NBER WORKING PAPER SERIES

MULTINATIONAL FIRMS AND THE FACTOR INTENSITY OF TRADE

Robert E. Lipsey
NBER and Queens College, CUNY

Merle Yahr Weiss
NBER and Temple University

with the assistance of
Barbara Rotenberg

Working Paper No. 8

NATIONAL BUREAU OF ECONOMIC RESEARCH, INC.
261 Madison Avenue
New York, N.Y. 10016

September 1973

Preliminary; Not for Quotation

In studying the impact of direct investment on the amount, direction, and composition of international trade we have found that the multinational firm fits uncomfortably into the usual theory of trade and capital movements. We attempt here to introduce the fact of the existence of multinational firms into the explanation of trade flows and particularly into the long-running debate over the relations among factor abundance, factor prices, and trade.*

Our thinking about the operation of the international economy is dominated by two sets of theories, one relating to commodity trade and one relating to factor (particularly capital) movements. Factor proportions theories explain the location of production and the movement of commodities by differences among commodities in relative factor requirements and differences among countries in relative factor abundance, and therefore price, under the assumption that resources are immovable across national borders. Theories of capital movement explain the flow of capital from one country to another by differences in rates of return.

When we consider direct investment or, more generally, the operations of multinational firms, it becomes clear that there is much that cannot be understood in terms of either of these sets of theories. For example, while there may be great potential returns to the investment of capital and various skills in Ruritanian oil exploration, such capital and

---

*This paper is an outgrowth of a National Bureau study of The Relation of U.S. Direct Investment to U.S. Exports, partly financed by the National Science Foundation.. However, it is not an official publication of the National Bureau, not having been reviewed or approved by the Bureau's Board of Directors. The views reported here are those of the authors and do not represent those of the National Science Foundation. Earlier papers from this study were Lipsey and Weiss [1969], [1971], and [1972].

skills may be unobtainable or extremely expensive for the Ruritanian National Oil Company but readily available to a large international oil company. And while there may be large returns to the investment of technology and skills in the production of electronic equipment in Ruritania, the cost of these factors may be very high for the Electronics Company of Ruritania but quite low for a large American electronics company. The existence of multinational firms may make possible a flow of capital, and also of management skills, technical knowledge, and marketing experience, that would never have been directed to native firms in the same industry, and the flow of resources may in turn result in trade flows which would not otherwise have occurred. Capital and other resources might flow more readily from one country to another within an individual enterprise than from one company to another within the same country. The multinational company may then make its decisions on the location of sales, service, assembly, and manufacturing activities on much the same basis internationally as it does within a single country, taking account of market concentration, transport cost of both raw materials and finished products, the cost of labor services, and the possibility of allocating different phases of production to different locations. The multinational firm thus introduces some new elements into the situation beyond the familiar ones of resource endowment and rates of return. Hence, in seeking to explain the location of production, the level of technology used at each location, the use of productive factors, and the flow of trade and of resources, we must take into account the effects of the ownership of productive facilities.

Why should the existence of the multinational firm have this effect? Why would the factors not move, as portfolio capital or licensing of technology, in the absence of such firms? In the case of capital, the reason is probably that the multinational's cost for use anywhere in the world is the cost to the parent corporation, to which the firm will add an appropriate allowance for any special risks involved in investment in the recipient country, rather than the higher usual cost to a native firm in that country. The risk premium added by the multinational firm in its internal calculations may be lower than that added by developed country capital markets to the cost of borrowing by a native firm. The multinational firm may face a lower risk of failure because it possesses complementary technological factors of production, or because its affiliate has no liquidity problems, or because it is in a stronger bargaining position vis-a-vis both host country governments and buyers of its products. In the case of technology, acquisition in the form of equity capital inflow through the multinational firm may be a much lower-risk form of purchase for a recipient country than licensing or purchase or other nonequity arrangements in which the purchaser bears most of the risk. In acquiring technology through the multinational firm the host country reduces risk by not taking on any fixed expenses of purchase or rental, at the cost of losing the possibility of exceptional gains. Similarly, other factors scarce in the receiving country's economy might be cheaper for the multinational firm than for the native firm--for example, knowledge about new technology, about sources of material inputs, and market conditions around the world. If the crucial cost difference is that between the expense of transferring resources within a firm and the expense of transferring them between firms, the advantage of the multinational firm is much like that of any large firm operating within a

single market.[1]

---

[1] For discussions of the nature of the multinational firm's advantages see, for example, Caves [1971] and Kindleberger [1969]. The issue is related to those raised in Coase [1937].

More broadly, we can think of factor abundance and factor prices as being characteristics not only of countries, as is customary in trade theory, but also of companies. To the extent that inter-company differences in the abundance and cost of resources outweigh inter-country differences in determining the location of production we should expect capital-intensive products to be manufactured not necessarily in capital-rich countries but by capital-rich companies, and products requiring intricate technology or high marketing skills by companies rich in those resources.

What does this view of multinational firms imply for the location of production? If we focus first on capital and labor and ignore, for the moment, the role of natural resources and other factors of production, and if we assume that labor (or, in some versions, unskilled labor) is the expensive factor relative to capital in the United States, we would expect that labor-intensive industries would locate outside the United States. American firms operating abroad in these industries would have no advantage

over native firms as producers. By contrast, American affiliates would have an advantage over other foreign firms in more capital-intensive industries because they could raise capital cheaply in the United States and transfer it to the foreign countries.[2] If the lower capital costs for

---

[2] Kravis [1956] pointed out that U.S. foreign investment was concentrated in industries with higher capital requirements per dollar of output than the average domestic industry.

American multinational firms reflected only their access to U.S. capital on terms no more favorable than those available to American firms in general--let us call that Assumption 1--we would expect that the most capital-intensive industries would manufacture in the U.S. and export from here and that industries intermediate in capital intensity would combine U.S. capital and foreign labor in production abroad by U.S. affiliates.

On the other hand, if the lower capital costs for American multinationals are specific to the firms, and lower than capital costs of other American firms--call that Assumption 2--, we would expect that the most highly capital-intensive production would take place within the multinational firm, regardless of physical location. If the multinational firms do not enjoy large economies of scale in production, they might be expected to place some of the production outside the United States, where they face capital costs approximately the same as in this country but lower labor costs or cheaper access to markets.

For resource-oriented industries, the location of which is dependent on the discovery and development of natural resources, we cannot expect to predict location but only ownership given location. The more capital-intensive of these industries, wherever located, will tend to be owned by U.S. (or other) multinational firms.

To the extent that this analysis is valid, it helps to explain the high capital intensity of U.S. imports found by Leontief and others. We would expect to find that this high capital intensity was to some extent accounted for by imports into the United States from foreign affiliates of U.S. firms, for which the price of capital was not the high price of the countries in which they are located but the low U.S. price or the still lower multinational firm price.

We have put this analysis in terms of the factor proportions characterizing individual industries, as most authors have done, setting aside the question of the extent to which firms in a given industry adapt their methods of production to differences among countries in prices of factors of production. In effect we are assuming that any adaptation is not so large as to disturb the ranking of industries with respect to capital intensity.[3] We

---

[3] That these rankings of industries by factor intensity are similar from one country to another was a conclusion of the Lary and Yahr studies. See Lary [1968] and Yahr [1968].

---

have also put most of the empirical analysis in terms of two factors of production, capital and labor, but we have divided the former into physical capital and human capital. The same arguments could be made with respect

to any other factor, such as technological skill, for which the multinational firm faces lower costs of purchase or transfer than other firms. Of these other factors we analyzed here only research and development intensity.

There are a number of possible variants of the capital-labor ratio that can be used. We have followed mainly the approach taken by Lary [1968, Chapter 2] who used value added per worker as his measure of total (physical and human) capital per worker, interpreting the wage component as a measure of returns to human capital and the nonwage component as a measure of returns to physical capital. Lary's measures have some defects we can correct. His nonwage value added includes taxes and certain service purchases from other business and the wage per worker excludes fringe benefits. We have therefore substituted employee compensation and property-type income, as calculated by the Bureau of Economic Analysis (see Walderhaug [1973]) for the wage and nonwage value added used by Lary.

Several attempts have been made to measure human capital intensity directly from information on the composition of the labor force in each industry: age, sex, education, skill level, etc. We have included some calculations based on one of the most recent measures of this type as a check on conclusions from data on employee compensation per worker.[4]

---

[4] See A.E. Fareed [1972]. The first calculation of human capital intensity along these lines was by Kenen [1965].

The original approach to the measurement of factor proportions was, of course, that of Leontief [1956], who calculated capital per manyear, defining capital as fixed, physical capital. These ratios were derived from

the 1947 input-output table, and we have used the same ratios in our own calculations for that and later years. Leontief's article was based on the sum of direct and indirect input requirements, but since we wish to focus on the characteristics of each industry, we have made use of only the direct coefficients.

It should be noted that both the Lary and the Leontief factor ratios, and those we are using, are computed from U.S. data, and are applied to both U.S. exports and U.S. imports.

If one thinks of research and development expenditures as a separate form of capital input, particularly for the United States or for American multinational companies, we can add, to the measures of human and physical capital intensity, a measure of R&D intensity. We have calculated that characteristic as the amount of R&D expenditure per worker.

If our suppositions about the role of multinational firms are correct, we should expect that U.S. imports from American-owned affiliates are more capital-intensive and more research-intensive than imports from non-U.S. firms. That this is predominantly the case is evident in section A of Table 1, which shows that the total value added per worker embodied in imports from U.S. affiliates in 1966 was a third higher than that embodied in imports from others, and that research intensity was over twice as high among imports from affiliates. The difference in value added per worker was particularly large for property-type income, smaller, but still over 10 per cent for compensation per worker, and very small for directly-measured human capital intensity.

From section B of Table 1 it can be seen that these large differences in capital intensity are heavily influenced by mining and petroleum--two resource-based industries with high capital intensity. For manufacturing

TABLE 1

Comparison of Value Added per Worker, Human Capital Intensity, and R&D Intensity of U.S. Imports from Affiliates with those of All Other U.S. Imports, 1966

	Imports		Ratio: Affiliates Other
	From Affiliates	Other	
A. Manufacturing and Mining, incl. Petroleum			
Total VA per Worker	12,540	9,505	1.32
Compensation per worker	7,613	6,812	1.12
Property-type income per worker	4,928	2,693	1.83
Human capital intensity	1,965	1,919	1.02
R&D expend. per worker	1,415	555	2.55
B. Manufacturing, excl. Petroleum Products			
Total VA per worker	10,320	9,390	1.10
Compensation per worker	7,669	6,820	1.12
Property-type income per worker	2,651	2,571	1.03
Human capital intensity	2,024	1,944	1.04
R&D expend. per worker	1,551	555	2.80

Source: Appendix tables and Fareed [1972].

alone, excluding petroleum refining, imports from U.S. affiliates appear to be only about 10 per cent more capital-intensive than imports from others, and most of the difference is in the employee compensation part of value added, which we interpret as reflecting human capital embodiment. The direct measure of human capital shows only a 4 per cent margin, close to that for property-type income per worker. However, the research intensity of imports from affiliates exceeds that of other imports by a larger margin in manufacturing alone than in manufacturing and mining.

If we use Leontief's measure of capital intensity, physical capital per manyear (Table 2), we find that imports from affiliates were twice as capital intensive as other imports in 1951 and 1965, and almost twice in 1947. Again, mining and petroleum accounted for a large part of this difference. Even in manufacturing, however, imports from affiliates were a third or a half more physical-capital intensive than other imports.

Apparently, U.S. imports produced by American affiliates were distinguished from imports produced by others mainly in being considerably more capital-intensive and far more research-intensive. That higher physical capital intensity of imports from affiliates was clearest in mining and petroleum, products for which the location of production was determined by the location of resources. In manufacturing the outstanding difference between the two sets of imports was the high R&D content of the imports from affiliates.

These results suggest that some substantial part of the high capital intensity of U.S. imports might be attributed to those imports that are produced abroad by U.S. firms facing U.S. rather than foreign capital costs. We can, then, compare the factor content of imports from non-U.S. companies with that of U.S. exports, to ask whether our imports from non-affiliated companies involve economizing on labor, capital, or research investment.

TABLE 2

Comparisons of Physical Capital per Manyear and Human Capital Intensity in U.S. Imports from Affiliates with those of All Other U.S. Imports, 1947, 1951, and 1965

	Imports from Affiliates	Other Imports	Ratio: Affiliates / Other
Physical Capital per Manyear			
A. Manufacturing and Mining, incl. Petroleum			
1965	15,644	7,500	2.09
1951	16,747	8,585	1.95
1947	15,464	8,755	1.77
B. Manufacturing, excl. Petroleum Products			
1965	7,502	5,779	1.30
1951	8,959	6,399	1.40
1947	8,735	5,270	1.66
Human Capital Intensity			
A. Manufacturing and Mining, incl. Petroleum			
1965	2,115	1,921	1.10
1951	1,879	1,768	1.06
1947	1,818	1,766	1.03
B. Manufacturing, excl. Petroleum Products			
1965	2,081	1,943	1.07
1951	1,995	1,832	1.09
1947	1,982	1,861	1.06

Source: Appendix tables and Fareed [1972].

The data in Table 3, based on value added per worker, indicate that exports were more capital-intensive than imports from non-affiliates, that this higher capital intensity of exports applied to both physical and human capital, but more strongly to the latter, and to manufacturing alone as well as to manufacturing, mining, and petroleum combined. Exports were also more research-intensive than these imports, and by a much larger margin of two-thirds or more. The data for earlier years on physical capital alone, based on Leontief's measure of physical capital intensity (Table 4), give the opposite result. For manufacturing and mining together, the physical capital intensity of exports was substantially below that of imports from non-affiliated companies (instead of substantially higher as in Table 3). In manufacturing taken alone, the ratios were much closer, but in only one year was capital per manyear as high in exports as in imports from non-affiliated companies. On the other hand, the human capital intensity measures for earlier years show much the same pattern as those for 1966: about 10 to 20 per cent higher for exports than for imports from non-affiliated companies.

The first set of results in Table 3 suggests that the traditional expectations about factor proportions in U.S. trade were correct. Imports not produced with U.S. capital were from industries with lower physical and human capital intensity and lower R&D intensity than U.S. exports. According to these results the relatively high capital-intensity of U.S. imports as a whole is accounted for by imports from U.S. affiliates, for whom foreign capital or research costs are not the relevant ones. On the other hand, the results of Table 4 suggest that the paradox of high physical capital intensity of imports cannot be completely explained in this way and that these high

TABLE 3

Comparison of Value Added per Worker, Human Capital Intensity, and R&D Intensity of U.S. Imports from Non-Affiliated Companies with those of U.S. Exports, 1966

	Exports	Imports from Non-Affiliated Companies	Ratio: Exports / Non-Affiliate Imports
A. Manufacturing and Mining, incl. Petroleum			
Total VA per worker	10,274	9,505	1.08
Compensation per worker	7,398	6,812	1.09
Property-type per worker	2,875	2,693	1.07
Human capital intensity	2,164	1,919	1.13
R&D expend. per worker	1,030	555	1.86
B. Manufacturing, excl. Petroleum Products			
Total VA per worker	10,141	9,390	1.08
Compensation per worker	7,449	6,820	1.09
Property-type per worker	2,692	2,571	1.05
Human capital intensity	2,209	1,944	1.14
R&D expend. per worker	1,030	555	1.86

Source: Appendix tables and Fareed [1972].

TABLE 4

Comparisons of Physical Capital per Manyear and Human Capital Intensity in U.S. Imports from Non-Affiliated Companies with those of U.S. Exports, 1947, 1951, and 1965

	Exports	Imports from Non-Affiliated Companies	Ratio: Exports / Non-Affiliate Imports
Physical Capital per Manyear			
A. Manufacturing and Mining, incl. Petroleum			
1965	5,852	7,500	.78
1951	6,309	8,585	.73
1947	6,048	8,755	.69
B. Manufacturing, excl. Petroleum			
1965	5,410	5,779	.94
1951	5,331	6,399	.83
1947	5,296	5,270	1.00
Human Capital Intensity			
A. Manufacturing and Mining, incl. Petroleum			
1965	2,213	1,921	1.15
1951	2,049	1,768	1.16
1947	1,998	1,766	1.13
B. Manufacturing, excl. Petroleum			
1965	2,282	1,943	1.17
1951	2,122	1,832	1.16
1947	2,056	1,861	1.10

Source: Appendix tables and Fareed [1972].

physical capital intensities do characterize imports from non-affiliates, even if these are not quite as capital intensive as imports from affiliates.

If we accept the results based on value added per worker we are still left with the question raised earlier of whether the capital or research costs of the U.S.-based multinational firms are those of the U.S. economy as a whole or are peculiar to these firms. Are the MNC's only a conduit for cheap U.S. capital and R&D or do they have their own low capital and R&D costs which they wish to exploit both in the United States and abroad? A test of that proposition can be performed by comparing the characteristics of exports by parent firms with those of U.S. exports by other firms.

As Table 5 indicates, the parent firms are in industries with higher capital and R&D intensities than other U.S. exporters. The difference between parent firms and others is larger for physical capital than for human capital, although it is substantial for both. It is still larger for R&D than for either type of capital. Thus the evidence suggests that the lower capital and R&D costs of these firms with foreign affiliates are characteristics of the firms themselves rather than of the U.S. economy as a whole.

In fact, as can be seen in Table 6, the capital and R&D intensities of exports by U.S. parent firms resemble those of imports from the foreign affiliates of these same firms more closely than they do those of exports by other U.S. firms and the characteristics of imports from non-affiliated foreign firms resemble those of U.S. exports by non-parents more than they do those of U.S. imports from affiliates. Thus, these data point to the distinctiveness of the multinational firms, in both their U.S. and their foreign operations, from other firms in the U.S. and abroad.

TABLE 5

Comparison of Value Added per Worker, Human Capital Intensity, and R&D Intensity of U.S. Exports by Parent Companies with those of Other U.S. Exports, 1966

	Exports by		Ratio:
	Parent Companies	Others	Parents / Others
A. Manufacturing and Mining, incl. Petroleum			
Total VA per worker	10,966	9,440	1.16
Compensation per worker	7,867	6,833	1.15
Property-type per worker	3,098	2,607	1.19
Human capital intensity	2,062	2,048	1.10
R&D expend. per worker	1,392	550	2.53
B. Manufacturing, excl. Petroleum			
Total VA per worker	10,837	9,256	1.17
Compensation per worker	7,903	6,871	1.15
Property-type per worker	2,934	2,384	1.23
Human capital intensity	2,283	2,115	1.08
R&D expend. per worker	1,398	550	2.54

Source: Appendix tables and Fareed [1972].

TABLE 6

Comparison of Value Added per Worker, Human Capital Intensity, and R&D Intensity among U.S. Parent Firm Exports, Imports from Affiliates, and Other Exports and Imports, 1966

	Parent Firms and Affiliates		Other Firms	
	Exports from U.S.	Imports into U.S.	Exports from U.S.	Imports into U.S.
A. Manufacturing and Mining, incl. Petroleum				
Total VA per worker	10,966	12,540	9,440	9,505
Compensation per worker	7,867	7,613	6,833	6,812
Property-type per worker	3,098	4,928	2,607	2,693
Human capital intensity	2,262	1,965	2,048	1,919
R&D expend. per worker	1,392	1,415	550	555
B. Manufacturing, excl. Petroleum				
Total VA per worker	10,837	10,320	9,256	9,390
Compensation per worker	7,903	7,669	6,871	6,820
Property-type per worker	2,934	2,651	2,384	2,571
Human capital intensity	2,283	2,024	2,115	1,944
R&D expend. per worker	1,398	1,551	550	555

Source: Appendix tables and Fareed [1972].

Conclusions

Our results indicate that U.S. imports from American-owned affiliates abroad are more capital-intensive, and particularly more research-intensive than U.S. imports from others. These imports from affiliates account for much of the high capital intensity that has been found to characterize U.S. imports. Using a measure of total capital intensity we find, in fact, that U.S. imports from non-affiliated companies embody, on the average, less capital and more labor than U.S. exports. The capital-intensive and research-intensive character of U.S. imports from affiliates appears to reflect mainly the low costs of capital, research, and possibly other factors of the parent companies, rather than only the costs to American firms in general. We make that judgment on the basis of the fact that exports from the United States by these parent companies are more capital- and research-intensive than exports by other U.S. companies.

There appear then to be several roles of American-based multinational firms. One is the provision of low-cost physical capital for capital-intensive resource-based industries, the location of which is fixed in foreign countries by the location of natural resources. Another is the provision of low-cost technology (assuming that technology is the fruit of research and development investment) for the production of research-intensive manufactured products in foreign countries. In both of these cases the multinational firms appear to produce using factor proportions far different from those of other American firms. Presumably, they do so because they enjoy comparatively low costs for these resources. The evidence also indicates, but not as strongly, that multinational firms act as a conduit for low-cost human capital flows to foreign countries.

All of these calculations are derived from data on the capital- and research-intensity of whole industries, on the assumption that firms are identical within an industry and the assumption that an industry is characterized by the same capital-intensity in each country. Both of these assumptions are open to question and we plan to investigate the validity of each in further studies. We will compare multinational parent firms with others in the same industries in the United States, compare affiliates with other firms in the same industries in the countries in which they operate, and compare parent firms' domestic operations with those of their own overseas affiliates.

TABLE A-1

Value Added per Worker, 1963, and U.S. Imports, by Industry and Region, 1966

Industry	Total Value Added per Worker	Employee Compensation per Worker	Property-Type Value Added per Worker	U.S. Imports						
				Total	Canada	Europe	EEC	Other Europe	Latin America	Other World
	(dollars)			(millions of dollars)						
Mining										
Stone & clay quarries	10,698	5,818	4,880	269.6	97.5	70.6	15.8	54.8	53.9	47.6
Chemicals & fertilizers	16,396	7,319	9,077	15.3	.1	.1	.1	0	14.6	.5
Iron ore	15,733	7,637	8,096	473.2	281.1	5.0	1.5	3.5	160.2	26.9
Nonferrous metal	11,062	7,091	3,971	1,373.6	383.6	20.3	3.8	16.4	589.8	379.9
Coal mining	10,250	6,323	3,927	15.2	13.8	1.4	1.0	.4	0	0
Petroleum	20,310	8,095	12,215	2,223.8	437.1	26.4	20.0	6.4	1,420.0	340.3
Food & kindred products	10,012	6,736	3,276	1,878.4	195.3	755.6	235.0	520.6	501.0	426.5
Paper & allied products	11,138	7,266	3,872	1,417.7	1,285.6	109.8	11.6	98.2	1.6	20.7
Chemicals	18,731	9,290	9,441	952.1	252.9	428.5	263.8	164.7	127.2	143.5
Plastics	17,385	9,667	7,718	59.3	7.9	37.6	24.1	13.5	.2	13.6
Other	19,059	9,198	9,861	892.8	245.0	390.9	239.7	151.2	127.0	129.9
Rubber & plastic manufactures	9,484	6,723	2,761	169.5	37.1	70.1	53.6	16.5	.1	62.2
Primary & fabricated mtls.	10,899	7,550	3,349	2,522.9	428.0	1,192.6	703.5	489.1	49.0	853.3
Ferrous	13,780	9,304	4,476							
Nonferrous	8,915	6,342	2,573							
Nonelectrical machinery	9,908	7,851	2,057	1,587.3	519.2	921.9	498.1	423.8	5.1	141.1
Farm	8,719	8,000	719	249.6	205.1	43.4	21.1	22.3	.3	.8
Other	10,007	7,838	2,169	1,337.7	314.1	878.4	477.0	401.4	4.8	140.4
Electrical machinery	9,394	7,648	1,746	1,074.2	115.3	333.2	166.6	166.6	4.0	621.7
Transportation equipment	11,115	9,001	2,114	2,206.4	1,006.3	1,190.1	793.7	396.4	1.0	9.0

(continued)

TABLE A-1 (concluded)

Industry	Total Value Added per Worker (dollars)	Employee Compensation per Worker (dollars)	Property-Type Value Added per Worker (dollars)	U.S. Imports (millions of dollars) Total	Canada	Europe	EEC	Other Europe	Latin America	Other World
Other manufacturing	7,188	5,376	1,812	4,430.8	552.2	1,869.8	1,034.9	834.9	141.3	1,867.5
Textiles & apparel	5,355	4,322	1,033	1,578.8	32.4	539.5	328.7	210.8	65.1	941.8
Lumber & furniture	6,676	4,962	1,714	788.4	457.6	83.4	26.5	56.9	35.0	212.4
Printing & publishing	8,483	6,958	1,525	96.7	8.2	75.7	25.9	49.8	4.9	7.9
Stone, clay, glass products	10,590	6,912	3,678	290.0	19.0	156.3	91.8	64.5	14.3	100.4
Instruments	10,528	7,395	3,133	393.2	8.6	272.9	132.2	140.7	1.0	110.7
Other	8,720	6,479	2,241	1,283.5	26.4	742.1	429.9	312.2	21.0	494.0

Notes to TABLE A-1

Value added data are for 1963 and are from "The Composition of Value Added in the 1963 Input-Output Study," by Albert J. Walderhaug, Survey of Current Business, April 1973, Table 7, p. 36, cols. 3 and 5.

Employment data are for 1963 and are from Census of Manufactures: 1963 (U.S. Bureau of the Census), Vol. I, pp. 46-66, and, for mining industries, from the Statistical Abstract of the U.S. 1966 (U.S. Bureau of the Census), pp. 710-711.

Import data are from U.S. Imports of Merchandise for Consumption Dec. 1966 (U.S. Bureau of the Census), FT 125. The translation from SITC to SIC was as follows:

Mining: SITC 27, 28, and 32, and imports of unwrought metals except from Europe and aluminum from Canada.

Petroleum: SITC 33 and 34.

Food and kindred products: SITC 013, 02, 032, 048, 052, 053, 0542, 0546, 055, 06, 073, 081, 09, 11, 41, 42.

Paper products: SITC 64 and 251.

Chemicals: SITC 43 and 5.

Rubber and plastic products: SITC 231.2, 62, and 893

Primary and fabricated metals: SITC 67, 68, 69, 723.1, and 81 except unwrought metals other than from Europe and aluminum from Canada.

Non-electrical machinery: SITC 71

Electrical machinery: SITC 72 less 723.1 plus 891.1 and 891.2.

Transportation equipment: SITC 73

Other manufacturing

Textiles and apparel: SITC 266, 267, 65, and 84.
Lumber and furniture: SITC 243, 63, and 82.
Printing and publishing: SITC 892.
Stone, clay, and glass products: SITC 66 less 667.
Scientific and professional instruments: SITC 86.
Other: SITC 122, 612, 667, 83, 85, and 89, less 892, 893, 891.1 and 891.2, plus SITC 95.

TABLE A-2

U.S. Imports from Affiliates, by Industry and Origin, 1966
(Unit: Millions of Dollars)

Industry	Total	Canada	Europe	EEC	Other Europe	Latin America	Other World
Mining							
Stone & clay quarries	.51	25.8	0	0	0	22.7	2.7
Chemicals & fertilizers	1	0	0	0	0	.6	0
Iron ore	370	236.1	0	0	0	128.2	5.9
Nonferrous metals	434	0	.8	0	.8	383.4	49.4
Coal mining	0	0	0	0	0	0	0
Petroleum[a]	2,224	437.1	26.4	20.0	6.4	1,420	340.3
Food & kindred products	181	46	30	8	22	65	40
Paper & allied products	418	406	1	1	0	1.6[c]	9.4
Chemicals	161	112	22	12	10	21	6
Plastics		7.9[b]	n.a.	n.a.	n.a.	n.a.	n.a.
Other		104.1	n.a.	n.a.	n.a.	n.a.	n.a.
Rubber & plastic products	17	12	1	0	1	0	4
Primary & fabricated mtls.	41	26	13	1	12	0	2
Ferrous		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nonferrous		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Nonelectrical machinery	257	118	132	73	59	0	7
Farm		65	n.a.	n.a.	n.a.	n.a.	n.a.
Other		53	n.a.	n.a.	n.a.	n.a.	n.a.
Electrical machinery	181	66	83	27	57	1	30
Transportation equipment	1,055	954	99	54	46	1[c]	0
Other manufacturing	364	247	65	19	47	26.4	24.6
Textiles & apparel		2	n.a.	n.a.	n.a.	n.a.	n.a.
Lumber & furniture		135	n.a.	n.a.	n.a.	n.a.	n.a.
Printing & publishing		1	n.a.	n.a.	n.a.	n.a.	n.a.
Stone, clay, glass products		19[d]	n.a.	n.a.	n.a.	n.a.	n.a.
Instruments		8.6[d]	n.a.	n.a.	n.a.	n.a.	n.a.
Other		26.4[d]	n.a.	n.a.	n.a.	n.a.	n.a.

Notes to TABLE A-2

Sources: U.S. Direct Investments Abroad, 1966, Part II. Investment Position, Financial and Operating Data (U.S. Department of Commerce, Bureau of Economic Analysis), pp. 50-54, 70-76.

Implications of Multinational Firms for World Trade and Investment and for U.S. Trade and Labor, U.S. Senate, Committee on Finance, February 1973, pp. 363-64, 373-74, 388-89.

U.S. Business Investments in Foreign Countries (U.S. Department of Commerce, Office of Business Economics, 1960), p. 114.

[a] For petroleum, we have assumed that all imports are from U.S. affiliates abroad, although the published data suggest a considerably lower fraction. The published data for this industry on imports from affiliates seem extremely unreliable. One evidence of this unreliability is the fact that exports to the U.S. reported by affiliates in several areas are substantially higher than total U.S. imports from these areas. For Canada, on the other hand, reported exports to the U.S. by affiliates were only 40 per cent of U.S. imports. This ratio seems absurdly low in view of the fact that, according to Canadian data, U.S. subsidiaries accounted for 72 per cent of Canadian exports of gas and oil to all countries, and one might expect the proportion in exports to the U.S. to be higher than that. Furthermore, that proportion is understated because Trans-Canada Pipe Lines, a Canadian-owned company, takes title to gas it transmits even though the gas may originate with a U.S.-controlled subsidiary (see Foreign Direct Investment in Canada, Information Canada, 1972, p. 159.

[b] Figure in source was reduced because it was greater than total U.S. imports. The lower figure used is comparable with the 1970 figure in The Reconciliation of U.S.-Canada Trade Statistics, 1970 (U.S. Department of Commerce), p. 57.

[c] Figure revised to agree with import data. Amount subtracted was added to "other manufacturing."

[d] Figures revised to agree with U.S. import data. Amounts subtracted from published figures for stone, clay, etc. and instruments were added to the "other" category.

TABLE A-3

Value Added per Worker, 1963, and U.S. Exports, Total and by Parent Companies, 1966

Industry	Value Added per Worker	Employee Compensation per Worker	Property-Type Value Added per Worker	Parent Company Exports	Total U.S. Exports
	(d o l l a r s)			($ millions)	
Mining	11,294	6,452	4,842	313	1,203.8
Food and kindred products	10,012	6,736	3,276	662	1,293.5
Paper & allied products	11,139	7,266	3,872	368	676.8
Chemicals & allied products	18,731	9,290	9,441	1,981	2,693.8
Soaps, cosmetics, drugs & other chemicals	12,748	6,181	6,566	640	1,191.1
Industrial chemicals & plastics	24,317	12,193	12,124	1,341	1,502.7
Rubber	9,485	6,723	2,761	275	426.5
Primary & fabricated mtls.	10,899	7,550	3,349	1,208	1,879.1
Primary	12,512	8,242	4,270	836	1,161.3
Fabricated	9,220	6,830	2,390	371	717.8
Nonelectrical machinery	9,909	7,851	2,057	2,715	5,547.2
Industrial & farm	9,623	7,735	1,888	1,669	2,530.7
Other	10,193	7,967	2,226	1,046	3,016.4
Electrical machinery	9,395	7,648	1,746	1,455	1,981.7
Transportation equipment	11,116	9,001	2,114	3,499	3,714.6
Motor vehicles	13,781	9,573	4,208	2,238	2,386.5
Other	9,078	8,564	513	1,260	1,328.2
Miscellaneous manufacturing	7,354	5,575	1,779	1,428	4,213.0
Textiles and apparel	5,356	4,322	1,033	119	818.0
Stone, clay, glass products	10,591	6,912	3,678	181	278.3
Instruments	10,528	7,395	3,133	615	762.7
Other	7,857	6,045	1,812	480	2,354.0
Petroleum	20,311	8,095	12,215	484.2	484.2

Value added and number of workers from same sources as for Table A-1.

Total U.S. exports from U.S. Exports, Commodity by Country, Dec. 1966, FT 410 (U.S. Bureau of the Census).

U.S. parent company exports from U.S. Direct Investment Abroad, 1966 (U.S. Department of Commerce, Bureau of Economic Analysis), Part II, pp. 61, 82, 88-89.

TABLE A-4

Physical Capital per Manyear in U.S. Imports and Exports, 1947 and 1951

	Manufacturing, Mining, Petroleum			Manufacturing, excl. Petroleum Products		
	1947	1951	1965	1947	1951	1965
Exports	6,048	6,309	5,852	5,296	5,331	5,410
Imports	10,260	10,377	9,474	5,903	6,812	6,072
Imports from affiliates	15,464	16,747	15,644	8,735	8,959	7,502
Other imports	8,755	8,885	7,500	5,270	6,399	5,779

Exports and imports for each industry in 1947 and 1951 and direct labor and capital input coefficients for each industry in 1947 are from Wassily Leontief, "Factor Proportions and the Structure of American Trade: Further Theoretical and Empirical Analysis," Review of Economics and Statistics, Nov. 1956, reprinted in Leontief, Input-Output Economics (Oxford University Press, 1966), pp. 129-133. These 1947 coefficients were used in all our estimates of capital per manyear. Data cover manufacturing and mining, including petroleum.

Estimates of the proportion of imports coming from U.S. overseas affiliates in 1947 and 1951 are from U.S. Business Investment in Foreign Countries (U.S. Department of Commerce, Office of Business Economics, 1960), and apply to the year 1957.

We have removed natural rubber from Leontief's Chemicals category on the ground that it is essentially an agricultural product and that the capital per worker ratio for the U.S. synthetic rubber industry is not an appropriate one for natural rubber.

Proportions for 1965 are from 1966 data, as in Table A-3.

TABLE A-5

Research Intensity of U.S. Imports and Exports, 1966

	R&D Expenditures per Worker
A. Manufacturing and Petroleum	
Total U.S. Exports	1,030
By parent companies	1,392
By others	550
Total U.S. Imports	707
From affiliates	1,415
From others	555
B. Manufacturing, excl. Petroleum Products	
Total U.S. Exports	1,030
By parent companies	1,398
By others	550
Total U.S. Imports	698
From affiliates	1,550
From others	555

Data on R&D expenditures are from Research and Development in Industry: 1970, National Science Foundation, 1972.

Number of employees, imports, and exports, from Tables A-1 through A-3 and sources listed there.

List of References

Caves, Richard E., "International Corporations: The Industrial Economics of Foreign Investment," Economica, Feb. 1971.

Coase, R.H., "The Nature of the Firm," Economica, Nov. 1937.

Fareed, A.E., "Formal Schooling and the Human-Capital Intensity of American Foreign Trade: A Cost Approach," Economic Journal, June 1972, pp. 629-640.

Kenen, Peter B., "Nature, Capital, and Trade," Journal of Political Economy, Oct. 1965, p. 457.

Kindleberger, Charles P., American Business Abroad: Six Lectures on Direct Investment, Yale University Press, 1969, Lecture 1.

Kravis, Irving B., "'Availability' and Other Influences on the Commodity Composition of Trade," Journal of Political Economy, April 1956.

Lary, Hal B., Imports of Manufactures from Less Developed Countries, NBER, 1968.

Leontief, Wassily, "Factor Proportions and the Structure of American Trade: Further Theoretical and Empirical Analysis," Review of Economics and Statistics, Nov. 1956; reprinted in Wassily Leontief, Input-Output Economics, Oxford University Press, 1966.

Lipsey, Robert E., and Merle Yahr Weiss, "The Relation of U.S. Manufacturing Abroad to U.S. Exports: A Framework for Analysis," 1969 Business and Economic Statistics Section Proceedings of the American Statistical Association, pp. 497-509.

_____, "Estimating the Structure of International Transport Costs," 1971 Business and Economic Statistics Section Proceedings of the American Statistical Association," pp. 418-424.

_____, "Analyzing Direct Investment and Trade at the Company Level," 1972 Business and Economic Statistics Section Proceedings of the American Statistical Association, pp. 11-20.

Walderhaug, Albert J., "The Composition of Value Added in the 1963 Input-Output Study," Survey of Current Business, April 1973.

Yahr, Merle I., "Human Capital, Factor Proportions, and the CES Production Function" in The Open Economy, edited by Peter Kenen and Roger Lawrence, Columbia University Press, 1968.