THE SKILL DISTRIBUTION AND COMPETITIVE TRADE ADVANTAGE OF HIGH-TECHNOLOGY INDUSTRIES

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Achieving an adequate level and rate of employment growth is among the most important objectives of economic policy. In an economy relatively open to international trade, strong growth in domestic demand is neither a necessary nor a sufficient condition for satisfactory growth in domestic employment. The higher the propensity to import foreign goods, the lower the stimulus to employment growth provided by growth in domestic demand. Conversely, if foreign demand for a country's exports is high, that country could exhibit robust employment growth even in the face of unimpressive domestic demand growth.

During the last quarter century the United States has become increasingly open to international trade. The ratio of imports to gross national product, a standard measure of openness, increased from 4.6 percent in 1960 to 12.0 percent in 1980. But the rate of growth in foreign demand for U.S. products has been significantly lower than the rate of growth in U.S. demand for foreign products. Consequently, the nation has experienced large and increasing merchandise trade deficits. In 1984 the U.S. trade deficit reached \$123 billion, more than 75 percent greater than the previous high of \$69 billion set only one year earlier; the deficit for 1985 was projected to exceed \$138 billion. Manufactured goods ac-

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count for a substantial (and growing) share of this deficit: the U.S. deficit for these goods increased from $38 billion in 1983 to $89 billion in 1984 and was expected to exceed $105 billion in 1985 (AFL-CIO 1986). The AFL-CIO estimates that a trade deficit of $138 billion results in the loss of (or failure to create) over 3 million U.S. jobs. This estimate may be slightly high (the ratio of one job per $50,000 of the trade deficit is also sometimes suggested), but it is probably of the right order of magnitude. Obviously, the ability of the U.S. economy to provide employment opportunities depends on its ability to reduce trade deficits.

Although there have been large U.S. trade deficits for manufactured goods as a whole, industries making up the "high-technology" sector of manufacturing have consistently experienced a trade surplus. As Table 1 indicates, the high-technology sector, as defined by the U.S. Department of Commerce (the issue of defining this sector is discussed in detail below), had a surplus in every year between 1970 and 1984, whereas the remainder of manufacturing had a deficit in every year except 1975. Indeed, despite the fact that the high-technology sector produced only 16 percent of the value added by manufacturing in 1977, the high-technology trade surplus was more than sufficient to offset the trade deficit generated in the other manufacturing sectors (the offset resulting in a surplus for manufactured products as a whole) in six of the fifteen years.

Our purpose in this paper is to provide and test empirically an explanation for the difference in trade performance between the high-technology sector and the other sectors of U.S. manufacturing, and to consider the implications of our explanation for macroeconomic public policy. In the next section we propose a theoretical explanation for the difference in trade performance, an explanation based on two propositions: the Heckscher-Ohlin theory of international trade, and the theory of product life cycles. The first theory implies that a country should specialize in producing (and hence tend to export) those products that make intensive use of factors in abundance in that country. The second theory implies that the United States is relatively well endowed with factors that are used extensively in the manufacture of high-technology products (that is, products at an early stage in their life cycles). Perhaps the key such factor is highly educated (and highly skilled) labor. The theory of product life cycles states that young (high-technology) industries differ from mature (other) industries in a number of important respects, such as the capital-intensity of production, the skill distribution of employment, the age of the capital stock, and the growth rate of output.

In the third section of this paper we compare the relative skill endowments of the labor force in the United States and other developed countries. The fourth section discusses our data base and the definition of the high-technology sector that we employ. The fifth presents data on real output, the capital stock, and employment in the high-technology and other manufacturing sectors in the years 1960, 1970, and 1980. This evidence provides strong support for our proposed explanation, the policy implications of which are considered in the final section.

Table 1. U.S. Trade in High-Technology and Other Manufacturing Sectors: 1970–84 (in billions of constant 1972 dollars[a])

Year	High-Technology Sector[b]			Other Manufacturing Sectors		
	Exports	*Imports*	*Balance*	*Exports*	*Imports*	*Balance*
1970[c]	$11.26	$ 4.59	$ 6.67	$20.78	$24.93	$ −4.16
1971[c]	11.87	5.10	6.77	19.79	28.54	−8.75
1972[c]	11.90	6.30	5.60	21.80	33.70	−11.90
1973[c]	15.04	7.47	7.57	27.23	37.64	−10.40
1974	18.68	8.52	10.17	36.50	43.19	−6.69
1975	18.20	7.55	10.65	38.24	36.17	2.07
1976	19.34	9.97	9.37	38.99	42.62	−3.63
1977	19.49	10.92	8.57	37.77	47.55	−9.78
1978	22.93	13.34	9.59	39.58	57.63	−18.06
1979	26.39	13.76	12.63	47.68	58.96	−11.27
1980	30.40	15.52	14.88	53.24	58.39	−5.15
1981	30.60	17.12	13.49	51.46	59.14	−7.68
1982[c]	27.75	16.45	11.31	43.31	56.19	−12.88
1983[c]	27.70	18.97	8.73	37.11	60.32	−23.21
1984[c]	29.08	26.29	2.79	38.59	77.53	−38.94

Source: National Science Board (1985).
[a]GNP implicit price deflators were used to convert current dollars to constant 1972 dollars.
[b]U.S. Department of Commerce DOC-3 definitions (see text, fourth section).
[c]Data in this row are estimates.

Government policies that tend to increase the (relative) supply of highly educated and highly skilled workers should maintain or enhance the comparative advantage in high-technology products held by the United States.

A THEORETICAL EXPLANATION

The Heckscher-Ohlin theory of international trade is rooted in the classical (Ricardian) doctrine of comparative advantage. The simplest version of the theory postulates a world in which there are two countries (1 and 2) both capable of producing two products (A and B) using two factors of production (X and Y). Each country is endowed with fixed quantities of each of the two factors. Both factors of production are assumed to be immobile between the countries, but both products are freely tradable between the countries. The two countries are assumed to have access to the same technology (that is, the production functions for each product are identical across countries). The technologies for the two products differ with respect to their relative factor intensities: Cost minimization requires that, at given relative factor prices, product A employs a greater ratio of factor X to factor Y than product B. (In other words the marginal rate of technical substitution between X and Y differs between the products when relative factor employment is the same for the two products.) Both countries face the problem of deciding how to allocate their fixed supplies of each factor between the two products or industries so that the value of the national product is maximized. The basic Heckscher-Ohlin result is that each country will specialize in (devote its resources to) the production of the product that makes intensive use of the factor with which the country is relatively well endowed. Thus, if country 1 is relatively well endowed with factor X, it will specialize in producing product A (even if consumers in country 1 tend to prefer product B). By virtue of its relative factor endowments, country 1 (2) has a comparative advantage with respect to the production of product A (B).

If we are to invoke the Heckscher-Ohlin theory as a basis for explaining why the United States has a comparative trade advantage with respect to high-technology products, we need to establish that the country is relatively well endowed with factors that are used intensively in high-technology industries. According to the theory of product life cycles this is indeed the case. As the data presented in the next section demonstrate, high-technology products tend to be at early stages in their life cycles; they tend, at least, to be produced with capital and labor of recent vintage. The life-cycle theory posits that the nature (including relative factor-intensity) of the production *process* changes in a systematic fashion as a product ages. Early in a product's life cycle no single, dominant, well-defined production technology emerges. Although the rate of output is rapidly increasing, capital equipment especially designed to produce the product has yet to be developed or diffused on a large scale. Consequently, relatively limited capital investment has occurred, and capital intensity is low. Because the technology is not yet well defined, job tasks have not been routinized or standardized. The industry's labor force is still devoting a significant amount of its energies to designing and redesigning an appropriate production technology. Relatively highly educated and highly skilled employees are required to efficiently perform such problem-solving and unstructured work activities.

As the product (or industry) matures, a dominant technology does emerge. The industry makes large-scale investment in specialized, standardized capital equipment, and the production technology is increasingly capital intensive. As the industry's cumulative output rises, the rate of (and returns to) worker learning about the technology falls. Work becomes increasingly routinized and thus can be performed by workers of lower skill. Most of the opportunities for productivity improvement and cost reduction (due in part to "learning") have already been exploited, and so output eventually begins to decelerate or even decline.

This synopsis of the theory of product life-cycles suggests that the relative factor intensities—and, in particular, the skill intensities—of young and mature industries are very different, with the young industries requiring a more highly skilled and educated labor force.

THE RELATIVE SKILL ENDOWMENTS OF THE U.S. LABOR FORCE

Before proceeding with our analysis of the skill distributions of the high-technology and other manufacturing sectors that is based on the product-life-cycle hypothesis, we need to show that the skill endowments of the U.S. labor force differ from those in other countries. UNESCO has developed a system for standardizing international educational statistics that facilitates a comparative analysis of educational attainment in different countries. In particular, we show in Table 2 the percentage of the civilian labor force that has reached the "third level" of education in each of the 15 developed countries that UNESCO has studied. According to UNESCO, "Third level refers to education which requires as a minimum condition of admission the successful completion of education at the second level (which is defined as education received in a high school, secondary school, teachers training school, vocational or technical school). It can be given in different types of institutions such as universities, teacher training institutes, technical institutes, etc."[1]

Table 2 demonstrates that the skill endowment of the U.S. labor force is sharply higher than that of the other 14 developed countries. The percentage of the U.S. labor force that has reached the third level of education is more than double any of the other percentages shown. Hence, we can conclude that the United States is relatively well endowed in highly skilled labor and should therefore have a comparative advantage in the production of those products that use

Table 2. Percentage of 1980 Civilian Labor Force with "Third Level" of Education

Country	*Percentage with Third Level*
United States	11.3
Netherlands	5.3
Spain	5.3
Belgium	4.8
Sweden	4.7
Italy	4.7
West Germany	4.5
France	4.5
Japan	4.3
Denmark	4.0
Greece	3.5
Ireland	3.4
Portugal	2.2
United Kingdom	2.0
Luxembourg	—

Source: Eurostat Review, various issues, 1974–83, Statistical Office of the European Communities.
Notes: Third level is defined as in United Nations (1984, 1047–48); See the text. Luxembourg's percentage was less than 0.05.

this factor intensively. According to the product-life-cycle hypothesis, it is the high-technology sector that will be skilled-labor-intensive.

A DEFINITION OF THE HIGH-TECHNOLOGY SECTOR AND DATA

As stated in a recent staff report of the U.S. Department of Commerce (1985, 36), "The definition of what are 'high technology' products has long been controversial. It is generally agreed that a high technology product requires 'above average' concentrations of engineering and scientific skills and/or research and development expenditures." The report indicates that the better known definitions of high technology are based on the ratio of R & D expenditures to total sales. Davis (1982) includes in the numerator not only the R & D funds spent directly by final producers, but also the funds spent by producers of intermediate products that are used in the final product; all other authors, to our knowledge, have simply included the expenditures made by final producers. If an industry equals, or is above, some threshold ratio, the industry is counted as being part of the high-technology sector of the economy.[2] We follow this approach in defining the high-technology sector of manufacturing in the United States.

We have developed a data base comprising longitudinal data for an exhaustive classification of 61 manufacturing industries during the period 1960–80; the industries are listed in the appendix. We derived the data from a number of different but consistent sources (matched on the basis of industry designation).

The Industrial Analysis and Productivity Research Program (IAPRP) of the U.S. Department of Commerce has provided us with estimates of the number of employees in each industry (coded as in the appendix), cross-classified by age, educational attainment, and occupation for the years 1960, 1970, and 1980.[3] These data are based on the Census of Population for each of those years. The IAPRP also provided data on the stock of capital and the average age of the capital stock for each of the industries in 1960, 1970, and 1980; the capital stock can be distinguished between plant and equipment. For information on industry output we used the Census/SRI/Penn Database for the same years.

Time-series data on R & D expenditures are not available for the industry classification used in our data base. Fortunately, however, Scherer (1984) constructed a technology matrix that measures each industry's R & D expenditures in 1974. Using his figures we have computed the ratio of 1974 R & D expenditures to 1974 sales (which are listed in the Census/SRI/Penn Database) for each of the industries in our classification—the ratio we employ to distinguish between the high technology industries and the rest of the manufacturing sector. Four industries had a ratio in excess of .05; the remaining 57 each had a ratio significantly less than .05, and the mean for this group was .01. The four industries and their associated R & D/sales ratios are shown in Table 3. It is these industries that we argue compose the high-technology sector. We are confident that ours is a reasonable definition of the sector because each of the four industries shown in Table 3 was classified as being in the high-technology sector according to *all* of the definitions surveyed in the U.S. Department of Commerce staff report (1985, table V-3).

OUTPUT, CAPITAL, AND EMPLOYMENT TRENDS IN THE TWO SECTORS

The data on output, capital stock, and employment in the high-technology and other manufacturing sectors are remarkably consistent with the theoretical framework presented earlier. Beginning with Tables 4 and 5 we find several results that were predicted by the theory. Table 4 shows that in all three years—1960, 1970, and 1980—the capital/labor ratio in the high-technology industries was lower than that of the other manufacturing industries; their output per worker was lower; and their capital stock (both plant and equipment) was newer. Table 5 shows that real output, the capital/labor ratio, and output per worker all grew much more rapidly in the high-technology sector between 1960 and 1980 than in the other manufacturing industries.

More specifically, all of these findings are consistent with the proposition that

Table 3. R & D/Sales Ratios in the High-Technology Sector, 1974

Industry	*R & D/Sales Ratio*
1. Office, computing, and accounting machines (SIC 357)	.090
2. Optical, ophthalmic, and photographic equipment and supplies (SIC 383, 385, 386)	.062
3. Radio, television, and communication equipment (SIC 365 and 366)	.055
4. Electronic components and accessories (SIC 367)	.051

Sources: R & D data from Scherer (1984); sales data from Census/SRI/Penn Database.

the high-technology sector is in the early stages of the product life cycle, during which no single, well-defined production technology emerges. The rate of output is rapidly increasing, but capital equipment specially designed to produce the product has not yet been developed or widely diffused. Consequently, the capital stock is of recent vintage and capital intensity is low. Since technological change is embodied in the capital stock, the relative newness of capital in the high-technology sector indicates, not surprisingly, greater technological advancement in that sector.[4] The remarkably higher rate of growth in labor productivity in the high technology sector (143 percent between 1960 and 1980) than in the rest of manufacturing (60 percent in those years) is also explained by the product-life-cycle model because the more mature sector would be expected to have already exploited most of its opportunities for productivity improvement.

The data in Table 6 confirm that highly educated labor is, indeed, employed more intensively in the young, high-technology industries than in the mature industries in the rest of manufacturing. Table 6 shows the employment shares of workers in three different educational groups: (1) those with fewer than 12 years of schooling, (2) those with 13 to 15 years of schooling, and (3) those with 16 or more years of schooling. In 1960 the high-technology sector had a substantially larger proportion of workers with 13 to 15 years of schooling (47.0 percent) than the other manufacturing industries (35.9 percent) in the latter. The high-technology sector also had a larger share of workers with 16 or more years of education than the other manufacturing industries: 10.5 percent versus 6.1 percent. Between 1960 and 1970 both sectors showed increases in the employment shares of the 13–15 and the 16+ groups, with substantial decreases in the share held by the 12− group. This, of course, is a reflection of the increase in the educational attainment of the U.S. labor force that took place during that decade.[5]

What is important to note, however, is that the high-technology industries showed a much more dramatic increase in the employment share of the 16+ group than did the other manufacturing industries. Between 1960 and 1970 the employment share of this group rose by 41 percent in the high-technology sector

Table 4. Labor, Capital, and Output in the Two Manufacturing Sectors, 1960, 1970, and 1980

Year *Manufacturing Sector*	*Employment (in millions)* *(1)*	*Real Capital Stock (billions of 1972 dollars)* *(2)*	*Real Output (billions of 1972 dollars)* *(3)*	*Capital/Labor Ratio (2)/(1)* *(4)*	*Output Per Worker (3)/(1)* *(5)*	*Mean Age of Plant* *(6)*	*Mean Age of Equipment* *(7)*
1960							
High-technology industries	1.08	5.79	15.98	5.36	14.79	9.61	5.95
Other manufacturing industries	17.53	186.6	452.20	10.64	25.80	12.76	7.20
1970							
High-technology industries	1.62	13.65	39.87	8.43	24.61	9.78	5.40
Other manufacturing industries	19.50	265.21	630.38	13.60	32.33	12.93	6.90
1980							
High-technology industries	2.04	24.87	73.24	12.19	35.90	11.68	5.77
Other manufacturing industries	20.19	357.95	833.47	17.73	41.28	14.47	6.92

Table 5. Percentage Growth in Labor, Capital, and Output Measures, 1960–80

Years Manufacturing Sector	Employment (1)	Real Capital Stock (2)	Real Output (3)	Capital/Labor Ratio (4)	Output Per Worker (5)
1960–70					
High-technology	.50	1.36	1.49	.57	.66
Other	.11	.42	.39	.28	.25
1970–80					
High-technology	.26	.82	.84	.45	.46
Other	.035	.35	.32	.30	.27
1960–80					
High technology	.89	3.30	3.58	1.27	1.43
Other	.15	.92	.84	.67	.60

Note: The percentage growth is calculated with initial year of each period as the base.

and by only 20 percent in the rest of manufacturing, which implies that most people with college degrees or better who entered the labor force during the 1960s went to work in the high-technology sector. The picture by 1980 was one of a labor force in the high-technology sector that was substantially better educated than the labor force in the rest of manufacturing. Fully 20 percent of workers in high technology had at least a college degree in 1980, whereas only 11 percent of the workers in the rest of manufacturing did. At the other end of the spectrum only 18 percent of the high-technology workers had fewer than 12 years of

Table 6. Employment Shares by Years of Education, 1960, 1970, and 1980

Years Manufacturing Sector	Years of Education 12 or Fewer	 13–15	 16 or More
1960			
High-technology	.425	.470	.105
Other	.580	.359	.061
1970			
High-technology	.287	.565	.148
Other	.465	.461	.073
1980			
High-technology	.180	.617	.203
Other	.310	.577	.113

schooling, whereas almost one-third of the workers in the rest of manufacturing fell into this category. This is precisely what the theory of product life cycles would predict. Since technology in the younger sector is not yet well developed, the firms in the sector require relatively greater numbers of well-educated employees to design and rework the technology.

Finally Table 7 shows the employment shares of eight major occupational groups in the two manufacturing sectors. The occupational distributions in the two sectors closely mirror the educational distributions we have just discussed. Note that in each of the three years the employment share of professional and technical workers in the high-technology sector was roughly 2.5 times larger than it was in the rest of manufacturing. A very interesting fact is that the clerical occupations accounted for a larger proportion of jobs in the high-technology sector than they did in the rest of manufacturing in all three years. It appears that less educated individuals are more likely to hold clerical positions if they are in the high-technology sector than if they are in the other sector. This result is consistent with the fact that the high-technology sector has a larger proportion of female workers than the rest of manufacturing. Our data show that the proportion of jobs held by women in high technology was .31 in 1960, .34 in 1970, and .39 in 1980; the comparable figures for the other manufacturing sector are .25, .27, and .31.

PUBLIC POLICY IMPLICATIONS

Large and growing trade deficits constitute one of the most serious problems confronting the U.S. economy, representing a threat to prosperity and economic growth. Within U.S. manufacturing only the high-technology sector has managed consistently to show trade surpluses since 1970, but these have, however, declined since 1980. We have argued that comparative advantage in high-technology products held by the United States in world markets is based to an important extent on this country's being relatively well endowed with highly educated workers.

The high average educational attainment of the U.S. labor force is not entirely fortuitous, however. It is partly a consequence of governmental policies (such as support of state universities, the GI Bill, and National Defense Student Loans) to subsidize the acquisition of higher education. In the current era of budgetary austerity, governmental support for higher education is no longer as secure as it once was. Indeed, some policy makers have called for reduced public support for higher education.

The arguments and evidence presented in this paper imply that changes in public policy with respect to financial aid to education may eventually affect the competitiveness of U.S. high-technology industries. Reductions in governmental subsidies to education would increase the private cost to individuals of acquiring education and hence the relative price (wage rate) of highly educated workers.

Table 7. Employment Shares by Occupation, 1960, 1970, and 1980

Year / *Manufacturing Sector*	*Professional and Technical Workers*	*Managers*	*Craft Workers*	*Operatives*	*Service Workers*	*Laborers*	*Clerical Workers*	*Sales Workers*
1960								
High-technology	.173	.050	.170	.387	.014	.018	.165	.022
Other	.072	.052	.203	.436	.018	.061	.117	.041
1970								
High-technology	.226	.060	.151	.349	.021	.020	.153	.019
Other	.088	.053	.198	.433	.024	.049	.121	.034
1980								
High-technology	.234	.093	.176	.272	.017	.025	.156	.026
Other	.093	.071	.213	.378	.023	.070	.121	.031

All industries would be affected by such a price increase to a certain extent, but because they employ a disproportionate number of highly educated workers the high-technology industries would be affected the most.

Acceptance of the notion that governmental subsidies to education tend to enhance the competitive posture of high-technology industries, and thereby U.S. export performance, does not necessarily mean we should support very large government budgets for education. The enhanced competitiveness of high-technology industries may be one of the benefits of greater educational attainment, but education is obviously a costly activity. The optimal rate of investment in education is the rate at which the marginal benefits of education (which include the greater productivity of highly educated workers) equal the marginal costs. The theories and data presented in this paper do not in themselves justify a claim that the United States is investing in education at less than the optimal rate and therefore the government should increase subsidies to education. In fact, a case could be made that most or all of the benefits of acquiring an education are appropriated by the recipient (in the form of higher wages), and therefore little or no public subsidy is required to promote an efficient rate of educational investment.

Although our analysis does not enable us to determine whether the current level of government support of education is inadequate or excessive, we think it does enable us to make predictions about the effects of changes in subsidies to education on the competitiveness of U.S. high-technology industries. Because, as we have argued, education and technological innovations are, loosely speaking, complementary, reductions in government subsidies to education are likely, in the long run, to erode the basis for the comparative advantage the United States enjoys in the production of high-technology products. We believe that policy makers engaged in debate about the size of education budgets should be aware of this linkage.

Appendix. Description of Industries, by 1972 Standard Industrial Classification Codes

	Sector Title	*1972 SIC Code*
1.	Food and kindred products	20
2.	Tobacco manufacturers	21
3.	Broad and narrow fabrics, yarn, and thread mills	221, 222, 223, 224, 226, 228
4.	Miscellaneous textile goods and floor coverings	227, 229
5.	Knitting mills	225
6.	Apparel	231, 232, 233, 234, 235, 236, 237, 238
7.	Miscellaneous fabricated textile products	239
8.	Lumber and wood products, except containers	241, 242, 243, 249
9.	Wood buildings and mobile homes	2451, 2452
10.	Wood containers	244

(continued)

Appendix. (*continued*)

11.	Household furniture	251
12.	Other furniture and fixtures	252, 253, 254, 259
13.	Paper and allied products, except containers, boxes, and paper mills, but including building paper	261, 263, 264, 266
14.	Paper mills, except building paper	262
15.	Paperboard containers and boxes	265
16.	Printing and publishing	27
17.	Chemicals and selected chemical products, except nitrogenous and phosphatic fertilizers, fertilizers (mixing only), and agricultural chemicals	281, 286, 289
18.	Nitrogenous and phosphatic fertilizers, fertilizers (mixing only) and agricultural chemicals not elsewhere classified	287
19.	Plastic and synthetic materials	282
20.	Drugs, cleaning and toilet preparations	283, 284
21.	Paints and allied products	285
22.	Petroleum refining	291
23.	Miscellaneous products of petroleum and coal	299
24.	Paving and roofing materials	295
25.	Rubber and miscellaneous plastics products	30
26.	Leather tanning and finishing	311
27.	Footwear and other leather products	313, 314, 315, 316, 317, 319
28.	Glass and glass products	321, 322, 323
29.	Cement, hydraulic	324
30.	Stone and clay products, except hydraulic cement	325, 326, 327, 328, 329
31.	Blast furnaces, steel works, and rolling and finishing mills	331
32.	Iron and steel foundries, forgings, and miscellaneous metal products	332, 339
33.	Primary nonferrous metals	333, 334, 335, 336
34.	Metal containers	341
35.	Heating, plumbing, and fabricated structural metal products	343, 344
36.	Screw machine products	345
37.	Metal stampings	346
38.	Other fabricated metal products	342, 347, 349
39.	Ordnance and accessories, except vehicles and guided missiles	348
40.	Engines and turbines	351
41.	Farm and garden machinery	352
42.	Constructing and mining machinery	3531, 3532, 3533, 3795
43.	Materials handling machinery and equipment	3534, 3535, 3536, 3537
44.	Metalworking machinery and equipment	354
45.	Special industry machinery and equipment	355
46.	General industrial machinery and equipment	356
47.	Miscellaneous machinery, except electrical	359
48.	Office, computing, and accounting machines	357
49.	Service industry machines	358

(*continued*)

Appendix. (*continued*)

50. Electrical transmission and distribution equipment and industrial appliances	361, 362
51. Household appliances	363
52. Electrical lighting and wiring equipment	364
53. Radio, television and communication equipment	365, 366
54. Electronic components and accessories	367
55. Miscellaneous electrical machinery, equipment, and supplies	369
56. Motor vehicles and equipment	371
57. Aircraft and parts	372, 376
58. Other transportation equipment	373, 374, 375, 379 (exc. 3795)
59. Professional, scientific, and controlling instruments and supplies	381, 382, 384, 387
60. Optical, ophthalmic, and photographic equipment and supplies	383, 385, 386
61. Miscellaneous manufacturing equipment	39

NOTES

1. This is discussed further in United Nations (1984, 1047–48).

2. Belous (1985) discusses another approach to defining the high-technology sector, namely, making qualitative judgments about the nature of the goods or services produced by the industry or about the actual production technology employed by the industry.

3. For a description of the data base created by the Industrial Analysis and Productivity Research Program, see Mohr (1980).

4. This confirms the validity of the R & D/sales ratio as the appropriate measure for distinguishing the high-technology sector from the rest of manufacturing.

5. In 1960, 50 percent of the U.S. labor force had fewer than 12 years of schooling; 40 percent had 13 to 15 years; and 9.6 percent had 16 or more years. By 1970 the distribution had changed to 34.8 percent, 52.3 percent and 12.9 percent, respectively (U.S. Department of Labor 1985, 164).

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