

EXPORTS AND FOREIGN INVESTMENT IN THE  
PHARMACEUTICAL INDUSTRY

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# CONTENTS

	<u>Page</u>
Introduction	1
The Trend of Pharmaceutical Exports	3
Input Characteristics of the Industry	3
Method of Analysis	6
Data and Variables	8
Types and Sources of Country Data	8
Types and Sources of Parent and Affiliate Data	12
Affiliate Variables	13
Determinants of U.S. and Foreign Exports to and Investments and Production in Individual Countries	15
Variables other than Investment	15
The Impact of U.S. Manufacturing Affiliates	17
The Impact of U.S. Nonmanufacturing Affiliates	21
Impact of Foreign-Owned Manufacturing Affiliates	22
Numbers and Size as Measures of Affiliate Activity	23
Export Shares	27
Determinants of the Number and Activity of U.S. Affiliates	27
Determinants of Total Exports and Investment of Individual U.S. Firms	29
Determinants of Exports and Investment by Area for Individual U.S. Firms	38
Summary	43
Bibliography	57
Appendix A: Country Trade Equations without Investment Variables	59
Appendix B: Country Trade Equations with Investment Variables	61
Appendix C: Country Export Share Equations	75
Appendix D: Country Investment Equations	77
Appendix E: Company Trade Equations	82
Appendix F: Company-Area Trade Equations	86

## EXPORTS AND FOREIGN INVESTMENT IN THE PHARMACEUTICAL INDUSTRY\*

### Introduction

The relationship between direct investment and trade has always been recognized as one of the most difficult aspects of the study of multinational companies and their impact on their own countries and their affiliates' host countries. The range of views on the trade impact, and therefore on the employment impact, of their activities, is enormous, with no agreement even on the direction. One analysis of 74 major U.S. multinational firms, fairly typical of business views, is that "...the international investment activities of the respondents played an important role in their rapid export growth...." and another suggested a net job gain of 600,000 as a consequence of the activities of U.S. multinational firms.<sup>1</sup> A directly opposite view,

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<sup>1</sup>Emergency Committee for American Trade [1972], p. 4, and Stobaugh [1972].

that foreign investment reduces U.S. exports and employment, has been expressed in several union documents and testimony before Congressional committees and in some academic studies.<sup>2</sup> An attempt by the U.S. Tariff Commission [1973] to

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<sup>2</sup>See, for example, the testimony of Andrew Biemiller for the AFL-CIO in U.S. Senate [1973] and Frank and Freeman [1975].

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sort out the issue for the Senate Finance Committee produced a variety of possible impacts, determined by the particular assumptions made as to what would have happened if the U.S. direct investment had not taken place. The crucial assumptions, as in the earlier Hufbauer-Adler [1968] and Reddaway [1967, 1968] studies, relate to the degree to which companies investing and producing abroad might have invested and produced at home instead, and the degree to which foreign companies (natives or other foreign investors) would have invested and produced in place of U.S. companies. Depending on the assumptions chosen, the Tariff Commission found impacts on U.S. employment ranging from positive to negative.

The variety of conclusions so far suggests that the issue is not only one that touches many economic interests, but also is a complex one. We cannot solve the fundamental dilemma of the inability to run controlled experiments to determine what would have happened without U.S. investment, but we have assembled a better set of data than was available to previous studies. From these we hope to narrow the range of plausible assumptions and, from there on, the range of plausible conclusions.

This paper describes some experiments with our data set on a single industry: pharmaceuticals (SIC 2833 and 2834).. This industry was chosen not because we consider it typical but because there are a substantial number of U.S. companies and they invest in a large number of countries, and also because it is one of the high technology industries which are thought to be the main strength of both U.S. exports and U.S. investment. However, we intend to apply a similar analysis across all U.S. manufacturing industries.

### The Trend of Pharmaceutical Exports

Exports of pharmaceuticals, including biological products, medicinals, and botanicals, were about \$500 million in 1970 and 1971, a little more than twice the 1954 value (Table 1). The rate of growth of exports has not been as high as that of domestic production, and the ratio of exports to production has therefore tended to decline, from 10-12 per cent in the 1950's to 7-8 per cent in the late 1960's. The proportion exported is comparatively high for the medicinals and botanicals group (SIC 2833) which is the main part of what we refer to later as bulk pharmaceuticals, but it is very low--only 3 per cent--for the larger part of the industry, pharmaceutical preparations (SIC 2834), which is close to the group we refer to as packaged pharmaceuticals. The composition of exports has shifted toward bulk pharmaceuticals, exports of which grew by 70 per cent between 1965 and 1971 while exports of packaged products grew by only 30 per cent.

The industry exhibits these low export ratios despite the fact that it has many of the characteristics often associated with high export propensities. It has comparatively high nonhuman capital per worker, as measured by either fixed capital stock per worker or by nonwage value added per worker, high levels of R&D per dollar of sales and per worker, a comparatively skilled labor force, as measured by average wage per worker or by the number of engineers and scientists as a per cent of the total labor force, and a high rate of new product development.

### Input Characteristics of the Industry

Some of the input characteristics of the two industries that are analyzed in this paper are described in Table 2. The average wage in 1970 was somewhat higher in packaged than in bulk pharmaceuticals, implying a higher average level of skill among employees or, in other words, a higher level of human

TABLE 1

U.S. Exports of Biological Products, Medicinals, and Pharmaceuticals, 1954-71  
Value and Per Cent of Domestic Output

	Value (\$ million)			Per Cent of Domestic Output		
	Biological Products SIC 2831	Medicinals and Botanicals SIC 2833	Pharmaceutical Preparations SIC 2834	Biological Products SIC 2831	Medicinals and Botanicals SIC 2833	Pharmaceutical Preparations SIC 2834
1954		242			12	
1955		225			10	
1956		245			10	
1957		253			10	
1958	26.6		250.4	22	10	9
1959	17.6		266.7	14		9
1960	14.9		260.3	12		9
1961	15.3		261.0	12		8
1962	15.7		267.8	10		8
1963	18.3		268.6	11		8
1964	22.6		272.7	13		8
1965	17.9	169.8	119.1	10	37	7 3
1966	21.3	185.3	116.0	11	34	3
1967	26.5	199.2	112.3	12	34	3
1968	28.4	218.8	125.4	11	35	3
1969	35.8	248.4	136.9	11	37	3
1970	42.6	314.2	151.6	12	42	3
1971	48.3	288.4	154.5	12	38	3

Sources: 1954-58: Exports in Relation to U.S. Production, 1959 and Comparisons with 1954-58, World Trade Information Series, Statistical Reports, Part 3, No. 60-30, U.S. Department of Commerce, Bureau of Foreign Commerce, Sept. 1960.

1958-65: U.S. Commodity Exports and Imports as Related to Output, 1965 and 1964, U.S. Department of Commerce, Bureau of the Census, 1967.

1965-71: U.S. Commodity Exports and Imports as Related to Output, 1971 and 1970, U.S. Department of Commerce, Bureau of the Census, 1974.

TABLE 2

Input Measures for Bulk and Packaged Pharmaceutical Industries, 1970

	SIC 2833 Medicinals & Botanicals (Bulk (pharmaceuticals)	SIC 2834 Pharmaceutical Preparations (Packaged (pharmaceuticals)
Gross book value of depreciable assets (\$ million)	438.5	2,223.5
Number of employees (000)	10.1	111.9
Payroll (\$ million)	96.0	1,137.7
Value added (\$ million)	288.4	4,678.0
Value added except payroll (\$ million)	192.4	3,540.3
Depreciable assets per worker (\$)	42,921	19,870
Value added per worker (\$)	28,554	41,805
Payroll per worker (\$)	9,505	10,167
Nonwage value added per worker (\$)	19,050	31,638

Source: Annual Survey of Manufactures, 1970-71, U.S. Bureau of the Census.

capital per worker. However, this was not true in some other years and we therefore do not take it as a characteristic of the two industries. Physical capital intensity, as measured by gross book value of depreciable assets per employee, was more than twice as high in bulk as in packaged pharmaceuticals, and this relationship is a stable one. On the other hand, nonwage value added per employee, which is sometimes taken as a broad measure of nonhuman capital intensity, is high in packaged pharmaceuticals. Nonwage value added reflects the high level of current expenditure on advertising, which we would prefer to exclude from value added as a service purchased from another industry. It also reflects high profit rates, as customarily calculated, and these in turn represent, to some degree, returns on capital in forms other than depreciable assets and not customarily capitalized, such as research and development investment and perhaps advertising investment also. Thus the only clear factor proportions comparison is that physical capital intensity is higher in bulk than in packaged pharmaceuticals.

#### Method of Analysis

This paper examines first U.S. investment and production in, and exports to, a cross-section of forty-five foreign destinations in 1970. We then compare exports and foreign investment among 12 U.S. pharmaceutical firms and exports and investment by each of those 12 firms in seven foreign areas. The basic assumption that underlies the analysis is that the answer to the question "What would have happened if U.S. companies did not produce abroad, or produced less?" is provided, in the first case, by those countries in which U.S. companies did not produce, or produced less than in others. In the second case, it is provided by those firms that produced less abroad and in the third case by those foreign areas in which an individual firm produced less.



These assumptions have some obvious weaknesses, the main one being that there are factors specific to a country, such as its size or its demand for a commodity, or factors specific to a company, such as its range of products, which may simultaneously, but independently, influence both exports and direct investment. To the extent that we fail to take account of such factors, we may attribute their effects to direct investment.

It would be convenient for our purposes, in a way, if locations of foreign affiliates were picked by U.S. and foreign companies at random. One could then easily estimate the effects of affiliate location on trade. But since parent companies do not make such choices by whim we are left with the likelihood that our variables measuring the size of affiliates are to some degree estimating the effects of some combination of influences including both host country policy and the response of parent firms to that policy.

We attempt to deal with this problem in several ways. One is that in country cross-sections we include some factors that may influence both investment and exports, such as consumption of pharmaceuticals, in our explanation of exports. In that way the coefficients of the affiliate size or production variables should reflect the net effect of investment. Another is that we examine the influence of foreign affiliates on U.S. exports and of U.S. affiliates on foreign exports. In company cross-sections we include factors such as company size and innovativeness which may influence both exports and investment. In this way, we hope, we can reduce the contamination of our results from omitted characteristics of countries and companies.

The first set of equations reported below relates exports of pharmaceuticals by the United States and by thirteen other industrial countries to forty-five destinations, to country characteristics and investment variables. The country characteristics include the size of the importing countries (or destinations), or their consumption of pharmaceuticals, their distance from

the United States and other major exporters, and membership in the European Economic Community. The investment variables include the number of U.S. pharmaceutical affiliates, divided between manufacturing and nonmanufacturing, the number of pharmaceutical manufacturing affiliates owned by foreign parents, the number of foreign parent companies, and various measures of the size of operations of the U.S.-owned affiliates. The second set of equations relates worldwide exports of 12 pharmaceutical firms to firm characteristics, including domestic sales, extent of foreign investment, and various measures of innovativeness or inputs into innovativeness. The third set relates exports to an area by a firm to the same firm characteristics and the country characteristics used in the first set.

This paper is a more thorough examination, using more comprehensive data for a later year, of some of the questions discussed in one of the earlier papers from the National Bureau's study of U.S. direct investment and its effects (Lipsey and Weiss [1972]) and we consider that it supercedes the earlier results for the pharmaceutical industry.

#### Data and Variables

As has been mentioned, our data fall into three categories: those that describe the countries which are hosts to U.S. direct investment and recipients of exports, those that describe the number or size of U.S.-and foreign-owned affiliates in a country, and those that describe U.S. parent firms. We list the main sources of data here and explain the way in which the original observations were manipulated to form the variables used in the equations below.

#### Types and Sources of Country Data

We would have liked to have a variable that represents the demand for pharmaceuticals in each country. The closest we could come, for developed

countries only, was a rough estimate of the consumption of pharmaceuticals, put together from a variety of sources.

For 1970, a pharmaceutical company supplied estimates of consumption for eighteen countries and we estimated consumption for Ireland and South Africa from national statistics on manufacturers' sales, imports, and exports.<sup>3</sup> For three other countries we obtained production data from two

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<sup>3</sup>Irish Statistical Bulletin, Dublin, March 1973, p. 62 and Bulletin of Statistics, Dec. 1970 (South African Dept. of Statistics, Pretoria, Vol. 4, No. 4, p. 83.

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sources,<sup>4</sup> and added imports and subtracted exports to obtain "apparent

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<sup>4</sup>Noyes Data Corporation, European Pharmaceutical Market Report, and United Nations, The Growth of World Industry, 1970.

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consumption." We then estimated consumption from an equation relating apparent consumption to consumption, which was fitted to the data for those countries for which we had both.

For 1966 we had direct consumption estimates for only five countries, and estimates for the others were roughly extrapolated from 1971 using changes in production, exports, and imports.

The other market size variables, which apply to the size of the country in general rather than to the pharmaceuticals market in particular, were GDP

in 1969, taken from United Nations data,<sup>5</sup> and exports of all manufactures

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<sup>5</sup>Yearbook of National Accounts Statistics, Vol. III, Table 1A.

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(SITC 5 through 8) by fourteen major exporting countries<sup>6</sup> to that host, or

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<sup>6</sup>U.S., U.K., Canada, Germany, France, Belgium and Luxemburg combined, Netherlands, Italy, Denmark, Norway, Sweden, Switzerland, Austria, and Japan.

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destination country. The GDP figures are more comprehensive and more of a measure of the economic size of a country but were, we suspected, much less accurate than the export data, which are reported by developed countries with comparatively advanced statistical reporting systems. The GDP figures, particularly for less developed countries, require a large amount of estimation for non-market sectors (which may generate little demand for imports in any case), and then are translated from domestic currency into dollars by exchange rates which, it has been frequently pointed out, distort the comparison severely, especially for the least developed countries.

Exports of pharmaceuticals by the United States and by thirteen other industrial countries were taken from a United Nations world trade tape prepared for the U.S. Department of Commerce. We consolidated the approximately 200 destinations on the original tape to 45 and summarized the 4-digit breakdown of pharmaceuticals into two groups: bulk pharmaceuticals, consisting of SITC 541.1 through 541.6 (primarily bulk medicinals and botanicals), and packaged pharmaceuticals, including SITC 541.7.

Total 14-country exports of all manufactures (SITC 5 through 8) were obtained from the same UN tape. The trade data are those reported by exporters to their own governments and, since they are value data, suffer from any valuation errors and deliberate over- or undervaluation that may occur in the attempt to minimize income or customs taxes. Furthermore, the destinations reported may not be the ultimate destinations, as was obvious in data for exports to certain Caribbean countries.

We found that some equations for less developed countries were dominated by exports to one destination, a grouping of small Caribbean and Central American countries including Bermuda, the Bahamas, and Panama. In at least one case, Bermuda, there was evidence that a large part of the exports were intended not for local consumption but for transshipment to other countries, but that was not the only such case. Vaitzos reports that pharmaceuticals of U.S. or European origin "were sold to Colombia via Panama, through the intervention of a holding company" [1974, p. 48].

To prevent our results being distorted by this misstatement of ultimate destination we ran equations for less developed countries omitting exports to the Caribbean countries. However, we could not do anything about the corresponding understatement of exports to the ultimate destinations, probably Latin American countries.

Distance from the United States, Germany, and Japan was derived for the shortest distance between main ports, as given in Marine Distance and Speed Tables (New York: Edward W. Sweetman Co., 1965), and Table of Distances Between Ports (U.S. Navy Dept., Hydrographic Office, 1943).

The EEC variable refers to the six-member EEC, before enlargement.

### Types and Sources of Parent and Affiliate Data

Information on the number of U.S.-owned affiliates is from a questionnaire sent to U.S. corporations by the National Bureau in which respondents were asked to list their foreign affiliates, to classify them by type of activity (manufacturing, assembly, sales and service, research), by industry (SIC), by major products, which we coded into the SITC, and by date of establishment. For companies that did not fill out the questionnaire we collected the same information as best we could from company annual reports, Moody's Industrials, and other public sources. The total number of parent firms owning foreign pharmaceutical affiliates was 55, of which 34 were pharmaceutical companies. These U.S. companies owned, altogether, 640 manufacturing affiliates and 532 nonmanufacturing affiliates in foreign countries.

We originally collected data on numbers of affiliates partly to secure information not otherwise available, such as the main products and date of establishment, and partly to enable us to study the influence of the numbers themselves. In this study, because they are more complete than our quantitative data, they perform still another function: they provide information on affiliates of companies omitted from the quantitative data. The quantitative data come from a voluntary survey in which not every company participated, while we used a wide variety of sources to put together what we think is a fairly complete list of numbers and locations of foreign pharmaceutical affiliates of U.S. companies.

Information on manufacturing affiliates of foreign pharmaceutical companies was taken from Vaupel and Curhan [1973].

The measures of size or activity of foreign affiliates are from the basic data underlying the Special Survey of U.S. Multinational Companies, 1970 (1972), conducted by the Bureau of Economic Analysis of the U.S. Department of Commerce. The 1970 Survey covered about 300 parent firms and 5,200

affiliates whose assets and sales in 1966 accounted for 55 and 62 per cent respectively of that year's total assets and sales, as derived from a presumably complete census. Only twelve pharmaceutical firms were covered in the 1970 survey, and the superiority of the BEA data over our simple count of numbers of affiliates, with respect to the richness of information, is partly offset by their incompleteness.

Parent company data are from the same BEA survey with the addition of data on pharmaceutical sales, R. & D. expenditures, and various measures of innovativeness from Cohen, Katz, and Beck [1975].

#### Affiliate Variables

The basic data on affiliates described above have been manipulated in various ways to form the variables used in our equations. The variables measuring affiliate activity in a country are of two types. One is a set of variables consisting of the numbers of pharmaceutical affiliates in a country. For U.S.-owned affiliates we can calculate the number that are

1. Manufacturing only
2. Nonmanufacturing only
3. Both manufacturing and nonmanufacturing

For affiliates of foreign countries we have data only on numbers, and these refer only to affiliates that have manufacturing operations, corresponding to the combination of (1) and (3), above, among the U.S. affiliates.

The second type of affiliate measure is a quantitative one: the sum, for all U.S.-owned pharmaceutical affiliates in a country, or for all foreign affiliates of a firm, or for all foreign affiliates of a firm that are located in one area, of each of the following items:

1. Value added
2. Net fixed assets
3. Depreciation
4. Payrolls
5. Net sales
6. Net local sales

Value added is defined as the sum of payrolls, net income before income taxes, and depreciation. Net sales are an affiliate's total sales minus its imports from the United States, and net local sales are the product of local sales (sales in the host country) multiplied by the ratio of net sales to total sales. The underlying assumption in the calculation of net local sales is that imports constitute the same fraction of inputs into local sales as of inputs into other sales.

Each of the measures involves some drawbacks. Value added would seem to be closest to an economic measure of the size of the affiliate since it includes all inputs, but it is subject to the vagaries of intracompany pricing which may dictate high markups in some countries, and thus high income and value added, and low markups in others, without any relation to the actual input of capital or other nonlabor assets in each country.<sup>7</sup> Net fixed

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<sup>7</sup>Vaitsos [1974, p. 62], for example, describes foreign-owned pharmaceutical affiliates in Colombia for which "reported" profits were \$362 thousand in 1968 and he estimates hidden profits resulting from overpricing of intermediate products to have been \$8.7 million. Of course we do not know whether these reported profits were the same as those reported to the U.S. Department of Commerce.

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assets and depreciation are less subject to this difficulty, although there may be over- or under-valuation of capital goods shipped to a country. However, they represent only part of one input, capital (excluding inventories and financial and intangible assets) and are ill-suited to measuring the size of nonmanufacturing affiliates. Payrolls, on the other hand, measure only labor costs, and those incompletely. Sales were measured net of imports from the United States to eliminate that part of affiliate sales which could be only a bookkeeping entry in which exports from the United States were passed through the affiliate. Such sales would, of course, be highly correlated with U.S. exports, but the line of causation would be unclear or even mainly running from exports to the affiliate sales. Net local sales were thought of as appropriate for measuring the impact of affiliate activity on exports to a particular country, on the notion that sales to Canada by a U.S.-owned affiliate in the United Kingdom should not affect U.S. exports to the U.K. although they could affect U.S. exports to Canada or to the world as a whole.

In these quantitative data we have divided affiliates into manufacturing and nonmanufacturing.

Determinants of U.S. and Foreign Exports to and Investment  
and Production in Individual Countries

Variables other than Investment

Our basic question is the extent and direction of any effect of affiliate presence and activity on exports by the United States and other countries. The activity of affiliates is, however, only one of many influences on exports. To measure the other influences we began with a simple version of a standard trade model<sup>8</sup> in which exports by the United

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<sup>8</sup>See, for example, Leamer and Stern [1970], Linneman [1966], Taplin [1967], and Tinbergen [1962].

---

States and by the thirteen other major developed exporters to each destination were related to the gross domestic product of the importing country, its total imports of manufactures, its consumption of pharmaceuticals, its distance from the United States, the United Kingdom, Germany, and Japan, and membership in the European Economic Community. It was assumed that distance was a proxy for such obstacles to trade as difficulties with the flow of information, rather than for transport costs, since pharmaceuticals are such a high-valued commodity that transport cost should be of minor importance in determining the direction and amount of trade.<sup>9</sup> For the same

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<sup>9</sup>On imports of pharmaceuticals to the United States in 1966 the ratio of transport cost to f.a.s. value was less than 1 1/2 per cent. See Lipsey and Weiss [1974], App. Table A-1.

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reason, no effort was made to estimate actual transport cost for these products.

The trade equations excluding affiliate variables are shown in Appendix Tables A-1 and A-2. Our conclusions from these calculations were tested later in equations including affiliate variables. One conclusion was that distance was of minor importance and was rarely statistically significant at the 5 per cent level. Those distance coefficients that were significant or close to it had the appropriate signs: negative for distance from the exporting country, positive for distance from rival exporters.

As might be expected, the variables measuring size of import markets went a good way toward explaining trade in at least some of the equations. Among the variables for size of market, consumption, which was not available for less developed countries, seemed to be the best scale variable for the

developed countries. For less developed countries, their imports of all manufactures, as measured by 14-country exports of manufactures to them was the variable chosen for later use, for reasons described above. The variable for EEC membership in equations for developed countries was positive for exports of thirteen countries (which includes the EEC members) despite the fact that sales by each EEC country in its own market were excluded. In the case of U.S. exports, EEC membership was associated positively with exports of bulk pharmaceuticals but negatively with exports of packaged pharmaceuticals (although neither coefficient was significant). The implication would seem to be that membership in EEC produced some substitution of bulk for packaged exports by U.S. pharmaceutical companies.

On the possibility that the relation between exports and consumption (or other variables) might be nonlinear, we fitted several logarithmic equations. The logarithmic fits were quite good, but the arithmetic fit of the log equations was no better than that of the original arithmetic equations. The log equations, therefore, were not used in subsequent work.

#### The Impact of U.S. Manufacturing Affiliates

Since one of the original issues behind our study was the existence and importance of substitution between affiliate activity and U.S. exports we tested a good many equations in which the presence of U.S. affiliates and their size was an independent variable and U.S. exports was the dependent variable. Our original supposition was that nonmanufacturing affiliates should have a positive relation to exports but that no prediction could be made a priori about manufacturing affiliates because there were both positive and negative influences at work (Lipsey and Weiss [1969]).

Our equations for the pharmaceutical industry show, with virtually no exceptions, either no impact of manufacturing affiliates on U.S. exports or a positive impact. In equations for exports to 22 developed countries, of which equations (1) and (2) are examples,

$$\begin{aligned}
 (1) \quad \text{USEXBD} &= 2.05 - .002 \text{ SC} + .07 \text{ USMFS} + .31 \text{ USNMFS} - .35 \text{ FMF} + 7.13 \text{ EEC} \quad \bar{R}^2 = .51 \\
 &\quad (1.36) \quad (.49) \quad (3.21) \quad (1.61) \quad (1.25) \quad (2.55) \\
 (2) \quad \text{USEXPD} &= 2.39 + .007 \text{ SC} + .04 \text{ USMFS} + .26 \text{ USNMFS} - .66 \text{ FMF} - 1.39 \text{ EEC} \quad \bar{R}^2 = .85 \\
 &\quad (3.34) \quad (3.36) \quad (4.01) \quad (2.77) \quad (4.97) \quad (1.05)
 \end{aligned}$$

where USEXBD = U.S. exports of bulk pharmaceuticals to developed countries

USEXPD = U.S. exports of packaged pharmaceuticals to developed countries

SC = Country scale variable (Consumption for developed countries;  
14-country exports of all manufactures to that country, for  
less developed countries)

USMFS = Manufacturing affiliate net sales (Total sales less imports  
by affiliate from the U.S.).

USNMFS = Nonmanufacturing affiliate net sales

FMF = Number of foreign manufacturing affiliates and parent com-  
panies in host country

EEC = Dummy variable for membership in six-member EEC

Figures in parentheses are t-values.

Source: Appendix Tables B-1 and B-2.

the coefficients are positive and, except for those on numbers of affiliates, statistically significant. The impact is stronger on bulk exports than on packaged exports. Much of this effect disappears when we drop Canada from the list of destinations (Tables B-3 and B-4) and the coefficients lose their statistical significance, but all except one remain positive.

In equations for less developed countries, such as (3) and (4),

$$(3) \text{ USEXBLD} = -.33 + .001 \text{ SC} + .06 \text{ USMFS} + .66 \text{ USNMFS} - .04 \text{ FMF} \quad \bar{R}^2 = .64$$

(.49)(1.45)      (3.24)      (3.15)      (.21)

$$(4) \text{ USEXPLD} = .42 + .001 \text{ SC} - .01 \text{ USMFS} + .92 \text{ USNMFS} + .06 \text{ FMF} \quad \bar{R}^2 = .27$$

(.38)(1.77)      (.47)      (2.71)      (.19)

where USEXBLD = U.S. exports of bulk pharmaceuticals to less developed countries

USEXPLD = U.S. exports of packaged pharmaceuticals to less developed countries

Figures in parentheses are t-values.

Source: Appendix Tables B-5 and B-6.

the relation of manufacturing affiliates to bulk exports of pharmaceuticals was again positive and statistically significant. For packaged exports the results were mixed in sign and far from significance.<sup>10</sup>

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<sup>10</sup>This result, based on later and more complete data, including quantitative measures of affiliate size, and on a more satisfactory equation, contradicts our earlier finding, in Lipsey and Weiss [1972], Table 2, of some negative relationship, at least in exports to less developed countries.

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Another set of equations examines the impact of U.S.-owned manufacturing affiliates on exports by the thirteen other exporters. Among developed countries, the coefficients are negative, as we might expect, but not significant for either bulk or packaged exports (Tables B-7 and B-8). When Canada is removed from the data, as in equations (5) and (6),

$$\begin{aligned}
 (5) \quad 13 \text{ EXBDC} &= -.15 + .02 \text{ SC} - .15 \text{ USMFS} - .12 \text{ USNMFS} + 2.69 \text{ FMF} + 13.67 \text{ EEC} \quad \bar{R}^2 = .78 \\
 &\quad (.05)(1.68) \quad (2.10) \quad (.28) \quad (4.15) \quad (2.29) \\
 (6) \quad 13 \text{ EXPDC} &= 32.04 + .02 \text{ SC} + .07 \text{ USMFS} + .48 \text{ USNMFS} - 3.18 \text{ FMF} + 38.86 \text{ EEC} \quad \bar{R}^2 = .58 \\
 &\quad (6.21)(1.14) \quad (.66) \quad (.71) \quad (3.06) \quad (4.07)
 \end{aligned}$$

where 13 EXBDC = 13-country exports of bulk pharmaceuticals to developed countries  
exc. Canada

13 EXPDC = 13-country exports of packaged pharmaceuticals to developed  
countries exc. Canada

Figures in parentheses are t-values.

Source: Appendix Tables B-9 and B-10.

the negative coefficients in the 13-country bulk export equations become stronger, but the equations for packaged exports show mixed signs and no significant relationships.

The results for less developed countries, as can be seen in equations (7) and (8) as well as others in Appendix B, are curious.

$$\begin{aligned}
 (7) \quad 13 \text{ EXBLD} &= .87 + .002 \text{ SC} + .13 \text{ USMFS} - .13 \text{ USNMFS} + .05 \text{ FMF} \quad \bar{R}^2 = .82 \\
 &\quad (.98) (3.65) \quad (4.94) \quad (.46) \quad (.21) \\
 (8) \quad 13 \text{ EXPLD} &= -10.27 + .03 \text{ SC} - .53 \text{ USMFS} - 2.43 \text{ USNMFS} + 1.14 \text{ FMF} \quad \bar{R}^2 = .90 \\
 &\quad (2.04)(10.98) \quad (3.64) \quad (1.57) \quad (.86)
 \end{aligned}$$

where 13 EXBLD = 13-country exports of bulk pharmaceuticals to less developed  
countries

13 EXPLD = 13-country exports of packaged pharmaceuticals to less  
developed countries

Figures in parentheses are t-values.

Source: Appendix Tables B-11 and B-12.

The presence and size of U.S. manufacturing affiliates appears to be positively related to bulk exports by the other thirteen countries, but negatively related to their packaged goods exports. Both relationships are significant, but the coefficients for packaged goods exports are considerably larger, and the net effect of U.S. manufacturing affiliates on 13-country pharmaceutical exports is therefore negative.

The positive relationship between U.S. affiliates and 13-country bulk exports is at first sight surprising. The most likely explanation is that the presence of U.S. firms in a country inhibits foreign firms' sales of packaged products and forces foreign firms to invest in their own manufacturing, substituting bulk for packaged exports. Another possible explanation is that there is a missing variable, which would be some measure of host-country policy toward imports and investment, which may be influencing both the investment and the export variables. A policy which discourages imports of packaged pharmaceuticals may encourage both manufacturing investment and bulk imports. Similarly, a policy which encourages manufacturing investment may discourage packaged imports and encourage bulk imports.

#### The Impact of U.S. Nonmanufacturing Affiliates

The relation of nonmanufacturing affiliates to U.S. exports to developed countries is positive, where it is significant, and stronger for packaged goods than for bulk pharmaceuticals, as we would expect (Equations (1) and (2) and Appendix Tables B-1 to B-4). Among less developed countries too, the presence of U.S.-owned nonmanufacturing affiliates is associated with higher U.S. exports, and, again, the effect is greater on packaged exports than on bulk exports (Equations (3) and (4) and Appendix Tables B-5 and B-6).

Despite our expectation of a negative relationship, there were virtually no statistically significant coefficients relating U.S.-nonmanufacturing affiliates to 13-country exports of pharmaceuticals, and the signs were erratic (Tables B-9 to B-12).<sup>11</sup>

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<sup>11</sup>The lack of relationship with 13-country exports contradicts the puzzling positive relationship we found earlier (Lipsev and Weiss [1972]), mainly for less developed countries. In fact, in our equations for packaged

exports, all the coefficients on size of U.S. affiliates are negative, with only the numbers measure giving the paradoxical positive relationship found earlier (but here not significant). It may be that the missing variable, host country policy, affects the member of affiliates more than it does their aggregate production or investment.

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#### Impact of Foreign-owned Manufacturing Affiliates

Just as we had expected the presence of U.S. manufacturing affiliates to reduce foreign countries' exports to a destination, we expect the presence of foreign-owned manufacturing affiliates to reduce U.S. exports. Among developed countries, all the coefficients for foreign-owned affiliates are negative (Tables B-1 to B-4). Few are significant for bulk exports but the impact on packaged goods exports is strong and statistically significant, as in Equation 2.<sup>12</sup> However, the foreign-owned manufacturing affiliates did not

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<sup>12</sup>It should be noted that the variable for foreign-owned manufacturing affiliates is the number of these, and is identical among all the equations. The change from one equation to another is in the measures for U.S.-owned affiliates.

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seem to affect U.S. exports to destinations in less developed countries.

The impact of foreign-owned affiliates on foreign exports to developed countries was positive for bulk exports and negative for packaged exports. The negative coefficients were generally higher than the positive ones, as in Equations (5) and (6), but the differences, and therefore the effect on total exports, were usually small. This is almost the only case of substitution we found, with exports of bulk pharmaceuticals replacing exports of



packaged pharmaceuticals in countries where manufacturing affiliates were located. The equations for packaged exports showed significant coefficients for EEC membership, and it is possible that this effect becomes mixed with that of the number and size of affiliates since the affiliates are concentrated in EEC countries.

Among destinations in less developed countries, the coefficients for the effect of foreign affiliates on foreign exports are all positive, but none are statistically significant.

#### Numbers and Size as Measures of Affiliate Activity

One can view the establishment of a foreign sales affiliate, and especially of a foreign manufacturing affiliate, as a discrete decision quite different from that involved in expanding an existing affiliate and having a separate impact on the firm's exporting policy. Many studies of foreign investment deal with the decision itself (for example, Richardson [1971]), or measure the firm's foreign involvement in terms of numbers of affiliates or numbers of countries in which a firm has affiliates, as in the Harvard Business School studies (Vaupel and Curhan [1969], [1973]). Aside from the idea of the discreteness of the investment decision, one can also justify working with numbers of affiliates on the ground that two or more small affiliates will have effects on exports different from that of one larger affiliate, partly because the separate affiliates probably involve separate product lines.

Because of the differences in coverage described earlier, it is difficult to interpret differences in the results between equations based on numbers and those based on quantitative data. It should be mentioned, however, that the two types of variables are quite highly correlated except for nonmanufacturing affiliates in LDC's (Table 3). And on the whole, as can be seen in Tables B-1

TABLE 3

Simple Correlation Between Numbers of Affiliates and Various Activity Measures

Activity Measure	Manufacturing Affiliates				Nonmanufacturing Affiliates			
	Developed Countries	Developed Countries exc. Canada	LDC's Caribbean	LDC's exc. Caribbean	Developed Countries	Developed Countries exc. Canada	LDC's Caribbean	LDC's exc. Caribbean
Value added	.87	.81	.77	.87	.72	.74	.05	.13
Net fixed assets	.83	.77	.77	.84	.68	.65	.09	.11
Depreciation	.86	.81	.71	.80	.78	.78	.06	.11
Payroll	.89	.87	.75	.84	.72	.78	.10	.17
Net sales	.89	.85	.76	.86	.80	.82	.06	.13
Net local sales	.92	.91	.76	.87	.75	.81	.05	.13

through B-14, the equations based on numbers of affiliates usually, but not always, suggest the same conclusions as those based on the affiliate activity measures, although there are often differences in the significance levels.

The equations for U.S. exports of bulk pharmaceuticals to developed countries (Table B-1), for example, show number of manufacturing affiliates as having a positive but not statistically significant impact, while the coefficients for variables measuring affiliate size or activity are significant. The opposite is true for the nonmanufacturing affiliates. For U.S. exports of bulk and packaged drugs to less developed countries, on the other hand (Tables B-7 and B-8), we find the activity variables for nonmanufacturing affiliates significant, but not the numbers. The paradoxical positive relationship between U.S. nonmanufacturing affiliates and exports by other countries to developed markets is visible only when numbers are used as the measure of U.S. affiliate activity, but not when the size measures are used (Table B-12).

If the coverage of the quantitative data were complete, we could test for any separate effect of the presence of affiliates by including both numbers and quantitative variables in the equations, unless the correlation between numbers and quantities was too great. As it is, however, the **values for numbers may only be acting as proxies for the quantitative variables** in cases where the quantitative information is missing.

Even given the incompleteness of coverage of the size measures, if the residuals from the relation between numbers and size of affiliates represent mainly exceptionally large or small affiliates, the equations including both variables should give us information on the separate influence of affiliate presence and affiliate size. However, if the residuals reflect mainly the incompleteness of coverage of the size data, the equations including both numbers and size will give a false impression of no relation between size of affiliates and exports.

If the number and size variables are measuring different aspects of the impact of affiliates, we should expect that coefficients for size variables will remain significant when the numbers variables are added to the equations. On the other hand, if numbers are mainly a more error-free measure than size for the same relationship, addition of the numbers variables will destroy the significance of the size coefficients.

A possible case of the former phenomenon is given in equations (9) and (10)

$$\begin{aligned}
 (9) \quad \text{USEXBDC} &= 1.94 - .001 \text{ SC} + .04 \text{ USMFS} + .27 \text{ USNMFS} - .21 \text{ FMF} + 7.27 \text{ EEC} \quad \bar{R}^2 = .42 \\
 &\quad (1.30) \quad (.27) \quad (1.31) \quad (1.39) \quad (.69) \quad (2.63) \\
 (10) \quad \text{USEXBDC} &= -1.29 + .002 \text{ SC} - .05 \text{ USMFS} + .09 \text{ USNMFS} - .59 \text{ FMF} + 6.30 \text{ EEC} + \\
 &\quad (.87) \quad (.44) \quad (1.32) \quad (.49) \quad (2.26) \quad (2.90) \\
 &\quad .14 \text{ USMFN} + .56 \text{ USNMFN} \quad \bar{R}^2 = .65 \\
 &\quad (.94) \quad (2.84)
 \end{aligned}$$

where USEXBDC = U.S. exports of bulk pharmaceuticals to developed countries except Canada

USMFN = number of U.S. manufacturing affiliates

USNMFN = number of U.S. nonmanufacturing affiliates

Figures in parentheses are t-values.

Source: Appendix Tables B-3 and B-13.

and others for U.S. bulk exports to developed countries. The  $\bar{R}^2$  are considerably higher when the variables for numbers of affiliates are added, the variable for number of U.S. nonmanufacturing affiliates has the positive sign we expect, instead of the mixture of nonsignificant coefficients in Tables B-3, and the variable for foreign affiliates becomes statistically significant with the expected negative sign.

Table B-16 is a possible example of the latter phenomenon. Addition of the numbers variable has little effect other than to reduce the significance levels of the size of U.S. manufacturing affiliates.

### Export Shares

The generally positive relations of U.S. affiliates to U.S. exports, and foreign affiliates to foreign exports, and the negative relation of U.S. affiliates to foreign exports and foreign affiliates to U.S. exports suggest that export shares to individual countries should reflect the nationality of ownership of affiliates. Since many of the equations for United States and foreign exports contain significant constant terms, however, they do not translate into any simple relationship between the relative number of affiliates and the relative amounts of exports.<sup>14</sup> Nevertheless, the ratio

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<sup>14</sup>If there were no significant constant term we could represent equations for U.S. exports ( $y_1$ ) and foreign exports ( $y_2$ ) as  $y_1 = b_1x_1$  and  $y_2 = b_2x_2$ .

Then  $\frac{y_2}{y_1} = \frac{b_2}{b_1} \cdot \frac{x_2}{x_1}$ . However, if there is a significant constant term,

$y_1 = a_1 + b_1x_1$  and  $y_2 = a_2 + b_2x_2$ , and then  $\frac{y_2}{y_1} = \frac{a_2}{a_1 + b_1x_1} + \frac{b_2x_2}{a_1 + b_1x_1}$ .

---

of foreign to U.S. exports or of foreign to total exports to a country should vary directly with the corresponding ratios for affiliates, even if the linear form is not the correct type of equation. The relations of export shares to the relative numbers of affiliates are shown in Table C-1. The equations there suggest that we are able to explain these shares to some extent, and that, where the affiliate coefficients are statistically significant, a higher ratio of foreign affiliates to U.S. affiliates is associated with a higher foreign share in pharmaceutical exports to a country.

### Determinants of the Number and Activity of U.S. Affiliates

Consumption and other measures of the size of markets should influence not only exports but also the presence and activity of United States and

foreign affiliates. Another variable often mentioned as precipitating a company's decision to establish a foreign affiliate is investment by rival firms (see Knickerbocker [1973]). To the extent that such rivalry is an important motive, and our results on trade suggest that it might well be, we should find that U.S. firms tend to locate where there are affiliates of foreign firms and foreign firms should tend to locate where there are affiliates of U.S. firms.

We find that the number and size of U.S. manufacturing affiliates are positively and significantly related to the number of foreign-owned manufacturing affiliates in both developed and less developed countries (Tables D-1 and D-2). However, we were better able to explain the number than the size of U.S. manufacturing affiliates in developed countries. The size of market variables, consumption and 14-country exports, were not statistically significant. The  $\bar{R}^2$  were much higher for the less-developed destinations than for the developed, although to judge by the numbers equation, the elimination of Canada substantially improves the equations for developed countries.

The results were very different for nonmanufacturing affiliates. Among developed countries consumption had a positive and significant coefficient for most of the measures, except for the numbers and the two measures relating to fixed capital, which are not satisfactory measures for nonmanufacturing affiliates in any case. The coefficients for foreign-owned manufacturing affiliates were significant in some cases but not consistent in sign. Among less developed countries, the number of U.S.-owned nonmanufacturing affiliates was related to 14-country exports, while the size of U.S. affiliates was not explained at all by the variables included.

If we ask the same question about foreign manufacturing affiliates (we have no data on nonmanufacturing affiliates) we find that among developed countries there is a slight tendency (not statistically significant) for them

to be located where there are U.S.-owned nonmanufacturing affiliates. Among less developed countries, however, there is a strong tendency for foreign manufacturing affiliates to be located in countries with large imports (14-country exports) and with large numbers of U.S.-owned manufacturing affiliates. On the other hand, we find a negative association with the size of U.S.-owned nonmanufacturing affiliates.

The consistency of the relationship between manufacturing affiliates of different countries and the inconsistency of the coefficients for non-manufacturing affiliates suggest that, either for competitive reasons, or because of host country trade policies, or some combination of these, the presence of one country's manufacturing affiliates or their growth is an inducement to rival countries to establish their own manufacturing facilities.

Determinants of Total Exports and Investment of  
Individual U.S. Firms

The second way in which we search for relationships between foreign investment and exports is to compare individual firms, although the number of observations is so small (12) that we give these comparisons less weight than those among destinations. We can ask whether firms that are most active with respect to foreign affiliates tend to export more or less than others. It is hard to make a priori judgments about the sign of these coefficients or their relationship to the earlier analysis for the U.S. as a whole. If a firm manufactures abroad it may win markets from other U.S. firms, producing positive coefficients in own-export equations but none in total U.S. equations. On the other hand, the firm may displace mainly foreign rivals, and thus produce positive coefficients in total U.S. equations as well as in own-export equations. The previous finding of positive effects of U.S. investment on U.S. exports suggests that the individual firm effects should also be positive, perhaps even more so.

The firm characteristics, aside from overseas activity, that we use to explain exports are parent sales in the U.S., as a measure of parent size, and several indicators of the innovativeness of parent firms, taken from Cohen, Katz, and Beck [1975]. We might expect that an innovative firm has more of a monopolistic advantage to exploit in foreign markets, and therefore might have a stronger incentive to invest abroad than another firm. On the other hand, an innovative firm might be more able to export without investing abroad, because no close substitutes exist for its products.<sup>15</sup>

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<sup>15</sup>One difficulty should be mentioned: size, which is almost always referred to as a determinant of a company's foreign investment, is related to our indicators of innovativeness. The six most innovative companies of the group are, on the average, 50 per cent larger in terms of U.S. drug sales than the six least innovative companies. It may be that size promotes innovativeness or it may be that it is their innovativeness that accounts for their present size. There is a possibility, then, that when we eliminate the effect of size we are also eliminating some of the effect of innovativeness.

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Table 4 shows a sample of the equations relating parent exports to parent size and affiliate activity. Those using other measures of affiliate activity, shown in Table E-1, produce similar conclusions. Parent size by itself explains a large part of variation in exports but the addition of affiliate activity substantially improves the fit of the equation and at the same time reduces the parent size coefficient. All the equations point to the conclusion that, for any given domestic size of firm, the firms that invest more abroad also export more from the United States.



TABLE 4

Relation of Parent Exports to Parent Domestic Sales  
and Size of Affiliates

12 Pharmaceutical Firms

Dependent Variable: Parent Firm Exports From the U.S.

	Constant Term	Parent Domestic Sales	Affiliate Net Fixed Assets		$\bar{R}^2$
			Mfg.	Nonmfg.	
(1)	-29.34 (1.40) <sup>a</sup>	.156 (4.26)			.609
(2)	3.24 (.24)	.037 (1.16)	.378 (4.83)		.879
(3)	-1.62 (.11)	.042 (1.28)	.272 (1.86)	2.558 (.86)	.875

<sup>a</sup>Numbers in parentheses are t-values.

The addition of variables measuring innovativeness has virtually no effect on most of the equations of Table E-1 but it does improve the two best equations, those using net fixed assets and depreciation as affiliate activity measures. The results, in Table 5, suggest that, when parent size and affiliate activity are held constant, the more innovative firms tend to have higher exports than the less innovative ones.<sup>16</sup>

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<sup>16</sup>Two other possible proxies for innovativeness that have been used elsewhere, which do not rely on a characterization of each drug as innovative or not, had no effect on the equations. The variables were the ratio of new drug sales to total drug sales and the share of single entity drugs in introductions of new drugs.

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It is possible that we may be overlooking some consequences of innovativeness if it affects the extent of affiliate activity, and has some indirect impact on exports in that way. The equations in Table 6 relating affiliate manufacturing activity to parent size and innovativeness (equations for nonmanufacturing activity were similar but much weaker) suggest that parent size was of major importance but that innovativeness, as we measured it earlier, had no influence at all. However, one rough proxy for innovativeness, the ratio of new single entity drugs to all new drugs, which we rejected earlier because it did not distinguish innovative from imitative new drugs, does seem to improve the equations and indicates a negative relationship between innovativeness and foreign manufacturing investment.

Thus, depending on which innovativeness measure we choose, we find some weak evidence that innovativeness has no effect on foreign investment but does tend to raise a firm's exports, given the level of foreign investment, or has

TABLE 5

Relation of Parent Exports to Parent Domestic Sales, Size of Affiliates, and Parent Innovativeness  
12 Pharmaceutical Firms

Measure of Affiliate Activity	Independent Variables				Innovativeness Variables			$\bar{R}^2$
	Constant	Parent Domestic Sales	Affiliate Activity		Innovative Drug Sales	# of Innovative New Drugs		
			Mfg. Affil.	Non-mfg. Affil.		Total U.S. Drug Sales	Total # New Drugs	
Net Fixed Assets	-9.26 (.64)	.04 (1.36)	.35 (2.48)	.97 (.34)	94.76 (1.60)			.896
"	-16.48 (1.07)	.04 (1.53)	.28 (2.21)	2.88 (1.10)		73.88 (1.84)		.904
Depreciation	-4.92 (.34)	.03 (.95)	4.66 (4.97)	-.17 (.02)	101.54 (1.85)			.899
"	-5.70 (.35)	.03 (.88)	4.67 (4.58)	-.63 (.06)		62.32 (1.40)		.883

TABLE 6

Relation of Manufacturing Affiliate Activity to Parent Size and Innovativeness  
12 U.S. Pharmaceutical Companies

Measures of		Independent Variables					-2 R
		Innovativeness Variables					
Parent Size	Manufacturing Affiliate Activity	Constant	Parent Size	Innovative		# Single Entity New Drugs	
				Drug Sales	# Innovative New Drugs		
Domestic Sales	Net Sales	-16.12 (1.28)	.44 (6.05)	Total Drug Sales	# New Drugs		
"	"	-78.04 (1.52)	.45 (6.29)			.760	
"	"	37.33 (.37)	.38 (4.25)			.774	
						.753	
Domestic Net Assets	Net Fixed Assets	-36.41 (1.30)	.46 (6.85)	-2.12 (.01)		.817	
"	"	-36.95 (1.14)	.46 (6.69)		1.44 (.01)	.817	
"	"	59.36 (.97)	.37 (4.89)			.859	
						-143.97 (1.65)	

(continued)

TABLE 6 (concluded)

no effect on exports, given the level of foreign investment, but tends to reduce foreign investment. In either case there would seem to be some hint that the more innovative firms have a higher ratio of exports to foreign production.

For these comparisons among firms we can ask something about the nature of the apparent complementarity between exports and foreign production by breaking exports down between exports to affiliates and to others, and between exports to affiliates for resale and exports for further processing. A sample of the relations among the equations for these various types of exports is given by Equations 11 through 14. We did not run any equations for exports

$$(11) \quad \text{PEXT} = -18.97 + .01 \text{ PDS} + .27 \text{ MFS} + .39 \text{ NMFS} \quad \bar{R}^2 = .838$$

(1.34) (.15) (2.32) (2.10)

$$(12) \quad \text{PEXAF} = 2.02 - .041 \text{ PDS} + .23 \text{ MFS} + .10 \text{ NMFS} \quad \bar{R}^2 = .774$$

(.25)(1.39) (3.41) (.97)

$$(13) \quad \text{PEXAFR} = .83 - .055 \text{ PDS} + .21 \text{ MFS} + .17 \text{ NMFS} \quad \bar{R}^2 = .720$$

(.10)(1.89) (3.09) (1.62)

$$(14) \quad \text{PEXAFP} = .93 + .014 \text{ PDS} + .02 \text{ MFS} - .07 \text{ NMFS} \quad \bar{R}^2 = .068$$

(.15) (.63) (.48) (.84)

where PEXT = Total parent exports from the U.S.

PEXAF = Parent exports to foreign affiliates

PEXAFR = Parent exports to foreign affiliates for resale without  
further processing

PEXAFP = Parent exports to foreign affiliates for processing or  
assembly

PDS = Parent domestic sales

MFS = Net sales (Total sales minus imports from the U.S.)  
by all manufacturing affiliates of a parent.

NMFS = Net sales by all nonmanufacturing affiliates of a parent.

Figures in parentheses are t-values.

Source: Appendix Tables E-1 through E-4.

other than to affiliates but the coefficients of such an equation can be inferred by subtracting the coefficients of equation (12) from those of equation (11).

Total parent exports are positively associated with net sales of both manufacturing and nonmanufacturing affiliates. Exports to affiliates are **strongly associated with sales of manufacturing affiliates while exports to others** are associated with sales of nonmanufacturing affiliates. That is, firms with larger manufacturing facilities overseas tended to sell more to their own affiliates; firms with larger nonmanufacturing facilities tended to sell more to others. The positive association of parent exports with overseas manufacturing was not, however, a consequence of exports to affiliates for further processing; it involved exports for resale. In other words the firms with larger manufacturing activity exported more than others mainly because they sold more products other than those manufactured overseas, not because they sold more raw materials to their own plants for processing.<sup>17</sup>

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<sup>17</sup>It should be stressed again here that the net sales size measure for affiliates is an attempt to exclude the pure resales, since it is calculated by subtracting imports from total sales. The measure may be affected by resales because any markup on these resales will enter net sales, as well as net local sales and value added. However, net fixed assets, depreciation, and payroll should be free of any spurious relationship on this count.

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Some of these relationships are confirmed by equations using fixed assets as the affiliate size variable, one free of possible distortion from including markups on resales in the size measures. Equations (15) and (16) confirm that manufacturing affiliate assets are positively associated with exports for resale

$$(15) \quad \text{PEXAFR} = 12.41 - .02 \text{ PDS} + .24 \text{ MFA} - .83 \text{ NMFA} \quad \bar{R}^2 = .603$$

$$(1.07) \quad (.74) \quad (2.10) \quad (.36)$$

$$(16) \quad \text{PEXAFP} = -6.38 + .04 \text{ PDS} - .09 \text{ MFA} + .72 \text{ NMFA} \quad \bar{R}^2 = .288$$

$$(1.01) \quad (2.70) \quad (1.43) \quad (.57)$$

where MFA = Net fixed assets of all manufacturing affiliates of a  
parent

NMFA = Net fixed assets of all nonmanufacturing affiliates of a  
parent

Figures in parentheses are t-values.

but there is a hint of a negative association with exports for further processing, a fact which suggests that the firms with larger manufacturing facilities abroad tended to have affiliates less dependent on their parent companies for materials than other firms were.

#### Determinants of Exports and Investment by Area for Individual U.S. Firms

The third approach to the relationship between investment and trade is to ask how an individual firm's investment in one of seven world areas affects its own exports to that area. If the effect is positive, as was suggested by the earlier calculations for U.S. exports by areas, it might be stronger for the firm's exports than for U.S. exports as a whole, since some gains in market share for the firm might be at the expense of other U.S. exporters. On the other hand, the negative impact of foreign-owned affiliates, noticed earlier, might be attenuated, since it too may be spread over all the U.S. companies in the same area.

The independent variables used are measures of affiliate activity, which are unique to each company-area combination, measures of market size, of which there are only two for less developed areas and five for developed areas, and measures of parent domestic sales and innovativeness, of which there are twelve, one for each company.



A set of equations for parent exports by area is shown in Appendix Table F-1. The equations for developed countries are better and less sensitive to the choice of affiliate activity measure than those for LDC's, perhaps because we have five observations for each company rather than only two. The results are fairly similar, however. In general, the larger the parent, the greater its sales in any area of the world, and the greater the investment or affiliate activity in any area of the world, the more the parent company will export to that area.

Size of area, in terms of pharmaceutical consumption or imports of manufactures, did not add much to the equations. The best of the innovativeness variables, the ratio of the number of innovative drugs introduced to the total number of drugs introduced, did slightly improve some of the equations for less developed countries, somewhat at the expense of the parent or affiliate activity variables. The results for these countries seemed to indicate that more innovative companies tended to export more to LDC's than the less innovative companies. Among the developed countries, however, the same innovativeness variable had a negative coefficient.

As in the earlier section we experimented with affiliate numbers as an independent variable in addition to affiliate activity measures in the equations for developed countries. These results (Table F-4) were hardly ever statistically significant and did not greatly alter the coefficients for parent sales affiliate activity, or innovativeness, but strengthened the market size variable. The coefficient for numbers of manufacturing affiliates was consistently negative, however, and, if it were taken seriously, would imply that a large group of small U.S. affiliates in an area might reduce U.S. exports but that a single large affiliate would increase exports. Put in another way, the mere establishment of a foreign manufacturing operation in an area tended to reduce exports by the parent to that area, but the expansion of an existing affiliate tended to increase exports.

If we try to test for the effect of the number of non-U.S. affiliates in an area we find (Table F-5) that while the coefficient is negative, as expected and as found earlier, it is never significant, and the equations are not greatly improved. One reason for the difficulty of finding any clear influence of foreign-owned affiliates may be that in this five-area geographical breakdown the measure of number of foreign-owned affiliates is highly correlated with other variables, including the host-country's market size measure: our estimate of pharmaceutical consumption. The results of this intercorrelation can be seen in the large coefficient changes that result when we remove the **foreign** affiliate variable.

To test whether affiliate activity is simply acting as a proxy for other variables we asked whether various measures of such activity were easily explained in terms of parent size, market size, parent innovativeness, or the number of foreign-owned affiliates in an area. We were not able to account for much of the variation in affiliate activity in this way, but there were significant positive coefficients for parent size and the size of a host country's market. The coefficients suggesting that the presence of foreign-owned affiliates reduces U.S. affiliate activity, which **contradicts the earlier** findings of the country cross-section, are probably the result of the heavy weight of Canada among only five areas here.

As in the case of the analysis for parent company exports to the world as a whole, we can examine several types of parent exports to particular areas, at least for developed areas, of which we have four if we exclude Canada.

$$(17) \text{ PEXTDC} = -4.235 + .0105 \text{ PDS} + .087 \text{ MFADC} + 2.963 \text{ NMFADC} + 1.057 \text{ SC} \quad \bar{R}^2 = .728$$

(2.07) (3.51) (4.00) (4.62) (1.56)

$$(18) \text{ PEXAFDC} = -1.671 + .0036 \text{ PDS} + .038 \text{ MFADC} + 1.892 \text{ NMFADC} + .535 \text{ SC} \quad \bar{R}^2 = .789$$

(1.92) (2.84) (4.08) (6.93) (1.85)

where PEXTDC = Total parent exports to a developed area other than Canada

PEXAFDC = Parent exports to affiliates in a developed area other than Canada

MFADC = Net fixed assets of a parent firm's manufacturing affiliates in a developed area other than Canada

NMFADC = Net fixed assets of a parent firm's nonmanufacturing affiliates in a developed area other than Canada.

Figures in parentheses are t-values.

Source: Appendix Tables F-5 and F-7.

On the whole, the same variables seem to influence exports to affiliates and exports to others in particular areas. It is not surprising to find that in the case of parent size and pharmaceutical consumption, but we also find, from the subtraction of coefficients, that manufacturing affiliate activity and nonmanufacturing activity are positively related to exports other than to affiliates.

Within exports to affiliates we can distinguish again between exports for resale and exports for further processing in equations (18), repeated for comparison, through (23), which are in terms of net sales as well as assets.

$$(18) \text{ PEXAFDC} = -1.671 + .0036 \text{ PDS} + .038 \text{ MFADC} + 1.892 \text{ NMFADC} + .535 \text{ SC} \quad \bar{R}^2 = .789$$

(1.92) (2.84) (4.08) (6.93) (1.85)

$$(19) \text{ PEXAFRDC} = -.979 + .0027 \text{ PDS} + .017 \text{ MFADC} + 1.570 \text{ NMFADC} + .059 \text{ SC} \quad \bar{R}^2 = .657$$

(1.18) (2.20) (1.90) (6.07) (.22)

$$(20) \text{ PEXAFPDC} = -.728 + .0011 \text{ PDS} + .022 \text{ MFADC} + .216 \text{ NMFADC} + .466 \text{ SC} \quad \bar{R}^2 = .388$$

(1.07) (1.10) (3.10) (1.01) (2.07)

$$(21) \text{ PEXAFDC} = -3.107 + .0058 \text{ PDS} + .034 \text{ MFSDC} + .112 \text{ NMFSDC} + .842 \text{ SC} \quad \bar{R}^2 = .494$$

(2.35) (2.89) (2.27) (1.54) (1.85)

$$(22) \quad \text{PEXAFRDC} = -2.075 + .0045 \text{ PDS} + .007 \text{ MFSDC} + .156 \text{ NMFSDC} + .327 \text{ SC} \quad \bar{R}^2 = .384$$

(1.91) (2.74)            (.53)            (2.62)            (.88)

$$(23) \quad \text{PEXAFFDC} = -1.007 + .0013 \text{ PDS} + .028 \text{ MFSDC} - .043 \text{ NMFSDC} + .478 \text{ SC} \quad \bar{R}^2 = .478$$

(1.51) (1.28)            (3.66)            (1.17)            (2.09)

where PEXAFRDC = Parent exports to affiliates in a developed area except  
Canada of products for resale

PEXAFFDC = Parent exports to affiliates in a developed area except  
Canada of products for processing or assembly

MFSDC = Net sales of a parent firm's manufacturing affiliates  
in a developed area other than Canada

NMFSDC = Net sales of a parent firm's nonmanufacturing affiliates  
in a developed area other than Canada

Figures in parentheses are t-values.

Source: Appendix Tables F-7 through F-9.

Parent size, in both sets of equations, affects exports for resale more than exports for further processing, while the size of the importing area is more clearly associated with the exports for further processing. The relationships with the two types of affiliate are just what we might expect; the larger the manufacturing affiliates in an area, the greater the exports to that area for further processing; the larger the nonmanufacturing affiliates, the greater the exports to that area for resale.

These results for the two types of exports fit better with our expectations than the earlier comparisons among firms' aggregate exports. Among firms, those with more manufacturing activity abroad had more exports for resale, but not more for further processing. Among areas, however, where there was more manufacturing activity, there was more export for further processing, and where there was more nonmanufacturing activity, exports for resale were greater.

### Summary

The main directions of association between exports from the United States and other countries and overseas production by U.S. and foreign companies in the pharmaceutical industry are summarized in Table 7 for the three ways in which we have examined them. The first was to relate exports of pharmaceuticals by the U.S. and by thirteen other developed countries to 43 or 44 destinations to the size or activity of U.S. owned pharmaceutical affiliates and to the number of foreign-owned pharmaceutical manufacturing affiliates in these countries. These relations are summarized in sections A.1, B.1, and C.1 of Table 7. The second method was to relate total exports by a U.S. firm, and various types of exports, to the size or activity of its own affiliates. These calculations are summarized in sections A.2 and B.2. The third method was to relate a U.S. firm's exports to a particular geographical area (much broader than the destinations used for method 1) to the size and activity of the firm's affiliates in that area. The results of this method appear in sections A.3 and B.3 of Table 7.

It is clear from Table 7 that there is a predominantly positive relationship between U.S. production abroad and U.S. exports (Sections A and B, Columns 1 and 2), and between foreign-owned manufacturing facilities and foreign exports (Section C, columns 3 and 4). Furthermore, U.S. production abroad is negatively related to foreign countries' exports (Section A, Columns 3 and 4) and foreign-owned manufacturing is negatively related to U.S. exports, at least to developed countries (Section C, column 1).

In order to interpret these relationships we need to know what would have happened to trade if U.S. firms had been prevented from producing abroad or, in some views, had not been induced by favorable tax treatment or overvalued exchange rates, to produce abroad. This alternative situation we need for comparison is not visible to us and we must therefore infer it in some way from

TABLE 7

Direction of Relationship between U.S. and Foreign-Owned  
Affiliates and Exports by the U.S. and Foreign Countries

+ or - indicates t-value of 2 or more

(+) or (-) indicates t-value of 1 or more but less than 2

0 indicates no consistent relationship

	U.S. Exports		13-Country Exports	
	Developed Countries exc. Canada	LDC's exc. Caribbean	Developed Countries exc. Canada	LDC's exc. Caribbean
<hr/>				
A. <u>U.S.-Owned Manufacturing Affiliates</u>				
1. Total Country Exports				
Bulk	(+)	+	-	+
Packaged	(+)	0	0	-
Total	(+)	+	(-)	-
	{			
2. Parent Exports, total		+	Not applicable	
to affiliates		+	"	
to affiliates for resale		+	"	
to affiliates for further processing or assembly		(-)	"	
	{			
3. Parent Exports, by Area, total	+	+		"
to affiliates	+	NA		"
to affiliates for resale	(+)	NA		"
to affiliates for further processing or assembly	+	NA		"
<hr/>				
B. <u>U.S.-Owned Nonmanufacturing Affiliates</u>				
1. Total Country Exports				
Bulk	(+), + <sup>a</sup>	+	0	0
Packaged	+	+	0	0
Total	+	+	0	0
	{			
2. Parent Exports, total		(+)	Not applicable	
to affiliates		0	"	
to affiliates for resale		(+)	"	
to affiliates for further processing or assembly		0	"	
	{			
3. Parent Exports, by Area, total	+	(+)		"
to affiliates	+	NA		"
to affiliates for resale	+	NA		"
to affiliates for further processing or assembly	0	NA		"
<hr/>				
C. <u>Foreign-Owned Manufacturing Affiliates</u>				
1. Total Country Exports				
Bulk	- <sup>a</sup>	0	+	0
Packaged	-	0	-	(+)
Total	-	0	0	(+)

<sup>a</sup>Equations using both number and activity variables.

the information we have about the present and near past. All the methods for doing this are subject to serious deficiencies, whether we start from the micro-economics of the firm and build up a model of location decisions or whether we somehow relate the amount of trade taking place to the amount and location of production. The former method demands a good deal of information we do not have about elasticities of demand, costs in different countries, and economies or diseconomies of scale, while the latter implies lines of causation not usually discussed as part of the theory of the firm.

What we have done in this paper is to assume that the answer to the question, "What would have happened if U.S. or foreign countries had not invested in abroad or had invested less, or had not invested in particular countries or regions, or had invested less there?" is provided by those countries in which there was less investment or by those companies that invested less. The assumptions have some obvious weaknesses. In the comparison among countries there are factors specific to a country, such as the size of its market for a product, which may simultaneously influence both exports to it and direct investment in it without there being any true interdependence between exports and investment. In the comparison among companies there are factors peculiar to individual companies that may affect both variables, such as the size of the company, its age, its technological capacity, or patent position, or some propensity for foreign operations. To the extent that we fail to take account of such factors, we may attribute their effects on exports to direct investment.

We attempt to deal with these problems in several ways. One is that in the explanation of exports we include some factors and tried others, not shown, that may influence both investment and exports, such as, for countries, measures of market size (pharmaceutical consumption, total imports of manufactures from 14 countries, GDP, population) and distance from sources of imports and investment, membership in the EEC, GDP per capita, and number of doctors per capita and,

for companies, measures of company size (parent domestic sales, parent pharmaceutical sales), innovativeness, and R & D inputs. The coefficients we derive for investment or production variables should thus be net of the influence of these factors.

A second method of dealing with common influences on exports and investment is by examining the relation of foreign affiliates to U.S. exports and of U.S. affiliates to foreign exports. The host-country policies toward imports and investment and other host-country characteristics should affect U.S. and foreign companies in the same way, but should not determine the proportion of affiliates that belong to U.S. companies. If the apparent relations between exports and investment were wholly spurious, dependent on host-country characteristics and policy, our equations should not be able to distinguish the relation between U.S. exports and foreign affiliates from that between U.S. exports and U.S. affiliates, or the relation between foreign exports and foreign affiliates from that between foreign exports and U.S. affiliates. That is clearly not the case, and we are therefore encouraged to believe that the coefficients of these equations do represent to some degree causal relationships flowing from overseas production decisions to exports.

That is not to say that the policies of governments are not one of the factors creating the interdependence between exports and investment. The interdependence could result from policies that restrict government purchases to firms that manufacture locally or that discourage imports from firms that do not also manufacture locally, or that require local content in products sold domestically. However, there exist links between investment and exports aside from government interventions, arising from cost differences, transport costs, and an important group of advantages in local production involving such things as the confidence of customers in the permanence of a firm's commitment to a market, and the speed of service and response to local conditions.



In the face of these links between exports and host-country production firms have to make choices about how and how much to serve different markets. We assume that there is much uncertainty about the results of these choices, that decisions correct for the past are often no longer optimal, but are difficult to alter, and that, partly because there is so much uncertainty, different firms have made different judgments even in the face of the same conditions or that the same firm has made different judgments in different countries. We are therefore assuming that we can examine the results of these not necessarily optimal decisions and use the differences among countries and among companies to estimate the interrelationships between investment and exports.

If we interpret the signs of coefficients in Table 7 in the light of these assumptions we can replace the statements about association with the conclusion that an increase in production in a country by U.S. pharmaceutical affiliates adds to U.S. exports of both bulk and packaged pharmaceuticals ~~exports~~ to that country but reduces exports by the thirteen other countries included in the study. The presence of U.S. manufacturing affiliates encourages the export of more bulk pharmaceuticals and less packaged pharmaceuticals by the other 13 countries, but the net balance is negative.

U.S.-owned nonmanufacturing affiliates are associated with comparatively large U.S. exports of all pharmaceuticals, but show no strong relation to exports by foreign countries.

The presence of foreign-owned manufacturing affiliates seems to have a negative effect on U.S. exports of bulk and packaged pharmaceuticals, at least to developed countries. This corresponds to the negative effect of U.S. affiliates on foreign exports. However, the effect of foreign affiliates on their own countries' exports to developed countries is ambiguous: a strong positive

impact on exports of bulk products but also a strong negative effect on their countries' packaged goods exports, with the net result close to zero. On exports to less developed countries there was some sign of a positive effect.

Thus, these equations seem to indicate that foreign affiliates in the pharmaceutical industry promote exports from their own countries to host countries and discourage exports by other countries to host countries. They also promote exports of bulk pharmaceuticals to some extent at the expense of packaged products. If we put the issue in terms of whether foreign production is a substitute for exports we can say that substitution would imply the following pattern of signs for coefficients of foreign investment or production measures in our country equations:

	<u>U.S. Exports</u>	<u>13-Country Exports</u>
U.S.-owned manuf.	-	
Foreign-owned manuf.		-
U.S.-owned non-manuf.	-	

In fact, the pattern, to summarize roughly, is

U.S.-owned manuf.		
Developed less Canada	+	
LDC's less Caribbean	+	
Foreign-owned manuf.		
Developed less Canada		
LDC's less Caribbean		+
U.S.-owned non-manuf.		
Developed less Canada	+	
LDC's less Caribbean	+	

Every coefficient that has a t-value above 1 contradicts the hypothesis of substitution where that hypothesis yields any prediction about the direction of the relationship. In fact they all point to the opposite conclusion: the presence of pharmaceutical affiliates in a country is associated with higher exports of pharmaceuticals to that country by the countries of parent companies. The only type of substitution shown is that production by U.S.-owned manufacturing affiliates seems to displace exports to a destination

by countries other than the United States and that the presence of affiliates of countries other than the United States in a destination leads to displacement of U.S. exports.

With respect to the substitution of one country's production for another country's exports, we provide support for a previous finding for the U.K. that "As for effects upon exports, the existence of the U.K.-owned company often ensures the continuity of supply of exports of semi-processed goods from the U.K." and that "the refusal of the United Kingdom companies to set up branches and subsidiaries would simply open the way to American or Continental companies...." but not the further strong statement that "...in aggregate it almost certainly reduces the overall level of exports from the United Kingdom."<sup>18</sup>

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<sup>18</sup>S. J. Wells, "The International Pattern of Finance," in Teeling-Smith [1967], p. 82.

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Our results support the notion of oligopolistic rivalry, or retention or expansion of market share as a motivation for the establishment of affiliates. That is, a firm can increase its market share by establishing an affiliate but will tend to lose part of its share if rival firms (at least foreign rival firms) establish affiliates. This idea is confirmed by direct tests which show that U.S. firms tend to have affiliates where there are foreign firms' affiliates, and foreign firms tend to have affiliates where there are U.S. firms' affiliates.

This rivalry among firms may also be related to host country governmental policies to encourage domestic manufacturing of pharmaceuticals. "...not only do Governments of most countries encourage the establishment and growth of domestic pharmaceutical industries by means of tariffs and (more important) by

direct trade controls; they frequently impose health control requirements of varying complexity which seriously increase the difficulties of exporting bread-and-butter products.... The Governments of developing countries have been particularly anxious to foster home production of pharmaceuticals, in many cases by the grant of a production licence to a foreign firm which was prepared to establish local manufacture behind a wall of almost prohibitive import restrictions."<sup>19</sup> Thus the existence of the tariff barriers and the

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<sup>19</sup>S. J. Wells, op. cit., pp. 74-75.

---

control of manufacturing entry by the host government may be the incentives that cause the establishment of pharmaceutical manufacturing in what would otherwise be unprofitable circumstances, and the entry of one firm may then preclude both entry and exports by other firms.

The substitution we find of bulk for packaged exports is also confirmed by anecdotal evidence and attributed, again to government policy in importing countries. Williamson, describing a British company's exports to continental Europe, states that "Not surprisingly, markets of this type deter the importation of finished pharmaceutical products. They take the view, as does the United Kingdom, that domestically they are quite capable of putting tablets into bottles or even making the tablets. Consequently, considerable persuasion is often exerted upon foreign manufacturers to encourage them to undertake local manufacture or to restrict importation to chemical substances. We have resisted these pressures on economic grounds wherever we could do so. We have learnt, however, that to comply in some cases even where it was partially disadvantageous

has locally been a political desirability."<sup>20</sup>

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<sup>20</sup>C.R.B. Williamson, "Exporting Pharmaceuticals," in Teeling-Smith [1967].

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The results of the comparisons among companies parallel those among countries: pharmaceutical companies with greater manufacturing affiliate activity abroad also export more. The effect of nonmanufacturing activity is also positive, but the coefficients are frequently not significant. Size of parent firm, as represented by domestic sales, shows no effect on exports, but this result may reflect only the difficulty of distinguishing between the effects of parent size and affiliate size because they are highly correlated--much more so than market size and investment. The more innovative parent companies also show some tendency to export more than their less innovative competitors, if we hold constant the size of parents and their overseas investment, or to some small extent to substitute exports for foreign production.

A company's exports to a particular geographic area seem to be larger if the company also has production in that area and if it has non-manufacturing facilities there. The exports are greater not only to the affiliates but also to other, non-affiliated customers. The impact of non-manufacturing affiliates in an area was largely on exports for resale, as we would expect, and only the manufacturing affiliates affected exports for further processing or assembly. A few of the equations for comparing exports by area also give some weak support to the finding, in comparisons among countries, that the presence of manufacturing affiliates owned by non-U.S. companies tends to depress U.S. exports, but the number of areas is too small to make this a good test of the issue.

We can use the coefficients of the various equations to measure the effect on trade of a dollar in net sales by U.S. affiliates in developed and less developed countries. (We could do the same for a dollar of investment in plant and equipment in place, the equations for which were sometimes better than the net sales equations, but net sales equations are intuitively clearer and probably more relevant for the nonmanufacturing affiliates.)

The country equations indicate that a dollar in net sales by a U.S. manufacturing affiliate adds 6 or 7 cents to U.S. exports of pharmaceuticals and reduces other countries' exports by 15 cents in developed country markets and by 40 cents in less-developed country markets. The larger impact in LDC's may be accounted for by the fact that there is comparatively little local production and most of the effect of U.S.-owned production is therefore felt by rival exporters.

A dollar of net sales by a U.S.-owned nonmanufacturing affiliate adds much more to U.S. exports and reduces foreign exports by a much higher amount also. The high values of these coefficients partly reflect the fact that each dollar of net sales represents more than a dollar of gross sales, particularly for nonmanufacturing affiliates.

We can make a rough comparison between these results from the country equations and those from various equations for total company exports, by area. The procedure is somewhat risky because the dependent variables in the two sets of equations are different. The company data show the impact of affiliates only on their own parents, ignoring what we might call company spillover--presumably negative effects on rival U.S. firms, which are incorporated into the country calculations. On this account the company data should give algebraically higher coefficients. However, because they apply to broader geographical areas than the country calculations, the company-by-area coefficients do include what we might

TABLE 8

Equations for Exports to 43 Destinations  
Coefficients for U.S. Affiliate Net Sales

	Bulk Pharmaceuticals		Packaged Pharmaceuticals	
	Manuf.	Nonmfg.	Manuf.	Nonmfg.
	Affil.	Affil.	Affil.	Affil.
U.S. Exports				
to Dev. Countries exc. Can.	+ .04	+ .27	+ .03	+ .24
to LDC's exc. Caribbean	+ .06	+ .66		+ .92
13-Country Exports				
to Dev. Countries exc. Can.	- .15			
to LDC's exc. Caribbean	+ .13	- .13	- .53	- 2.43

Source: Tables B-3 through B-6, B-9 through B-12.

call country spillover--the effects of affiliate exports from one country on the parents' exports to neighboring countries. On this account the company data should give smaller coefficients, since any displacement of parent exports of finished products in countries other than the host country is not offset by any increased export of bulk pharmaceuticals. We do not know the net outcome of these two effects.

The coefficients from several company-by-area equations are compared with those from country equations in Table 9. With the exception of the coefficients from Table F-5, in which we came very close to using up all our degrees of freedom, the coefficients are **reasonably similar, despite the use of two very different** types of data, a reassuring result. The fact that they are generally lower suggests that company spillover is outweighed by country spillover.

A breakdown of the impacts on various types of parent exports is given in Table 10. Of the addition to exports from a dollar of net sales of manufacturing affiliates most involves sales to affiliates, and these were predominantly sales for further processing. Of the addition to net sales from a dollar of non-manufacturing affiliate net sales only a small part consisted of sales to affiliates, and these were essentially sales for resale.

All our results seem to point to a finding that U.S. investment in foreign pharmaceutical manufacturing increases U.S. exports of pharmaceutical products, and that finding is confirmed by several methods of analysis. U.S. investment in nonmanufacturing affiliates seems to operate in the same direction. The activity of foreign-owned manufacturing affiliates competes with U. S. exports and that of U.S. affiliates competes with foreign countries' exports. The effects of a company's innovativeness do not show up strongly, but what evidence we have points to some positive effect on exports and a hint of a tendency to substitute exports for foreign production. The findings on innovativeness,



TABLE 9

Coefficients for U.S. Affiliate Net Sales in  
Country Equations and Company-by-Area Equations  
Developed Countries

	Manufacturing Affiliates	Nonmanufacturing Affiliates
Country Equation, excl. Canada	.07	.51
Country Equation, incl. Canada	.11	.57
Company-by-Area Equations, incl. Canada		
Table F-1	.06	.45
"    F-2	.07	.44
"    F-3	.06	.41
"    F-4	.07	.36
"    F-5	.22	.69

TABLE 10

Equations for Parent Exports to 4 Developed Areas other than Canada  
Coefficients for Affiliate Net Sales

	Manufacturing Affiliates		Nonmanufacturing Affiliates	
	Excl. Canada	Incl. Canada	Excl. Canada	Incl. Canada
Parent exports to affiliates	.03	.05	.11	.04
For resale	.01	.02	.16	.09
For further processing or assembly	.03	.03	-.04	-.05

Source: Tables F-7 through F-9 and underlying data.

however, are much less well supported than those of relations between foreign production and exports.

From the differences in factor proportions described earlier we can infer some of the factor market implications of the trade effects implied by our equations. U.S. manufacturing operations overseas, by their encouragement of bulk exports in place of packaged exports, increase the demand for physical capital relative to labor in the U.S. and in the 13 other exporting countries, since bulk pharmaceuticals are relatively capital intensive. Foreign manufacturing affiliates have the same effect on the U.S. Nonmanufacturing affiliates in less developed countries have the same effect on the other 13 exporters but the opposite effect on the U.S.: that is, they appear to encourage U.S. exports of packaged pharmaceuticals, the more labor-intensive product, more than those of bulk pharmaceuticals.

How can these results regarding the complementarity between exports and investment be reconciled with the apparent downward trend in the ratio of exports to production in the pharmaceutical industry described in the introduction, at a time when the industry's foreign investment was rising and foreign demand for pharmaceuticals was increasing rapidly? The relationships we have examined are all cross-sectional, dependent on the conditions of a single time. The move abroad may have been induced partly by the U.S. industry's awareness of the gains in market share, including exports, that would result from foreign production and perhaps even more by the loss of export markets that would result from the establishment of affiliates by foreign rivals. It may also have reflected a belief on the part of U.S. firms that conditions were changing, and that exports would have risen still less if the foreign investment had not been made.

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TABLE A-1

Equations Relating U.S. and 13-Country Exports of Pharmaceuticals  
to a Destination to Market Size, Distance and EEC Membership

Developed Countries  
(22 observations)

Dependent Variables: U.S. and 13-Country Exports of  
Bulk and Packaged Pharmaceuticals

Dependent Variable	Independent Variables					$R^2$
	Constant Term	Consumption	Distance U.S.	Distance Germany	EEC	
<u>U.S. Exports</u>						
Bulk	+4.24 (2.37)	+0.008 (2.42)	$-6.75 \times 10^{-8}$ (.51)	-.0004 (1.04)		.15
Bulk	+3.23 (1.72)	+0.005 (1.60)	$-4.79 \times 10^{-8}$ (.37)	-.0001 (.36)	+5.47 (1.42)	.20
Packaged	+.28 (.24)	+0.008 (4.19)	$+4.33 \times 10^{-8}$ (.51)	-.0003 (1.26)		.52
Packaged	+.89 (.74)	+.01 (4.44)	$+3.14 \times 10^{-8}$ (.37)	-.0002 (.60)	-3.32 (1.33)	.54
<u>13-Country Exports</u>						
Bulk	+12.17 (3.18)	+.03 (4.49)	$-1.7 \times 10^{-7}$ (.60)	-.002 (2.61)		.50
Bulk	+9.69 (2.46)	+.02 (3.50)	$-1.2 \times 10^{-7}$ (.45)	-.001 (1.77)	+13.43 (1.66)	.54
Packaged	+25.78 (3.79)	+.02 (2.07)	$+4.68 \times 10^{-8}$ (.09)	-.0008 (.59)		.06
Packaged	+19.85 (3.06)	+.01 (1.04)	$+1.62 \times 10^{-7}$ (.36)	+0.0006 (.43)	+32.03 (2.40)	.27

TABLE A-2

Equations Relating U.S. and 13-Country Exports of Pharmaceuticals  
to a Destination to Market Size and Distance

Less Developed Countries Except Central America and Caribbean  
(22 observations)

Dependent Variables: U.S. and 13-Country Exports of  
Bulk and Packaged Pharmaceuticals

Dependent Variable	Independent Variables				$R^2$
	Constant Term	14-Country Exports	Distance U.S.	Distance Germany	
<u>U.S. Exports</u>					
Bulk	+1.29 (1.58)	$+5.19 \times 10^{-4}$ (.99)			-.001
Bulk	+2.76 (1.58)	$+5.48 \times 10^{-4}$ (1.10)	$-5.70 \times 10^{-4}$ (2.25)	$+2.33 \times 10^{-4}$ (.99)	.13
Packaged	+1.35 (1.51)	+0.001 (1.74)			.09
Packaged	+1.91 (.88)	+0.001 (1.63)	$-1.56 \times 10^{-4}$ (.50)	$+4.24 \times 10^{-4}$ (.15)	.001
<u>13-Country Exports</u>					
Bulk	+2.59 (2.00)	+0.002 (2.32)			.17
Bulk	+7.01 (2.40)	+0.002 (2.11)	$-4.46 \times 10^{-4}$ (1.05)	$-2.59 \times 10^{-4}$ (.66)	.22
Packaged	-18.04 (3.19)	+0.03 (7.97)			.75
Packaged	-10.24 (.83)	+0.03 (7.89)	+0.003 (1.57)	-0.003 (1.92)	.77

TABLE B-1

Equations Relating U.S. Exports of Bulk Pharmaceuticals to a Destination  
to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned Affiliates,  
and EEC Membership

**Developed Countries**

Dependent Variable: U.S. Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables						$\bar{R}^2$
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	-.75 (.51)	+.002 (1.36)	+.15 (1.44)	+.48 (2.83)	-.78 (3.00)	+5.78 (2.58)	.69
Value added	+1.59 (1.01)	-.002 (.49)	+.20 (3.21)	+.83 (1.34)	-.19 (.65)	+6.62 (2.29)	.49
Net fixed assets	+2.13 (1.16)	+.004 (1.42)	+.20 (2.08)	+.23 (.23)	-.27 (.65)	+6.18 (1.92)	.32
Depreciation	+2.00 (1.28)	+.004 (1.48)	+3.40 (3.25)	-.92 (.36)	-.32 (1.12)	+6.04 (2.16)	.48
Payroll	+2.29 (1.50)	-.001 (.15)	+.33 (3.25)	+2.89 (1.34)	-.39 (1.38)	+5.74 (2.07)	.49
Net sales	+2.05 (1.36)	-.002 (.49)	+.07 (3.21)	+.31 (1.61)	-.35 (1.25)	+7.13 (2.55)	.51
Net local sales	+2.43 (1.70)	-.004 (.81)	+.09 (3.57)	+.32 (1.64)	-.31 (1.19)	+7.76 (2.88)	.55

TABLE B-2

Equations Relating U.S. Exports of Packaged Pharmaceuticals to an Area  
to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned  
Affiliates, and EEC Membership

**Developed Countries**

Dependent Variable: U.S. Packaged Exports

U.S. Affiliate Activity Measure	Independent Variables						$\bar{R}^2$
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	+1.16 (1.18)	+0.01 (7.93)	+0.05 (.79)	+0.24 (2.12)	-.81 (4.64)	-2.51 (1.66)	.79
Value added	+1.98 (2.76)	+0.005 (3.85)	+0.12 (4.15)	+0.85 (3.00)	-.51 (3.85)	-1.41 (1.06)	.85
Net fixed assets	+2.42 (2.30)	+0.01 (6.94)	+0.09 (1.69)	-.10 (.18)	-.52 (2.24)	-2.25 (1.22)	.70
Depreciation	+2.46 (2.64)	+0.01 (7.57)	+1.69 (2.72)	-.33 (.22)	-.61 (3.62)	-2.33 (1.40)	.75
Payroll	+2.61 (2.91)	+0.01 (3.86)	+0.17 (2.81)	+1.58 (1.26)	-.65 (3.93)	-2.48 (1.53)	.76
Net sales	+2.39 (3.34)	+0.007 (3.36)	+0.04 (4.01)	+0.26 (2.77)	-.66 (4.97)	-1.39 (1.05)	.85
Net local sales	+2.66 (3.70)	+0.006 (2.68)	+0.05 (3.85)	+0.27 (2.76)	-.61 (4.63)	-1.07 (.79)	.84



TABLE B-3

Equations Relating U.S. Exports of Bulk Pharmaceuticals to a  
Destination to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned  
Affiliates, and EEC Membership  
**Developed Countries Except Canada**  
Dependent Variable: U.S. Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables						$\bar{R}^2$
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	-.71 (.50)	+.003 (1.35)	+.03 (.21)	+.53 (3.07)	-.67 (2.27)	+5.81 (2.55)	.64
Value added	+1.56 (1.01)	-.002 (.40)	+.10 (1.08)	+.80 (1.31)	-.04 (.14)	+7.21 (2.49)	.41
Net fixed assets	+1.89 (1.12)	+.004 (1.48)	+.06 (.57)	-.09 (.10)	-.05 (.13)	+6.61 (2.25)	.33
Depreciation	+1.90 (1.27)	+.004 (1.55)	+2.20 (1.78)	-1.12 (.45)	-.21 (.73)	+6.49 (2.42)	.44
Payroll	+2.19 (1.40)	+.0003 (.07)	+.20 (1.01)	+2.38 (1.04)	-.26 (.76)	+6.10 (2.14)	.37
Net sales	+1.94 (1.30)	-.001 (.27)	+.04 (1.31)	+.27 (1.39)	-.21 (.69)	+7.27 (2.63)	.42
Net local sales	+2.35 (1.58)	-.003 (.61)	+.07 (1.42)	+.30 (1.46)	-.25 (.80)	+7.70 (2.77)	.43

TABLE B-4

Equations Relating U.S. Exports of Packaged Pharmaceuticals to a  
Destination to Market Size, U.S. Affiliate Activity, Number of  
Foreign-Owned Affiliates, and EEC Membership

Developed Countries Except Canada  
Dependent Variable: U.S. Packaged Exports

Dependent Variable: U.S. Packages Imported							
U.S. Affiliate Activity Measure	Independent Variables						$\bar{R}^2$
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	+1.20 (1.36)	+.01 (8.62)	-.06 (.69)	+.29 (2.64)	-.71 (3.82)	-2.42 (1.71)	.83
Value added	+1.96 (2.83)	+.006 (2.48)	+.07 (1.52)	+.84 (3.05)	-.43 (3.12)	-1.09 (.84)	.85
Net fixed assets	+2.26 (2.47)	+.01 (7.88)	+.003 (.05)	-.31 (.63)	-.38 (1.80)	-1.96 (1.23)	.75
Depreciation	+2.38 (2.78)	+.01 (8.20)	+.86 (1.21)	-.46 (.33)	-.53 (3.32)	-2.02 (1.31)	.77
Payroll	+2.50 (2.86)	+.01 (4.22)	+.03 (.29)	+1.04 (.81)	-.51 (2.70)	-2.11 (1.32)	.75
Net sales	+2.34 (3.29)	+.007 (3.53)	+.03 (1.87)	+.24 (2.55)	-.59 (4.12)	-1.33 (1.00)	.84
Net local sales	+2.59 (3.47)	+.006 (2.63)	+.03 (1.37)	+.26 (2.47)	-.56 (3.51)	-1.12 (.81)	.82

TABLE B-5

Equations Relating U.S. Exports of Bulk Pharmaceuticals to a  
Destination to Market Size, U.S. Affiliate Activity, and  
Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: U.S. Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables					R <sup>2</sup>
	Constant	14-Country Exports	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	
			Mfg.	Nonmfg.		
Number of affiliates	-.11 (.15)	+3.7x10 <sup>-4</sup> (.54)	+.15 (2.59)	+.05 (.54)	-.14 (.62)	.40
Value added	+.17 (.25)	+.0004 (1.22)	+.16 (2.98)	+1.56 (2.28)	-.08 (.39)	.57
Net fixed assets	+.96 (1.16)	+.001 (1.36)	+.31 (3.31)	-.38 (.27)	-.26 (1.20)	.40
Depreciation	-.15 (.21)	+.001 (1.31)	+1.94 (2.03)	+51.42 (1.31)	-.03 (.18)	.55
Payroll	-.18 (.24)	+.0004 (1.04)	+.19 (2.85)	+3.45 (2.41)	+.05 (.27)	.56
Net sales	-.33 (.49)	+.001 (1.45)	+.06 (3.24)	+.66 (3.15)	-.04 (.21)	.64
Net local sales	-.001 (.0006)	+.001 (1.43)	+.07 (3.13)	+.50 (1.89)	-.11 (.54)	.52

TABLE B-6

Equations Relating U.S. Exports of Packaged Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, and Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: U.S. Packaged Exports

U.S. Affiliate Activity Measure	Constant	14-Country Exports	Independent Variables			$R^2$
			U.S.-owned Affiliates		Foreign-owned Mfg. Affiliates	
			Mfg.	Nonmfg.		
Number of affiliates	+1.54 (1.39)	+0.001 (1.20)	+0.06 (.73)	+0.02 (.18)	-.35 (1.06)	.02
Value added	+.92 (.84)	+0.001 (1.69)	-.03 (.31)	+2.43 (2.29)	-.01 (.02)	.21
Net fixed assets	+1.81 (1.45)	+0.001 (1.74)	+0.03 (.20)	+.89 (.42)	-.22 (.68)	.16
Depreciation	+.76 (.73)	+0.001 (1.77)	-1.28 (1.00)	+72.19 (2.64)	-.0003 (.001)	.26
Payroll	+.32 (.30)	+0.001 (1.89)	-.07 (.69)	+5.86 (2.79)	+.06 (.25)	.28
Net sales	+.42 (.38)	+0.001 (1.77)	-.01 (.47)	+.92 (2.71)	+.06 (.19)	.27
Net local sales	+.55 (.48)	+0.001 (1.87)	-.01 (.36)	+.94 (.36)	-.001 (.004)	.23

TABLE B-7

Equations Relating 13-Country Exports of Bulk Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, Number of Foreign Owned Affiliates, and EEC Membership

Developed Countries

Dependent Variable: 13-Country Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables						-2 R
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	-1.14 (.29)	+.01 (2.29)	-.41 (1.52)	+.45 (.99)	+2.03 (2.94)	+13.56 (2.27)	.75
Value added	+.65 (.19)	+.02 (1.79)	-.18 (1.32)	-.97 (.72)	+2.06 (3.28)	+12.77 (2.03)	.75
Net fixed assets	+1.10 (.32)	+.01 (2.32)	-.20 (1.14)	+1.44 (.79)	+1.82 (2.40)	+12.97 (2.18)	.76
Depreciation	+.28 (.08)	+.01 (2.21)	-3.08 (1.36)	-.51 (.09)	+2.24 (3.64)	+13.55 (2.23)	.75
Payroll	-.06 (.02)	+.01 (1.09)	-.19 (.84)	+1.81 (.37)	+2.03 (3.20)	+13.96 (2.25)	.73
Net sales	+.12 (.04)	+.01 (1.40)	-.07 (1.54)	-.007 (.02)	+2.32 (3.81)	+13.29 (2.17)	.75
Net local sales	-.25 (.07)	+.01 (1.64)	-.07 (1.16)	-.17 (.37)	+2.17 (3.53)	+12.61 (1.99)	.74

TABLE B-8

Equations Relating 13-Country Exports of Packaged Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned Affiliates, and EEC Membership

Developed Countries  
Dependent Variable: 13-Country Packaged Exports

U.S. Affiliate Activity Measure	Independent Variables						R <sup>2</sup>
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	+26.76 (4.99)	+0.03 (3.33)	-.70 (1.84)	+1.39 (2.21)	-3.37 (3.52)	+37.71 (4.55)	.67
Value added	+30.92 (5.96)	+0.01 (.69)	-.08 (.41)	+2.11 (1.02)	-2.36 (2.47)	+41.56 (4.34)	.59
Net fixed assets	+30.00 (5.85)	+0.02 (2.99)	-.22 (.84)	-4.12 (1.51)	-1.61 (1.41)	+38.54 (4.31)	.62
Depreciation	+32.05 (6.11)	+0.03 (2.93)	-.003 (.001)	-6.44 (.75)	-2.72 (2.86)	+38.54 (4.11)	.58
Payroll	+32.03 (6.29)	+0.03 (2.31)	-.35 (1.02)	-3.17 (.44)	-2.39 (2.53)	+38.17 (4.15)	.59
Net sales	+31.67 (6.07)	+0.02 (1.38)	-.02 (.33)	+0.33 (.49)	-2.68 (2.79)	+39.38 (4.07)	.57
Net local sales	+31.77 (6.19)	+0.02 (1.38)	-.06 (.68)	+0.32 (.45)	-2.53 (2.70)	+38.57 (3.99)	.58

TABLE B-9

Equations Relating 13-Country Exports of Packaged Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned Affiliates, and EEC Membership

Developed Countries Except Canada  
Dependent Variable: 13-Country Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables						$\bar{R}^2$
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	-1.14 (.28)	+ .01 (2.10)	-.59 (1.57)	+ .54 (1.09)	+2.14 (2.51)	+13.38 (2.05)	.70
Value added	+ .59 (.18)	+ .01 (1.92)	-.38 (1.83)	-1.03 (.77)	+2.38 (3.57)	+14.11 (2.25)	.77
Net fixed assets	+ .95 (.27)	+ .01 (2.25)	-.29 (1.28)	+1.23 (.65)	+1.96 (2.44)	+13.25 (2.18)	.76
Depreciation	+ .17 (.05)	+ .01 (2.17)	-4.26 (1.49)	-.71 (.13)	+2.35 (3.64)	+13.99 (2.26)	.75
Payroll	-.34 (.10)	+ .01 (1.30)	-.54 (1.21)	+ .41 (.08)	+2.40 (3.19)	+14.92 (2.36)	.74
Net sales	-.15 (.05)	+ .02 (1.68)	-.15 (2.10)	-.12 (.28)	+2.69 (4.15)	+13.67 (2.29)	.78
Net local sales	-1.22 (.38)	+ .02 (2.27)	-.23 (2.13)	-.37 (.82)	+2.82 (4.09)	+11.83 (1.97)	.78

TABLE B-10

Equations Relating 13-Country Exports of Packaged Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, Number of Foreign-Owned Affiliates, and EEC Membership

Developed Countries Except Canada

Dependent Variable: 13-Country Packaged Exports

U.S. Affiliate Activity Measure	Independent Variables						-2 R
	Constant	Consumption	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	EEC	
			Mfg.	Nonmfg.			
Number of affiliates	+26.07 (4.69)	+0.02 (2.88)	-.37 (.72)	+1.50 (2.20)	-4.05 (3.46)	+35.11 (3.93)	.65
Value added	+31.00 (5.99)	+0.01 (.60)	+0.18 (.56)	+2.19 (1.06)	-2.77 (2.69)	+39.84 (4.11)	.59
Net fixed assets	+30.28 (5.82)	+0.03 (2.98)	-.07 (.19)	-3.75 (1.33)	-1.86 (1.55)	+38.04 (4.19)	.61
Depreciation	+32.33 (6.26)	+0.03 (2.98)	+3.15 (.73)	-5.92 (.70)	-3.02 (3.13)	+37.36 (4.03)	.59
Payroll	+32.14 (6.10)	+0.03 (2.08)	-.21 (.31)	-2.63 (.34)	-2.53 (2.21)	+37.80 (3.93)	.56
Net sales	+32.04 (6.21)	+0.02 (1.14)	+0.07 (.66)	+0.48 (.71)	-3.18 (3.06)	+38.86 (4.07)	.58
Net local sales	+32.60 (6.23)	+0.02 (.92)	+0.08 (.47)	+0.49 (.67)	-3.09 (2.76)	+39.24 (4.03)	.57



TABLE B-11

Equations Relating 13-Country Exports of Bulk Pharmaceuticals to a Destination to Market Size, U.S. Affiliate Activity, and Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: 13-Country Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables					<sup>-2</sup> R
	Constant	14-Country Exports	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	
			Mfg.	Nonmfg.		
Number of affiliates	-.23 (.24)	+.002 (1.91)	+.15 (2.10)	-.05 (.47)	+.45 (1.58)	.69
Value added	+1.01 (1.05)	+.001 (3.06)	+.28 (3.96)	-.60 (.65)	+.11 (.42)	.77
Net fixed assets	+.69 (.75)	+.002 (3.29)	+.45 (4.33)	-.06 (.04)	+.11 (.47)	.78
Depreciation	+.57 (.68)	+.002 (3.54)	+4.77 (4.58)	-1.92 (.09)	+.17 (.77)	.81
Payroll	+.99 (1.24)	+.001 (3.66)	+.42 (5.92)	-1.02 (.67)	+.19 (1.06)	.86
Net sales	+.87 (.98)	+.002 (3.65)	+.13 (4.94)	-.13 (.46)	+.05 (.21)	.82
Net local sales	+.82 (.93)	+.002 (3.61)	+.13 (4.96)	-.14 (.46)	+.08 (.37)	.82

TABLE B-12

Equations Relating 13-Country Exports of Packaged Pharmaceuticals to a Destination  
to Market Size and Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: 13-Country Packaged Exports

U.S. Affiliate Activity Measure	Independent Variables					R <sup>2</sup>
	Constant	14-Country Exports	U.S.-owned Affiliates		Foreign- owned Mfg. Affiliates	
			Mfg.	Nonmfg.		
Number of affiliates	-11.21 (2.19)	+0.02 (4.64)	-1.33 (3.42)	+1.10 (1.91)	+2.02 (1.34)	.86
Value added	-12.88 (2.60)	+0.03 (10.76)	-1.33 (3.57)	-4.98 (1.04)	+1.38 (1.00)	.89
Net fixed assets	-14.73 (2.83)	+0.03 (9.85)	-2.25 (3.83)	-.34 (.04)	+1.98 (1.45)	.88
Depreciation	-10.14 (1.96)	+0.03 (10.11)	-16.78 (2.64)	-216.04 (1.59)	+66 (.50)	.87
Payroll	-10.77 (1.99)	+0.03 (11.09)	-1.57 (3.25)	-12.85 (1.25)	+28 (.23)	.88
Net sales	-10.27 (2.04)	+0.03 (10.98)	-.53 (3.64)	-2.43 (1.57)	+1.14 (.86)	.90
Net local sales	-11.09 (2.15)	+0.03 (10.70)	-.57 (3.73)	-2.06 (1.17)	+1.30 (1.00)	.89

TABLE B-13

Equations Relating U.S. Exports of Bulk Pharmaceuticals to a Destination to Market Size,  
U.S. Affiliate Activity, Number of U.S. and Foreign-Owned Affiliates, and EEC Membership

**Developed Countries Except Canada**

Dependent Variable: U.S. Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables										-2 R
	Constant	Consumption	U.S. Affiliate Activity		Foreign- owned Mfg.	Affiliates	EEC	U.S. Affiliates		Number of U.S. Affiliates	
			Mfg.	Nonmfg.				Mfg.	Nonmfg.		
Value added	- .80 (.55)	+ .0001 (.03)	+ .05 (.47)	+ .44 (.83)	- .52 (1.78)	+6.97 (2.97)	+ .08 (.52)	+ .47 (2.61)		.62	
Net fixed assets	-1.40 (.99)	+ .002 (1.23)	- .20 (1.80)	- .60 (.93)	- .53 (1.74)	+5.78 (2.81)	+ .15 (1.00)	+ .58 (3.61)		.68	
Depreciation	- .78 (.48)	+ .003 (1.42)	- .45 (.27)	+ .09 (.04)	- .62 (2.06)	+6.15 (2.69)	+ .04 (.24)	+ .53 (2.70)		.59	
Payroll	-1.34 (.91)	+ .002 (.90)	- .32 (1.46)	+ .05 (.03)	- .59 (2.18)	+6.56 (3.10)	+ .16 (1.04)	+ .55 (3.13)		.66	
Net sales	-1.29 (.87)	+ .002 (.44)	- .05 (1.32)	+ .09 (.49)	- .59 (2.26)	+6.30 (2.90)	+ .14 (.94)	+ .56 (2.84)		.65	
Net local sales	-1.39 (.83)	+ .003 (.63)	- .07 (1.02)	+ .08 (.41)	- .55 (2.01)	+5.95 (2.59)	+ .16 (.93)	+ .51 (2.71)		.63	

TABLE B-14

Equations Relating U.S. Exports of Bulk Pharmaceuticals to a Destination to Market Size.  
U.S. Affiliate Activity, Number of U.S. and Foreign-Owned Affiliates, and Membership  
Less Developed Countries Except Central America and Caribbean  
Dependent Variable: U.S. Bulk Exports

U.S. Affiliate Activity Measure	Independent Variables								R <sup>2</sup>
	Constant	14-Country Exports	U.S. Affiliate Activity		Foreign- owned Mfg. Affiliates	Number of U.S. Affiliates			
			Mfg.	Nonmfg.		Mfg.	Nonmfg.		
Value added	-.12 (.16)	-.0003 (.47)	+1.17 (2.36)	+1.84 (2.26)	+1.0 (.38)	+1.05 (.67)	+1.12 (1.35)	.56	
Net fixed assets	+40 (.42)	+001 (.58)	+21 (1.77)	-.19 (.13)	-.28 (1.09)	+07 (1.02)	+04 (.40)	.41	
Depreciation	-.30 (.41)	+001 (.80)	+1.45 (1.46)	+43.21 (2.10)	-.13 (.55)	+06 (.98)	+01 (.08)	.52	
Payroll	-.41 (.51)	-.76x10 <sup>-4</sup> (.11)	+18 (1.97)	+3.42 (2.06)	+11 (.47)	-.01 (.11)	+08 (.87)	.53	
Net sales	-.44 (.60)	+0002 (.33)	+06 (2.30)	+64 (2.67)	+01 (.04)	-.01 (.12)	+05 (.59)	.60	
Net local sales	-.17 (.20)	+0002 (.30)	+06 (2.03)	+46 (1.47)	-.06 (.24)	+002 (.02)	+06 (.63)	.48	

TABLE C-1

Equations Relating Export Share (U.S. vs. 13 Countries) to a Destination to Relative Numbers  
of United States and Foreign Manufacturing Affiliates and Distance

Dependent Variable	Destinations Included	Constant Term	Number of Affiliates				Distance	
			$\frac{\text{U.S.}}{\text{Foreign}}$	$\frac{\text{Foreign}}{\text{U.S.}}$	$\frac{\text{Foreign}}{\text{U.S.} + \text{Foreign}}$	$\frac{\text{U.S.}}{\text{Germany}}$	$\frac{\text{Germany}}{\text{U.S.}}$	$\frac{\text{U.S.}}{\text{R}^2}$
U.S. Bulk Exp. 13-Country Bulk Exp.	LDC's except Central America, Caribbean and Hong Kong	+18 (.79)	+03 (1.82)			-.05 (.29)		.16
U.S. Pack. Exp. 13-Country Pack. Exp.	Ditto	+72 (2.82)	+001 (.07)			-.51 (2.61)		.29
13-Country Bulk Exp. U.S. Bulk Exp.	Ditto	+3.77 (1.56)		+10.57 (3.59)			-1.02 (.79)	.43
13-Country Pack. Exp. U.S. Pack. Exp.	Ditto	+22.89 (2.38)		+86 (.07)			-8.87 (1.71)	.07
13-Country Bulk Exp. U.S. + 13-Country Bulk Exp.	Ditto	+69 (6.65)			+63 (2.63)		-.05 (.90)	.31
13-Country Pack. Exp. U.S. + 13 Country Pack. Exp.	Ditto	+95 (11.28)			+25 (1.31)		-.14 (3.52)	.48
U.S. Bulk Exp. 13-Country Bulk Exp.	Developed countries exc. Finland and Germany	-.22 (1.76)	+11 (5.40)			-6.27x10 <sup>-7</sup> (.11)		.59
U.S. Pack. Exp. 13-Country Pack. Exp.	Ditto	-.24 (1.66)	+07 (3.16)			-1.98x10 <sup>-7</sup> (.03)		.30

(cont.)

TABLE C-1 (concl.)

Dependent Variable	Destinations Included	Constant Term	Number of Affiliates				Distance	
			U.S. Foreign	Foreign U.S.	Foreign U.S. + Foreign	U.S. Germany	Germany U.S.	
13-Country Bulk Exp.	Developed countries except Germany	+83 (15.60)		-.002 (.38)			-.08 (2.17)	.12
U.S. Bulk Exp.								
13-Country Pack. Exp.	Ditto	+12.90 (2.60)		+25.24 (1.61)			-3.85 (1.30)	.16
U.S. Pack. Exp.								
13-Country Bulk Exp.	Ditto	+83 (15.60)			-.002 (.38)		-.08 (2.17)	.12
U.S. + 13-Country Bulk Exp.								
13-Country Pack. Exp.	Ditto	+97 (25.78)			-.005 (1.10)		-.09 (3.49)	.35
U.S. + 13-Country Pack. Exp.								

TABLE D-1

Equations Relating U.S. Manufacturing Affiliate Activity in a Destination to  
Market Size and Number of Foreign-Owned Affiliates

**Developed Countries**

Dependent Variable: Size of U.S. Manufacturing Affiliates

Measure	Constant	Independent Variables			$R^2$
		Consumption	Foreign-owned Mfg. Affiliates		
Numbers	+4.67 (1.31)	+0.003 (.50)	+1.59 (2.89)		.38
Value added	+3.85 (.67)	+0.004 (.44)	+1.84 (2.10)		.22
Net fixed assets	+3.74 (.84)	-.001 (.09)	+1.17 (1.70)		.08
Depreciation	+0.24 (.70)	$+4 \times 10^{-4}$ (.07)	+0.11 (2.05)		.17
Payroll	+1.75 (.50)	+0.002 (.28)	+1.02 (1.91)		.18
Net sales	+8.37 (.53)	+0.009 (.33)	+5.63 (2.29)		.25
Net local sales	+3.65 (.26)	+0.02 (.83)	+4.18 (1.96)		.25
Numbers, excl. Canada	+3.16 (1.20)	+0.003 (.72)	+1.58 (3.94)		.53

TABLE D-2

Equations Relating U.S. Manufacturing Affiliate Activity in a Destination to  
Market Size and Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: Size of U.S. Manufacturing Affiliates

Measure	Constant	Independent Variables			R <sup>2</sup>
		14-Country Exports	Foreign- owned Mfg. Affiliates		
Numbers	+2.93 (.88)	-.003 (1.42)	+3.08 (5.10)		.53
Value added	-2.24 (.79)	-.002 (1.23)	+2.83 (5.51)		.58
Net fixed assets	-1.25 (.70)	-.001 (1.40)	+1.85 (5.70)		.59
Depreciation	-.09 (.50)	-.001 (1.34)	+.16 (5.06)		.53
Payroll	-1.41 (.63)	-.001 (.83)	+1.72 (4.28)		.44
Net sales	-4.29 (.62)	-.01 (1.34)	+6.87 (5.53)		.58
Net local sales	-3.84 (.57)	-.01 (1.30)	+6.50 (5.35)		.56



TABLE D-3

Equations Relating U.S. Nonmanufacturing Affiliate Activity in a Destination to  
Market Size and Number of Foreign-Owned Affiliates

**Developed Countries**  
Dependent Variable: Size of U.S. Nonmanufacturing Affiliates

Measure	Independent Variables			$\bar{R}^2$
	Constant	Consumption	Foreign- owned Mfg. Affiliates	
Numbers	+5.80 (2.69)	+ .002 (.49)	+1.19 (3.59)	.48
Value added	+.49 (.84)	+ .007 (6.94)	-.20 (2.22)	.70
Net fixed assets	-.59 (1.36)	-.0002 (.38)	+.24 (3.53)	.40
Depreciation	+.07 (.53)	-.001 (.38)	+.02 (.91)	.00
Payroll	-.05 (.30)	+ .001 (5.36)	+.03 (1.19)	.71
Net sales	+.44 (.24)	+ .02 (5.74)	-.17 (.60)	.66
Net local sales	+.10 (.06)	+ .02 (6.22)	-.23 (.87)	.69
Numbers, excl. Canada	+5.27 (2.58)	+ .002 (.54)	+1.19 (3.81)	.56

TABLE D-4

Equations Relating U.S. Nonmanufacturing Affiliate Activity in a Destination to Market Size and Number of Foreign-Owned Affiliates

Less Developed Countries Except Central America and Caribbean  
Dependent Variable: Size of U.S. Nonmanufacturing Affiliates

Measure	Constant	Independent Variables			$R^2$
		14-Country Exports	Foreign-owned Mfg. Affiliates		
Numbers	+2.73 (1.21)	+0.01 (3.94)	-.11 (.26)		.41
Value added	+.42 (1.91)	$+.2 \times 10^{-4}$ (.16)	-.04 (.97)		<.005
Net fixed assets	+.26 (2.18)	$-.47 \times 10^{-4}$ (.67)	-.002 (.10)		<.005
Depreciation	+.02 (1.87)	$-.12 \times 10^{-5}$ (.26)	+.001 (.35)		<.005
Payroll	+.27 (2.56)	$-.13 \times 10^{-5}$ (.02)	-.02 (1.04)		<.005
Net sales	+1.65 (2.54)	$+.17 \times 10^{-4}$ (.05)	-.14 (1.16)		<.005
Net local sales	+1.50 (2.58)	$-.54 \times 10^{-4}$ (.16)	-.10 (.93)		<.005

TABLE D-5

Equations Relating Number of Foreign-Owned Affiliates in a Destination  
to Market Size and Number of U.S. Affiliates

Dependent Variable: Number of Foreign Manufacturing Affiliates

	Constant	Independent Variables			$\bar{R}^2$
		Consumption or 14-Country Exports	Number of U.S. Affiliates		
			Mfg.	Nonmfg.	
Developed countries	+0.37 (.27)	+0.003 (1.53)	+0.06 (.58)	+0.27 (1.83)	.52
Developed countries excl. Canada	+1.83 (1.14)	+0.005 (2.69)	-.10 (.66)	+0.29 (1.49)	.33
Less developed countries except Central America and Caribbean	+0.78 (1.00)	+0.002 (3.01)	+0.21 (5.82)	-.16 (2.00)	.64

TABLE E-1

12 U.S. Pharmaceutical Companies: Equations Relating Parent Exports to  
Parent Size and Affiliate Activity  
Dependent Variable: Parent Company Exports from U.S.

Measure of Affiliate Activity	Constant	Independent Variables			$\bar{R}^2$
		Parent Domestic Sales	Affiliate Activity		
			Mfg.	Non-mfg.	
Value added	-20.15 (1.25)	-.02 (.30)	1.06 (3.16)	.42 (1.14)	.827
Net fixed assets	-1.62 (.11)	.04 (1.28)	.27 (1.86)	2.56 (.86)	.875
Depreciation	5.67 (.38)	.03 (.79)	4.37 (4.15)	1.56 (.14)	.869
Payroll	-20.53 (1.47)	-.01 (.27)	1.77 (2.86)	3.55 (2.09)	.827
Net sales	-18.97 (1.34)	.01 (.15)	.27 (2.32)	.39 (2.10)	.838
Net local sales	-25.17 (1.58)	-.001 .01	.41 (2.31)	.90 (1.73)	.787

TABLE E-2

12 U.S. Pharmaceutical Companies: Equations Relating Parent Exports  
to their Affiliates to Parent Size and Affiliate Activity  
Dependent Variable: Parent Company Exports from U.S. to Foreign Affiliates

Measure of Affiliate Activity	Constant	Independent Variable			$\bar{R}^2$
		Parent	Affiliate Activity		
		Domestic Sales	Mfg.	Non-mfg.	
Value added	-.39 (.04)	-.034 (.84)	.607 (2.63)	.180 (.72)	.660
Net fixed assets	6.02 (.41)	.019 (.53)	.145 (.99)	.023 (.01)	.483
Depreciation	9.39 (.65)	.015 (.44)	1.926 (1.90)	-6.262 (.59)	.496
Payroll	.449 (.05)	-.044 (1.16)	1.265 (2.97)	.637 (.59)	.684
Net sales	2.021 (.25)	-.041 (1.39)	.228 (3.41)	.105 (.97)	.774

TABLE E-3

12 U.S. Pharmaceutical Companies: Equations Relating Parent Exports  
to their Affiliates for Resale to Parent Size and Affiliate Activity  
Dependent Variable: Parent Company Exports from U.S. to Affiliates for Resale

Measure of Affiliate Activity	Constant	Independent Variables			$\bar{R}^2$
		Parent Domestic Sales	Affiliate Activity		
			Mfg.	Non-mfg.	
Value added	.102 (.01)	-.066 (1.98)	.699 (3.63)	.205 (.98)	.705
Net fixed assets	12.411 (1.07)	-.019 (.74)	.241 (2.10)	-.831 (.36)	.603
Depreciation	13.90 (1.22)	-.024 (.91)	2.569 (3.23)	-3.450 (.41)	.613
Payroll	-.488 (.05)	-.064 (1.84)	1.229 (3.11)	1.471 (1.35)	.662
Net sales	.829 (.10)	-.055 (1.89)	.205 (3.09)	.174 (1.62)	.720

TABLE E-4

12 U.S. Pharmaceutical Companies: Equations Relating Parent Exports  
to their Affiliates for Further Processing to Parent Size and Affiliate Activity  
Dependent Variable: Parent Company Exports  
from U.S. to Affiliates for Further Processing

Measures of Affiliate Activity	Constant	Parent Domestic Sales	Affiliate Activity		$\bar{R}^2$
			Mfg.	Non-mfg.	
Value added	-.841 (.12)	-.032 (1.31)	-.089 (.64)	-.021 (.14)	.044
Net fixed assets	-6.383 (1.01)	.038 (2.70)	-.089 (1.43)	.718 (.57)	.288
Depreciation	-4.527 (.76)	.038 (2.77)	-.611 (1.46)	-3.373 (.77)	.350
Payroll	.647 (.11)	.019 (.37)	.041 (.16)	-.770 (1.08)	.112
Net sales	.929 (.15)	.014 (.63)	.024 (.48)	-.067 (.34)	.068

TABLE F-1

12 U.S. Pharmaceutical Companies: Equations Relating Company Exports to an Area to Parent Size and Affiliate Activity in the Area  
Dependent Variable: Exports by Parent Company to Specific Area

U.S. Affiliate Activity Measure	Constant	Independent Variables			$\bar{R}^2$
		Parent Domestic Sales	U.S.-Owned Affiliates		
			Mfg.	Nonmfg.	
<u>Less Developed Areas (2)</u>					
Value added	-11.81 (2.29)	.0180 (2.09)	1.07 (2.98)	.814 (2.84)	.492
Net fixed assets	-3.83 (.70)	.0125 (1.11)	.99 (2.09)	3.01 (.87)	.335
Depreciation	-4.41 (.77)	.0170 (1.31)	10.98 (1.95)	6.24 (.16)	.254
Payroll	-6.27 (1.24)	.0112 (1.07)	1.78 (3.27)	1.75 (1.04)	.423
Net sales	-6.28 (1.12)	.0084 (.66)	.440 (2.31)	.243 (1.24)	.299
Net local sales	-4.97 (.83)	.0151 (1.18)	.337 (1.73)	.418 (.31)	.262
<u>Developed Areas (5)</u>					
Value added	-3.99 (2.47)	.0127 (3.93)	.237 (4.20)	.671 (2.95)	.583
Net fixed assets	-2.25 (1.68)	.0106 (4.14)	.101 (5.02)	2.94 (5.16)	.725
Depreciation	-2.10 (1.28)	.0114 (3.58)	.164 (5.39)	4.22 (1.42)	.605
Payroll	-4.88 (3.26)	.0124 (4.19)	.452 (4.41)	6.09 (4.67)	.647
Net sales	-3.97 (2.47)	.0130 (3.98)	.0597 (2.42)	.454 (3.79)	.588
Net local sales	-4.77 (2.87)	.0145 (4.19)	.0849 (2.20)	.567 (3.62)	.562



TABLE F-2

12 U.S. Pharmaceutical Companies: Equations Relating Company Exports to  
Affiliate Activity in an Area and to Innovativeness  
Dependent Variable: Exports by Parent Company to Specific Area

U.S. Affiliate Activity Measure	Constant	Parent Domestic Sales	Independent Variables		Innovativeness: Ratio of No. of New Innovative Drugs to No. of New Drugs	$\bar{R}^2$
			U.S.-Owned Affiliates Mfg.	Nonmfg.		
<u>Less Developed Areas (2)</u>						
Value added	-15.82 (2.58)	.0213 (2.38)	.987 (2.71)	.750 (2.59)	21.17 (1.19)	.502
Net fixed assets	-12.21 (1.91)	.0156 (1.49)	.876 (1.98)	4.591 (1.40)	40.27 (2.13)	.434
Depreciation	-11.38 (1.61)	.0200 (1.58)	9.946 (1.81)	16.955 (.43)	32.99 (1.57)	.306
Payroll	-13.72 (2.26)	.0143 (1.44)	1.686 (3.29)	2.421 (1.51)	35.17 (1.95)	.494
Net sales	-12.90 (1.87)	.0139 (1.09)	.400 (2.15)	.222 (1.17)	31.08 (1.55)	.345
Net local sales	-12.20 (1.75)	.0173 (1.42)	.270 (1.43)	1.019 (.77)	37.16 (1.79)	.336
<u>Developed Areas (5)</u>						
Value added	-2.225 (1.06)	.0117 (3.55)	.239 (4.26)	.633 (2.78)	-7.81 (1.29)	.588
Net fixed assets	-1.110 (.65)	.0101 (3.87)	.0990 (4.93)	2.916 (5.11)	-5.27 (1.08)	.726
Depreciation	-.604 (.29)	.0107 (3.31)	1.604 (5.27)	4.448 (1.50)	-7.01 (1.19)	.608
Payroll	-3.032 (1.57)	.0114 (3.79)	.453 (4.48)	5.992 (4.64)	-8.23 (1.50)	.654
Net sales	-1.382 (.67)	.0112 (3.37)	.0658 (2.71)	.443 (3.79)	-11.35 (1.93)	.607
Net local sales	-2.307 (1.08)	.0128 (3.65)	.0907 (2.39)	.563 (3.67)	-10.91 (1.80)	.579

TABLE F-3

12 U.S. Pharmaceutical Companies: Equations Relating Company Exports to an Area to Affiliate Activity in the Area, Market Size, and Company Innovativeness  
 Dependent Variable: Exports by Parent Company to Specific Area

U.S. Affiliate Activity Measure	Constant	Parent Domestic Sales	Independent Variables				R <sup>2</sup>	
			U.S.-Owned Affiliates		Innovativeness:			Market Size: LDC's: 14-Country Exports DC's: Consumption of Pharmaceuticals
			Mfg.	Nonmfg.	Ratio of No. of New Innovative Drugs to No. of New Drugs			
<u>Less Developed Areas (2)</u>								
Value added	-4.119 (.34)	.0247 (2.63)	.622 (1.28)	.741 (2.58)	24.44 (1.36)	-.0273 (1.13)	.510	
Net fixed assets	-.696 (.06)	.0179 (1.70)	.514 (.96)	4.971 (1.52)	41.67 (2.22)	-.0276 (1.18)	.446	
Depreciation	2.421 (.19)	.0238 (1.86)	4.808 (.72)	18.312 (.48)	36.19 (1.75)	-.0340 (1.29)	.330	
Payroll	-11.03 (.79)	.0150 (1.40)	1.551 (1.91)	2.449 (1.48)	35.92 (1.91)	-.0064 (.21)	.467	
Net sales	.490 (.03)	.0197 (1.41)	.211 (.81)	.193 (1.01)	33.85 (1.68)	-.0312 (1.04)	.348	
Net local sales	.922 (.06)	.0220 (1.70)	.0943 (.37)	.967 (.74)	39.11 (1.88)	-.0306 (1.03)	.338	

(continued)

TABLE F-3 (concluded)

TABLE F-4

12 U.S. Pharmaceutical Companies: Equations Relating Company Exports to an Area to  
 Affiliate Activity and Affiliate Numbers in the Area, Market Size, and Company Innovativeness  
 Dependent Variable: Exports by Parent Company to Specific Area  
 Developed Countries

U.S. Affiliate Activity Measure	Constant	Parent Domestic Sales	Independent Variables							Innova- tiveness	Market Size	-2 R
			U.S.-Owned Affiliates		No. of Affiliates			Mfg. & both	Nonmfg. only			
			Affiliate Activity									
			Mfg.	Nonmfg.								
Value added	-3.037 (1.35)	.0115 (3.54)	.229 (4.00)	.396 (1.68)	-1.068 (2.14)	.818 (1.69)		-8.296 (1.42)	1.711 (2.19)	.625		
Net fixed assets	-2.015 (1.03)	.0106 (3.96)	.0954 (4.62)	2.472 (3.85)	-.480 (1.10)	.294 (.73)		-5.408 (1.09)	1.009 (1.45)	.724		
Depreciation	-2.667 (1.22)	.0111 (3.59)	1.452 (4.79)	2.370 (.67)	-.873 (1.82)	.581 (1.09)		-6.719 (1.21)	2.068 (2.83)	.652		
Payroll	-3.010 (1.39)	.0114 (3.69)	.446 (4.21)	4.707 (2.93)	-.817 (1.66)	.441 (.91)		-8.036 (1.45)	.991 (1.21)	.655		
Net sales	-2.296 (.98)	.0115 (3.34)	.0692 (2.64)	.300 (2.10)	-.854 (1.60)	.514 (.96)		-11.066 (1.87)	1.457 (1.76)	.614		
Net local sales	-2.744 (1.15)	.0119 (3.30)	.105 (2.65)	.360 (2.06)	-1.007 (1.89)	.793 (1.57)		-10.784 (1.80)	1.431 (1.65)	.597		

TABLE F-5

12 U.S. Pharmaceutical Companies: Equations Relating Company Exports to an Area to Parent Size, Affiliate Activity in the Area, Market Size, and Number of Foreign-Owned Affiliates

Dependent Variable: Exports by Parent Company to Specific Area

Developed Countries

60 Observations

U.S. Affiliate Activity Measure	Constant	Independent Variables				No. of Foreign-Owned Mfr. Affiliates	-2 R
		Parent Domestic Sales	U.S.-Owned Affiliates Mfg.	Nonmfg.	Market Size		
Value added	-3.739 (1.79)	.0120 (3.88)	-.163 (.09)	1.615 (5.36)	2.484 (2.32)	-.0820 (1.04)	.626
Net fixed assets	-6.211 (2.75)	.0145 (4.29)	.383 (1.06)	.406 (3.34)	2.274 (1.89)	-.0505 (.58)	.540
Payroll	-7.167 (3.08)	.0147 (3.95)	.158 (1.74)	.0883 (2.13)	2.482 (1.94)	-.0360 (.40)	.509
Net sales	-4.608 (2.25)	.0133 (4.15)	.216 (3.78)	.689 (3.03)	2.415 (2.16)	-.124 (1.52)	.602
Value added	-5.703 (2.94)	.0134 (4.16)	.214 (3.70)	.625 (2.76)	1.063 (1.55)		.593
Net fixed assets	-3.266 (1.99)	.0110 (4.25)	.099 (4.90)	2.755 (4.61)	.609 (1.06)		.726
Developed Countries except Canada							
48 Observations							
Value added	-7.172 (2.87)	.0140 (3.81)	.194 (3.00)	.664 (2.71)	1.557 (1.83)		.581
Net fixed assets	-4.235 (2.07)	.0105 (3.51)	.087 (4.00)	2.963 (4.62)	1.057 (1.56)		.728

TABLE F-6

12 U.S. Pharmaceutical Companies: Equations Relating Affiliate Activity to  
Parent Size, Size of Market, Innovativeness, and  
Number of Foreign-Owned Affiliates  
Dependent Variable: Affiliate Activity  
Developed Countries

U.S. Affiliate Activity Measure	Constant	Independent Variables				$\bar{R}^2$
		Parent Domestic Sales	Market Size	Innova- tiveness	No. of Foreign-Owned Mfg. Affiliates	
Value added	.359 (2.04)	.0002 (1.28)	.0031 (2.24)	.205 (.52)	-.0486 (2.57)	.111
Net fixed assets	2.929 (2.93)	.0014 (1.32)	.0208 (2.67)	-1.226 (.55)	-.332 (3.10)	.187
Payroll	11.584 (2.86)	.0095 (2.17)	1.083 (3.43)	1.309 (.14)	-1.679 (3.86)	.261
Net sales	-11.594 (1.87)	.0291 (4.36)	-.0304 (.63)	2.261 (.16)	.612 (.92)	.249

TABLE F-7

12 U.S. Pharmaceutical Companies: Equations Relating Parent Company Exports  
to Affiliates in an Area to Affiliate Activity and Market Size

Dependent Variable: Exports by Parent Company from U.S. to Affiliates in Specific Area  
Developed Countries except Canada

48 Observations

U.S. Affiliate Activity Measure	Independent Variables					$\bar{R}^2$
	Constant	Parent Domestic Sales	U.S.-Owned Affiliates Mfg.	Nonmfg.	Market Size	
Value added	-3.226 (2.47)	.0060 (3.10)	.105 (3.11)	.187 (1.46)	.866 1.95	.509
Net fixed assets	-1.671 (1.92)	.0036 (2.84)	.038 (4.08)	1.892 (6.93)	.535 (1.85)	.789
Depreciation	-2.871 (2.32)	.0057 (3.20)	.696 (3.79)	2.702 (1.67)	.976 (2.41)	.563
Payroll	-2.730 (2.40)	.0051 (3.07)	.239 (4.01)	2.797 (3.68)	.322 (.78)	.625
Net sales	-3.107 (2.35)	.0058 (2.89)	.034 (2.27)	.112 (1.54)	.842 (1.85)	.494
Net local sales	-3.197 (2.45)	.0064 (3.21)	.039 (1.61)	.246 (2.67)	.646 (1.39)	.513

TABLE F-8

12 U.S. Pharmaceutical Companies: Equations Relating Parent Company Exports to  
Affiliates in an Area for Resale to Affiliate Activity, and Market Size

Dependent Variable: Exports by Parent Company from U.S. to  
Affiliates in Specific Area for Resale  
Developed Countries except Canada  
48 Observations

U.S. Affiliate Activity Measure	Constant	Independent Variables				$\bar{R}^2$
		Parent Domestic Sales	U.S.-Owned Affiliates		Market Size	
			Mfg.	Nonmfg.		
Value added	-2.327 (2.12)	.0047 (2.88)	.045 (1.58)	.232 (2.15)	.405 (1.08)	.369
Net fixed assets	-.979 (1.18)	.0027 (2.20)	.017 (1.90)	1.570 (6.07)	.059 (.22)	.657
Depreciation	-1.943 (1.80)	.0044 (2.81)	.392 (2.44)	2.325 (1.65)	.412 (1.16)	.397
Payroll	-1.830 (1.97)	.0039 (2.84)	.106 (2.19)	2.985 (4.32)	-.133 (.39)	.550
Net sales	-2.075 (1.91)	.0045 (2.74)	.007 (.53)	.156 (2.62)	.327 (.88)	.384
Net local sales	-2.251 (2.16)	.0053 (3.36)	-.001 (.05)	.266 (3.62)	.189 (.51)	.439



TABLE F-9

12 U.S. Pharmaceutical Companies: Equations Relating Parent Company Exports to Affiliates in an Area for Further Processing to Affiliate Activity, and Market Size

Dependent Variable: Exports by Parent Company From U.S. to Affiliates in Specific Area for Further Processing or Assembly  
Developed Countries except Canada  
43 Observations

U.S. Affiliate Activity Measure	Independent Variables					$\bar{R}^2$
	Constant	Parent Domestic Sales	U.S.-Owned Affiliates Mfg.	Nonmfg.	Market Size	
Value added	-.875 (1.30)	.0013 (1.30)	.061 (3.49)	-.046 (.69)	.425 (1.85)	.375
Net fixed assets	-.728 (1.07)	.0011 (1.10)	.022 (3.10)	.216 (1.01)	.466 (2.07)	.388
Depreciation	-.898 (1.29)	.0013 (1.33)	.312 (3.02)	.231 (.26)	.530 (2.33)	.345
Payroll	-.884 (1.35)	.0013 (1.34)	.134 (3.92)	-.230 (.53)	.427 (1.30)	.411
Net sales	-1.007 (1.51)	.0013 (1.23)	.028 (3.66)	-.043 (1.17)	.478 (2.09)	.388
Net local sales	-.925 (1.33)	.0011 (1.01)	.040 (3.10)	-.018 (.38)	.420 (1.70)	.347