NBER WORKING PAPER SERIES

TECHNOLOGICAL CHARACTERISTICS OF INDUSTRIES AND THE THE COMPETITIVENESS OF THE U.S. AND ITS MULTINATIONAL FIRMS

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Working Paper No. 2933

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
April 1989

The research reported on here is part of the National Bureau's program in International Studies. It was supported by a grant to the National Bureau by the National Science Foundation and by a grant to the University of Pennsylvania by the Ford Foundation. We are indebted to David Robinson for research assistance and to Maryellen Sykes, James Hayes, and Rosa Schupbach for preparation of the manuscript. Any opinions expressed are those of the authors and do not necessarily reflect those of the National Bureau of Economic Research or the sponsoring agencies.

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ABSTRACT

The share of U.S. multinational firms in world exports of manufactures has remained almost constant at about 17 per cent for the last 20 years while that of the U.S. as a country has declined substantially.

The composition of world manufactured exports shifted toward high-technology or R&D-intensive products during these years and away from low-technology products. The comparative advantage of the U.S., and even more that of U.S. multinationals, were in high-tech products throughout the period, as was that of Japan. However, the U.S. and its multinationals shifted even further toward such products during the period than did the world as a whole, and the Asian NIC's exports moved still faster in this direction.

With respect to short-run fluctuations, we find that the export shares of U.S. multinationals have been less sensitive to exchange rate fluctuations than those of the U.S. And shares in high-tech exports have been less sensitive than those in low-tech exports.

High R&D intensity was a factor raising the competitiveness of U.S. industries and particularly that of U.S. multinationals in those industries. High advertising intensity raised the competitiveness of U.S multinationals but not usually that of their industries. Higher growth in R&D-intensity also led to increase in multinationals' shares of world exports between 1977 and 1982.

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Technological Characteristics of Industries and The Competitiveness of the U.S. and Its Multinational Firms

Introduction

As we showed in earlier work (Lipsey and Kravis, 1987), the shares of the U.S. and the shares of U.S. multinational enterprises (MEs) in world manufactured exports have changed in very different ways. Thus, in analyzing the causes of changes in competitiveness, a distinction must be made between the competitiveness of the United States as a location and the competitiveness of U.S. MEs which export both from the U.S. and from foreign locations. For example, the case for attributing the falling U.S. share in world exports to failures of American management, such as undue attention to short-run profits, is weakened if American controlled affiliates abroad, presumably under the same management, do not also experience declining export shares.

In this paper, we compare the trends in competitiveness for the U.S. and its multinationals for industries of differing R & D or technological levels with those of some of the main rivals of the U.S. as exporters of manufactured goods. We then attempt to explain the differences among industries by such potential influences on competitiveness as capital intensity, labor costs, and investment in R&D and in advertising.

The ME is an enterprise that has broken or at least loosened the dependence on home country factors of production and their prices. It can avoid or reduce the consequences of macroeconomic events such as inflation in the home country that reduces the country's overall competitiveness. It can escape the consequences of long-run changes in home country factor prices, such as a rise in the price of labor as the home country develops and reaches higher income levels. Consequently, relative factor prices in the U.S. and

factor intensities should have more explanatory power for the exports of non-multinational U.S. firms, necessarily originating in the U.S., than for the worldwide exports of multinational firms.

Trends in The Competitiveness of the U.S. and of U.S. Multinationals

Export Shares in Total Manufactures

The contrast between the movement of U.S. shares and those of U.S.-owned multinationals in world exports of manufactures is clearly visible for the twenty-year span in Table 1, where we have revised and updated our earlier calculations. The U.S. share dropped from 17 per cent in 1966 to 13 per cent in 1977, recovered somewhat from 1977 to 1982 after a period of low exchange values for the dollar, and then fell again over the next four years, with a particularly sharp drop to 12 per cent in 1986. These changes in the export shares of the U.S. took place in a world of rapidly expanding trade. Of the other two members of the trio that are, with the U.S., the world's leading manufactures exporters, the German share showed no trend while the Japanese share climbed from 7 per cent in 1966 to 14 per cent in 1985 and 1986.[1] Other big gainers were four newly industrializing Asian countries (Korea, Hong Kong, Singapore, and Taiwan) whose aggregate share jumped from 1.5% in 1966 to 7% in 1986.

The U.S. multinationals' share of world exports showed a slight upward trend until 1985 and then a large decline, as did the U.S. share (The 1986 data on multinational exports are preliminary but the revisions in previous years were slight.) Within multinational firms, there was a tendency for the

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[1]GATT data show a drop of more than 1 percentage point in Japan's share from 1986 to 1987, a slight increase in the German share, and a slight decline in that of the U.S. However, the GATT definition of "manufactures" is not the same as used here (GATT, 1988, Tables AB3, AB8, AB9, and AB11.)

Table 1

Shares (%) of the U.S., U.S. Multinationals, Japan, Germany, and Asian NICs[a] in World[b] Exports of Manufactures
Selected Years, 1966-86

	1966	1977	1982	1985	1986[c]
U.S.	17.1	13.2	14.6	13.4	11.7
Japan	7.2	11.1	12.1	13.7	13.7
Germany	14.2	15.5	14.3	13.5	15.1
Asian NICs	1.5	4.2	6.0	7.0	7.1
U.S. Multinationals[d]	17.3	17.5	17.6	18.3	16.7
Parents	10.7	9.2	9.4	9.4	8.1
Affiliates[e]	8.0	9.6	9.6	10.3	9.8

[a]Korea, Hong Kong, Singapore, & Taiwan

[b]Market Economies

[c]Preliminary

[d]Parents and majority-owned affiliates

[e]Share of majority-owned affiliates in exports of world except U.S.

Source: UN trade tapes and U.S. Department of Commerce (1975), (1981), (1985), (1988a), (1988b)

shares of parents in world exports to decline, while the shares of affiliates in exports of the world outside the U.S. drifted upwards. The affiliate share of world exports declined in 1986, as did the U.S. and parent shares, but to a much smaller degree. In 1985 and 1986, parent shares were below the 1966 level, while affiliate shares were well above it.

The share of majority owned affiliates in the total exports of the multinational firms increased sharply over the 20 year period with the biggest jump from 1966 to 1977:

	Share (%) of Majority-Owned Affiliates in Exports of U.S. Multinationals
1966	38.1
1977	47.6
1982	46.7
1983	48.4
1984	48.9
1985	48.8
1986	51.6

Source: Lipsey, Blomström, and Kravis (1989).

By 1986, U.S. multinationals were exporting more from their overseas affiliates than they were from the U.S.

The record of the 20 years since 1966 is one of a declining share for the U.S. in world exports of manufactures, while U.S. multinational firms, exporting from both the U.S. and from their overseas operations, kept their share constant or slightly increasing until 1985, and only in 1986 lost some ground. The world export share of the parent firms in the U.S. fell much more sharply in 1986 than did that of their foreign affiliates, a continuation of the 20-year trend in which U.S. multinationals supply larger and larger proportions of their worldwide export markets from their foreign production.

Export Share Trends and Technological Intensities

Much of the current discussions of the American trade position focuses not only on the overall share, but also on the extent of technological leadership. For the world as a whole, trade in manufactures has been shifting out of low tech goods into high products, according to data based on an OECD classification of the R&D-intensity of the industries from which exports originate:[2]

Distribution of World[a] Exports of Manufactured Goods, by Technology Class

	Low Technology	Medium Technology	High Technology	Total
1966	48.4	37.2	14.4	100.0
1977	43.2	39.0	17.8	100.0
1982	41.2	39.4	19.4	100.0
1985	38.5	39.8	21.7	100.0
1986	37.6	40.4	22.0	100.0

[a]Developed Market Economy

Source: NBER reclassification of data on UN trade tapes.

The distribution of world output has also been shifting toward high technology products, but not as rapidly as the export distribution (OECD, 1986, p. 63).

When we divide individual countries' exports into the three technology categories, we find, as we might expect, that both the United States and Japan have their highest shares in the most high-tech sector and their lowest shares in the low-tech one (Table 2). The Japanese high-tech shares are somewhat exaggerated because two groups that should ideally have been separated from the high-tech class, but were not, TV and radio equipment and transport

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[2]The assignment of industries to these three sectors is based on OECD (1986), with some modifications to fit the industry classification we use. For the industries in each class, see Table 7. In order to compare country trade data with data for multinationals we had to first assign SITC trade data

Table 2

Shares (%) of the U.S., Germany, Japan, and Asian NICs[a] in World Exports[b] of Three Technology Classes of Products,[c] Selected Years, 1966-86

	1966	1977	1982	1985	1986[c]
			High Technology		
U.S.	23.9	18.8	22.0	20.8	18.7
Japan	12.4	19.8	19.0	21.6	21.6
Germany	15.4	14.8	12.9	11.0	12.2
Asian NICs	.9	5.3	7.4	9.6	9.2
			Medium Technology		
U.S.	20.9	15.6	15.9	14.3	11.8
Japan	4.5	10.4	12.8	15.2	15.7
Germany	20.4	21.0	19.1	18.1	20.4
Asian NICs	.4	1.1	2.3	2.6	2.7
			Low Technology		
U.S.	11.5	8.3	9.1	7.5	7.0
Japan	7.8	7.7	7.7	6.9	6.0
Germany	8.4	10.5	10.2	10.1	11.1
Asian NICs	2.7	6.8	9.1	10.1	10.6

[a]Korea, Hong Kong, Singapore, & Taiwan

[b]Developed Market Economies

[c]For assignment of industries to technology classes, see Table 7

[d]Preliminary

Source: NBER classification of export data from UN Trade Tapes

equipment other than motor vehicles and aircraft, are much more important for Japan than for the U.S. The share of the Asian NICs in the high-technology group is probably also exaggerated for the same reason.

Both Japan and the Asian NICs gained ground in the high-tech group, the latter starting from almost nothing. The U.S. and Japan lost shares in the low-tech group while the Asian NICs gained sharply. Germany's strongest performance was in medium-tech exports in all the years, and it lost shares in the high-tech sector and gained in the low-tech sector.

Some of these changes in shares represent mainly the changes in each country's overall competitiveness in manufacturing, while others represent shifts in comparative advantage. (For a discussion of the relation between competitiveness and comparative advantage, see Appendix B). The comparative advantages of each country across these technology groups are shown in Table 3 by the ratios of shares in each technology class to country shares in total exports of manufactures.

For the U.S., there were clear trends in comparative advantage toward high-tech and away from medium-tech exports. The U.S. had a comparative advantage relative to the world as a whole in both groups initially, but lost it in the medium-tech group by 1986. The U.S. comparative disadvantage in low-tech exports in 1985 was the largest in the 20 years, but it was reduced in 1986. However, if there was any trend, it was for that disadvantage to

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by commodity to the industries for which data on multinationals were available and then to categorize the industries by technology levels. We use the terms high-, medium-, and low technology throughout this paper as shorthand for high, medium, and low R & D intensity.

Table 3

Comparative Advantage[a] of the U.S., Japan, Germany, and Asian NICs[b]
by Three Technology Classes of Products[c]
and Shares (%) in World Exports of Manufactures
Selected Years, 1966-86

	1966	1977	1982	1985	1986[c]
			High Technology		
U.S.	1.40	1.42	1.51	1.55	1.60
Japan	1.72	1.78	1.57	1.58	1.58
Germany	1.08	.96	.90	.81	.81
Asian NICs	.60	1.26	1.23	1.37	1.30
			Medium Technology		
U.S.	1.22	1.18	1.09	1.07	1.01
Japan	.62	.94	1.06	1.11	1.15
Germany	1.44	1.35	1.34	1.34	1.35
Asian NICs	.27	.26	.38	.37	.38
			Low Technology		
U.S.	.67	.63	.62	.56	.60
Japan	1.08	.69	.64	.50	.44
Germany	.59	.68	.71	.75	.74
Asian NICs	1.80	1.62	1.52	1.44	1.49

[a]Share in Technology group relative to share in all manufactures
[b]Korea, Hong Kong, Singapore, & Taiwan
[c]For assignment of industries to technology classes, see Table 7
[d]Preliminary

Source: UN trade tapes and Table 2.

increase.

What is a little more surprising in Table 3 is that Japanese comparative advantage has not moved toward the high-tech group. If anything, Japan's exports in this set of products have not quite kept pace with the rise in Japanese manufactured exports in general, and Japan's comparative advantage in high-tech products relative to the U.S. has been reduced to something like equality between the two countries. However, these are fairly small changes that probably do not deserve any major effort at interpretation. The major changes in Japanese comparative advantage have been a large increase in medium-tech products and an even larger fall in low-tech products. These shifts probably reflect to some extent the large increase in Japanese real per capita income and increases in costs of unskilled labor over the period.

For the Asian NIC's, the outstanding development in comparative advantages was the strong shift toward high-tech products and the much smaller ones toward medium-tech and away from low-tech products. However, their strongest comparative advantage was still in low-tech products in 1985 and 1986.

When we compare the shares of U.S. multinationals with those of the U.S., we find that the ME shares were consistently much higher for the high- and medium-technology groups (Table 4).[3] The implication is that technology is an element of U.S. competitiveness but even more important for the competitiveness of U.S. multinationals. The same pattern of shares across technology groups is visible in 1977 and in the figures for 1985 and 1986 based on

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[3]We have two measures of the trade shares of multinationals, each based on a different way of assigning affiliates' trade to a technology class. Neither of the methods is ideal. One assigns each affiliate to the industry of its parent; the other to the industry in which the affiliate itself operates. The drawback to the classification by industry of parent, available only for

Table 4

Shares (%) of the U.S. and of U.S. Multinationals in World Exports[a] of Three Technology Classes of Products,[b] Selected Years, 1977-86

	1977	1982	1985	1986[c]
		High Technology		
U.S.	18.8	22.0	20.8	18.7
U.S. MEs, by Industry of Parent	28.8	33.3		
U.S. MEs, by Industry of Affiliate	(25.6)[d]	29.6	29.0	26.4
		Medium Technology		
U.S.	15.6	15.9	14.3	11.8
U.S. MEs, by Industry of Parent	26.5	24.1		
U.S. MEs, by Industry of Affiliate	(23.1)[d]	21.0	21.5	19.6
		Low Technology		
U.S.	8.3	9.1	7.5	7.0
U.S. MEs, by Industry of Parent	8.3	8.1		
U.S. MEs, by Industry of Affiliate	(7.4)[d]	7.2	7.4	6.8

[a]Developed Market Economies

[b]For assignment of industries to technology classes, see Table 7

[c]Preliminary

[d]Extrapolated from 1982 on the basis of the data by industry of parent.

Source: UN trade tapes and U.S. Department of Commerce (1975), (1981), (1985), (1988a) and (1988b).

affiliate industry, although the contrast between the U.S. and its multinationals is not quite as strong using the affiliate industry classification.

The changes in competitiveness from 1977 to 1982 and from 1982 to 1985 and 1986, although they provide only a few observations, seem consistent with the speculation that exchange rates influence U.S. trade shares far more than they affect U.S. multinational firm shares (Table 5). We might think of the earlier period changes as being influenced by the low level of the exchange value of the U.S. dollar reached around 1980 and the latter period as influenced by the subsequent rise of the value of the dollar. The changes in the share of total manufactures exports that we might attribute to exchange rate movements were much larger for the U.S. than for U.S. multinationals. That is especially clear for the period of the rising value of the U.S. dollar: from 1982 to 1985, the multinationals' share rose while that of the U.S. declined. From 1977 to 1982, when the exchange value of the dollar fell to low levels, the U.S. share gained much more than did the share of the U.S. multinationals.

Another contrast is by the technology levels of products: the decline in the U.S. share for medium-tech products from 1982 to 1985 was much larger than that for high-tech products, and the decline for low-tech products much larger

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benchmark survey years, is that, for example, it would include in the high-tech category a low-tech industry affiliate of a high-tech industry parent. The drawback to the classification by industry of affiliate is that it would, for example, exclude from the high-tech category exports of high-tech products by wholesaling affiliates of high-tech multinationals because wholesaling is not part of the manufacturing category. We suspect that the latter is a more important defect and therefore emphasize the data by the parent classification when we can.

Table 5

Percentage Change in Shares of the U.S. and U.S. Multinationals in World Exports[a] of Three Technology Classes of Products[b]

	1977-82	1982-85	1982-86[c]
		All Manufacturing	
U.S.	+11	-9	-20
U.S. Multinationals	+1	+4	-5
		High Technology	
U.S.	+17	-5	-15
U.S. MEs, by Industry of Parent	+16		
U.S. MEs, by Industry of Affiliate		-2	-11
		Medium Technology	
U.S.	+2	-10	-26
U.S. MEs, by Industry of Parent	-9		
U.S. MEs, by Industry of Affiliate		+2	-7
		Low Technology	
U.S.	+10	-18	-23
U.S. MEs, by Industry of Parent	-2		
U.S. MEs, by Industry of Affiliate		+3	-6

[a]Developed Market Economies

[b]For industry classification, see Table 7.

[c]Preliminary

Source: Tables 1 and 4.

than for medium-tech products. The differences could reflect differences in trend, but they might also represent a lower sensitivity to exchange rate changes--that is, a lower price elasticity of demand--for the higher-technology products.

The contrast between the change in shares of the U.S. and of U.S. multinationals was also much greater in the medium- and low-technology groups than in high-tech exports. High-tech exports by U.S. multinationals may be more dependent than medium- or low-tech exports on events specific to the U.S. economy, such as changes in U.S. exchange rates or other macroeconomic developments. That may be because high-tech exports are more likely to originate in the parent company or because there is less possibility of switching such exports from parents to affiliates.

We can translate the export shares of the U.S. and its multinationals into a comparative advantage framework by comparing the export shares in each technology group to overall manufactured export shares.

Relative to the U.S. as a country, U.S. multinationals had strong comparative advantages in medium-tech exports and comparative disadvantages in low-tech exports (Table 6). The picture for high-tech exports is not as clear because the preferred measure, by industry of parent, is not available for the later years. However, the multinationals had a comparative advantage relative to the U.S. as a whole in high-tech exports in 1982 and, if the relation between the two measures for the MEs remained constant, in 1985 and 1986 as well.

Explaining the Competitiveness of the U.S. and of U.S. Multinational Firms

The differences in the behavior of the shares in world manufactured

Table 6

Comparative Advantage[a] of the U.S. and U.S. Multinationals by Three Technology Classes of Products,[b] Selected Years, 1977-88

	1977	1982	1985	1986[c]
High Technology				
U.S.	1.42	1.51	1.55	1.60
U.S. MEs, by Industry of Parent	1.65	1.89		
U.S. MEs, by Industry of Affiliate	1.46	1.66	1.58	1.56
Medium Technology				
U.S.	1.18	1.09	1.07	1.01
U.S. MEs, by Industry of Parent	1.51	1.37		
U.S. MEs, by Industry of Affiliate	1.32	1.19	1.17	1.17
Low Technology				
U.S.	.63	.62	.56	.60
U.S. MEs, by Industry of Parent	.47	.46		
U.S. MEs, by Industry of Affiliate	.42	.41	.40	.41

[a]Share in technology group relative to share in all manufactures.
[b]For assignment of industries to technology classes, see Table 7.
[c]Preliminary

Source: Tables 1 and 4.

exports between the U.S. as a location and U.S.-controlled firms in all locations suggest that the competitiveness of the U.S. and its multinationals rest on different causes. In the case of country competitiveness, for example, these could be factor endowments and macroeconomic policies. The competitiveness of MEs presumably rests on various firm-specific assets. Since we are dealing here with differences among industries rather than among firms within industries, the determinants of competitiveness we use to explain them are industry, rather than firm characteristics. We have no way, in these data, of knowing whether an industry characteristic is typical of all firms in the industry or only of the multinational firms because we do not have separate data for each group. Most of our measures come from the data on multinationals, but some R & D data and the advertising data are for whole industries. In many of the industries, multinationals account for a large part of the industry's input and output, especially of the larger firms in the industry. The distinction between the multinationals and others may not, therefore, be of great importance.

The movements of parent and affiliate shares within the multinational firm also differ substantially. The differences are to be expected since the parent exports are the outcome of an admixture of own-firm and U.S. characteristics, while the affiliates' exports are the result of a combination of own-firm and host country characteristics.

The data used to investigate these differences are described more fully in Appendix A. They are drawn largely from the 1982 benchmark survey of U.S. investments abroad (U.S. Department of Commerce, 1985). This source contains statistics on U.S. parents and foreign affiliates for 32 manufacturing

industries. The data include various measures of capital and labor, sales to different destinations, and R & D activity. Data on advertising expenditures were obtained from U.S. corporate tax returns. The export statistics were taken from U.N. tapes, and reclassified to conform to the 32 industries used in the Commerce Department benchmark survey. (For a description of the concordance used for the reclassification, see Blomström, Kravis and Lipsey, 1989.)

It is to be expected that the nature of firms' advantages will vary from industry to industry, and that, more specifically, the roles of R & D and of advertising will vary from industry to industry. This can be seen in Table 7 in which R & D/sales ratios and ratios of advertising expenses to business receipts are shown for industries cross classified by technology level and advertising intensity. There are few surprises. Basic materials, like lumber and stone, clay, etc., tend to be clustered in the upper left cell which contains low-tech, low advertising industries.[4] The industries in the right-most column are industries catering to many individual buyers, and in which manufactures rely on advertising to win the brand allegiance of consumers. While the technology levels are based mainly on R & D intensity, there is no perfect correspondence with these R & D measures, which are based on R & D intensities of parent companies, classified by their major industries, rather than on R & D at the establishment or product level.

Our data include four industry characteristics: property, plant, and equipment per employee and average compensation per employee in U.S. parents,

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[4]Apparel may be heavily advertised, but one may surmise that a very large part of the advertising is carried on by wholesalers and retailers rather than the manufacturers.

Table 7

R & D and Advertising Intensities of Industries
Cross Classified by Technology Level and Advertising Intensity

Low Advertising Intensity (12)			Medium Advertising Intensity (15)			High Advertising Intensity (5)		
			A. LOW TECHNOLOGY (13)					
	R&D Sales	Advt./Bus. Receipts		R&D Sales	Advt./Bus. Receipts		R&D Sales	Advt./Bus. Receipts
Prim. Ferr.Metals	.30	.22	Print. & Publ.	.08	1.44	Beverages	.24	5.96
Lumb.,Wood, Furn.	.36	.71	Other Food	.36	1.97	Tobacco	.38	7.52
Textiles & Apparel	.24	.88	Paper, Pulp,etc.	1.11	1.05	Grain Mill,Bakery	.51	3.19
Glass	.61	.71						
Stone, Clay, etc.	.70	.62						
Prim.Nonferr.Metals	.80	.53						
Fabr. Metal Prod.	1.61	.83						
			B. MEDIUM TECHNOLOGY (12)					
Misc.Plastic Prod.	1.17	.73	Other Manufact.	.95	2.43	Soap, Cleansers, etc.	1.07	5.57
Other Non-El.Mach.	1.20	.90	Rubber Products	1.16	1.28			
Construction Mach.	1.26	.56	Farm &Gard.Mach.	1.58	1.33			
Industr. Chemicals	2.82	.83	Other Chemicals	2.08	2.04			
			Agric. Chemicals	2.11	2.17			
			Household Appl.	2.21	2.21			
			Motor Veh.Equip.	2.64	1.11			
			C. HIGH TECHNOLOGY (7)					
Other Transp.Equip	5.33	.43	Other Elec.Mach.	3.06	1.13	Drugs	7.34	6.21
			Instruments,etc.	4.88	2.51			
			Office, Computer Machinery	12.33	1.26			
			Electronic Components	13.12	1.24			
			Radio, TV, etc.	13.12	1.69			

Notes to Table 7

The classification of industries into the three levels of technological intensity is based on an OECD classification which depends on 11-country weighted averages of 1980 R & D expenditures to production (OECD, 1986). The R & D/Sales ratios shown in the table refer to the U.S. and have been estimated by the authors from R & D intensities by SITC product groups in Aho and Rosen (1980). The calculation was performed using the concordance between the SITC trade classification and the BEA industry classification given in Blomström, Kravis, and Lipsey (1988) and weighting the commodity groups by 1982 U.S. exports. If the Department of Labor ratios were used, Fabricated Metal Products would clearly be assigned to the medium technological intensity group. More marginally, the positions of Paper, Pulp, Etc. and Other Manufactures would be inter-changed. If an intensity range of 1 to 3 percent were taken as the limits of the medium class, no further changes beyond these three industries would have to be made.

For advertising, the limits of the medium category were taken as 1 to 3 percent.

The number of industries is given in parentheses.

the ratio of advertising expenditures to total business receipts in the U.S. industry as a whole, and the ratio of R & D employment to total parent employment. The first of these is a measure of physical capital intensity. The second is a measure of human capital intensity or, possibly, of the price of labor, if that price differs substantially among industries for labor of a given quality. The third and fourth are indicators of what we expect to be firm-specific attributes: R & D and advertising intensity.

The competitiveness of the United States is explained mainly, but not very fully, by R & D intensity and average compensation, the former a positive influence and the latter a negative one (Table 8, line 1). The same equations do much better in explaining the competitiveness of U.S. multinationals (Table 8, line 3), the two significant influences here being the ones associated with the creation of firm-specific advantages, R & D intensity and advertising intensity. The higher each one is in an industry, the larger the share of U.S. multinationals in world exports in that industry.

The separate equation for non-multinationals (Table 8, line 2) has the disadvantage that the dependent variable -- export shares of non-multinational firms -- is obtained by subtracting ME exports from U.S. exports, thus concentrating errors of observation on this dependent variable. Compounding this difficulty is the fact that the sales and export data for parents and affiliates from the Department of Commerce benchmark study of MEs include all of the firm's exports -- not only those in a given specified manufacturing industry, but also exports produced primarily by other manufacturing industries and by non-manufacturing industries as well. For many firms classified in a particular manufacturing industry because that is their pri-

Table 8

Regressions (log) Explaining Shares in World Manufactures Exports
(32 Industries)
1982

Dependent Variable: Share in World Exports	Intercept	Par.PPE/ Empl.	Parent Wage	Advertising/ Bus.Receipts	Parent R&D Employment/ Total Empl.	$\bar{R}^2$
1. U.S. Exports	4.20 (1.9)	.278 (1.2)	-1.57 (2.2)	-.041 (.3)	.578 (3.9)	.290*
2. Non-ME Exports[a]	11.02 (1.7)	.429 (.7)	-3.72 (1.9)	.267 (.5)	.604 (1.4)	.055
3. ME Exports	1.81 (.9)	.341 (1.6)	-.259 (.4)	.371 (2.8)	.630 (4.5)	.576**
4. Parent Exports	1.09 (.4)	.545 (1.9)	-.481 (.5)	.211 (1.2)	.810 (4.4)	.494**
5. Affiliate Exports	1.90 (.7)	.271 (1.0)	-.327 (.4)	.587 (3.5)	.502 (2.8)	.451**
6. ME External Exports[b]	.612 (.2)	.526 (2.0)	-.688 (0.8)	.206 (1.3)	.419 (2.6)	.241*
7. ME Intra-firm Trade[c]	2.60 (1.0)	.237 (.9)	-.095 (.1)	.689 (4.3)	.778 (4.6)	.653**
8. ME Sales to Foreigners[d]	2.32 (1.0)	.294 (1.2)	.083 (.1)	.670 (4.6)	.369 (2.4)	.522**

**Significant at 1% level
*Significant at 5% level

[a]27 industries. Excludes 5 industries in which parent exports exceeded U.S. exports.
[b]Exports to unaffiliated buyers.
[c]Exports to affiliated buyers.
[d]Parent exports to unaffiliated buyers plus affiliate sales other than to the U.S.

mary activity, sales and exports in other industries, both manufacturing and non-manufacturing, are substantial. An extreme example is provided by parents in the tobacco manufacturing industry, for which less than half of total sales consists of tobacco manufacturing industry products (U.S. Dept. of Commerce, 1985, Table III, N2). One result of this classification problem is that for 5 industries, parent exports as entered in the benchmark data exceed U.S. exports (drugs, soap, etc., radio and TV, tobacco, and rubber). (This mix-of-industry problem also affects the regressions for MEs, parents, and affiliates.) All things considered, it is hardly surprising that the equation for non-MEs (Line 2), which excludes the 5 industries for which parent exports exceeded U.S. exports, is not significant.

If we separate the exports of multinationals into parent and affiliate exports, we find that the R & D intensity is a significant positive influence on both, but with a much larger coefficient for parent exports (Lines 4 and 5). Advertising intensity is only significant for affiliate exports. There is an implication here, that high R & D intensity moves multinationals in the direction of serving their foreign markets from U.S. production, while high advertising intensity provides no such incentives and leaves them free to supply export markets from their foreign operations. However, when the share of parents in total ME exports was regressed against R & D and advertising intensities, neither the coefficient of R & D nor that of advertising was significant, though the former had a positive and the latter a negative sign.

Important as high advertising intensity is for explaining the export competitiveness of the multinationals and especially their foreign operations, it plays an even larger role in explaining their total foreign sales including

their domestic as well as their export sales.[5] High R & D intensity also tends to lead to large foreign sales, but the effect here is not as strong as on the multinationals' exports from the U.S.[6]

Changes in Shares between 1977 and 1982

To what extent do changes in the variables discussed thus far explain changes in the world export shares of the U.S. and U.S. multinationals between 1977 and 1982? In addition to changes between 1977 and 1982 in R & D and advertising intensities, the two variables that explained the level of ME exports, we include three other independent variables. One is the initial (1977) share of U.S. multinationals in the industry's world exports, another is the growth in world exports in the industry, and the third is the change in affiliate sales in the industry.

The initial share variable is a check on the possibility that the results could be biased by the presence of very high shares that cannot increase much under any circumstances, and the presence of low initial shares, which might produce large gains in shares that are of little significance. The growth of world exports in an industry might affect shares if, for example, it was harder for an existing firm to hold on to past shares in a rapidly growing industry. And the affiliate sales variable might flag any substitution of affiliate for parent sales.

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[5]The sum of parent exports from the U.S. to unaffiliated buyers and total sales of foreign affiliates excluding sales to the U.S. Using world exports of an industry as a denominator, or industry scaling variable, is not really appropriate for total foreign sales, but we do not have data for worldwide sales or consumption, which would be preferable.

[6]As noted earlier, the R & D intensities in these equations are derived from the data for multinationals, and could conceivably not be typical of the whole industries involved. However, the substitution of Department of Labor R & D/shipments ratios, referring to all firms in each industry, produced

Table 9

Regressions (log) Explaining Changes in U.S. Multinationals' Shares of World Manufactures Exports, 1977-82

Dependent Variable 1982/77	Intercept	Adver-tising/ Receipts	R&D/ Sales	World Exports	Affiliate Sales	Affiliate Net Sales	World Exports	1977 Share in World Exports	$\bar{R}^2$
	Ratios of 1982 to 1977								
1. ME Exports (26)	.643 (1.8)	-.021 (.4)	.120 (2.8)	-.165 (.6)	.305 (2.7)			-.032 (.1)	.339*
2. ME Exports (26)	.661 (2.2)	-.020 (.4)	.121 (3.0)	-.184 (1.0)	.307 (2.8)				.370*
3. ME Exports (26)	.569 (1.7)	-.020 (.4)	.119 (2.8)	-.081 (.5)		.261 (2.3)			.313*
4. ME Exports (26)	.524 (.4)	-.022 (.4)	.117 (2.6)	-.033 (.1)		.257 (2.2)		-.084 (.2)	.281*
5. Parent Exports (26)	.924 (2.0)	-.032 (.5)	.316 (5.6)	-.190 (.7)			-.220 (1.4)	.743 (1.3)	.567*
6. Parent Exports (26)	.998 (2.2)	-.044 (.7)	.317 (5.8)	-.129 (.5)		-.267 (1.9)		.819 (1.51)	.595*
7. Affiliate Exports (28)	.117 (.2)	-.071 (.9)	-.030 (.4)	.796 (1.8)				-2.37 (2.1)	.049

**Significant at 1% level
*Significant at 5% level

Number of industries in parentheses

For the multinationals as a whole, inclusive of parents and affiliates, the greater the increase in R & D intensity for parents, and the more rapid the growth of affiliate sales, the larger the growth of exports (Table 9, lines 1 and 2). Since affiliate sales are partly resales of parent exports included in the dependent variable, that affiliate sale coefficient is somewhat ambiguous. In lines 3 and 4, we substitute the growth of affiliate net sales, which are affiliate sales net of imports from the parent. This is a rough measure of the affiliates' own production and does not overlap the dependent variable. The results are essentially the same, although the $\bar{R}^2$ are lower and the coefficients of affiliate net sales are smaller than those for gross sales. Again, the growth of exports by multinationals in an industry is higher, the larger the increase in parent R & D intensity and the greater the increase in affiliate production in that industry.

For parents, the only significant relationship was that competitiveness tended to increase in industries in which R & D intensities rose. If we include the growth of affiliate net sales in the equation, representing affiliate production, the coefficient is negative and almost statistically significant. That is, the faster the growth of affiliate production in an industry, the slower the growth of parents' exports from the U.S. Since the effect of the growth of affiliate production on the growth of the whole multinational's exports is positive, there must be a larger effect of affiliate production on exports by the affiliates themselves.

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substantially similar results. (See Appendix Table 1.)

For affiliates, we did not succeed in explaining changes in exports to any significant degree. They tended to gain shares in industries in which world trade was rapidly growing, and to lose shares in industries in which the U.S. had high initial shares.

Conclusions

The competitiveness of the U.S., defined as its share in world manufactured exports, dropped from 17 per cent to less than 12 per cent in the period 1966-86. Most of the decline occurred between 1966 and 1977. There was some improvement between 1977 and 1982, but there has been a steady erosion since then. Over the same 20 years, the shares of Japan and the Asian NICs rose rapidly and that of Germany was roughly stable.

The share of U.S. multinational firms, including exports from the U.S. and from the foreign locations of majority owned foreign affiliates, edged upward between 1966 and 1985, although there was a sharp decline in 1986, the last year for which data are available.

The favorable performance of U.S. multinationals, relative to the U.S. as a country, was mainly in the form of a rise in exports from majority owned foreign affiliates. By 1986, they accounted for a little over half of the manufactures exports of U.S. multinational firms. The performance of the parent firms in exporting from the U.S. was not as unfavorable as that of all U.S. firms, including non-multinationals.

U.S. and Japanese shares of world exports have been higher in high- and medium-technology products than in low-tech products. The German share was highest in the medium-tech sector, and that of the Asian NICs in low-tech

exports. These overall changes in manufactures export shares occurred against a background in which world trade was shifting towards technology intensive goods. High tech products expanded from 14 percent of world manufactures exports in 1966 to 22 percent in 1986, while the share of medium tech products remained near the 40 percent level and the low tech shares declined from 48 to 38 percent. The comparative advantage of the U.S. has been moving toward the high-tech sector, as has that of the Asian NIC's, particularly from 1966 to 1977, while those of Germany and Japan have shifted away from that sector.

In the medium-tech sector Japan has gained and the U.S. has lost. There has also been a substantial loss for Japan in the low-tech sector, which is not surprising given the rapid rise in Japanese income levels.

U.S. multinationals' comparative advantage was even more tilted toward high-tech and medium-tech products than that of the U.S. They lost some comparative advantage in medium-tech products over the latest decade, as the U.S. did, and gained some in high-tech areas.

The differences between the U.S. as a location and U.S.-controlled firms in all locations in the behavior of the shares in world manufactured exports suggest that competitiveness must rest on different industry characteristics or different responses to the same characteristics.

Shorter-term differences between the behavior of U.S. shares and that of U.S. multinationals suggest that the multinationals' exports were less sensitive to changes in U.S. exchange rates. Also, exports of high-tech products appear to be less sensitive to exchange rate more than those of low-tech products.

R & D intensity was clearly a factor that raised the competitiveness of

industries in the U.S. and in U.S.-controlled operations worldwide. That comparison among industries confirms the impression from the aggregate data on technological levels of exports examined earlier. In addition, high advertising intensity added to the competitiveness of U.S. multinationals, but not that of the U.S., while high compensation levels were associated with lower U.S. export shares but not with the shares of U.S. multinationals. Thus, the multinationals' competitiveness was determined in large part by the level of investment in firm-specific assets, while the competitiveness of the U.S. was much less well accounted for by these variables.

The same advertising and R & D-intensity variables explained not only the multinationals' exports but also their total sales in foreign markets, including local sales in their host country markets. The higher the R & D and advertising intensity, the higher these foreign market shares. Advertising and R & D intensity explained even better the importance of exports that were intra-firm trade; the higher advertising and R & D intensities were in an industry, the higher the proportion of world-exports represented by the multinationals' exports to their own affiliates. The results appear to confirm the role of these types of investment in leading to the internalization of trade transactions.

Just as R & D intensity helped to explain the level of U.S. multinationals' exports and foreign sales, changes in R & D intensity were associated with the growth of multinationals' trade shares. The more rapid the growth of R & D intensity, the more rapid the growth of exports by multinationals. More rapid growth of affiliate production tended to increase the rate of growth of the total exports of multinationals in an industry but to decrease that of the parents in favor of that of the affiliates.

Appendix A

The Data

Most of the data were taken from the Commerce Department's 1982 benchmark survey of U.S. direct foreign investment (Department of Commerce, 1985). In this source, sales of U.S. parents are broken down into sales to U.S. persons, to foreign affiliates, and to other foreign persons. Parent exports were taken as the sum of the last two categories.[7] Sales of majority owned affiliates are subdivided into local sales, sales to the U.S., and sales to other countries. Affiliate exports was taken as the difference between total sales and local sales. ME exports were obtained by summing parent exports and affiliate exports.

The capital/labor ratio derived from the benchmark data is the ratio of net property, plant, and equipment to the number of employees. An alternative capital/labor ratio using total assets as the measure of capital yielded similar results, sometimes with marginally higher t-statistics. The net property measure was selected because it comes closer to the Heckscher-Ohlin concept of capital as physical assets than does total assets which includes cash, receivables, and external investments such as those in other firms.[8] Data for both concepts are based on historical cost.

The benchmark data include data on compensation per employee ("wage") for

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[7]Sales to other foreign persons and also sales to foreign affiliates may include changes in ownership that do not involve any movement of a product or service across national borders, but these are apparently concentrated mainly in services and petroleum.

[8]Kravis and Lipsey, 1982.

U.S. parents in each industry. On the basis of the literature on comparative advantage, it is anticipated that exports from the U.S. will be intensive in human capital. If interindustry wage differences reflect human capital intensities, U.S. exports should be greater in industries with higher wages as compared to other U.S. industries, other things being equal. If, on the other hand, the industry differences are due mainly to differences in worker's bargaining power, low wage industries could be expected to do better in world competition. There is no a priori expectation about the human capital intensity of U.S. multinational parents versus that of other U.S. firms.

R & D and advertising serve here as indicators of the firm's specific advantages, but each has its limitations for this role. R & D refers to the current year expenditures or employment seeking new knowledge, whereas a measure of the accumulated stock of knowledge is desired. However, there is a very high correlation between the distribution of R & D expenditures in different individual years and the cumulation of R & D expenditures over the years to get closer to a stock measure.[9]

There are also some measurement problems concerning R & D. For the most part, the R & D data are drawn from the benchmark survey of U.S. direct foreign investment. A choice has to be made between R & D expenditures for parents and majority-owned affiliates (MAJs) and R & D carried out by them. For affiliates, there is not much difference between the two series, but for parents, R & D performed for others, mainly the U.S. Government, was substantial; R & D performed by the parents was 47 percent higher than R & D

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[9]For example, the Pearson correlation coefficient for 1982 and 1980-1982 R & D expenditures relative to sales was .997. For 1982 and a 10 year cumulation, it was .985. (Compustat data for 699 manufacturing firms.)

performed for parents in all industries combined and 57 percent higher in manufacturing. About one-third of the parent R & D expenditures was on R & D performed for others, with all but around 4 percent for the federal government (III Q1). While the analyses are based for the most part on R & D reported by the MEs in the Department of Commerce survey, ratios of R & D expenditure to shipments for U.S. firms in general, available from a Department of Labor study, are also used.

More reliance was placed on an alternative measure of R & D activity -- the proportion of employees engaged in R & D. Employment data are available for all 32 manufacturing industries, but R & D expenditures by affiliates are available for only 27 industries. Employment might be a better indicator if there are large differences between parents and affiliates in the prices paid for labor and other R & D inputs. More on this point presently.

Advertising data were not available from the benchmark survey. They were taken relative to business receipts, from corporate tax returns.[10] Unlike the other variables which refer to MEs, these data refer to the whole set of corporate tax filers. Also advertising may be more closely related to the nature of the product than to the structure of the firm. They may be a reasonably good indicator of efforts to differentiate products by different firms within an industry, but the role of advertising varies according to the concentration of buyers of the products of the industry. The advertising budget relative to sales for corn flakes is probably much larger than that for Boeing 747s. Also, the advertising expenditures refer mainly to the parent

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[10]Internal Revenue Service, Source Book, Statistics of Income, 1982.

company and may or may not include the expenditures of affiliates.[11]

Averages or aggregates for the variables involved in the analysis are shown in Appendix Table 2. Majority-owned affiliates were much more export oriented than their parents were; they exported one third of their sales, while parents exported a little over a tenth of their sales. Still, as a result of the much larger parent sales base (line 1), the dollar exports of parents and affiliates are not very different (line 9). Trade between parents and majority-owned affiliates was an important but not a dominating factor in the exports of both. Parent sales to these affiliates accounted for 35 percent of parent exports, and the corresponding share of the affiliates' exports going to the U.S. was not very different--30 percent.

R & D expenditures by majority-owned affiliates were less than 7 percent of those of parents, but the number of their R & D employees was 15 percent of parent R & D employment. The difference in the expenditure and employment percentages largely reflected the lower per employee compensation that prevailed in affiliate employment (see line 8).

If this difference reflects a lower quality of R & D labor in affiliates, expenditures are the better indicator of relative R & D activity, but if, as seems more likely, it represents mainly differences in labor and other costs, employment is the preferable indicator.

The use of advertising data based on tax returns involves the assumption that the relative importance of advertising for the non-multinational firms in different industries is similar to that of the multinational firms in those

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[11]Corporations could file consolidated returns for 80%-owned affiliates.

industries. For all corporate income tax filers, the percentage of business receipts devoted to advertising varied among the 32 industries from 0.2 to 2.5, and the average was 1.9.

Appendix B

Comparative Advantage and Competitiveness

There have been many studies seeking the sources of the comparative advantage of the United States. That comparative advantage, typically measured in empirical studies in terms of shares in world exports, or sometimes in terms of net exports, presumably depends in the long run on the supply and prices of productive factors in the United States and on inter-industry differences in productivity of U.S. industries relative to those of other countries. The factors of production that are relevant to U.S. comparative advantage must be those that tend to be immobile between the United States and other countries, since mobile factors tend to have more nearly equal prices in all countries or would move from one country to another in such a way as to eliminate price differences.

For an industry, changes in competitiveness and in comparative advantage are essentially the same phenomena, except that the former include the effects of changes in the overall competitiveness of the country, as measured by its aggregate export shares.

More precisely, we can define the overall competitiveness of the U.S. (C_{US}) as $\frac{EXUS}{EXW}$, where EXUS is exports to the world from the U.S., and EXW is exports by the world as a whole.[12] While these measures refer mainly to markets outside the U.S., competitiveness could also be measured as the shares of domestic production and of imports in the U.S. market. Ideally, we would like to measure competitiveness in all markets including each country's domestic market, but that would require the assembling of comparable

production and consumption data, in addition to the more readily available trade data we have used.

Here, we use world trade as the basis and measure the U.S. comparative advantage (or disadvantage) in an industry i as

$\frac{EXUS_i}{EXUS} \div \frac{EXW_i}{EXW}$ or as $\frac{EXUS_i}{EXW_i} \div \frac{EXUS}{EXW}$, and we speak of the U.S. has having a comparative advantage in industry i relative to the world if $\frac{EXUS_i}{EXUS} > \frac{EXW_i}{EXW}$ or, in other words, if $\frac{EXUS_i}{EXW_i} > \frac{EXUS}{EXW}$.
The latter expression can also be described as showing that the United States is more competitive in industry i than in industries in general.

There is, of course, no such thing as an overall comparative advantage, but if one thinks of $EXUS_i/EXW_i$ as an absolute measure of the competitiveness of U.S. industry i, one can also think of the U.S. as having an overall competitive position represented by EX_{US}/EX_W. A change in the competitiveness of the U.S. in industry i, from 1977 to 1982, for example, $\frac{EXUS_i(82)}{EXW_i(82)} \div \frac{EXUS_i(77)}{EXW_i(77)}$ can be thought of as the product of two elements: a change in the overall competitiveness of the U.S., $\frac{EXUS(82)}{EXW(82)} \div \frac{EXUS(77)}{EXW(77)}$, and a change in the comparative advantage of the U.S. in industry i:

$$\frac{\frac{EXUS_i(82)}{EXW_i(82)}}{\frac{EXUS(82)}{EXW(82)}} \div \frac{\frac{EXUS_i(77)}{EXW_i(77)}}{\frac{EXUS(77)}{EXW(77)}}$$

A parallel set of calculations can be performed for U.S. multinational enterprisea (MEs), combining all their worldwide operations. However, the

basis for the competitiveness and comparative advantage of the multinationals, since it involves production outside the United States, must be different from that of the U.S. For the ME, competitiveness must rest on specific advantages that are relatively immobile among firms but mobile across country boundaries (Lipsey and Kravis, 1985; Lipsey, 1988). They might include the possession of patents or other technological assets arising from the firm's research and development investment. They may involve techniques of managing certain types of production or marketing operations or the exploitation of a reputation for quality or service associated with a particular brand or firm name.

Appendix Table 1

Regressions (log) Explaining Shares in World Manufactures Exports
with Two Versions of R&D Expenditures
(30 Industries)

A. Department of Commerce R & D/Sales Data

Dependent Variable: Share in World Exports	Intercept	Par.PPE/ Empl.	Parent Wage	Parent R&D Advertising/ Bus.Receipts	Parent R&D Expenditures /Sales	$\bar{R}^2$
1. U.S. Exports	1.25	.298	-9.03	-.028	.356	.109
	(.5)	(1.2)	(1.2)	(.2)	(2.6)	
2. Non-ME Exports[a]	2.97	.145	-1.89	.095	.012	-.104
	(.4)	(.2)	(.9)	(.2)	(.03)	
3. ME Exports	-.415	.405	.227	.408	.445	.468*
	(.2)	(1.6)	(.3)	(2.8)	(3.4)	
4. Parent Exports	-.855	.657	-.059	.309	.613	.408*
	(.3)	(2.0)	(.06)	(1.6)	(3.4)	
5. Affiliate Exports	-.820	.291	.272	.573	.310	.316*
	(.3)	(1.0)	(.3)	(3.2)	(1.9)	

B. Department of Labor R & D/Sales Data

1. U.S. Exports	-1.58	.110	-.313	-.042	.253	.077
	(.9)	(.5)	(.5)	(.3)	(2.4)	
2. Non-ME Exports[a]	3.47	.199	-2.13	.088	.107	-.098
	(.7)	(.3)	(1.2)	(.2)	(.3)	
3. ME Gross Exports	-4.00	.164	.988	.392	.308	.426*
	(2.2)	(.7)	(1.6)	(2.6)	(2.9)	
4. Parent Gross Exports	-5.96	.304	1.07	.291	.398	.332*
	(2.4)	(1.0)	(1.2)	(1.4)	(2.8)	
5. Affiliate Exports	-3.21	.138	.749	.560	.233	.312*
	(1.5)	(.5)	(1.0)	(3.1)	(1.9)	

* Significant at 1% level

a. 25 industries. Excludes 5 industries for which parent exports exceeded U.S. exports and 2 industries for which Dept. of Commerce R & D expenditure data were unavailable.

Appendix Table 2

Sales, Factor Intensities, Exports and R & D for Parents and Affiliates in Manufacturing, 1982

	Parents	MOFAS
1. Sales (mil. $)	990,570	271,099
2. Total assets ($ bil.)	1,000	190
3. Net plant property & equip. ($ bil.)	327	66
4. Employee compensation ($ bil.)	306	57
5. Employment (1000)	10,268	3,558
6. Total assets/employment ($1000)	97	57
7. Net property/employment ($1000)	32	20
8. Compensation per employee ($1000)	30	17
9. Exports (mil. $)	109,849	91,832
10. Exports/Sales (9 ÷ 1) (%)	11.1	33.9
11. R & D by firm (mil. $)	47,145	3,247
12. R & D/Sales (11 ÷ 1) (%)	4.8	1.2
13. R & D employees (1000s)	503.7	76.2
14. R & D employees as % of all employees	1.8	2.3

Source: U.S. Department of Commerce (1985)

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