Is Japanese Manufacturing Really Hollowing Out?

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Working Paper Series Vol. 2002-24
September 2002

The International Centre for the Study of East Asian Development, Kitakyushu

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September 2002

Abstract

This essay is a non-technical summary of evidence from previous studies that examine the relationship between Japanese exports or the exports of Japanese multinational parent firms on the one hand and the economic activities of foreign affiliates of Japanese multinationals on the other. Although there are many possible definitions of hollowing out, one of the most common definitions refers to a process where the transfer of economic activities to foreign affiliates of multinationals leads to reduction of economic activities in home country and more specifically in the home country parents of those multinationals. The economic activity most directly affected is exports, and changes in exports can then lead to changes in production, employment, and so on. However, the empirical evidence summarized in this essay suggests that there is no negative relationship between economic activities of foreign affiliates and exports of Japanese parents or Japanese manufacturing exports. These results are generally consistent with previous results for Sweden and the United States, which suggest that activities of foreign affiliates usually stimulate or have no relationship to economic activity in the parent firm or home industry.

[1] The author wishes to thank Robert E. Lipsey and Magnus Blomström, who have co-authored previous papers on this topic, for their advice on related topics. I would also like to thank members of the Committee for Analysis of the Survey of Overseas Business Activities of Japanese Companies (Nihon Kigyou no Kaigai Jigyou Katsudou Chousa Bunseki Kenkyukai) in 1998-2001, particularly Kyoji Fukao, for comments on related research, data, and information that helped me understand the nature of the data being used. The author is solely responsible for all remaining errors and for all opinions expressed.

1. Introduction

Recently, it is common to hear assertions that Japanese manufacturing is going through a process that is often referred to as hollowing out. Although there are many possible definitions of hollowing out, one of the most common definitions refers to a process where the transfer of economic activities to foreign affiliates of multinational corporations (MNCs) leads to reduction of economic activities in home country and more specifically in the home country parents of those multinationals.[2] This essay examines this question by summarizing results of investigating the relationships between (1) Japanese exports to a country and manufacturing affiliate activity in that country originally reported in Lipsey and Ramstetter (2001) and (2) exports of Japanese parents to a region and manufacturing affiliate activity in that region originally reported in Ramstetter (2001).[3] The emphasis in the essay is on describing how these relationships were examined and explaining their implications for the discussions on hollowing out.[4] However, there are also numerous problems related to poor data quality and so the essay begins with a brief discussion of the data and the growth of Japanese manufacturing affiliates between the mid-1980s and the mid-1990s, the period during which the discussion of hollowing out became common.

2. Trends in Japan's Exports and Japanese Manufacturing Affiliate Activity

Underlying the hollowing out debate in Japan is the fact that manufacturing has grown relatively slowly in Japan since the mid-1980s. For example, manufacturing's share of Japanese employment peaked at 25.0 percent in 1985 and then began to fall, reaching 24.1

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[2] Note that MNC activities are not the only possible cause of so-called hollowing out. For example, Shinohara (1987) also identifies the yen's appreciation as a possible cause of hollowing out.

[3] Note that Ramstetter (2001) reestimates equations originally reported in Lipsey, Ramstetter, and Blomström (1999, 2000b).

[4] Interested readers are referred to the original papers for technical details.

percent in 1990, 22.6 percent in 1995, and 20.5 percent in 2000 (International Centre for the Study of East Asian Development 2002). Manufacturing's share of real GDP also fell from 27.9 percent in 1985 to 24.3 percent in 1990, 23.0 percent in 1995, and 22.4 percent in 1999. In short, Japanese production and employment has been shifting out of manufacturing relatively rapidly in the last 15 years. These changes, combined with the large increase in foreign affiliate activity (see below), have led some to assert that Japan is hollowing out or losing its core manufacturing capability as Japanese MNCs transfer manufacturing capacity abroad. In marked contrast, however, manufacturing shares of exports remained steady at 97 percent in 1985-1993 and fell only slightly thereafter to 96 percent in 1994-1996 and 95 percent in 1997-2000. The ratio of real exports of manufactures to real GDP fell from approximately 8.4 percent in 1985 to 7.3 percent in 1990 and 8.0 percent in 1995, but then rose markedly to 10.3 percent in 2000.[5] In short, although Japan's production and employment have been shifting out of manufacturing, exports of manufactures have not declined similarly.

On the other hand, Japanese affiliates abroad have expanded at a rapid rate throughout this period. Unfortunately, it is impossible to get reliable estimates of the scope of Japanese affiliate activities from official surveys of Japanese MNCs because they are not mandatory and suffer from severe coverage problems. The coverage of the surveys varies greatly across years as a firm often reports in one year but not another and across variables as most firms report basic indicators such as sales and employment but many do not report data on intermediate purchases or international trade, for example.[6] Thus, one is never sure if observed patterns are real or the result of a sampling bias when using the official published data on affiliates or parents. Fortunately, for affiliate sales and employment, Kyoji Fukao and his colleagues (e.g., Fukao, Yuan, and Sakashita 1999) have created a

[5] These shares are approximate because the export price index for all merchandise, not just manufactures, is used to calculate real exports. However, the difference between these estimates and estimates using an export price index for manufactures will be very small (probably less than 0.1 percent of GDP) because almost all exports are manufactures.

[6] Aspects of these problems are detailed in Lipsey, Ramstetter, and Blomström (1999; 2000a) and Ramstetter (2001).

panel of the firm-level data and estimated missing observations, thereby generating more realistic estimates of these two variables.[7] When investigating the relationship between exports from Japan or the parent on the one hand, and affiliate activity on the other, one would probably prefer to measure affiliate activity as value added, rather than with sales (which includes value added and intermediate purchases) or employment. However, because of the coverage problems with the data on intermediate purchases, affiliate activity is measured as employment in this analysis.[8]

Table 1 shows the data on employment in all manufacturing affiliates of Japanese MNCs by industry of affiliate and Table 2 then shows the same data by major region and/or country of operation for 1986-1995. The tables show both the revised estimates used in these analyses and the original reported estimates from official publications. Both the reported and the revised employment data suggest a very rapid increase of affiliate employment in 1986-1995, with revised employment increasing 2.55 fold from 1.0 million to 2.6 million (Table 1). The revised estimates are as much as 81 percent larger in 1992 and 71 percent larger in 1989, but only 45 percent larger in 1986 and 40 percent larger in 1995. Note that there was wide variation in the differentials between the revised and reported data from as high as 242 percent in food, beverages, and tobacco in 1986 to as low as 20 percent in the same industry in 1995. By industry, electric machinery affiliates were by far the largest, employing slightly less than one-third of the total in all years. Transportation machinery affiliates were second largest in 1995 followed rather distantly by other manufacturing, textiles, apparel and leather, and general and precision machinery. This represented a change from 1986 when transportation machinery was followed very

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[7] Note that the compilations of revised employment estimates used in this study differ slightly from the published results Fukao, Yuan, and Sakashita (1999) in some industries. The cause of these differences is unknown but these differences are very small in size.

[8] The cross-country distributions of affiliate value added and employment differ markedly. For example, the value added data suggest that affiliates in Europe and North America are relatively large while the employment data suggest Asian affiliates are relatively large. However, analysis using smaller samples of firms reporting both employment and value added suggests that results would be similar whether affiliate activity is measured as value added or employment (Lipsey, Ramstetter, and Blomström (1999; 2000a) and Ramstetter 2001).

closely by textiles, apparel, and leather and metals and metal products. By country, affiliates in the United States were the largest employers in all years, with employment in these affiliates rising from 0.14 million in 1986 to 0.42 million in 1995 (Table 2). If combined, affiliates in Asia as a region were much larger, employing 0.57 million workers in 1986 and 1.63 million workers in 1995. In 1995, affiliates in China were the largest employers followed by affiliates in Thailand, Malaysia, Indonesia, Taiwan, and Korea. This is another marked change from 1986 when the affiliates in Taiwan and Korea were the largest, followed by affiliates in Thailand, Malaysia, Indonesia, and Singapore, and affiliates in China were still very small.

Table 3 presents another data set on employment of affiliates who had parents that reported parent exports by region. Because a large number of parents do not report exports by region, these samples of affiliates are relatively small, covering only about four-fifths of the revised employment totals reported in Tables 1-2. The industry distributions in this table also differ some from the distributions in Table 1 because the data in Table 3 are classified by industry of parent, not industry of affiliate. The regional distribution of affiliate employment is similar to that observed in Table 2 with Asian affiliates accounting for over half of the employment in these samples, followed by affiliates in North America.

3. Japan's Exports and Manufacturing Affiliates of Japanese MNCs

Most of the previous research on the relationship between home country exports and activities of foreign affiliates has analyzed the Swedish and U.S. cases (e.g., Blomström, Lipsey, and Kulchycky 1988; Lipsey and Weiss 1981). The most important result of these studies is that home country exports tend to be positively related or unrelated to the net sales (sales less imports from the home country) of foreign affiliates after taking into account the effects of factors incorporated in a simple gravity model of exports. In other words, these studies reveal very few industry-year combinations where there is a negative

and statistically significant relationship between home country exports and foreign affiliate activities. The results reported in this section essentially replicate the methodology of Blomström, Lipsey, and Kulchycky (1988) for the Japanese case.

The first set of results in Table 4 measures the correlation between Japanese exports and employment in Japanese affiliates after removing the effects of variables included in a standard gravity model of exports across countries. Estimates are made for 9 manufacturing industries in 1986, 1989, 1992, and 1995. The variables included in the standard, static, gravity model are the economic size (GDP) in the partner country, income levels (per capita GDP) in the partner country, and the distance to the partner country. The relatively comprehensive estimates of affiliate employment by country as described in Table 2 are then added to gravity equations. Coefficients on the affiliate employment variable indicate how much Japanese exports would change in response to a one person change in affiliate employment after removing the effects of gravity variables and these coefficients are the measures shown in Table 4. As the detailed in Lipsey and Ramstetter (2001, Appendix Table A1), these gravity equations generally explain the variation of Japanese exports across countries relatively well.

Two results from Table 4 are conspicuous. First, there are no negative coefficients that are statistically significant at the 5 percent level or better. In other words, if one were to conclude that any of these coefficients were negative, one would have at least a 5 percent (and often much larger) probability of being incorrect in all 9 industries for all 4 years. Second, in 1986 and 1989, positive and statistically significant coefficients are observed in roughly half of the 9 industries and in 1992 and 1995 positive and significant coefficients are observed in all but one industry, wood, furniture, and paper. In other words, exports tend to be larger in countries where foreign affiliate activity is large in most of the industry-year combinations examined. Both of these results constitute very strong evidence contrary to the implications of the hollowing out arguments.

However, even if Japanese exports and affiliate employment are positively correlated at a point in time as some of these results suggest, the change in exports over time may

have a different relationship to affiliate employment, and Tables 5-6 present the results of two attempts to estimate this relationship. In this case, the control variables differ somewhat. For example, distance does not change over time and thus cannot explain the country-wise variation of changes in exports over time. The control variables used are the change in partner country size (GDP), the growth rate of the ratio of Japanese export prices to partner country prices (the GDP deflator), and Japanese exports to the partner country in the initial year. It should be noted that these models do not explain the country-wise variation in the change of exports that well (see Lipsey and Ramstetter 2001, Appendix Table A3).

Table 5 shows the correlations between the change in Japanese exports and employment of affiliates in the initial year after excluding the effects of these control variables and Table 6 shows similar correlations between the changes in Japanese exports and changes in affiliate employment. Here again perhaps the most important result is the complete lack of evidence suggesting a negative relationship between the change in Japanese exports and these two measures of affiliate activity. The relationship with affiliate employment in the initial year shown in Table 5 is usually statistically insignificant suggesting that there is neither a positive or negative relationship in this case. The relationship with changes in affiliate employment shown in Table 6 is positive in about half of the industry-year combinations examined. However, there is very little consistency in the observed relationships across time.

These results thus suggest that affiliate activity was not negatively related to the variation in Japanese exports at a point in time or to the changes in Japanese exports over time. These results do not mean that export substitution did not happen. Some Japanese exports, especially exports from Japanese parents, were certainly replaced by the production of Japanese affiliates abroad during this period. However, Japanese affiliate activity also stimulated exports from Japan by expanding markets for Japanese products and creating demand for intermediate inputs and capital goods produced in Japan. These results suggest this stimulus was equal to or larger than any export substitution that may

have occurred.

4. Exports of Japanese Parents and Their Manufacturing Affiliates

Although the results described above do not reveal a negative relationship between Japan's exports and affiliate activity, this result may obtain because the exports stimulated by foreign affiliate activity come from firms other than the MNC parents in Japan. If this is the case, there may still be a negative relationship between affiliate activity and exports from the parent firm. The results reported in this section analyze this possibility by measuring the correlation between Japanese parent exports to a region and employment of manufacturing affiliates belonging to the parent that operate in that region.[9] The first results reported in Table 7 look at the static relationship between Japanese parents exports and affiliate employment in a given year after excluding the standard gravity effects (region size, region income, and distance to the region). In this case, data on employment of affiliates with parents who report exports by region are used and because some parents do not report exports by region, the coverage of parents and affiliates is both less than comprehensive (e.g., for affiliates, compare Table 3 with Tables 1 and 2).[10]

Here again, the models perform rather well (see Ramstetter 2001, Appendix Table A1) and the results provide absolutely no evidence of a negative and statistically significant relationship between affiliate employment and parent exports. There are a number of cases where positive and significant relationships were observed but there was neither a positive nor a negative and significant relationship in the majority of the cases revealed. However, here again the number of industries where positive and significant relationships were observed increased over time.

The relationship between changes in parent exports by region on the one hand, and

[9] Ideally one would want to examine country-wise variation of parent exports as done for Japanese exports in the previous section, but there are no data on parent exports by country. Moreover, even parent exports by region are not available after 1992.

[10] For information on the coverage of parents see Ramstetter 2001 (Tables 1-2).

affiliate employment in the initial year (Table 8) and the change in affiliate employment (Table 9) on the other hand, are then examined. As in analysis of Japanese exports, these models of the changes in parent exports perform relatively poorly. The results in Table 9 suggest there is one industry-period combination (electric machinery in 1986-1989) in which affiliate activity is negatively and significantly correlated with changes parent exports. However, there are more cases in which a positive and significant relationship is observed and in most cases there is no significant relationship, either positive or negative.

These results thus suggest that a portion of the increase in Japanese exports that results from the expansion of Japanese affiliates abroad (as described in the previous section) comes from the parent firms themselves. These results are generally similar to previous results from studies of Sweden (Swedenborg 1979, 1982, 1985) and the United States (Lipsey and Weiss 1984). In short, the expansion of markets and increased affiliate demand for intermediate goods and capital goods purchased from the parent are thus larger than any direct substitution of foreign production for parent exports that might exist. Thus, even when the analysis is narrowed to focus on Japanese MNC parents, there is no evidence of a negative relationship between parent exports and affiliate employment as the hollowing out argument would imply.

5. Conclusions

In the title of this essay I ask whether Japanese manufacturing is really hollowing out in the sense that the expansion of foreign affiliates in manufacturing industries abroad has led to a reduction of Japan's exports of manufactures or exports by Japan's MNC parents in non-oil manufacturing. It is of course impossible to answer this question definitively on the basis of the evidence summarized here, primarily because there is still a lot of additional evidence that could be generated on this subject. However, this essay summarizes the most comprehensive set of evidence on these relationships that is available at present and the evidence suggests very strongly that the answer to this question is "no" if

one defines hollowing out narrowly as a negative relationship between Japanese exports or Japanese parent exports and foreign affiliate activity.

In this context, it is also very important to emphasize that Japan (and all other economies) are continually undergoing a process of structural change where workers, capital, and production trend upwards in some industries and downwards in other industries. For example, since the mid 1980s the share of manufacturing in Japanese employment and production has fallen and the shares of other industries have risen. In contrast, there has been very little change in the share of manufacturing in Japanese exports. It is extremely important to understand that these kinds of changes can be caused by many factors other than MNC activities, and that they are not necessarily the result of a hollowing out process.

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Table 1: Employment of All Japanese Manufacturing Affiliates Abroad by Industry of Affiliate

Industry	1986	1989	1992	1995
REVISED EMPLOYMENT/REPORTED EMPLOYMENT (percentage difference)				
All manufacturing	45%	74%	81%	40%
Food, beverages, tobacco	242%	77%	129%	20%
Textiles, apparel, leather	67%	164%	124%	74%
Wood, furniture, paper	60%	84%	178%	53%
Chemicals-a	64%	110%	113%	42%
Metals, metal products	65%	62%	112%	62%
General & precision machinery	21%	89%	192%	52%
Electric machinery	37%	63%	60%	36%
Transportation machinery	39%	85%	54%	24%
Other manufacturing-a	31%	38%	61%	48%
REVISED EMPLOYMENT, CALCULATED FROM FUKAO'S DATA SET (number)				
All manufacturing	1,022,417	1,608,213	2,025,590	2,602,828
Food, beverages, tobacco	26,244	50,480	70,286	97,832
Textiles, apparel, leather	140,723	152,100	199,164	255,794
Wood, furniture, paper	16,762	28,093	29,188	35,054
Chemicals-b	58,211	110,223	146,030	171,383
Metals, metal products	125,744	142,168	166,478	196,384
General & precision machinery	96,800	143,911	183,103	225,373
Electric machinery	316,393	500,168	631,252	831,422
Transportation machinery	154,162	276,886	364,880	495,843
Other manufacturing-c	87,378	204,184	235,209	293,743
REPORTED EMPLOYMENT, ALL AFFILIATES (number)				
All manufacturing	703,628	922,525	1,118,488	1,854,731
Oil & coal products	1,361	275	744	1,334
Non-oil manufacturing	702,267	922,250	1,117,744	1,853,397
Food, beverages, tobacco	7,665	28,463	30,643	81,314
Textiles, apparel, leather	84,465	57,664	88,915	146,800
Wood, furniture, paper	10,475	15,260	10,485	22,964
Chemicals	35,601	52,429	68,718	121,019
Metals, metal products	76,269	87,834	78,417	121,236
General & precision machinery	79,907	75,953	62,769	147,839
General machinery	55,629	53,956	49,940	104,006
Precision machinery	24,278	21,997	12,829	43,833
Electric machinery	230,163	307,039	394,757	612,596
Transportation machinery	110,784	149,976	236,996	400,771
Other manufacturing	66,938	147,632	146,044	198,858

a-Comparisons are imprecise because of differences explained in notes b and c.

b-Includes oil refining (1986-1992) or oil products (1995).

c-Includes other oil & coal products (1986-1992) or coal products (1995).

Source: Lipsey, Ramstetter, and Blomström (2000a, Table 1).

Table 2: Employment of All Japanese Manufacturing Affiliates Abroad by Region or Economy of Affiliate (thousands)

Region, economy	Revised employment, calculated from Fukao				Revised/reported employment (% difference)			
	1986	1989	1992	1995	1986	1989	1992	1995
All countries	1,022,417	1,608,213	2,025,590	2,602,828	46%	74%	81%	40%
North America	151,682	360,588	400,945	453,370	20%	28%	56%	22%
Canada	8,029	17,424	19,557	23,569	34%	54%	47%	39%
United States	142,930	339,800	375,265	423,188	19%	25%	54%	20%
C.&S. America	158,875	176,792	174,721	175,291	64%	79%	109%	65%
Brazil	107,480	114,193	96,555	92,735	52%	62%	127%	63%
Mexico	31,180	41,743	51,729	57,114	113%	101%	79%	55%
Asia	568,318	854,855	1,150,808	1,627,986	51%	105%	93%	45%
China	11,491	49,199	124,254	334,710	67%	164%	203%	59%
Hong Kong	24,581	34,537	51,254	71,869	20%	154%	62%	30%
India	23,863	35,315	38,379	45,915	108%	200%	100%	66%
Indonesia	52,328	71,354	119,470	185,137	63%	64%	66%	17%
Korea	122,820	147,292	133,980	124,944	61%	128%	175%	119%
Malaysia	54,316	109,067	175,873	243,613	49%	90%	66%	26%
Philippines	21,285	41,433	63,043	88,505	26%	148%	73%	42%
Singapore	49,028	67,311	73,742	85,923	21%	55%	69%	32%
Taiwan	136,308	143,679	134,855	132,519	50%	107%	78%	54%
Thailand	65,977	145,777	221,278	289,613	54%	92%	94%	49%
Middle East	7,343	7,556	9,190	7,909	67%	182%	139%	191%
Europe	86,870	152,330	234,658	277,554	38%	73%	60%	28%
Belgium-Luxen	5,623	7,916	15,163	26,813	17%	33%	110%	16%
France	13,477	20,012	26,208	26,988	24%	68%	72%	74%
Germany	13,625	23,948	33,831	33,302	19%	37%	62%	16%
Italy	3,767	5,814	7,567	13,891	44%	211%	193%	46%
Netherlands	2,942	10,909	16,885	25,000	64%	213%	250%	20%
Portugal	4,224	6,207	8,394	10,405	16%	98%	30%	16%
Spain	22,656	30,406	30,495	22,238	97%	142%	54%	94%
United Kingdor	15,490	36,848	81,740	100,449	30%	43%	34%	17%
Oceania	30,290	38,987	40,490	41,050	13%	38%	40%	83%
Australia	26,459	31,833	33,694	31,867	9%	37%	35%	100%
Africa	19,039	17,105	14,778	19,668	157%	224%	370%	64%

Note: All unlisted countries never had revised employment estimates of 10,000 or greater.
Source: Lipsey, Ramstetter, and Blomström (2000a, Table 2).

Table 3: Employment of Manufacturing Affiliates with Parents Reporting Exports by Region (number or percent)

	Revised/Reported Empl.			Revised Employment			Reported Employment		
Industry, Region	1986	1989	1992	1986	1989	1992	1986	1989	1992
BY INDUSTRY OF PARENT									
Non-oil manufacturing	42%	57%	60%	816,618	1,302,878	1,602,437	573,078	828,930	1,001,513
Food, beverages, tobacco	465%	47%	114%	16,726	27,397	32,186	2,959	18,624	15,052
Textiles	59%	198%	68%	90,519	91,714	109,420	56,763	30,787	65,052
Chemicals	87%	84%	81%	43,963	89,511	126,684	23,527	48,544	70,053
Metals	43%	28%	67%	84,355	102,708	129,181	58,818	80,205	77,410
Primary metals	43%	22%	61%	79,121	89,714	111,315	55,414	73,806	69,124
Fabricated metals	54%	103%	116%	5,234	12,994	17,866	3,404	6,399	8,286
Machinery	38%	59%	55%	493,382	784,901	971,483	357,548	493,279	626,602
General machinery	26%	119%	145%	36,457	73,561	103,618	28,918	33,543	42,333
Electric machinery	41%	52%	43%	300,988	453,120	539,230	214,081	298,110	377,518
Transportation machinery	37%	54%	49%	133,737	224,248	280,541	97,517	145,724	188,601
Precision machinery	30%	114%	165%	22,200	33,972	48,094	17,032	15,902	18,150
Miscllaneous manufacturir	19%	31%	58%	87,673	206,647	233,483	73,463	157,491	147,344
BY REGION OF OPERATION									
World	42%	57%	60%	816,618	1,302,878	1,602,437	573,078	828,930	1,001,513
North America	16%	19%	43%	138,951	326,343	348,955	120,092	273,710	243,714
Central and Latin America	72%	62%	78%	105,156	119,014	119,425	61,224	73,300	67,158
Asia	51%	85%	69%	458,918	675,464	879,166	304,286	365,343	520,689
Europe	36%	60%	50%	77,663	137,182	208,630	57,013	85,527	139,400
Other regions	18%	45%	51%	35,930	44,875	46,261	30,463	31,050	30,552

Note: Chemical fibers are included in chemicals here, not in textiles as is the practice in MITI publications.
Source: Ramstetter (2001, Tables 3-4).

Table 4: Correlations between Japanese Exports by Country and Employment of Non-oil manufacturing Affiliates after Excluding the Effects of Country Size, Country Income Levels, and Distance to the Country from Japan

	1986 (98 countries)		1989 (98 countries)		1992 (98 countries)		1995 (96 countries)	
Equation, Industry	Japanese Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Japanese Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Japanese Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Japanese Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level
Food, beverages, tobacco	2.142	-	1.644	1%	1.276	0%	0.822	1%
Textiles, apparel, leather	1.072	-	1.104	-	1.846	2%	2.039	0%
Wood, furniture, paper	-1.025	-	0.436	-	0.654	-	0.315	-
Chemicals	12.024	4%	9.705	0%	9.863	0%	10.759	0%
Metals	-0.784	-	4.345	-	6.594	2%	7.097	0%
General & precision machinery	40.643	5%	51.212	0%	40.915	0%	25.652	0%
Electric machinery	7.935	1%	8.694	0%	6.179	0%	4.231	0%
Transportation machinery	11.733	-	26.733	4%	16.725	4%	11.945	1%
Other manufacturing	6.671	2%	5.911	0%	4.734	0%	3.026	0%

- = not significant at the 5% level or better.
Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at the 5% level or less; see Lipsey and Ramstetter (2001, Appendix Table A1) for detailed results and notes.
Source: Lipsey and Ramstetter (2001, Table 1).

Table 5: Correlations between Changes in Japanese Exports by Country and Employment of Non-oil manufacturing Affiliates in the Initial Year after Excluding the Effects of Changes in Country Size, Japanese Exports to the Country in the Initial Year, and the Growth of Japanese Export Prices Relative to the Country's Domestic Prices

	1986-1989 (93 countries)		1989-1992 (90 countries)		1992-1995 (88 countries)	
Equation, Industry	Japanese Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level	Japanese Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level	Japanese Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level
Food, beverages, tobacco	0.256	-	0.556	-	-0.150	-
Textiles, apparel, leather	0.633	1%	0.503	-	0.490	-
Wood, furniture, paper	0.643	-	-0.367	-	0.750	2%
Chemicals	3.531	-	0.245	-	-0.155	-
Metals	2.696	-	1.142	-	-1.487	-
General & precision mach.	10.553	-	12.673	-	9.595	0%
Electric machinery	4.036	0%	2.606	0%	2.923	0%
Transportation machinery	5.643	3%	0.152	-	2.434	-
Other manufacturing	2.281	-	-0.645	-	0.555	-

- = not significant at the 5% level or better.

Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at the 5% level or less; see Lipsey and Ramstetter (2001, Appendix Table A3) for detailed results and notes.

Source: Lipsey and Ramstetter (2001, Table 3).

Table 6: Correlations between Changes in Japanese Exports by Country and Changes in Employment of Non-oil manufacturing Affiliates after Excluding the Effects of Changes in Country Size, Japanese Exports to the Country in the Initial Year, and the Growth of Japanese Export Prices Relative to the Country's Domestic Prices

	1986-1989 (93 countries)		1989-1992 (90 countries)		1992-1995 (88 countries)	
Equation, Industry	Increases in Japanese Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Increases in Japanese Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Increases in Japanese Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level
Food, beverages, tobacco	-0.996	-	0.722	-	0.555	-
Textiles, apparel, leather	0.366	-	2.693	0%	2.314	0%
Wood, furniture, paper	3.567	-	1.719	0%	-0.157	-
Chemicals	0.757	-	2.038	-	3.657	0%
Metals	12.153	3%	4.026	-	6.223	-
General & precision machin	26.639	0%	7.807	1%	6.512	-
Electric machinery	2.907	0%	3.102	-	4.956	0%
Transportation machinery	12.105	0%	2.774	-	8.593	2%
Other manufacturing	-1.268	-	4.150	0%	1.101	-

- = not significant at the 5% level or better.
Significance levels are calculated from t-statistics; calculations use heteroscedasticity-consistent standard errors if the White F-test for heteroscedasticity is significant at the 5% level or less; see Lipsey and Ramstetter (2001, Appendix Table A3) for detailed results and notes.
Source: Lipsey and Ramstetter (2001, Table 3).

Table 7: Correlations between Parent Exports by Region and Employment of Non-oil manufacturing Affiliates after Excluding the Effects of Region Size, Region Income Levels, Distance to the Region from Japan, and Parent Size

	1986-1989		1989-1992		1986-1992	
Equation, Industry	Parent Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Parent Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Parent Exports (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level
Food manufacturing	0.161	-	0.244	-	2.956	0%
Textiles	0.803	-	1.115	-	0.367	-
Chemicals	2.015	-	0.794	-	4.184	1%
All metals	5.799	-	1.327	-	2.320	-
Primary metals	5.258	-	1.113	-	2.205	-
Fabricated metals	1.179	-	0.201	-	1.407	-
All machinery	8.178	1%	7.801	0%	9.255	0%
General machinery	2.335	-	9.417	0%	5.189	0%
Electric machinery	8.322	0%	7.820	0%	6.813	0%
Transportation machinery	11.852	-	6.706	-	26.473	3%
Precision machinery	2.514	-	8.360	-	22.567	-
Miscellaneous manufacturin	2.870	3%	1.546	0%	0.959	5%

- = not significant at the 5% level or better.

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. See Ramstetter (2001, Appendix Table A1) for details.

Source: Ramstetter (2001, Table 5).

Table 8: Correlations between Changes in Parent Exports by Region and Initial Employment of Non-oil manufacturing Affiliates after Excluding the Effects of Changes in Region Size, Parent Exports to the Region in the Initial Year, and Changes in Parent Size

	1986-1989		1989-1992		1986-1992	
Equation, Industry	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in Affiliate Employment in the Initial Year	Signifi-cance Level
Food Manufacturing	cannot estimate		2.376	0%	cannot estimate	
Textiles	0.053	-	2.651	-	0.733	2%
Chemicals	-0.227	-	2.026	0%	-0.072	-
All metals	0.180	-	-0.937	-	-1.195	-
Primary metals	0.119	-	-1.022	-	-1.308	-
Fabricated metals	1.022	0%	1.171	3%	2.097	0%
All machinery	4.667	0%	6.335	0%	4.758	-
General machinery	1.368	-	3.890	-	6.095	-
Electric machinery	3.052	3%	7.066	0%	4.994	1%
Transportation machinery	4.843	-	3.788	-	6.488	-
Precision machinery	1.149	-	0.727	-	22.079	-
Miscellaneous manuf.	6.337	-	0.404	-	-1.627	-

- = not significant at the 5% level or better.

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. See Ramstetter (2001, Appendix Table A1) for details.

Source: Ramstetter (2001, Table 5).

Table 9: Correlations between Changes in Parent Exports by Region and Changes in Employment of Non-oil manufacturing Affiliates after Excluding the Effects of Changes in Region Size, Parent Exports to the Region in the Initial Year, and Changes in Parent Size

	1986-1989		1989-1992		1986-1992	
Equation, Industry	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level	Increases in Parent Export Changes (yen millions) resulting from a 1 Person Increase in the Change of Affiliate Employment	Signifi-cance Level
Food Manufacturing	cannot estimate		-3.425	0%	cannot estimate	
Textiles	-0.267	-	11.805	-	0.523	0%
Chemicals	5.778	-	-1.212	-	1.505	2%
All metals	0.508	-	-3.855	-	0.003	-
Primary metals	0.523	-	-4.101	-	-0.175	-
Fabricated metals	0.845	-	2.375	3%	1.629	1%
All machinery	-1.561	-	11.703	0%	7.897	1%
General machinery	2.436	-	5.406	-	0.371	-
Electric machinery	-4.289	1%	11.962	0%	3.006	-
Transportation machinery	19.937	1%	8.678	-	16.521	1%
Precision machinery	0.538	-	-5.101	-	4.349	-
Miscellaneous manuf.	4.392	-	0.081	-	-2.064	-

- = not significant at the 5% level or better.

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. See Ramstetter (2001, Appendix Table A1) for details.

Source: Ramstetter (2001, Table 5).