sweden's 77 per cent of the U.S. level in 1985 (Ward, 1985). Sweden and the U.S. invested about the same proportion of GDP in research and development in 1985, and Swedish business enterprises spent more on R&D than U.S. enterprises, relative to their output. In both these respects, Sweden was one of the countries most similar to the United States.

The role of Sweden and the United States in each other's trade

Given the relative size of the two countries it is clear that Sweden must play a much smaller role in U.S. trade than the U.S. in Swedish trade. Furthermore, because of their distance from each other, neither country was a natural trading partner for the other. And because of the similarity in their comparative advantages, the two countries tended historically to be rivals for markets more than they were trading partners. In the 19th century, the major similarity was that both countries were relatively land-abundant, with large forest areas and temperate climates. More recently, it was that both

were high-income, technologically advanced countries (Blomström, Lipsey, and Ohlsson, 1989).

For the United States, trade with Sweden was around 1 per cent or less of its total trade from the mid-1970s to the early 1980s. That was well below the Swedish share in world exports and world imports (Table 1). In other words, the U.S. traded much less with Sweden, relative to total U.S. trade, than other countries did. However, Sweden's role in U.S. trade grew relative to its role in world trade,

TABLE 1

SWEDEN'S SHARE IN U.S. AND WORLD EXPORTS AND IMPORTS, 1974-1988

	Sweden's Share (%) of				Sweden's Relative Share (%) in	
	U.S. Exports[a] (1)	World Imports[b] (2)	U.S. Imports[c] (3)	World Exports[d] (4)	U.S. Exports[e] (5)	U.S. Imports[f] (6)
1974-76	.89	2.11	.83	2.08	42	40
1977-80	.82	1.77	.72	1.76	46	41
1981-83	.79	1.51	.81	1.57	52	52
1984-86	.82	1.49	1.14	1.73	55	66
1987-88	.80	1.64	1.15	1.86	49	62

[a] U.S. Exports to Sweden as per cent of all U.S exports
[b] Imports into Sweden as per cent of world imports
[c] U.S. Imports from Sweden as per cent of all U.S. imports
[d] Exports from Sweden as per cent of world exports
[e] Col. 1 ÷ Col. 2
[f] Col. 3 ÷ Col. 4
Source: Appendix Tables 1 and 2

TABLE 2

THE U.S SHARE IN SWEDISH AND WORLD EXPORTS AND IMPORTS, 1974-1988

	U.S. Share (%) of				U.S Relative Share (%) in	
	Swedish Exports[a] (1)	World Imports[b] (2)	Swedish Imports[c] (3)	World Exports[d] (4)	Swedish Exports[e] (5)	Swedish Imports[f] (6)
1974-76	5.0	13.4	6.6	12.9	37	51
1977-80	5.7	14.2	7.2	11.8	40	61
1981-83	7.3	14.6	8.4	12.3	50	68
1984-86	11.5	18.8	8.1	11.6	61	70
1987-88	10.3	16.9	7.3	11.3	61	65

[a] Swedish exports to the U.S. as per cent of all Swedish exports
[b] Imports into the U.S. as per cent of world imports
[c] Swedish imports from the U.S. as per cent of all Swedish imports
[d] Exports by the U.S. as per cent of world exports
[e] Col. 1 ÷ Col. 2
[f] Col. 3 ÷ Col. 4
Source: Appendix Tables 1 and 2

until a dip in 1987-88. The importance of Sweden as an exporter to, and importer from, the United States, particularly the former, became closer to its importance to the rest of the world's trade.

The same analysis can be made of the importance of the United States as a Swedish trade partner (Table 2). The United States was less important in Swedish trade than in the trade of the world as a whole, but its role in Swedish trade increased. In the early 1970s, the share of Sweden's trade that was carried on with the U.S. was between a third and a half of the average for all countries, but by the late 1980s, the U.S. share in Sweden's trade was two thirds of the average for the U.S. shares in world trade.

Thus, over this decade or so, Sweden and the United States have been drawing closer as trading partners, despite their similarity in income levels and ratios of R&D to total income. Sweden has been increasing in importance as a trading partner for the U.S. and the U.S. has been increasing in importance as a partner for Sweden.

Swedish-U.S trade by broad commodity groups

Although both Sweden and the United States are blessed with abundant resources and land, or perhaps because they both are, most of the trade between the two countries is in manufactured goods. Manufactures account for more than 96 per cent of Sweden's exports to the United States, and 86 per cent of its imports from the U.S. (Table 3). Manufactures also account for more than three quarters of Sweden's trade with the world as a whole, but the share of manufactures in the bilateral trade between Sweden and the United States is higher than in Sweden's trade with the rest of the world. One reason for that is that Sweden is resource-abundant and land-abundant relative to other European countries, but not relative to the United States. Sweden, therefore, serves as a large supplier of raw materials and semi-manufactures to the European market, but not to the United States.

The trend has been toward an increasing share of manufactured goods in Sweden's exports to the world and in Sweden's imports from the United States. Within manufacturing, machinery and transport equipment have come to play a more significant role over the years. That shift was apparent in exports and in imports and in trade with the world and with the United States. The counterpart to the growth of machinery and equipment trade was a decline in trade in crude materials and semi-manufactures.

TABLE 3

THE COMMODITY COMPOSITION OF SWEDISH TRADE WITH THE UNITED STATES AND THE WORLD, 1970 AND 1986

	Swedish Trade with			
	U.S.		World	
	1970	1986	1970	1986
	% of Total			
	Exports			
Manufactures				
Chemicals	2.9	3.9	4.1	6.7
Semi-manufactured good	23.4	16.3	27.7	26.3
Machinery and transport equipment	59.9	70.7	39.8	43.8
Misc. manuf. articles	9.5	5.5	5.4	7.7
Total manufactures	95.7	96.4	77.0	84.5
Other Goods				
Food, beverages, tobacco and unclass.	1.4	2.4	2.3	3.4
Crude materials, except fuel	2.8	0.8	19.4	9.2
Mineral fuels etc.	0.0	0.4	0.9	2.9
All Goods	100.0	100.0	100.0	100.0
	Imports			
Manufactures				
Chemicals	9.3	10.1	8.5	9.7
Semi-manufactured goods	12.2	5.8	23.5	16.6
Machinery and transport equipment	43.1	58.0	29.6	36.1
Misc. manuf. articles	9.5	12.0	11.6	14.5
Total manufactures	74.1	85.9	73.2	76.9
Other Goods				
Food, beverages, tobacco and unclass.	12.9	6.2	10.9	7.8
Crude materials, except fuel	9.7	3.7	5.3	4.4
Mineral fuels etc.	3.4	4.2	10.6	10.8
All Goods	100.0	100.0	100.0	100.0

Source: National Central Bureau of Statistics, Sweden.

A similar set of calculations can be made for the United States. The commodity composition of U.S. exports remained almost constant between 1970 and 1986, although there was some move away from foods and semi-manufactures and toward chemicals, machinery, and transport equipment (see Table 4). The changes on the import side were more significant. In particular, the importance of machinery and transport equipment increased sharply and the importance of foods, crude materials, and semi-manufactures decreased. The changes in the import distribution were in the same direction, on the whole, as those on the export side, but much larger. As a result, by 1986, machinery and transport equipment played as large a role in

TABLE 4

THE COMMODITY COMPOSITION OF U.S. TRADE WITH THE WORLD, 1970 AND 1986

	SITC	U.S. Exports to the World		World Exports to the U.S.	
		1970	1986	1970	1986
		(% of Total)			
Chemicals	5	9.0	10.8	3.1	4.1
Semi-manuf. & misc.	6+8	18.0	15.1	34.4	28.8
Mach. & transp. equip.	7	42.0	46.2	29.7	46.2
Unclassified	9	6.2	5.3	1.0	1.9
Total Mfrs.	5–9	75.2	77.4	68.2	80.9
Foods, beverages	0+1	11.9	9.7	14.7	6.6
Crude materials	2+4	9.2	8.9	8.8	3.0
Mineral fuels	3	3.7	4.0	8.3	9.5
All Goods	0–9	100.0	100.0	100.0	100.0

Source: Appendix Table 3.

U.S. imports as in U.S. exports, and manufactured goods as a whole were a larger part of imports than of exports. Within manufactures, chemicals were a larger part of exports and semi-manufactures a larger part of imports.

In bilateral trade with Sweden, U.S. exports were much more heavily concentrated in machinery and transport equipment (almost 60 per cent) than U.S. exports to other countries, and were much less concentrated in foods, crude materials, and semi-manufactures. U.S. imports from Sweden were even more heavily focussed on machinery and transport equipment. Over 70 per cent of imports from Sweden were in that category, as compared with 46 per cent from the rest of the world. In every other group, aside from miscellaneous manufactured articles, not comparable between the Swedish and U.S. data, the share in U.S. imports from Sweden was smaller than in U.S. imports as a whole. In other words, the shifts that were visible in the composition of U.S. imports in general had, by 1986, gone much further in the bilateral trade with Sweden.

R&D content in U.S-Swedish trade

Another way of answering the question as to what Sweden and the U.S. trade with each other is to analyze the bilateral trade between the two countries by level of technology. We distinguish

high-tech, medium-tech, and low-tech industries, as defined in Appendices A and B.

As shown in Table 5, U.S. exports to Sweden in 1985 and 1986 averaged just between high and medium-tech, while Swedish exports to the United States were medium-tech. U.S. exports to Sweden were more high-tech than U.S. exports to the world and to all developed countries. U.S. imports from all groups of countries were of similar technological level by this classification, a little higher-tech from developed countries than from developing countries. In trade with the world, developed countries, and Sweden, the exports by the United States were of a higher tecnhology level than its imports, but the contrast was particularly large in the bilateral trade with Sweden.

TABLE 5

TECHNOLOGICAL LEVEL OF U.S. TRADE WITH VARIOUS PARTNERS

Partner	1970	1978	1982	1985	1986
	U.S. Exports				
World	2.02	2.05	2.10	2.18 (2.17)	2.19 (2.17)
Developed Countries	2.07	2.06	2.14	2.22 (2.21)	2.21 (2.20)
Sweden	2.27	2.23	2.11	2.50 (2.49)	2.50 (2.49)
	U.S. Imports				
World	1.68	1.76	1.84	1.92 (1.87)	1.94 (1.89)
Developed Countries	1.74	1.83	1.89	2.00 (1.94)	2.03 (1.97)
Sweden	1.89	1.86	1.90	2.00 (1.99)	2.00 (1.99)

Note: Levels are based on OECD ratings applied to 34 industries. Figures in parentheses for 1985 and 1986 are based on data for 36 industries, with aircraft separated from other transport equipment and TV and radio equipment separated from other telecommunications equipment. See Appendix B.
High-tech = 3; Medium-tech = 2; Low-tech = 1.

Source: UN World Trade Tapes.

Between 1970 and 1986, both U.S. exports and U.S. imports moved up the technological scale in trade with the world and with developed countries. The same was true of U.S. trade with Sweden after 1982; there was a particularly sharp shift in U.S. exports toward higher technology industries.

A more quantitative measure of the technological level of trade can be constructed by calculating the amount of R&D input embodied in each dollar of exports or imports. For lack of data on R&D intensities in countries other than the United States, we

assume that in each industry they are the same abroad as in the U.S. The calculation is performed by weighting the amount of research and development expenditures embodied in each dollar of a U.S. industry's sales by the weight of that industry in each bilateral trade.[1]

For U.S. exports, the results are shown in Table 6. The R&D intensity of U.S. exports to all destinations together has been rising steadily. It has always been higher in exports to developed countries than in those to developing countries, but the gap has diminished greatly and, in fact, almost disappeared. Exports to Sweden, always, during these years, far more R&D-intensive than those to developed countries in general, have also been getting more R&D-intensive.

TABLE 6

R&D EXPENDITURES PER $100 OF U.S. EXPORTS[a] OF MANUFACTURES

Exports to	1970	1978	1982	1985	1986
World	3.10	3.18	3.48	3.97	4.02
Developed Countries	3.29	3.24	3.65	4.05	4.04
Sweden	3.83	4.21	4.23	4.95	5.02

[a] R&D expenditures as per cent of sales in each U.S. industry weighted by share of each industry in U.S. exports to the world, developed countries, and Sweden.

Source: R&D data from KRAVIS and LIPSEY (1989); U.S. exports from UN World Trade Tapes.

On the import side the same general trends are visible, but there are larger fluctuations. As Table 7 shows, the R&D content of U.S. imports has risen steadily, as has that of exports, but it has risen much faster for imports. Furthermore, the position of Sweden is very different on the import side. U.S. imports from Sweden, dominated by motor vehicles and equipment, and with primary metals and wood and paper products the third and fourth ranking imports, are in industries that are less R&D-intensive than those from developed countries as a group, or from the world as a whole, even though imports from Sweden had been a little more R&D-intensive than average in 1970.

[1] An article by MOMIGLIANO and SINISCALCO (1984), called to our attention by a referee, suggests a different method of calculating the technological intensity of an industry, using the R&D input not only of the industry itself, entering its value added, as we do, but also the R&D input of supplying industries, entering into the total value of product. The procedure is akin to LEONTIEF's (1953) calculation of direct and indirect factor inputs. The choice between the methods depends partly on the question to be answered (in their case different from ours) and partly on the tightness of the links between an industry and its suppliers or between a company and its suppliers. The role of such linkages is discussed below in connection with the explanation for the relatively low R&D intensity of Swedish exports.

TABLE 7

R&D EXPENDITURES PER $100 OF U.S. EXPORTS[a] OF MANUFACTURES

Imports from	1970	1978	1982	1985	1986
World	2.23	2.52	2.92	3.27	3.32
Developed Countries	2.41	2.54	2.88	3.34	3.40
Sweden	2.55	2.20	2.43	2.76	2.86

[a] R&D expenditures as per cent of sales in each industry weighted by share of each industry in U.S. imports from the world, developed countries, and Sweden.

Source: R&D data from KRAVIS and LIPSEY (1989); U.S. imports from UN World Trade Tapes.

The data for exports and imports can be summarized by comparing the average R&D content of exports and imports in trade with each area (see Table 8). The difference in technology content between U.S. exports and U.S. imports has fallen in trade with the world as a whole and in trade with all developed countries, in both absolute and relative terms. That difference in technology content, always much larger in trade with Sweden than in trade with others, has not shown a similar downward trend. Thus, U.S. trade in manufactured products with one of the richest (in terms of real income per capita) and most advanced industrial countries is much more of an exchange of high-technology goods for lower technology goods, than U.S. trade in general.

TABLE 8

R&D EXPENDITURES PER $100 U.S. EXPORTS OF MANUFACTURES COMPARED WITH R&D EXPENDITURES PER $100 OF U.S. IMPORTS OF MANUFACTURES

Trade with	1970	1978	1982	1985	1986
	Absolute Differences (Exports minus Imports)				
World	.87	.66	.56	.70	.70
Developed Countries	.88	.70	.77	.71	.64
Sweden	1.28	2.01	1.80	2.19	2.16
	Ratios (Exports/Imports)				
World	1.39	1.26	1.20	1.21	1.21
Developed Countries	1.37	1.28	1.27	1.21	1.19
Sweden	1.50	1.91	1.74	1.79	1.79

Source: Tables 6 and 7.

A similar analysis can be performed from the Swedish side, although the data and industrial detail available are somewhat different. The Swedish trade data can be subdivided into 110 industries, but relatively little information is available on R&D inputs in Swedish industries. Instead, the industries are classified according to the extent of their exposure to foreign trade and their use of various factors of production.

Owing to natural and political (mainly agricultural policies) barriers to trade, some industries are "trade sheltered". These are defined as industries in which the sum of exports and imports is less than 20 per cent of domestic apparent consumption. The remaining industries are grouped into four main categories according to their factor intensities.

First, industries with high physical capital intensities. This sector includes the pulp and paper industry, the steel and non-ferrous metal industry, petroleum refineries, and parts of the food and chemical industries. The first two of these are not only physical-capital intensive, but also natural-resource based.

Second, industries that are intensive in their use of unskilled labor. This labor-intensive sector includes parts of the food and wood industries, and textiles and clothing.

A *third* group is the R&D-intensive sector. Here we include more or less the same industries as in the above mentioned OECD study, *i.e.* computers, telecommunications, and instrument industries, pharmaceuticals, aerospace, and electrical engine and generator industries, among others.

Finally, industries with relatively high intensities of skilled personnel, especially technicians and skilled manual workers, but only medium in their R&D intensities. This skilled labor-intensive sector includes the shipbuilding industry, industries producing durable consumer goods (such as automobiles and white goods), investment goods (excluding the R&D-intensive ones), and miscellaneous intermediate goods and consumer non-durables that are skill-intensive.

As Table 9 shows, about three quarters of the exchange of manufactures between the United States and Sweden consists of skilled labor-intensive and R&D-intensive products. This proportion is much higher than for Swedish exports and imports in general. Furthermore, the share of skill-intensive and R&D-intensive products in U.S.-Swedish trade has also increased markedly over the years.

TABLE 9

DISTRIBUTION OF SWEDISH MANUFACTURING TRADE WITH THE WORLD AND THE UNITED STATES, BY SECTOR[a]
(per cent)

Year	Destination	Trade Sheltered	Industries Intensive in: Unskilled Labor	Physical Capital	Skilled Labor	R&D
			EXPORTS			
1969	World	3.7	18.9	33.8	36.0	7.5
	U.S.	1.5	13.3	22.9	55.0	7.2
1979	World	3.3	17.8	30.8	37.5	10.5
	U.S.	0.9	7.5	22.8	59.8	9.0
1985	World	3.7	17.4	29.5	35.5	13.9
	U.S.	1.5	6.7	15.8	59.8	16.3
1987	World	3.3	17.7	27.6	37.8	13.6
	U.S.	2.0	6.6	15.8	58.9	16.6
			IMPORTS			
1969	World	5.4	27.2	27.7	27.7	10.8
	U.S.	4.8	17.7	17.3	31.7	28.1
1979	World	4.3	25.3	31.8	26.6	10.9
	U.S.	3.1	15.8	17.4	28.5	34.8
1985	World	3.8	24.3	24.5	30.0	17.3
	U.S.	2.6	8.8	15.4	23.2	49.9
1987	World	3.9	26.9	18.0	34.2	17.1
	U.S.	2.4	10.6	9.4	25.6	52.0

[a] For composition of each sector, see Appendix A

Source: For 1969-1985: OHLSSON and VINELL (1987).
For 1987: Calculations from foreign trade statistics of the Swedish Central Bureau of Statistics.

In this trade in advanced products between the two countries, there is a clear division of labor. Half of Sweden's imports from the United States emanate from the R&D-intensive sector, and less than a quarter from the skill-intensive sector. Of Sweden's exports to the United States, 60 per cent come from the skill-intensive sector, and only 16 per cent from the R&D-intensive sector. Thus, in its trade with the high-tech leader of the world, Sweden acts as a medium-tech country, mainly exchanging skill-intensive products for R&D-intensive products.

One reason for the strong Swedish position in industries of low R&D intensity is the importance of trade based on the abundance of natural resources, such as forests, waterfalls (cheap electricity), and iron ore, in Sweden. Especially in the pulp and paper industry, there

are substantial economies to be gained by locating the manufacturing stages of production close to raw material production. Sweden, therefore, because of its raw material abundance, exports not only the raw materials, but also large amounts of capital-intensive paper and metal products.

On the other hand, such integration economies are small or absent in those industries where Swedish multinationals are most common, namely the medium technology engineering industries. Even before 1970, but increasingly so since then, several leading Swedish companies have globalized their production. This means that there has been a widening gap between the market shares of Sweden as an industrial producer and that of Sweden's medium technology companies, exporting from their overseas facilities as well as from Sweden (Blomström and Lipsey, 1989). The competitiveness of Swedish companies in these industries, as represented by their exports from all locations, has grown in comparison with that of Sweden itself, as represented by exports from Sweden.

Swedish exports are concentrated in industries with low or medium R&D intensities, despite the fact that Sweden, in the 1980s, became the OECD country with the highest ratio of business enterprise R&D to industry output – 3.0 per cent in 1985 as compared with 2.3 per cent for the United States. However, total R&D expenditures are about the same proportions of GDP in the United States and Sweden (OECD, 1988). Swedish business firms, at least in recent years, have been investing heavily in R&D. The effects of that investment are not completely absent from the bilateral trade figures. In two of the R&D-intensive industries, drugs and aircraft and parts, exports to the United States played a larger role than in total Swedish exports.

The development of new products (or new production methods) does not necessarily generate product exports from the home country. The inventing company may choose to produce a new product outside the home country or it may choose to sell the license to the new technology. Both of these could be substitutes for exports of new products.

A possible reflection of the recent stress on R&D in Sweden is the fact that, despite biases that tend to lead to understated license export figures, Sweden has reported the development of a surplus on licensing income in the balance of payments (see Table 10). The largest contributor to this surplus is the pharmaceutical industry,

TABLE 10

SWEDEN'S BALANCE OF PAYMENTS IN LICENSING WITH THE UNITED STATES AND THE WORLD IN MANUFACTURING
(Millions of $)

	1979	1983	1985
United States	−4.2	10.8	8.6
World	−3.7	39.2	27.5

Source: National Central Bureau of Statistics, Sweden

particularly in its license trade with the United States. Electronics industries have a deficit against the United States. Since it is unlikely that the Swedish pharmaceutical industry is developing more new products of R&D than the U.S. industry, the most likely explanation of the licensing surplus is that U.S. firms are exploiting their R&D through production abroad, while Swedish firms are reluctant to undertake the costs required to enter the U.S. market as local producers.

While the United States and Sweden are equally R&D intensive economies in terms of the proportion of total output devoted to R&D, if R&D outside of the business sector is included in the calculation, the total expenditure on R&D is, of course, much greater in the U.S. That fact alone may cause the United States to be the dominant producer of new technology, even if the share of R&D in U.S. national output is smaller than in some other countries. Another factor is the difference between the United States and Sweden in the composition of R&D expenditures. The U.S. spends more on basic and experimental research, while the typical Swedish R&D dollar goes to applied research (OECD, 1986). As a consequence of the small size of its economy, Sweden is highly dependent upon imports of new knowledge from the larger economies and, particularly from the United States. One of the channels for this import is, of course, imports of R&D intensive products from the U.S. As is pointed out below, Sweden's R&D intensive exports are partly dependent on these imports of R&D intensive products.

Specialization within technology classes

Swedish exports to the United States, and particularly the skill-intensive exports, are dominated by consumer goods, notably automobiles (see Table 11). They were already a third of Swedish exports to the American market in the late 1960s, and the proportion increased to over 40 per cent in the mid-1980s.

The dynamic markets for advanced industrial products since the late 1970s are associated particularly with the growth of R&D-intensive electronics. A remarkable rise in the share of such electronics in Sweden's imports from the United States is one reflection of this. The share of these products in total Swedish exports rose more than 70 per cent and it doubled in exports to the United States. The growth was even faster on the import side. The fact that the share of electronics products was much smaller in exports to the U.S. than in

TABLE 11

SUBSECTORAL SHARES[a] OF SWEDISH MANUFACTURING TRADE WITH THE WORLD AND THE UNITED STATES
(per cent)

Year	Destination	Skill Intensive Industries			R&D Intensive Industries	
		Durable Consumer Goods	Investment Goods	Other	Electronics	Other
		EXPORTS				
1969	World	11.2	15.3	4.9	5.5	2.0
	U.S.	33.4	12.4	9.2	3.9	3.2
1979	World	15.7	16.3	5.3	8.0	2.6
	U.S.	35.5	19.8	4.4	6.4	2.6
1985	World	16.5	14.7	4.0	10.4	3.6
	U.S.	42.0	13.9	3.9	7.8	8.5
1987	World	18.1	15.3	4.0	9.5	4.1
	U.S.	43.6	12.3	3.1	7.8	8.8
		IMPORTS				
1969	World	9.5	13.0	4.0	6.9	3.9
	U.S.	4.6	20.5	6.5	15.2	12.8
1979	World	9.7	12.2	3.8	7.7	3.2
	U.S.	4.0	18.9	5.7	25.5	9.3
1985	World	10.6	13.7	4.9	12.9	4.4
	U.S.	3.5	13.8	5.9	35.7	14.2
1987	World	14.1	14.4	5.1	12.8	4.3
	U.S.	4.9	15.1	5.6	37.2	14.8

[a] For composition of subsectors see Appendix A.
Source: Same as Table 9.

imports from the U.S. reflects the strong competitive position of the United States in electronics.

The bilateral division of labor between Sweden and the United States operates even within the high-tech sector. For example, Sweden is a major exporter of telecommunications through the Ericsson company. Telephone switches are constructed as modular system products that allow for flexible adaptation to the specific demands of national telephone companies. The sophisticated multitude of electronic components that entered the new generation of switches in the late 1970s meant that electro-mechanical components made in Sweden had to yield to imported electronics from the United States. During the 1980s, the Ericsson company has been able to rapidly expand its sales of telecommunication equipment from both its Swedish and its foreign plants. This Swedish success, based partly on U.S. technology, has thus indirectly supported the U.S. specialization in high-tech exports.

It is clear from these comparisons that the intensifying bilateral exchange between Sweden and the United States in advanced industrial products has been accompanied by increased specialization between the two countries. Sweden exports medium technology products such as cars, home appliances, and investment goods to the United States, in exchange for U.S. high-tech products such as electronics, computers, and aircraft. Along with specialization, there has also been a tendency toward an intensified two-way trade in the three most human capital intensive subsectors, that is investment goods, electronics, and the miscellaneous R&D industries. Nevertheless, U.S. enterprises firmly maintain their leadership in the most advanced products.

The relatively advanced character of U.S. exports to Sweden is confirmed by the fact that the unit value (value per ton) of U.S. exports to Sweden in all the three most human capital intensive subsectors is about twice as high as that of Swedish exports to the U.S. (see Table 12). In other words, in each subsector, Sweden specializes in goods that require less human capital input per ton than goods imported from the U.S.

This characteristic contrasts with Swedish trade in general. In four of the five groups shown in Table 12, unit values for Sweden's exports to the world were higher than unit values in its imports.

All the evidence from the bilateral trading patterns regarding the indirect trade in production factors points in the same direction.

TABLE 12

THE RATIO OF EXPORT UNIT VALUES TO IMPORT UNIT VALUES IN SWEDISH TRADE WITH THE UNITED STATES AND THE WORLD, BY SUBSECTORS
Average 1985-1987

Trade with	Skill-Intensive Industries			R&D Intensive Industries	
	Durable Consumer goods	Intermediate goods and consumer non-durables	Investment goods	Electronics	Other
U.S.	1.08	1.43	0.58	0.63	0.75
World	1.27	0.59	1.05	1.49	1.21

[a] For composition of subsectors, see Appendix A.
Source: National Central Bureau of Statistics, Sweden

Sweden appears to be abundant (relative to the United States) in engineers and skilled manual workers, with skills suitable to the development, design, and production of medium technology goods. The United States is, in contrast, abundant in a broad range of R&D personnel and other skills needed in the production of high technology products.

Conclusions

In the last decade, the United States and Sweden have enjoyed growing trade relations, especially when viewed from the Swedish side, despite the similarity in their income levels and investment in technology. The share of Swedish exports going to the United States more than doubled and the share of Swedish imports originating in the United States increased as well.

What accounted for this change? While in the past, Sweden and the United States had shared similar resource-based comparative advantages, both countries have shifted the composition of their global exports toward manufactured goods. And within that category, both Sweden and the United States came to export and import the more knowledge intensive goods, especially machinery and transport equipment. Within these industries, the United States specialized in exports based on high technology, or high R&D intensity, while Sweden specialized in medium technology products, some based on its original natural resource advantages.

These trends in U.S. and Swedish trade with the world were accentuated in the bilateral trade between the two countries. Their shifting comparative advantages seem to have increased the scope for trade on the basis of specialization within similar industries. Swedish exports and imports to and from the United States are much more concentrated in machinery and transport equipment than Swedish exports and imports to and from the world as a whole. And U.S. exports to and imports from Sweden are more concentrated in those groups than U.S. trade with the rest of the world. U.S. exports to Sweden are considerably more technology-intensive than other U.S. exports. However, despite the heavy Swedish investment in R&D in recent years, Swedish exports to the United States remain concentrated in medium-tech sectors.

The evidence from the bilateral trading patterns regarding indirect trade in production factors points in the same direction. Sweden appears to be abundant (relative to the United States) in engineers and skilled manual workers suitable to development, design, and production of medium technology goods. U.S. trade, in contrast, reveals an abundance of a broad range of R&D personnel and the complementary skills for research, development, and production of high technology goods.

The pessimistic view of the future of trade with which we introduced the paper is belied by the Swedish-U.S. trade relationship. The similarities in per capita incomes, in population density, in education levels, and in the share of income devoted to R&D, have not prevented an increase in the extent of bilateral trade. Most of that trade is now an exchange of machinery and transport equipment for machinery and transport equipment, with the basis for specialization being the different technology levels or R&D intensities of the goods being traded. The example of these two countries suggests that mutual technological progress need not be any obstacle to trade and may, in fact, promote trade.

Stockholm
Flushing, N.Y MAGNUS BLOMSTRÖM - ROBERT E. LIPSEY -
Stockholm LENNART OHLSSON

Appendix A

Classification of Swedish Industries[a] by Factor Intensity Characteristics

The unskilled labor intensive sector:

3113	3114	3119	3121	3211
3212	3213	3214	3215	3219
32201	32202	32203	32204	32205
32209	3231	3233	3240	33111
33119	3319	3320	34113	3412
3419	3551	3559	3560	3610
3620	3691	3812	38193	38194
38195	38199	38393	38412	3849
3902	3903	3909		

The physical capital intensive sector:

3122	3131	3133	3140	34111
34112	35111	35112	3512	3513
3530	3540	37101	37102	37201/2
37203				

The skill intensive sector:

a. Durable consumer goods industries:

38291	3833	38413	38431	38432
3844				

b. Investment goods industries:

3821	3822	38231	38232	38241
38242	38249	382991	382992	382993
382999	38391	38399	38421	

c. Intermediate goods and consumer non-durables industries (incl. miscellaneous industries)

3521	3523	3529	3811	38192
38259	38392	3852		

d. Shipbuilding:

38411

The R&D intensive sector:

a. Electronics:

38251	3832	3851

b. Miscellaneous R&D intensive industries:

3522	3831	38451

[a] Sectors and subsectors in terms of the SNI – the Swedish variant of the ISIC.

Appendix B

Classification of Industries by Technology Level

1. *Low technology*
   - Grain mill, bakery products
   - Other food products
   - Beverages
   - Primary ferrous metals
   - Primary non-ferrous metals
   - Fabricated metal products
   - Lumber, wood, furniture
   - Paper, pulp, etc.
   - Printing & publishing
   - Textiles & apparel
   - Glass products
   - Stone & clay products
   - Tobacco

2. *Medium technology*
   - Soap, cleansers, etc.
   - Industrial chemicals
   - Agricultural chemicals
   - Farm & garden machinery
   - Construction machinery
   - Other non-electrical machinery, except office & computing machinery
   - Household appliances
   - Radio, TV equipment
   - Motor vehicles and equipment
   - Transportation equipment other than aircraft and motor vehicles and equipment
   - Rubber products
   - Misc. plastic products
   - Other manufactures

3. *High technology*
   - Drugs
   - Office & computing machinery
   - Electronic components
   - Communications equipment, except radio & TV equipment
   - Other electrical machinery
   - Aircraft
   - Instruments

APPENDIX TABLE 1

U.S. AND SWEDISH FOREIGN TRADE, WITH THE WORLD AND WITH EACH OTHER, 1974-1988
(Annual Averages, Millions of $)

	U.S.				Sweden			
	Exports to		Imports from		Exports to		Imports from	
	World	Sweden	World	Sweden	World	U.S.	World	U.S.
1974-76	107,038	956	113,665	945	17,230	869	17,882	1,173
1977-80	166,964	1,370	206,444	1,483	24,812	1,424	25,717	1,860
1981-83	215,514	1,704	266,038	2,147	27,617	2,025	27,531	2,318
1984-86	216,109	1,779	363,288	4,134	32,243	3,704	28,895	2,345
1987-88	286,634	2,300	441,989	5,099	47,126	4,850	42,810	3,138

Source: IMF, *Direction of Trade Statistics Yearbook*, 1981, 1984, 1987, 1989.
Data are on DOT basis.

APPENDIX TABLE 2

VALUE OF WORLD EXPORTS AND IMPORTS, TOTAL, AND TO AND FROM THE U.S., 1974-1988
(Billions of $)

	Value of World Exports		Value of World Imports	
	To the U.S.	Total	From the U.S.	Total
1974-1976	101.9	827.1	112.3	845.6
1977-1980	188.2	1,411.4	178.6	1,454.0
1981-1983	245.0	1,756.9	231.0	1,826.7
1984-1986	332.0	1,859.0	231.7	1,934.6
1987-1988	420.5	2,530.4	307.2	2,613.0

Source: IMF, *Direction of Trade Statistics Yearbook*, 1981, 1984, 1987, 1989.
Data are on DOT basis.

APPENDIX TABLE 3

U.S. TRADE WITH THE WORLD, BY COMMODITY DIVISIONS, 1970 AND 1986
(Millions of $)

	SITC	U.S. Exports to the World		World Exports to the U.S.	
		1970	1986	1970	1986
Manufactures					
Chemicals	5	3,830	22,198	1,230	14,234
Semi-manuf. & misc.	6+8	7,660	31,246	13,460	101,051
Mach. & transp. equip.	7	17,880	95,422	11,610	161,823
Unclassified	9	2,660	10,978[a]	390	6,538
Total Mfrs.	5–9	32,030	159,844	26,690	283,646
Other goods					
Foods, beverages	0+1	5,060	20,072	5,770	23,209
Crude materials	2+4	3,910	18,338	3,440	10,355
Mineral fuels	3	1,590	8,154	3,240	33,300
All Goods	0–9	42,590	206,408	39,140	350,510

[a] Including $2.3 billion of identified military products and $7.1 billion of "special transactions".
Source: UN (1976a), Special Table C; (1976b), Special Table C; (1988a), Special Table E; (1988c), Special Table C.

REFERENCES

BLOMSTRÖM, MAGNUS, ROBERT E. LIPSEY, and LENNART OHLSSON (1989), *Economic Relations Between the U.S. and Sweden*, Stockholm, Svenska Handelsbanken and The Federation of Swedish Industries.

BLOMSTRÖM, MAGNUS and ROBERT E. LIPSEY (1989), "The Export Performance of U.S. and Swedish Multinationals", *Review of Income and Wealth*, Series 35, Number 3, September.

BURENSTAM-LINDER, STAFFAN (1961), *An Essay on Trade and Transformation*, John Wiley and Sons.

INTERNATIONAL MONETARY FUND (1981), *Direction of Trade Statistics Yearbook*, Washington, D.C.

INTERNATIONAL MONETARY FUND (1984), *Direction of Trade Statistics Yearbook.*

INTERNATIONAL MONETARY FUND (1987), *Direction of Trade Statistics Yearbook.*

INTERNATIONAL MONETARY FUND (1989), *Direction of Trade Statistics Yerbook.*

KRAVIS, IRVING B. and ROBERT E. LIPSEY (1989), "Technological Characteristics of Industries and the Competitiveness of the U.S. and its Multinational Firms", *NBER Working Paper* 2933.

LEAGUE OF NATIONS (1945), *Industrialization and Foreign Trade*, by Folke Hilgerdt, Geneva, League of Nations.

LEONTIEF, WASSILY (1953), "Domestic Production and Foreign Trade: The American Capital Position Re-examined", *Proceedings of the American Philosophical Society*, September, pp. 332-349.

MOMIGLIANO, FRANCO, and DOMENICO SINISCALCO (1984), "Technology and International Specialization", in this *Review*, No. 150, September.

OECD (1986), *OECD Science and Technology Indicators No. 2, R&D, Invention, and Competitiveness*, Paris.

OECD (1988), *Main Science and Technology Indicators, 1981-87*, Paris.

OHLSSON, LENNART and LARS VINELL (1987), *Tillväxtens Drivkrafter. En Studie av Industriers Framtidsvillkor*, Stockholm, Industriförbundet.

ROBERTSON, DENNIS A. (1938), "The Future of International Trade", *Economic Journal*, March.

TORRENS, ROBERT (1821), *Essay on the Production of Wealth*, London.

UNITED NATIONS (1976a), *Monthly Bulletin of Statistics*, Vol. XXX, No. 2, February.

UNITED NATIONS (1976b), *Monthly Bulletin of Statistics*, Vol. XXX, No. 8, August.

UNITED NATIONS (1988a), *Monthly Bulletin of Statistics*, Vol. XLII, No. 2 February.

UNITED NATIONS (1988b), *Monthly Bulletin of Statistics*, Vol. XLII, No. 3 March.

UNITED NATIONS (1988c), *Monthly Bulletin of Statistics*, Vol. XLII, No. 5 May.

WARD, MICHAEL (1985), *Purchasing Power Parities and Real Expenditures in the OECD*, Paris.