NBER WORKING PAPER SERIES

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Working Paper 7623
http://www.nber.org/papers/w7623

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2000

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NBER Working Paper No. 7623
March 2000
JEL No. F14, F23, L23

ABSTRACT

Within Japanese multinational firms, parent exports from Japan to a foreign region are positively related to production in that region by affiliates of that parent, given the parent's home production in Japan and the region's size and income level. This relationship is similar to that found for Swedish and U.S. multinationals in parallel studies.

A Japanese parent's worldwide exports tend to be larger, relative to its output, the larger the firm's overseas production. In this respect also, Japanese firms resembled U.S. multinationals.

A Japanese parent's employment, given the level of its production, tends to be higher, the greater the production abroad by the firm's foreign affiliates. Japanese firms' behavior in this respect is similar to that of Swedish firms, but contrasts with that of U.S. firms. U.S. firms appear to reduce employment at home, relative to production, by allocating labor-intensive parts of their production to affiliates in developing countries. Swedish firms seem to allocate the more capital-intensive parts of their production to their foreign affiliates, mostly in high-wage countries. We conclude that in Japanese firms, supervisory and ancillary employment at home to service foreign operations outweighs any allocation of labor-intensive production to developing countries.

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Introduction

One aspect of foreign direct investment that has been studied intensively is the relationship between a firm's production abroad and its exports from its home country, or exports in general from the home country. There have been quite a few studies of U.S. and Swedish firms, because these countries led in collecting data and making it accessible. There was also a one-time study of UK investment and its effects, and there have been recent parallel studies for France, Italy, and Austria, and perhaps others. Now Japan has begun to permit access to the firm-level data that has been collected over many years by the Ministry of International Trade and Industry (MITI).

The motivation behind most of the past studies was the fear that direct investment abroad replaced home country production and exports in foreign markets and, as a consequence, caused unemployment at home. This motivation was probably misguided, for many reasons. What we have actually been studying is why there are differences among firms in their strategies for serving foreign markets or for allocating their production among geographical locations. There are differences among industries, among types of firms, possibly among countries, and differences over time. None of these have obvious implications for aggregate home employment levels, even if they do affect employment by the parent firms making the investments. In this respect, the firm investment decisions are akin to those made by trade markets to allocate production among countries according to their comparative advantages.

Japanese FDI in and Exports to a Region

In this paper, we will summarize some of the findings from two papers based on MITI data for individual parent firms and affiliates and compare them, and their implications, with what has been found for the most intensively studied other developed countries. The studies for Japanese firms reported here followed closely, partly for reasons of comparability, the methods described and used in earlier studies for the United States and Sweden. Those for the United States go back to Lipsey and Weiss (1969, 1976a, 1976b, 1981, and 1984), and those for Sweden go back to Swedenborg (1973, 1979, and 1982).

Despite the intention to duplicate the methods used in the studies for other countries, there are characteristics of the Japanese data and the Japanese economy that limit the degree of comparability. One is the uncertain and inconsistent coverage of the MITI data, inconsistent over time, across industries and firms in any one survey, and across survey questions even for a single firm's responses in a particular survey. Another problem, institutional rather than purely statistical, but with statistical implications, is the important role played by the large general trading companies (the sogo shosha) in Japanese exports, not matched in any other country. The trading companies are not included in our calculations because we focus on manufacturing parents. If the trading companies handled the exports of manufacturing parent companies, and the manufacturing parents reported their sales to the trading companies as domestic sales, exports from manufacturing parents would be understated and the equations for parent exports distorted. However, there is at least one indication that some manufacturing parents report exports through trading companies as their own export sales: the reported total exports by all parents are greater than aggregate exports reported in the balance of payments in each of the three years studied, 1986, 1989, and 1992 (Lipsey, Ramstetter, and Blomström, 1999a, p. 97).

The equations here for exports to a region relate a parent firm's exports to a region to some of the usual variables in a gravity equation, such as the region's real income, per capita real income, and the average distance of the region's countries from Japan. For GDP and GDP per capita, we expect positive coefficients, although the latter depend also on the income elasticity of demand, and for distance we expect negative coefficients, varying with industry transport costs. A variable for parent sales is included to remove the influence of parent size. That variable, of course, is expected to have a positive coefficient. The relation to foreign affiliate activity is estimated using two alternative measures, value added in affiliates and employment in affiliates. Value added in affiliates is the closest approximation to affiliate output. Employment in affiliates is available for a larger fraction of affiliates than value added and it is less affected by exchange rate fluctuations than value added, sales, assets, or other monetary measures. There is no a priori expectation as to the sign of this coefficient.

The first pair of equations is 1a and 1b, which are the same except that in equation 1b, employment is substituted for value added.

(1a) PSXR = f1a (GDPR, GDPPR, DISTR, PS, AVMR)

(1b) PSXR = f1b (GDPR, GDPPR, DISTR, PS, AEMR).

Where:

PSXR = exports of parent p to region h, in millions of Yen.

GDPR = real GDP of region h, at current international prices, in thousands of current international dollars.

GDPPR = real per capita GDP of region h, at current international prices, in thousands of current international dollars

DISTR = average distance from Japan to region h, in thousands of nautical miles

PS = total sales of parent p, in millions of Yen.

AVMR = value added (sales less purchases) in affiliates of parent p in non-oil manufacturing industries of region h for all affiliates reporting positive value added and intermediate purchases, millions of Yen.

AEVMR= number of employees in affiliates of parent p in non-oil manufacturing industries of region h for all affiliates reporting positive employment, value added, and intermediate purchases.

The great majority of the coefficients on affiliate production that are significant at the 5 per cent level are positive (Table 1). In 1986, the coefficients were positive for 3 out of the 10 industries, in 1989, 4 were positive and one negative, and in 1992, 7 were positive. Larger production in a region by a firm's affiliates is associated with larger exports to the region from the parent firm, aside from the influence of region size and income level, parent firm size, and distance from Japan. Aside from one extremely large coefficient for Precision machinery in 1992, the other 13 positive and significant coefficients seem to be clustered around 1, with an average of 1.1. Thus, a firm that produces a million Yen more in a region than another tends also to export a million Yen more to that region. The Electrical machinery industry is a consistent outlier; the equation always explains two thirds or more of the variation in parent exports to a region, the coefficients are significant by any standard criterion, and they are larger than for most industries, close to or above 2.

The general impression from these calculations is that a firm's exports to a region and its affiliates' production in the region are positively related to each other. The export-promoting effects of affiliate production, plus whatever firm-specific characteristics (such as R&D intensity) or region-specific characteristics (such as openness to trade and investment) tend to increase both parent exports and affiliate production, seem to be predominant. They outweigh any tendencies of affiliate production to replace parent exports and any firm-specific or region-specific influence that tend to favor parent exports at the expense of affiliate production (such as restrictions on foreign ownership), or affiliate production at the expense of parent exports (such as tariffs).

One reason for choosing the particular equation forms used here was the desire to compare the Japanese results with earlier ones for the United States and Sweden, although differences in the content and detail of the data make the comparisons inexact. One of the earliest of the similar studies was by Lipsey and Weiss (1981), reporting results described more fully in two unpublished 1976 papers by the same authors (1976a) and (1976b). These used a cruder measure of U.S. affiliate production (net sales), but added a still cruder measure of the presence of affiliates of firms from 13 other countries. They divided the world into many more export markets, and used exports by industry for both the U.S. (rather than by U.S. parent firms), and by 13 rival exporting countries. The use of country exports has advantages and drawbacks. It loses the variation across firms within industries but it takes account of any effect of one firm's affiliate activity in a market on exports by rival firms in the same industry to that market.

This study found only positive coefficients for U.S. affiliate activity in equations for U.S. exports among those significant at the 5 per cent level. These were 10 out of 14 for exports to developed countries and 9 out of 11 for exports to developing countries (Lipsey and Weiss, 1981, Table 1). The significant coefficients for developed country affiliate activity averaged about .16, while those for developing country affiliate activity averaged about .41. Since net sales are roughly three times gross product for U.S. manufacturing affiliates as a whole, these estimates should be multiplied by three for comparison with the Japanese coefficients. That would give about .5 for affiliates in developed countries and about 1.2 for those in developing countries. Since the affiliates in developed countries are much more important, the average across all countries would still probably be below the coefficient we calculated for Japan.

In this early paper for the U.S., the authors attempted to reduce the role of omitted characteristics of destinations, such as market openness, by including in the equations a rough proxy for the presence of non-U.S. affiliates in each market. The coefficients for those affiliates were negative when they were significant, suggesting that affiliate activity was not acting simply as a proxy for market characteristics, such as demand or openness. Thus it was the affiliate activity, rather than market characteristics, that accounted for the positive coefficients for U.S. activity on U.S. exports. A further test of this interpretation was to include U.S. affiliate activity in equations for exports to a market by the 13 countries other than the U.S. These coefficients were generally negative, lending further support to the interpretation that affiliate activity by a country's firms encouraged exports from that country, and discouraged exports from other countries, to the affiliate location. It does appear that one country's affiliate production tends to substitute for exports by rival countries while promoting exports from the affiliates' home countries. The test is still not conclusive, because it assumes, in effect, that the host countries are homogeneous in their relationships to home countries. It is possible that they are not, and that some host countries have close political or economic ties to the United States that encourage both trade and investment from the U.S. but discourage it with other countries. Other host countries may have close ties to home countries other than the United States that discourage both imports and investment from the U.S.

A later study (Blomström, Lipsey, and Kulchycky, 1988) based on the 1982 U.S. outward investment survey covered 34 industries with total U.S. industry exports as the dependent variable. The equations included GDP and per capita GDP in host countries as independent variables. Among the coefficients for affiliate net sales that were statistically significant, there was a mixture of positive and negative ones, 7 positive and 4 negative. The positive ones were for Textiles and apparel, Printing and publishing, Agricultural chemicals, Office and computing machinery, Electronic components, Instruments, and Other manufacturing. Three of the seven are relatively high-tech industries, but the others are far from high-tech. The industries for which the coefficients of affiliate net sales were negative were Other food products, Drugs, Primary nonferrous metals, and Lumber, wood, furniture, and fixtures. Only one of these, Drugs, is a high-tech industry, and that one showed positive relationships between affiliate production and both parent exports and industry exports in Lipsey and Weiss (1981) and (1984). In the parent export equation, the explanation of the difference seems to be related to the market size measure used. The positive coefficients in Lipsey and Weiss (1981) and (1984) were from equations using a market size measure based on the consumption of pharmaceutical products, rather than GDP, and also included a variable that was a proxy for the innovativeness of the parent firm. The corresponding equation based on GDP as a market size measure had a negative, but not statistically significant, coefficient for affiliate net sales.

The same paper included a set of Swedish export equations for seven broad industry groups, including as market size measures real PPP-converted GDP and GDP per capita and a dummy for Nordic countries. All the coefficients for affiliate net sales were positive, and the six that were statistically significant at the 5 per cent level averaged out to .5, implying a coefficient for production of perhaps 1.5, even above that for Japanese affiliate production.

Another experiment with the Swedish data examined the change in Swedish exports in seven broad industry groups between 1970 and 1978. Given the level of exports by each industry to each destination in 1970 and the change in real GDP in each importing country, the change in exports was related to the level of affiliate net sales in 1970 and the change in them from 1970 to 1978. The higher the initial level of affiliate net sales in an industry in a host country, the larger the increase in Swedish exports in that industry to that country. And the larger the growth in affiliate net sales in an industry in a host country, the larger the growth in Swedish exports to that country in that industry.

The closest analogue for the United States to the Japanese export equations in this paper is a set for U.S. multinational firms' parent exports to five developed country regions in 1970 (Lipsey and Weiss, 1984). The control variables were market size, as represented by nominal GDP, and parent sales in the United States, and a variable for non-production affiliates was also included. The significant coefficients, for five out of fifteen industries, were as follows:

Drugs	.085
Other nonelectrical machinery	.246
Office machinery and computers	.116
Household appliances and electrical appl..	.152
Stone, clay, glass, & concrete products	.036

The average coefficient for net sales in the equations for parent exports was .13, which means that the corresponding coefficient for output would be about .4, fairly close to the .5 for total U.S. industry exports to the more detailed set of destinations in the earlier U.S. study.

Another analogue to the Japanese equations is in the series of studies of Swedish multinationals by Swedenborg (1979), (1982), and (1985). They use, as their dependent variable, exports by Swedish parent firms, rather than industry exports, as in the U.S. studies cited above. In that way they more closely resemble the Japanese study here. However, they are based on net sales as a production measure, rather than value added, and the equations are run across all industries because there are not enough Swedish firms to permit individual industry equations. In Swedenborg (1985) the author pooled data from four cross-sections, for 1965, 1970, 1974, and 1978, and used a 2SLS procedure to remove the effects of simultaneity between decisions to produce abroad and decisions to export. She concluded that, for manufacturing as a whole, a parent firm's "…total exports to a country increase by about .10 dollars…when foreign production increases by $1." (1985, p.235). "Foreign production" in these equations is measured by net sales. If value added or gross product were used, instead of net sales, that might translate into about .30 dollars in exports for every dollar of production. That figure is lower than the one for the U.S. exports to developed countries (Sweden's investment is heavily concentrated in developed countries) from a very different calculation, and still lower than the Japanese coefficient relating to all countries. The levels of the coefficients differ, but it is hard to interpret the differences without redoing the calculations for the three countries in a uniform way. However, there is no doubt about the predominance of positive relationships between production in a host country by firms from a home country and exports to that host country from that home country.

Japanese FDI and Total Parent Firm Exports

One objection that has been raised to drawing conclusions about FDI-trade relationships from data by country or region is that foreign affiliates in one country or region might, by their own exports, displace parent exports to a third country or region. That issue has been raised particularly by Svensson (1996), with respect to Swedish multinational firms.

Lacking detailed data on affiliate export trade it is difficult to study this question for Japanese multinationals. One possibility is to relate total foreign affiliate activity by a firm to the parent's total exports to all foreign destinations. If there were displacement of parent exports to third countries it should be reflected in this export total.

There are some additional problems with interpreting this relationship. Characteristics specific to a firm that influence both FDI and exports become more important than in an equation for individual export destinations. In an equation for exports to individual countries, if there were enough country observations, the firm characteristics could be allowed for by using firm dummy terms, but that is not possible for total parent exports. A useful experiment would be to introduce a variety of parent characteristics, in addition to parent size, that might affect both affiliate production and parent exports. A problem with the Japanese data is that samples become small for some industries, especially in the earlier years, and some equations have been omitted here for that reason.

The form of the calculations run here is described by equations 2a and 2b.

(2a) PSX = f2a(PS, AVMMDR, AVMLDR)

(2b) PSX = f2b(PS, AEMMDR, AEMLDR)

where

PSX = total exports of parent p, millions of Yen

PS = total sales of parent p, millions of Yen

AVMMDR = value added in affiliates of parent p in non-oil manufacturing industries of more developed regions for affiliates that report positive value added and intermediate purchases, millions of current Yen

AVMLDR = same for affiliates in less developed regions

AEMMDR = number of employees in affiliates of parent p in non-oil manufacturing industries of more developed regions that report positive employment

AEMLDR = same for affiliates in less developed regions

On the whole, parent firms that produced more abroad, also exported more. Negative relationships were more common for production in developed countries than for production in developing countries. Coefficients that were significant at the 5 per cent level were positive in 8 out of 13 cases for production in developed countries and in 7 out of 9 cases for production in developing countries (Table 2). These relationships were not as consistent as those for production in and exports to regions. Even statistically significant coefficients changed signs over time within an industry. The most consistent result was that the coefficients for affiliate production in the Precision machinery industry in developed and developing countries were each positive in two out of the three periods.

Employment abroad does not appear to have a clear relationship to parent exports. There is only one significant coefficient out of 28 equations for employment in developing countries. For employment in developed countries, there are more, almost evenly split between positive and negative coefficients, with a slight leaning toward a negative relationship. In no industry are the coefficients significant in all three periods but in the three industries for which there are two significant coefficients, both are negative for Chemicals and Electric machinery and both are positive for Miscellaneous manufacturing. The employment data do not point to any strong relationship between a firm’s foreign affiliate activity and parent exports. In contrast to what we found for production, foreign employment is as frequently associated with lower parent exports as with higher exports.

An earlier study of U.S. multinational firms (Lipsey and Weiss, 1984) examined the impact of worldwide affiliate production on worldwide exports by pharmaceutical industry parents in 1970. It used a market size measure more specific to the industry than GDP, added a measure for the innovativeness of individual firms, and took account of parent size, as in the Japanese equations. A significant positive coefficient was found for affiliate production, as measured by net sales. An equation for exports to affiliates alone produced a slightly smaller coefficient for affiliate net sales, indicating that for the parent firm as a whole, exports to affiliates were not a substitute for exports to others.

Each one of the analyses here has defects. While they include various attempts to escape the problem of simultaneity between exporting from home and producing abroad, additional steps in this direction could be taken. However, we think it is safe to conclude that larger production abroad has not, on average, been associated with lower levels of exports by parent firms or their industries in home countries, or with lower exports relative to home sales. In this respect, the findings from the newly available data for Japan match very well those from similar, though not identical, data for the United States and Sweden.

Japanese Parent Employment and Foreign Production

If firms are not, on average, moving production out of home countries, they may nevertheless be reallocating their production to economize on transport costs, to gain foreign market share by proximity to customers, or to take advantage of differences in factor prices and factor abundance. Since home countries tend to be high-income and high-skill countries, multinationals might tend to allocate their labor-intensive or unskilled-labor-intensive production to their foreign operations, especially those in developing countries. And they might tend to allocate capital-intensive or skill-intensive production to their home operations. If they did that, they would use less labor at home for any given level of home output than a firm that had less production abroad or did not allocate its production in this way. On the other hand, foreign production might require home employment for supervision or for ancillary services not needed for home production, but more suitably performed at home rather than in foreign locations. In that case, parents with larger foreign operations would tend to have higher employment at home for a given level of home production than firms with smaller foreign activity.

The possible impacts on home employment are examined here using equation 3. It relates parent employment to parent production and to affiliate production. Affiliate production is divided for this purpose into manufacturing and non-manufacturing affiliates and into developed and developing countries:

(3) PE = f3 (PV, AVMMDR, AVMLDR, AVNMDR, AVNLDR)

Where:

PE = Number of employees in parent p

PV = Value added (sales less intermediate purchases) of parent p, in billions of Yen.

AVMMDR = Value added in affiliates of parent p in non-oil manufacturing industries of more developed regions that report positive value added and intermediate purchases, in millions of Yen

AVMLDR = Same for less developed regions

AVNMDR = Same for trade and other affiliates in more developed regions

AVNLDR = Same for trade and other affiliates in less developed regions

There is little support here for the idea that Japanese firms allocated labor-intensive operations to their affiliates and therefore employed fewer workers at home relative to their home production.

The coefficients for affiliate production, in equations explaining home employment, given home production, were mostly not statistically significant; out of 136 equations, only 51 had significant coefficients. Of these, 39 were positive and only 12 were negative. It would appear that the need for supervision, or other home activities needed for overseas production, was the dominant influence on home employment. Most of the negative coefficients were for production in developed countries, not what we would expect if labor costs were driving the allocation of overseas production. Not only were the negative coefficients concentrated in developed countries, but there seemed to be a trend toward positive coefficients. There were 6 negative coefficients out of 18 significant ones in 1986, 4 out of 15 in 1989, and only 2 out of 18 in 1992. If allocation of production to low labor cost areas had any importance as an influence at one time, it does not seem to be important in the later period.

Swedish firms' behavior resembled that of Japanese firms, in that larger affiliate sales were associated with higher employment in parent operations, for a given level of parent sales (Blomström, Fors, and Lipsey, 1997). That positive effect on parent employment was much larger per unit of affiliate sales for affiliate activity in developing countries than for affiliate activity in developed countries, where Swedish firms have most of their investment. The coefficients for the effect of affiliate activity in general have been declining over the last twenty years, possibly because of the increasing importance of production in developed countries. Affiliate production in general is associated with higher blue collar employment at home, an association that suggests an allocation of capital-intensive and skill-intensive activities to foreign affiliates, rather than increased supervisory or research activities at home to support foreign production operations.

A similar set of equations for U.S. multinationals in six manufacturing industries (Lipsey, 1999) produced quite different results, although it is not possible to make exact comparisons because of differences in the grouping of countries and types of affiliates. In that paper, affiliates were divided between those in developed and developing country locations, as in the Japanese calculations, but in addition, the developing countries were further divided, very roughly, into those that were "outward-oriented," defined as Mexico and Asian countries except India, and "inward-oriented," which were all others.

Almost all the coefficients for affiliate net sales (value added was not available) were statistically significant at the 5 per cent level. In equations for all manufacturing industries combined, non-manufacturing affiliate activity was associated with higher levels of parent employment, given parent output, while manufacturing affiliate activity was associated with lower parent employment. If the affiliates are divided between developed and developing countries, all the negative effect on parent employment is from the developing countries, as would be expected if multinationals are allocating labor-intensive activities to those locations. If the affiliates are further subdivided into the more and less open groups, all the negative effects are from production in the inward-oriented group, as if the location of production there had been influenced by barriers to trade.

If the multinationals are divided into industry groups, and affiliates are not separated by type of country, the two machinery industries show significant positive relationships of affiliate activity to parent employment and Transport equipment a significant negative relationship. Once the affiliates are divided up by type of country, the simplicity of the relationships disappears. In no industry group do the all three affiliate activity coefficients have the same sign. The positive relationships in machinery industries and negative ones for Transport equipment are duplicated for developed countries and outward-oriented developing countries, but the signs for inward-oriented countries are the opposite. For the other industries, many of the affiliate activity coefficients are significant, but the pattern of positive and negative coefficients is not easily explained.

The apparent pattern of allocating labor-intensive activities to developing countries, visible for U.S. multinationals in Transport equipment, contrasts with the Japanese case where the parent employment relationship to developed country affiliate activity, in which the United States is probably important as a host country, is positive. Another contrast is in Electrical machinery, where the Japanese firms show some signs of a negative relationship, but only for developed country affiliates, while the relationship in U.S. firms in this industry is positive, particularly for activity in developed countries.

On the whole, the effects of overseas production on parent employment in Japanese firms seem to resemble those for Sweden more than those for the United States. We have no firm explanation for the contrasts among the countries. Since the Japanese firms were later starters in developed country affiliate activity, they may be at an earlier stage of development. The apparent trend toward positive relationships in Japanese firms makes that interpretation seem unlikely. It may also be that both Japanese and Swedish firms would prefer to make the reallocations of production that U.S. firms have carried out, but find it more difficult to alter the composition of their home labor force than U.S. firms do.

Summary

Within individual Japanese manufacturing firms, parent exports from Japan to a foreign region are positively related to production in that region by affiliates of that parent, in industries where there is any significant relation. The relationship has become stronger over time and implies that a firm that produces a million yen more in a region tends also to export a million yen more to that region from Japan, given the parent's size and the region's size and income level. This relationship is similar to that found for U.S. and Swedish firms in parallel studies, although the impact of affiliate production on parent exports seems to be larger for Japanese firms. Japanese parent worldwide exports also tended to be larger, relative to parent size, for firms that carried out more production overseas. The relationship was not as strong as for parent exports to a particular region, but it resembled that found in other studies for U.S. multinational firms.

Japanese parent employment, given the level of parent production, tends to be higher, the more the firm produces abroad. Thus there is little indication that labor-intensive operations have been allocated to foreign locations to any major extent. The higher employment at home may result from a need for supervisory or ancillary employment at home to service foreign operations. An alternative explanation, that labor-intensive operations are being concentrated at home by Japanese firms, is unlikely for such a high-wage country.

The Japanese firms' behavior with respect to home employment is somewhat similar to that of Swedish firms, but contrasts with that of U.S. firms. Among U.S. firms, production in developing countries is associated with lower parent employment at home, given the level of parent output. We interpret that as indicating that U.S. multinationals are allocating the more labor-intensive parts of their output to developing countries and the more capital-intensive or skill-intensive parts to the home, or parent facilities.

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Table 1: Coefficients on measures of economic activity in non-oil manufacturing affiliates and adjusted R-squared from regressions explaining parent exports by region (dependent variable=PSXR)

Equation, Industry	1986			1989			1992		
	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared
Coefficients on value added of affiliates (=AVMR) from equation (I a)									
Food Manufacturing	0.137	29	0.29	0.039	25	0.05	0.797	0	0.41
Textiles	2.415	16	0.41	0.057	83	0.23	1.362	0	0.46
Chemicals	0.187	21	0.35	0.079	46	0.27	1.067	1	0.47
Primary metals	0.272	4	0.41	0.115	23	0.38	0.133	39	0.58
Fabricated metals	0.952	5	0.18	0.079	69	0.05	0.636	0	0.19
General machinery	0.043	94	0.49	0.979	0	0.52	1.184	0	0.50
Electric machinery	2.701	0	0.67	1.786	0	0.74	2.271	0	0.76
Transportation machinery	-3.486	49	0.31	-0.103	3	0.22	1.121	35	0.47
Precision machinery	-0.500	77	0.37	1.201	0	0.44	11.411	0	0.89
Miscellaneous manufacturing	0.488	23	0.28	0.157	0	0.12	0.082	6	0.18
Coefficients on employment of affiliates (=AEMR) from equation (Ib)									
Food Manufacturing	0.134	42	0.11	0.348	16	0.06	2.845	6	0.20
Textiles	0.732	49	0.26	0.815	53	0.24	0.369	34	0.20
Chemicals	2.361	4	0.36	0.860	41	0.27	4.910	3	0.30
Primary metals	3.861	8	0.42	0.751	25	0.38	2.301	13	0.50
Fabricated metals	2.889	0	0.19	-0.097	92	0.05	1.485	12	0.10
General machinery	4.043	23	0.51	9.171	0	0.54	5.621	2	0.40
Electric machinery	10.923	0	0.45	7.333	0	0.50	7.210	0	0.60
Transportation machinery	6.723	53	0.31	1.798	76	0.21	27.539	7	0.54
Precision machinery	5.520	27	0.38	8.144	5	0.41	51.013	8	0.50
Miscellaneous manufacturing	3.566	2	0.32	1.518	0	0.13	0.931	6	0.19

Notes: Chemical fibers are included in chemicals here, not in textiles as is the practice in MITI publications. Shipbuilders reporting large exports to Central & South America and/or Africa are excluded from the samples in transportation machinery because these exports are not generally bound for these regions. Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at 5% or less (all cases in this table).

Source: Lipsey, Blomström and Ramstetter (1999a).

Table 2: Coefficients on measures of economic activity in non-oil manufacturing affiliates activity and adjusted R-squared from regressions explaining total parent exports (dependent variable=PSX)

Equation, Industry	1986			1989			1992		
	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared
Coefficients on value added of affiliates in more developed regions (=AVMMDR) from equation (2a)									
Food Manufacturing	less than 30 observations			-0.035	66	0.17	1.016	8	0.85
Textiles	-619.20%	4	0.79	-0.537	22	0.57	3.612	0	0.91
Chemicals	-56.00%	6	0.83	-0.219	2	0.64	1.048	23	0.68
Primary metals	less than 30 observations			0.142	77	0.91	-4.853	0	0.97
Fabricated metals	3.179	50	-0.01	1.341	0	0.22	1.522	0	0.36
General machinery	-0.769	51	0.88	0.212	81	0.71	1.009	2	0.71
Electric machinery	2.453	0	0.93	1.614	10	0.93	1.613	29	0.88
Transportation machinery	-31.989	2	0.96	-1.101	0	0.95	1.911	57	0.94
Precision machinery	-1.874	36	0.81	0.605	0	0.86	5.507	0	0.99
Miscellaneous manufacturing	-0.667	69	0.54	0.268	0	0.38	0.111	76	0.36
Coefficients on value added of affiliates in less developed regions (=AVMLDR) from equation (2a)									
Food Manufacturing	less than 30 observations			0.024	89	0.17	1.392	0	0.85
Textiles	2.892	14	0.79	2.294	12	0.57	1.966	3	0.91
Chemicals	2.190	0	0.83	-1.661	30	0.64	0.305	44	0.68
Primary metals	less than 30 observations			-0.391	13	0.91	-0.13	45	0.97
Fabricated metals	-0.268	88	-0.01	-2.453	32	0.22	-2.983	3	0.36
General machinery	-4.325	0	0.88	1.780	62	0.71	2.431	35	0.71
Electric machinery	-0.521	63	0.93	-0.487	76	0.93	2.373	1	0.88
Transportation machinery	7.628	16	0.96	3.986	3	0.95	-2.245	26	0.94
Precision machinery	-1.85	75	0.81	0.984	0	0.86	7.230	2	0.99
Miscellaneous manufacturing	-1.518	58	0.54	0.401	63	0.38	0.062	24	0.36
Coefficients on employment of affiliates in more developed regions (=AEMMDR) from equation (2b)									
Food Manufacturing	less than 30 observations			-0.298	73	0.17	-3.653	71	0.56
Textiles	-22.92	0	0.80	-5.062	9	0.46	-6.441	77	0.64
Chemicals	-2.47	4	0.87	-1.693	2	0.69	-1.54	28	0.61
Primary metals	less than 30 observations			-1.978	38	0.91	-6.085	0	0.95
Fabricated metals	6.690	48	0.00	25.520	1	0.21	9.593	46	0.15
General machinery	11.669	14	0.88	15.205	2	0.76	6.839	37	0.69
Electric machinery	-20.474	5	0.91	-7.71	9	0.90	-9.654	4	0.85
Transportation machinery	3.579	77	0.97	-59.388	6	0.90	2.516	95	0.93
Precision machinery	10.946	50	0.82	-14.952	47	0.83	65.785	0	0.99
Miscellaneous manufacturing	0.295	89	0.54	2.456	0	0.41	2.095	0	0.42
Coefficients on employment of affiliates in less developed regions (=AEMLDR) from equation (2b)									
Food Manufacturing	less than 30 observations			0.154	80	0.17	8.802	19	0.56
Textiles	2.919	20	0.8	-0.528	81	0.46	0.522	70	0.64
Chemicals	3.919	0	0.87	-16.068	11	0.69	-0.292	93	0.61
Primary metals	less than 30 observations			-2.171	46	0.91	-4.005	12	0.95
Fabricated metals	-2.142	61	0.00	-8.968	14	0.21	-4.245	39	0.15
General machinery	12.504	32	0.88	9.021	22	0.76	8.948	49	0.69
Electric machinery	1.378	71	0.91	3.758	34	0.90	2.601	62	0.85
Transportation machinery	26.082	7	0.97	16.891	59	0.90	4.897	77	0.93
Precision machinery	-9.022	21	0.82	4.066	46	0.83	17.148	6	0.99
Miscellaneous manufacturing	-6.463	27	0.54	8.279	15	0.41	-1.578	77	0.42

Notes: Chemical fibers are included in chemicals here, not in textiles as is the practice in MITI publications. Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at 5% or less, OLS standard errors otherwise.

Source: Lipsey, Blomström and Ramstetter (1999a).

Table 3: Coefficients on value added of foreign affiliates from regressions explaining parent employment when parent size is measured as parent value added (dependents variable=PE)

Equation, Industry	1986			1989			1992		
	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared	Coefficients	Significance level (%)	Adjusted R-squared
Coefficients on AVMMDR (non-oil manufacturing affiliates in more developed regions)									
Food Manufacturing	less than 30 observations			-0.225	11	0.65	0.337	13	0.65
Textiles	0.350	2	0.96	0.146	0	0.87	0.093	38	0.90
Chemicals	0.129	7	0.82	0.047	0	0.91	0.036	1	0.86
Primary metals	less than 30 observations			-0.114	0	0.96	0.021	95	0.84
Fabricated metals	2.305	0	0.69	0.063	30	0.95	0.068	1	0.93
General machinery	0.011	79	0.97	0.015	79	0.87	0.021	44	0.88
Electric machinery	-0.429	1	0.88	-0.139	1	0.90	0.058	20	0.90
Transportation machinery	1.637	13	0.69	0.019	0	0.89	0.325	0	0.93
Precision machinery	-1.015	0	0.82	-0.003	92	0.81	0.021	78	0.98
Miscellaneous manufacturing	0.257	0	0.90	0.005	26	0.71	0.018	21	0.79
Trade	0.001	98	0.85	-0.059	8	0.76	-0.032	6	0.84
Other industries	-8.137	2	0.08	-0.069	76	0.39	0.219	77	0.71
Coefficients on AVMLDR (non-oil manufacturing affiliates in less developed regions)									
Food Manufacturing	less than 30 observations			0.042	12	0.65	-0.036	62	0.65
Textiles	-0.100	46	0.96	0.452	12	0.87	0.094	52	0.90
Chemicals	0.156	63	0.82	-0.085	13	0.91	-0.029	21	0.86
Primary metals	less than 30 observations			0.079	2	0.96	0.085	18	0.84
Fabricated metals	0.044	86	0.69	0.576	0	0.95	0.741	0	0.93
General machinery	0.952	0	0.97	-0.142	48	0.87	-0.011	79	0.88
Electric machinery	-0.094	34	0.88	0.067	47	0.90	0.133	19	0.90
Transportation machinery	0.554	11	0.69	0.079	29	0.89	-0.141	6	0.93
Precision machinery	-0.512	42	0.82	-0.017	18	0.81	-0.023	92	0.98
Miscellaneous manufacturing	-0.349	0	0.90	0.160	5	0.71	0.000	91	0.79
Trade	0.001	77	0.85	-0.019	18	0.76	0.064	14	0.84
Other industries	-3.272	0	0.08	-0.407	21	0.39	2.505	55	0.71
Coefficients on AVNMDR (trade and other affiliates in more developed regions)									
Food Manufacturing	less than 30 observations			0.107	0	0.65	-1.677	37	0.65
Textiles	-0.224	27	0.96	1.905	7	0.87	-1.031	35	0.90
Chemicals	1.744	1	0.82	0.017	36	0.91	0.010	78	0.86
Primary metals	less than 30 observations			-1.160	0	0.96	7.352	0	0.84
Fabricated metals	0.187	84	0.69	0.980	32	0.95	1.778	5	0.93
General machinery	0.493	4	0.97	0.166	8	0.87	0.023	65	0.88
Electric machinery	-0.165	11	0.88	0.421	0	90	-0.244	13	0.90
Transportation machinery	0.129	38	0.69	0.055	0	0.89	0.092	0	0.93
Precision machinery	-0.134	9	0.82	0.061	21	0.81	0.014	1	0.98
Miscellaneous manufacturing	0.357	2	0.90	0.087	7	0.71	-0.058	0	0.79
Trade	-0.035	1	0.85	0.000	8	0.76	-0.032	25	0.84
Other industries	0.404	27	0.08	0.515	10	0.39	0.006	96	0.71
Coefficients on AVNLDR (trade and other affiliates in less developed regions)									
Food Manufacturing	less than 30 observations			0.858	4	0.65	3.600	0	0.65
Textiles	3.937	1	0.96	1.837	65	0.87	2.632	0	0.90
Chemicals	-1.979	50	0.82	-0.800	0	0.91	0.404	58	0.86
Primary metals	less than 30 observations			7.520	0	0.96	-2.876	4	0.84
Fabricated metals	19.785	5	0.69	1.388	68	0.95	3.196	0	0.93
General machinery	-2.048	22	0.97	0.290	77	0.87	1.667	0	0.88
Electric machinery	9.070	2	0.88	-0.267	52	0.90	5.591	1	0.90
Transportation machinery	0.264	74	0.69	0.138	31	0.89	1.401	1	0.93
Precision machinery	5.722	4	0.82	-1.789	27	0.81	0.853	0	0.98
Miscellaneous manufacturing	1.160	58	0.90	1.071	51	0.71	1.267	1	0.79
Trade	-0.024	29	0.85	0.002	6	0.76	0.021	48	0.84
Other industries	0.364	2	0.08	-0.894	8	0.39	-0.669	46	0.71

Note: Chemical fibers are included in chemicals here, not in textiles as is the practice in MITI publications. Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at 5% or less, OLS standard errors otherwise.