THE EVOLVING EXTERNAL ORIENTATION OF MANUFACTURING INDUSTRIES: EVIDENCE FROM FOUR COUNTRIES

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ABSTRACT

Significant changes in the external orientation of manufacturing industries are observed in

the United States, Canada, and the United Kingdom, but not in Japan. The observed increases in

external orientation are in terms of industry export shares, import penetration, and imported input

use in production. United States industries have experienced a particularly dramatic increase in

imported input use, accompanied by highly variable patterns of industry net external orientation over

the past two decades. Although similar manufacturing industries have strong export orientation in

all countries, across countries these same industries have profoundly different patterns of import

penetration, imported input use, and net external exposure to exchange rate and trade policy changes.

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I. Introduction

Producers, policy-makers, economists, and market analysts often express concern about the implications of currency movements for the profitability and valuation of particular industries. Informed discussions of the effects of exchange rates and trade policies on investment, employment, and industry growth require basic facts on the level and type of external orientation of particular industries. This paper provides these facts. We document the external orientation of manufacturing industries for four countries: the United States, Japan, Canada, and the United Kingdom. The pattern of changes in the components of external orientation -- through industry exports, import penetration, and imported input use -- are studied using annual data which spans more than two decades.

There does not exist a single measure of industry external orientation that can adequately capture the form and extent of importance of the international economy for any given industry. Any ideal measure should reflect differences across industries and over time in industry sensitivity to external forces like changes in exchange rates or in the terms-of-trade. Moreover, an accurate measure of orientation should be specific to the particular subject of the exposure, whether this subject is the adjustment of profits, investment, jobs or wages, to name just a couple of relevant examples. Finally, external exposure measures also could have a time dimension, reflecting the fact that an international shock may have different implications over one quarter, one year, or even longer.

At present, the most widely used indicator of external orientation is a construct often referred to as industry "openness to trade". This construct is calculated as the value of industry trade of final products (imports plus exports of final products) relative to domestic production or consumption in that industry. Openness to trade is an interesting measure from a political perspective and also from the perspective of assessing the likely effects of

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expanding market access.[1] These trade measures generally have been carried over into studies which address industry exposure to various external shocks, including exchange rate movements.[2] However, such application of these measures can lead to misleading and erroneous conclusions. For some purposes, the appropriate measures of external orientation would focus on the particular role played by patterns of trade for the international transmission of shocks.

The commonly applied measures ignore the other channels of external orientation that have growing importance, including the increasing role of imported inputs into production and various components of multinational activity. A simple example illustrates the shortcomings of the commonly applied "openness to trade" indicators in painting a useful picture of the "exposure" or sensitivity of an industry to external forces. Consider an industry with low levels of exports and imports. The openness to trade measure (or a measure of export share of total revenues) indicates a low level of external orientation of this industry, and therefore suggests limited exposure to international shocks. However, the industry actually could have significant exposure to external shocks if it relies heavily on imported goods as inputs into the production process, or if it engages in foreign investment and production activity.

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[1] In the OECD, relevant empirical evidence on observed bilateral trade patterns relative to the predictions of an imperfectly competitive market benchmark is provided by Harrigan (1996). Saxonhouse and Stern (1989) review earlier related studies. In developing countries, and particularly with regard to issues of regional trade bloc formation, "gravity approaches" to interpreting observed levels of openness have provided useful lessons for policy debates.

[2] For example, see Marston (1996).

In this paper, we provide measures which better reflect both the external orientation and the scope of external exposure of industries. Our approach entails using industry-specific and time-varying measures of industry external orientation through exports, import competition and imported inputs into production costs. We report (by industry, by country, by year): (*i*) export revenue share, (*ii*) imports relative to consumption, and (*iii*) imported input share in production. This latter series is constructed using industry production input-output tables and industry-by-industry import shares. The resulting measures of industry imported input shares are particularly useful since they reflect the often ignored potential exposure of producers to shocks through the cost side of their balance sheets. We also report a measure of industry net external orientation, defined as the difference between industry export share and imported input share.[3]

We present and analyze annual industry data for each of approximately twenty manufacturing industries for the period spanning the early 1970s through the present. The twenty years of data provide perspective on external orientation trends within and across industries, and across four countries: the United States, the United Kingdom, Canada, and Japan. Five key conclusions result from this analysis:

1. The *levels* of all measures of external orientation of manufacturing industries in these countries have increased considerably in the last two decades, with the notable exception of industries in Japan. The levels of external orientation of industries continue to

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[3]Our measure does not explicitly confront the issue of the role of multinational activity and long-term licensing arrangements in each industry. A priori, the relationship between foreign production and an industry's external orientation (and possibly exposure to exchange rate movements) is ambiguous. In some cases, foreign production substitutes for export of domestic products to foreign markets. In other cases, the presence of foreign production activity encourages increased trade of intermediate and related products.

be considerably higher in Canada and the United Kingdom than in the United States and Japan.

2.　　The *relative ranking* of industries in each country according to each of the measures of industry external orientation has been very stable over time. In other words, an industry which had a higher export share than other industries in the early 1970s remained a relatively export-oriented industry into the mid 1990s. Analogously, industries with relatively high levels of import penetration or imported input use in the early 1970s retained their relatively high reliance on imported inputs through the mid 1990s.

3.　　Significant changes over time and differences across countries are evident in the net external orientation of industries (i.e., in export share minus imported input share). In the United States, levels of net external orientation of industries have shifted dramatically over time. Mirroring some patterns in the overall U.S. trade deficit, manufacturing industries became largely net imported input oriented in the mid 1980s. In 1986, for example, industries with export shares smaller than their imported input shares accounted for 55 percent of manufacturing shipments. By the mid 1990s, U.S. industries shifted back toward net export orientation, on balance, but the size of this net position generally was smaller than in the 1970s. In Japan, by contrast, the net external orientation of industries has been very stable over the past two decades. Japanese industries have consistently been either net-export oriented or net-imported-input oriented throughout the period, with export-oriented industries accounting for about two-thirds of overall manufacturing shipments.

4.　　High export-oriented industries tend to be the same across the four countries. The main difference in export orientation is one of degree: in contrast to the other countries, Japan maintains a large concentration of total exports among a small subset of manufacturing industries.

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5.	Import share and imported input share rankings of industries are not highly correlated across countries. By the mid 1990s, the only positively signed correlation among imported input share rankings was for the United States and United Kingdom industries. In other words, countries are very different in which industries are most heavily reliant on both imported inputs into production and import penetration.

The paper is organized as follows. We begin with a brief section defining the data and methodology that we apply in constructing the net orientation results. The next four sections of the paper are organized by country results. For each country (the United States, Japan, Canada, and the United Kingdom) we show detailed histories on industry external orientation. These sections are followed by a cross-country comparison of industry trends in external orientation. The paper concludes by arguing that particular classes of industries in particular countries are likely to be most susceptible to changes in exchange rates. Indeed, we argue that many formal studies of the real effects of exchange rate movements may have missed important channels through which exchange rates impact industries. Moreover, even the direction of expected effects of exchange rate changes on industry profitability may be incorrectly assessed in some studies. Our net orientation numbers provide a useful qualitative guide to exchange rate exposure of industries over medium-run horizons.

II. External Orientation of Industries in Each Country

For each manufacturing industry (at the two-digit SIC level) in each country we work with annual data series which begin in the early 1970s and end in the mid 1990s.[4] The approximately twenty industries for each country (detailed in the country tables throughout the paper) range from Food, to Textiles, to Chemicals, through various types of machinery. We track four series: export revenues relative to shipments (χ_i), imports relative to consumption (M_i), imported inputs as a share of the value of production (α_i), and net external orientation ($\chi_i-\alpha_i$). Export share and import share data are readily available through country sources. The third series, imported input share, is more novel: as described in Box 1, we construct this series using the production input-output tables of each country and industry import share data.[5] All series are shown in charts found in the paper appendix.

A. External Orientation, United States Manufacturing Industries.

Our data for the United States span the years 1972 through 1995. All manufacturing industries in the United States have increased their use of export markets for sales of their production. Although export share dipped briefly for some industries when the dollar peaked in 1985, there has been an overwhelming rise in export orientation of U.S. manufacturing. For manufacturing overall, export share rose from approximately 7.5 percent in the early

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[4] Specific details regarding the data for each country are provided in the Appendix. We use the latest available year of data for each country in our analysis: 1995 for the United States, 1994 for the United Kingdom, and 1993 for Canada and Japan.

[5] The measures of export, import and net exposure are shown in the charts in the back of the paper. Feenstra and Hanson (1996) combine import data and data on material purchases to also calculate a measure of imported inputs for U.S. industries.

BOX 1: **Imported Inputs into Production**

To construct this series, we begin with the input-output tables for each sector of each country, which provide information on the weight of each industry as an input into the final output of another industry. The component input shares are combined with the fraction of that component input industry that is imported. The formula for the imported input share of an industry indexed by i is given by:

$$\alpha_t^i = \frac{\sum_{j=1}^{n-1} m_t^j p_t^j q_j^i}{VP_t^i}$$

where $i =$ index representing the output industry;

  $j =$ index representing the production input industry;

  $m_t^j =$ share of imports in consumption of industry j in period t;

  $p_t^j q_{j,t}^i =$ the value of inputs from industry j used in the production of industry i in period t;

  VP_t^i = value of total production of industry i in period t.

The appendix details the specific data sources and features of each of these variables for the different countries. The imported input share series are useful for comparisons of industries within a particular country. However, the constructed series are not fully comparable across countries, so any such comparisons should be performed with caution. The two most important reasons for cross-country differences are worth mentioning here: (*i*) for Canada and Japan the measure includes imported inputs from agriculture, raw materials and manufacturing: by contrast, the U.S. and the U.K. measures include only manufacturing inputs; (*ii*) the denominator differs across countries due to data availability.

1970s to nearly 15 percent by the mid 1990s (Table 1). Those industries with relatively high export shares in the early 1970s were still the most export oriented by the mid 1990s (see the bottom row of Table 1).[6] Thus, despite the large increases in overall levels of export orientation across industries, the relative pattern of export orientation across industries has been very stable over time.

In the past two decades U.S. manufacturing industries also experienced large increases in the degree of import penetration. The proportionate increase in import penetration of total manufacturing is comparable to the export share increase. However, in contrast with the export share developments, industries differ tremendously in the scale of increase in import penetration. In a number of industries import penetration has risen to more than twenty percent of domestic consumption (i.e., in Apparel and Mill Products, Leather and Leather Products, Industrial Machinery, Electronics and Electrical Machinery, Transportation Equipment, and Instruments and Related Products). By contrast, some other sectors have experienced little or no change in import penetration. Imports remain below ten percent of U.S. consumption in 7 of 20 manufacturing industries (i.e., Food, Tobacco, Textile Mill Products, Printing and Publishing, Petroleum and Coal, Stone Clay and Glass, and Fabricated Metal Products). A comparison over time shows that the industries that had relatively high import penetration in the early 1970s were, by and large, the industries with relative high import penetration in the mid 1990s. But, the spread between industries with low versus high import penetration has significantly widened.

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[6] This comparison is done using Spearman Rank Correlation Statistics. These statistics measure the correlation between two variables based on the ordinal positions of the observations, without otherwise considering the level of the variables.

Table 1: UNITED STATES EXPORT, IMPORT AND IMPORTED INPUTS, SELECTED YEARS

Year	1975			1985			1995		
Industry:	X_i	M_i	α_i	X_i	M_i	α_i	X_i	M_i	α_i
Food & Kindred Products	3.32	3.74	2.84	3.57	4.33	3.56	5.91	4.24	4.15
Tobacco Products	6.85	0.60	1.45	8.05	0.51	1.57	14.94	0.56	2.11
Textile Mill Products	5.06	4.26	2.99	3.60	7.70	5.41	7.60	9.14	7.26
Apparel & Other Textiles	2.01	8.49	1.27	1.82	22.39	2.32	7.38	31.36	3.24
Lumber and Wood Products	7.18	6.93	2.20	5.27	10.54	3.50	7.60	10.34	4.25
Furniture & Fixtures	1.31	3.04	3.57	1.63	9.16	5.25	5.51	14.09	5.69
Paper & Allied Products	5.91	5.87	4.17	4.28	7.10	5.09	9.02	10.01	6.28
Printing & Publishing	1.60	0.96	2.66	1.21	1.22	2.97	2.37	1.55	3.54
Chemicals & Allied Products	10.14	3.59	2.99	11.67	6.51	4.47	15.76	10.95	6.34
Petroleum & Coal Products	1.71	9.65	6.81	3.14	9.54	6.83	3.86	5.65	5.35
Rubber & Miscellaneous Products	4.80	4.87	2.75	3.93	6.29	3.94	9.15	12.76	5.28
Leather & Leather Products	3.88	17.72	5.62	6.10	49.61	15.73	14.41	59.46	20.46
Stone, Clay & Glass Products	3.44	3.44	2.13	3.44	7.63	3.59	5.58	9.48	4.72
Primary Metal Products	5.10	9.79	4.95	3.68	16.60	9.21	11.24	17.37	10.62
Fabricated Metal Products	6.26	3.00	4.75	4.66	5.45	7.76	7.90	8.46	8.66
Industrial Machinery & Equipment	23.34	6.27	4.14	20.06	13.89	7.20	25.75	27.82	10.98
Electronic & Other Electric Equipment	11.05	8.48	4.46	10.08	16.95	6.71	24.17	32.46	11.60
Transportation Equipment	15.79	10.35	6.40	13.04	18.42	10.66	17.77	24.32	15.70
Instruments & Related Products	16.77	7.44	3.78	15.52	13.68	5.37	21.35	20.14	6.30
Miscellaneous Manufacturing	9.85	13.40	4.55	8.14	34.98	8.51	13.52	41.05	9.86
Total Manufacturing	8.40	6.28	4.06	7.94	10.97	6.21	13.35	16.27	8.20
Industry Rank Correlations with 1975 Values	---	---	---	0.901	0.850	0.934	0.765	0.614	0.812

U.S. manufacturing industries also have steadily increased their use of imported inputs in production. The average imported input share rose from 4.8 percent in 1974 to 8.2 percent in 1995. The increase in imported input use across manufacturing was sharpest in the first half of the 1980s, corresponding to the dramatic appreciation of the U.S. dollar. By 1985, the share of imported inputs into total costs in U.S. manufacturing industries had risen to 9.10 percent and was on average larger than the manufacturing export share. The presence of imported inputs did not abate when the dollar depreciated through the second half of the 1980s. In fact, the opposite occurred. For most industries the fraction of productive inputs that were imported continued to rise. An important implication is that the increases in imported input use more than doubled in numerous industries over the past two decades.

In 1975 more than 85 percent of U.S. manufacturing had a net external orientation favoring exports (i.e., export share exceeded imported input share, $\chi_i - \alpha_i > 0$). Very few industries had a negative net external orientation, with imported input shares exceeded export share (i.e., $\chi_i - \alpha_i < 0$). By the early / mid 1980s, the balance of external orientation had shifted tremendously. In 1985, eight U.S. manufacturing industries retained a positive net external orientation, accounted for slightly over half of manufacturing shipments. In 1986, only seven industries, accounting for 45 percent of total shipments, had net export orientation.

The pendulum on net external orientation gradually swung back over the course of the late 1980s and early 1990s. Export share growth rates exceeded imported input share growth in the late 1980s and these sectors now have larger external orientation through export market sales than through imported inputs (Table 2). By 1995, only five of twenty manufacturing industries recorded net imported input orientation. Net exporters once again

account for more than eighty percent of all manufacturing shipments (to both domestic and foreign markets).

Table 2	Evolution of Industry Net Orientation, The United States (out of a total of 20 manufacturing industries)					
	1975		1985		1995	
	# industries	% of shipments	# industries	share of shipments	# industries	share of shipments
$\chi_i - \alpha_i \geq 10\%$	2	11.27	2	11.81	4	23.91
$5 \leq \chi_i - \alpha_i < 10\%$	5	27.89	2	9.38	1	10.21
$0 \leq \chi_i - \alpha_i < 5\%$	9	48.52	4	37.23	10	49.24
$-5 \leq \chi_i - \alpha_i < 0\%$	3	5.55	10	36.33	4	16.34
$-10 \leq \chi_i - \alpha_i < -5\%$	1	6.78	2	5.26	1	0.30
$\chi_i - \alpha_i < -10\%$	0	0.0	0	0.0	0	0.0

*Computed using 1982 input-output basis for United States. 1987 basis yields results slightly more skewed toward heavy imported input orientation.

There also have been important changes over time in the *scale* of positive and negative net external orientation for many industries, despite the fact that the relative industry *rankings* of export, import and imported input orientation have been very stable over this period. However, as shown in Table 2, those industries with net orientation towards exports in 1995 have a smaller net positive orientation than they did in 1974. Likewise, those industries with net external orientation toward imported inputs have a more pronounced net orientation in that direction compared with the 1970s. These dramatic changes in net external

orientation of United States industries underscore the potentially large changes over time in industry exposure to exchange rate movements and other external shocks. We return to this important theme in the concluding section of the paper, after we survey the evolution of orientation for sectors in Japan, the United Kingdom, and Canada.

B. External Orientation, Canadian Manufacturing Industries

Over the last two decades Canadian manufacturing industries also have sharply increased all channels of external orientation. Table 3 shows industry export shares, import penetration, and imported input shares for 1974, 1984, and 1993. Canada has experienced more changes than any other country in our sample in the actual ranking of sectors according to their export orientation. By contrast, import penetration and imported input share rankings have been much more stable.

In most industries, export growth was tremendous. For total manufacturing, export to shipment ratios (χ_i) rose from 23 percent in 1974 to nearly 50 percent in 1993. For two industries export share rose tenfold -- for Chemical and Chemical Products, from 2.7 to 37.2 percent, and for Furniture and Fixtures, from 4.6 to 49.2 percent. Most other industries starting from low initial export shares trebled or quadrupled their use of export markets between the mid 1970s and mid 1990s. Industries which entered the 1970s exporting over thirty percent of their output generally exported more than 60 percent by the mid 1990s.

Import penetration (M_i) of Canadian manufacturing exceeded 10 percent of consumption of most industries in the early 1970s (and was 25 percent of total manufacturing). These numbers grew across the board over the following two decades. By

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Table 3: CANADA EXPORT, IMPORT AND IMPORTED INPUTS, SELECTED YEARS

Year	1974			1984			1993[a]		
Industry	X_i	M_i	α_i	X_i	M_i	α_i	X_i	M_i	α_I
Food & Beverages	8.15	10.31	6.62	8.03	11.00	5.70	18.58	18.40	6.55
Tobacco Products	10.19	3.82	6.59	6.39	3.31	5.29	39.95	51.74	9.78
Rubber & Plastic Industries	6.43	29.02	10.97	16.33	25.57	10.78	34.41	41.92	16.57
Leather Industries	4.74	31.25	12.64	6.18	41.28	12.30	22.79	72.39	21.83
Textile Industries	6.20	34.19	14.87	9.43	33.54	14.15	25.43	49.26	20.22
Knitting Mills	4.18	17.18	17.86	5.88	29.04	17.87	18.75	48.03	21.64
Wood Industries	38.11	12.94	3.62	49.68	10.95	3.25	75.23	24.40	4.81
Furniture & Fixtures	4.59	13.73	9.73	17.55	14.25	8.09	49.18	51.53	14.17
Paper & Allied Products	49.46	10.65	4.78	53.42	14.91	5.40	62.59	30.18	10.47
Printing & Publishing	2.64	14.13	4.17	4.51	13.10	5.50	6.19	19.62	8.75
Primary Metal Products	37.18	25.87	14.73	28.42	20.67	11.59	53.24	38.08	11.40
Fabricated Metal Products	7.14	19.44	10.80	12.37	21.90	8.64	16.77	27.38	13.57
Machinery Industries	35.24	65.89	17.65	64.45	83.61	21.85	110.79	103.98	26.57
Trasnportation Equipment	55.75	62.14	29.12	78.05	77.70	36.95	94.38	93.54	49.67
Electrical Machinery Products	14.47	36.52	13.24	28.00	46.94	17.14	38.93	60.75	30.92
Non-Metallic Mineral Products	6.98	16.83	6.08	13.44	20.30	6.60	21.76	32.48	8.46
Petroleum & Coal Products	11.40	8.11	70.00	15.19	9.21	15.14	27.06	18.21	12.09
Chemical & Chemical Products	2.70	26.38	9.03	3.50	25.51	8.75	37.24	46.86	15.13
Total Manufacturing	23.01	25.49	15.86	30.28	30.63	14.40	48.39	46.71	20.17
Industry Rank Correlations with 1974 Values	---	---	---	0.841	0.957	0.938	0.688	0.676	0.754

[a] Preliminary estimates.

the early 1990s the minimum import penetration of Canadian manufacturing industries was about 20 percent, and more often industry import penetration was 50 percent or higher.[7]

Imported input use (α_i) in Canadian manufacturing has not evolved as dramatically as the other external orientation channels. For all of manufacturing, the imported input share rose from 15.9 to 20.2 percent over two decades. While some industries experienced more rapid increases (two industries doubled imported input shares), imported input use even declined in a number of cases (Petroleum and Coal Products; Primary Metal Products; and Food and Beverages). The Petroleum and Coal industry use of imported inputs has declined precipitously since the 1970s (from 70 percent to 12 percent).

Table 4 pulls together these lessons for Canadian manufacturing by reporting the stark implications for net external orientation. In 1974, nine manufacturing industries (out of a total of eighteen), accounting for 67 percent of total manufacturing shipments, had positive net external orientation. For 5 of these industries, representing 40 percent of all manufacturing shipments, the net orientation toward exports was well above 10 percent. By the mid 1990s 16 out of 18 manufacturing sectors in Canada had a net export orientation, representing more than 90 percent of manufacturing shipments. One reason for this increasing tendency toward positive external orientation is substantial export growth without the types of gains in imported input use that have been observed in the United States. Therefore, unlike the United States, in Canada the tendency of manufacturing industries has been toward increased net external orientation in the direction of exports, without offsetting cost and exposure of producers on the imported input side.

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[7] For the Machinery Industry the export share and import to consumption share in 1993 were greater than 100% due to the large amount of re-exports of imported goods.

Table 4	Evolution of Industry Net Orientation, Canada					
(out of a total of 18 manufacturing industries)						
	1974		1984		1993*	
	# industries	share of shipments	# industries	share of shipments	# industries	share of shipments
$\chi_i - \alpha_i \geq 10\%$	5	40.5	6	45.3	12	78.7
$5 \leq \chi_i - \alpha_i < 10\%$	0	0.0	3	6.3	2	9.2
$0 \leq \chi_i - \alpha_i < 5\%$	4	26.8	4	31.9	2	5.5
$-5 \leq \chi_i - \alpha_i < 0\%$	3	12.5	2	6.0	2	6.6
$-10 \leq \chi_i - \alpha_i < -5\%$	4	10.9	2	8.2	0	0.0
$\chi_i - \alpha_i < -10\%$	2	9.4	1	2.3	0	0.0

* Preliminary numbers from Statistics Canada for 1993.

C. External Orientation, United Kingdom Manufacturing Industries

The external orientation of industries across U.K. manufacturing has changed significantly over the past two decades. Export orientation of all industries grew (Table 5). The largest absolute increase in U.K. manufacturing export share was in exports of Professional Goods. For total manufacturing, export share of total shipments increased from nearly 20 percent in 1974 to nearly 30 percent by 1993. The industries which entered the 1970s as relatively large exporters continued to be relatively large exporters (as a share of total industry production) into the mid 1990s.

Import penetration of U.K. manufacturing also increased from approximately 20 percent to 30 percent of consumption. Imports of Textiles, Chemicals, Rubber Products, and

Table 5: UNITED KINGDOM EXPORT, IMPORT AND IMPORTED INPUTS, SELECTED YEARS

Year	1974			1984			1993		
Industry	X_i	M_i	α_i	X_i	M_i	α_i	X_i	M_i	α_I
Food	5.81	21.43	8.38	7.26	18.05	8.65	9.62	18.93	9.10
Beverages	17.70	11.12	8.78	20.47	13.46	11.10	22.26	16.24	13.21
Tobacco Products	10.58	3.36	8.34	24.85	23.23	9.97	7.99	58.71	9.95
Textiles & Wearing Apparel	18.33	20.10	15.66	22.54	35.79	26.65	30.90	29.13	24.21
Leather & Leather Products	16.73	18.02	14.99	25.67	42.00	24.74	33.76	73.16	35.62
Wood Products	1.98	34.25	20.55	3.57	33.81	21.80	2.73	15.63	12.91
Furniture & Fixtures	5.71	6.04	14.74	7.70	15.43	19.85	7.93	51.94	14.14
Paper & Paper Products	7.05	28.55	18.90	9.98	32.61	23.18	15.14	31.22	23.08
Printing & Publishing	6.93	4.08	10.85	7.75	5.47	13.45	8.31	5.59	13.62
Chemical & Allied Products	25.00	19.64	13.10	36.67	32.04	20.58	45.05	38.52	22.52
Petroleum & Coal Products	12.90	14.76	3.71	18.17	24.66	6.10	19.03	9.40	4.80
Rubber Products	16.91	10.89	11.79	23.68	23.09	19.12	31.24	33.18	21.32
Plastic Products	8.58	13.39	14.07	10.13	15.20	21.58	8.59	14.52	24.72
Non-Metallic Products	11.69	8.28	7.82	9.81	9.78	12.99	11.84	11.72	13.80
Iron & Steel	11.89	14.50	11.70	17.00	16.92	15.63	29.11	25.98	20.14
Non-Ferrous Metals	29.13	38.59	29.06	39.59	47.65	36.91	37.60	51.75	40.10
Fabricated Metal Products	11.22	6.60	15.41	17.89	16.07	20.83	17.09	19.11	24.62
Non-Electrical Machinery	35.63	26.90	16.07	44.47	43.13	24.87	51.07	52.48	31.30
Electrical Machinery	18.38	17.63	14.94	23.97	30.03	23.57	47.03	51.73	34.57
Transport Equipment	30.72	18.35	14.33	35.14	38.13	25.50	40.83	47.65	32.19
Professional Goods	42.11	39.94	13.24	109.20	108.80	22.61	107.60	111.90	29.47
Other Manufacturing	76.62	76.62	20.58	116.40	114.70	28.19	118.20	112.80	28.97
Total Manufacturing	18.45	19.56	13.40	24.14	29.01	18.96	29.84	33.77	21.64
Industry Rank Correlations with 1974 Values	---	---	---	0.915	0.837	0.883	0.893	0.735	0.801

Machinery registered large gains. Overall, however, even if import penetration rose, those industries which were subjected to a relatively strong foreign presence in the 1970s continued to be the industries which retained high import penetration into the 1990s.

Imported input use rose in all U.K. manufacturing industries over the past two decades, from an average of 13 percent in 1974 to 22 percent in 1993. The industries which exhibited the most significant increases in imported input use were the same industries which experienced significant gains in import penetration. This finding is sensible, since manufacturing industries tend to use their own broad product groups as inputs into their own production.

The net orientation of U.K. manufacturing industries has varied considerably over the past two decades, as it has in the context of the United States. By the mid 1980s about half the shipments of manufacturing were in industries that had a net orientation balanced on the side of imported inputs. By the mid 1990s, the share of total shipments in the negative net exposure category actually declined significantly, but more industries were in this group. In other words, more industries had negative net orientation, but these industries became a smaller portion of total U.K. manufacturing.

Table 6			Evolution of Industry Net Orientation, United Kingdom			
			(out of a total of 19 manufacturing industries)			
	1974		1984		1993	
	# industries	share of shipments	# industries	share of shipments	# industries	share of shipments
$\chi_i - \alpha_i \geq 10\%$	5	31.0	6	30.6	6	37.2
$5 \leq \chi_i - \alpha_i < 10\%$	3	10.7	2	12.1	5	22.4
$0 \leq \chi_i - \alpha_i < 5\%$	7	27.0	5	15.8	1	12.9
$-5 \leq \chi_i - \alpha_i < 0\%$	3	20.6	4	26.6	4	7.7
$-10 \leq \chi_i - \alpha_i < -5\%$	2	2.4	1	2.9	4	15.4
$\chi_i - \alpha_i < -10\%$	2	8.3	4	12.1	2	4.4

D. External Orientation in Japanese Manufacturing

Patterns of external orientation of Japanese industries are markedly different from their counterpart industries in the United States, United Kingdom, and Canada. First, as shown in Table 7, both levels and rankings of industry export share and import penetration have been very stable. Second, the bulk of Japanese industrial exports are concentrated in four industries with a heavy export orientation. Third, import penetration and imported input shares are significantly lower in Japan, compared with the other countries examined in this paper.

Japanese exports are heavily concentrated in the durable goods manufacturing industries: Ordinary Machinery, Electrical Machinery, Transportation Equipment, and

Table 7: JAPAN EXPORT, IMPORT AND IMPORTED INPUTS, SELECTED YEARS

Year	1974			1984			1993		
Industry	X_i	M_i	α_i	X_i	M_i	α_i	X_i	M_i	α_i
Food & Beverages	1.06	6.40	9.98	1.10	7.01	7.06	0.55	7.98	4.31
Textile Products	8.52	6.83	4.56	9.22	7.88	4.32	5.84	14.59	4.81
Lumber & Wood Products	0.79	5.16	7.38	0.98	6.70	5.45	0.64	11.98	6.03
Pulp, Paper & Paper Products	3.01	4.56	3.04	2.73	4.45	2.92	2.36	3.72	2.13
Printing & Publishing	0.63	1.06	1.41	0.76	0.56	1.45	0.40	0.60	0.89
Chemical Products	12.50	7.82	5.18	9.75	8.47	4.75	7.96	5.86	2.57
Petroleum & Coal Products	2.07	10.62	57.90	2.16	13.04	54.04	2.48	8.42	25.48
Leather & Rubber Products	12.52	5.46	3.58	14.77	7.18	3.51	12.64	8.20	2.57
Non-Metallic Products	4.00	0.98	14.47	7.03	2.21	11.81	4.78	2.47	7.05
Iron & Steel	14.97	1.50	4.62	10.97	2.25	4.88	7.40	2.32	3.07
Non-Ferrous Metal Products	9.97	17.87	23.97	8.55	25.74	18.69	7.88	18.90	9.83
Fabricated Metal Products	7.27	1.02	1.83	7.65	1.23	2.16	3.33	1.43	1.69
Ordinary Machinery	12.31	4.28	2.14	18.29	2.67	1.90	20.76	3.88	1.77
Electrical Machinery	15.49	4.00	3.10	24.59	4.02	3.42	24.87	6.89	2.90
Transportation Equipment	24.42	2.47	1.78	32.84	3.19	2.35	25.02	3.74	2.83
Instruments & Related Products	27.71	16.67	4.65	34.00	11.94	4.06	31.88	17.33	3.69
Other Manufacturing	7.75	5.71	3.31	7.56	5.07	3.21	11.91	14.80	4.38
Total Manufacturing	10.52	4.93	8.24	13.54	5.48	7.31	12.07	6.32	4.07
Industry Rank Correlations with 1974 Values	---	---	---	0.978	0.968	0.976	0.929	0.858	0.831

Instruments and Related Products.[8] As of 1995, these four industrial groups (accounting for 67 percent of total exports from Japan) had export shares representing between twenty and thirty percent of their shipments (approximately). While the ranking correlation of export share by industry across time has been extremely stable, export activity in Japan has actually become more concentrated in the four main export industries over the past twenty-five years.

Import penetration of Japanese manufacturing industries has remained low and stable. Relative to the levels of imported inputs observed in other countries and to their growth over time in particular, the lack of movement in this data is striking for Japan. By the mid 1990s, import penetration averaged about 7 percent of industrial consumption: much of this activity was related to raw materials imports.

Even more dramatic is the reduction in imported input use over time. The two sectors which pull up the averages for Japanese industries are Petroleum and Coal Products, and Non-Ferrous Metal Products. Without these two industries, imported input shares generally are well below 5 percent across the board for Japanese industries.

The picture on net external orientation that emerges for Japan is one of a highly stratified economy. Five industry groups, representing 40 percent of manufacturing, have net external orientation exceeding 10 percent. Since many other sectors export very little of their output, about 30 percent of manufacturing is consistently more exposed internationally through their use of imported inputs. The absolute size of this negative net exposure has been declining over time, as export growth for even these sectors exceeds their growth in the use of imported inputs into production.

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[8] These four industries also are relatively export oriented in the United States, the United Kingdom, and Canada.

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Table 8	Evolution of Industry Net Orientation, Japan (out of a total of 19 manufacturing industries)					
	1974		1984		1990	
	# industries	share of shipments	# industries	share of shipments	# industries	share of shipments
$\chi_i - \alpha_i \geq 10\%$	5	43.7	5	39.1	5	38.8
$5 \leq \chi_i - \alpha_i < 10\%$	3	13.7	2	22.0	1	14.5
$0 \leq \chi_i - \alpha_i < 5\%$	2	9.2	2	8.5	4	18.7
$-5 \leq \chi_i - \alpha_i < 0\%$	2	6.0	5	11.2	4	21.8
$-10 \leq \chi_i - \alpha_i < -5\%$	2	15.9	1	11.2	1	2.7
$\chi_i - \alpha_i < -10\%$	3	11.5	2	8.2	2	3.5

III. Cross-Country Comparisons of Industry Orientation

Our external orientation results show that, in general, export shares of manufacturing industries have been growing across the four countries of our sample (i.e., the United States, the United Kingdom, Canada, and Japan). However, this growth often is unevenly distributed across sectors and countries. Likewise, there have been tendencies toward increased import penetration of industries and increased reliance on imported inputs into production. Given this uneven growth, one can ask whether countries are becoming more similar or dissimilar in terms of the international orientation of their manufacturing sectors.

To analyze these similarities among countries, we first rank for each country and year all industries (from 1 to k, where k is the number of industries) according to three distinct criteria: export share, import penetration share, and imported input use share. We then

correlate, at particular dates, the industry rankings for each country across countries using the Spearman rank correlation formula.[9] The resulting Spearman rank correlation estimates , computed for 1974, 1984 and 1993, are reported in Table 9.

Our intention is to show the relative similarities or differences in patterns of the three categories of external orientation of industries across countries, as distinct from the absolute size of external orientation. This will also provide some evidence on the extent to which rankings of industries may be becoming more or less stable over time across countries. Overall, we find that the external orientation patterns of U.S. and U.K. industries are most similar -- and increasingly so -- while the other cross-country comparisons of external orientation rankings are more mixed.

Cross-Country Similarities in Industry Export Orientation. The United States and United Kingdom have highly positively correlated rankings of industries in terms of export share. By contrast, Canadian industry rankings have little in common with the rankings of industries for the United States and United Kingdom. Industries in Japan have moderate similarities with the industry rankings in all countries, reflecting the fact that large export industries tend to be similar across these countries. Most of the export orientation rank correlations have been stable over time within countries. If any tendencies can be detected in terms of trends, the tendencies are for reinforcing the patterns that we have noted.

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[9] In order to make comparisons across countries we convert the original data for each country, into a set of fifteen industries equally defined across the four countries.

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Table 9   Spearman Rank Correlations, by Orientation Category of Sectors Across Countries.

Export Orientation

	United Kingdom			Japan			Canada		
	1974	1984	1993	1974	1984	1993	1974	1984	1993
United States	0.65	0.63	0.72	0.28	0.43	0.47	0.19	0.23	0.01
Canada	0.10	0.10	0.01	0.21	0.34	0.31			
Japan	0.40	0.44	0.37						

Import Penetration

	United Kingdom			Japan			Canada		
	1974	1984	1993	1974	1984	1993	1974	1984	1993
United States	0.38	0.58	0.70	0.36	0.05	-0.31	0.51	0.59	0.11
Canada	0.30	0.39	0.21	0.04	0.16	0.15			
Japan	0.56	0.30	-0.27						

Imported Input Share

	United Kingdom			Japan			Canada		
	1974	1984	1993	1974	1984	1993	1974	1984	1993
United States	-0.03	0.44	0.70	-0.19	-0.04	-0.31	-0.16	0.24	0.11
Canada	-0.04	0.13	0.21	-0.05	-0.09	0.15			
Japan	-0.11	-0.08	-0.27						

Cross-Country Similarities in Industry Import Penetration. The United States and United Kingdom also are the country pair most alike in terms of the rankings of industries by import penetration. Although Canada had strong similarities to these countries in the 1970s, the similarities with respect to the U.S. and U.K. have progressively eroded over time and have remained low with respect to Japan. Over the past two decades, correlations between Japanese industry rankings and those for the United States and United Kingdom have turned negative. The sectors which have relatively high import penetration in Japan are likely to have relatively low import penetration in the other two countries.

Cross-Country Similarities in Industry Imported Input Use. Again, the United States and United Kingdom have the highest correlations among country rankings of industry by this orientation criterion. Indeed, this correlation is becoming stronger over time. In the 1970s Canadian rankings were negatively correlated with the rankings of these countries, but evolved to positive correlations through the late 1970s into the 1990s. Japanese industry rankings are (increasingly) negatively correlated with the rankings of industries in the United States and United Kingdom in terms of imported input use.

IV. Conclusions

This paper has shown that there are important differences in the external orientation of industries within and across countries. The United States, Canada, Japan, and the United Kingdom share a set of manufacturing industries that are relatively strong exporters. This finding is consistent with the observed similarities in manufacturing industry specializations among these countries relative to the rest of the world and the high degree of intraindustry trade among them. However, the countries differ substantially in the ranking of industries by their reliance on imports and especially on imported inputs into production. Some of these

differences in imported input reliance can potentially be explained by differences in endowments of raw materials in each country.

Trade relative to domestic manufacturing production or consumption is highest in Canada and the United Kingdom, followed by the United States, and then by Japan. Trade shares in the United States have sharply increased over time. In Japan, external exposure shares have been quite stable. Sectors in Canada and the United Kingdom have consistently higher export shares and imported input shares than the United States. The Japanese economy has fewer sectors oriented toward exporting, but higher export shares of these sectors. Japanese producers generally do not rely heavily on manufacturing imported inputs into production.

Industries in the United States have had the most volatile patterns in net external orientation. After having been, on average, primarily export oriented in the 1970s, in the 1980s U.S. industries were more exposed internationally through their reliance on imported inputs into production. In the 1990s the United States industries have more balanced external exposure: some industries have positive net external orientation, while others have negative net positions.

Canadian industries are more starkly oriented toward exporting. In 1993, 80 percent of Canadian manufacturing industries had high net export orientation, compared with 40 percent of manufacturing industries in the early 1970s. United Kingdom and Japanese manufacturing sectors have had relatively stable patterns of net external orientation, despite the substantial changes in the real exchange rates and demand conditions facing these economies over the past two decades.

Japanese manufacturing industries are distinct from those in the other countries along a number of dimensions. First, in Japan a small group of large industries account for the bulk

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of exports of the country. Second, Japanese industries have experience relatively little import penetration and generally have low shares of imported input use. Nonetheless, since some industries export very little of their production, roughly 30 percent of manufacturing output in Japan is in industries with a consistently negative net external orientation. Finally, over time, we observe that Japan is more and more dissimilar to the United States and United Kingdom in terms of industry import penetration and imported input use.

This paper has focused on the size and composition of the external orientation of manufacturing industries. A direct application of this information will be the estimation of the effects that changes in exchange rates during this period have on the growth and composition of manufacturing activity in these countries. To what extent industry performance -- whether measured by stock market returns, profits, growth or any other measure of industry activity -- is affected by international shocks, such as exchange rate changes, should depend on the size and direction of the net external orientation of the industry. The exclusion of the channels for these effects may account, for instance, for the apparent lack of response of indicators of economic activity to exchange rate movements found in a number of existing empirical studies (Bodnar and Gentry, 1993; Amihud 1994).[10]

Our work on the effects of exchange rate movements on industry investment suggests the importance of controlling for an industry's net external orientation. First, the apparent sign of the effects of real exchange rate depreciations for foreign direct investment activity in the United States switched negative in the mid 1980s [Goldberg (1993)]. Indeed, an explanation for this phenomenon is that the sensitivity of an industry investment rates to

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[10] Recent work by Alleyanis (1996) highlights the importance of controlling for the export and import share of a firm in order to estimate the reaction of stock market returns to exchange rate changes.

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exchange rates varied depending on the industry's net external orientation and on its competitive features, with more significant effects for the United States and Japan than for Canada and the United Kingdom [Campa and Goldberg (1995 and 1996)]. Likewise, the degree of industry employment response to exchange rates is sensitive to the particular form and magnitude of industry external orientation [Campa and Goldberg, 1997].

To understand the effects that an increasingly integrated global economy have on domestic economic activity, it is important to understand the channels through which international shocks get transmitted into the economy. The purpose of this paper has been to provide evidence on three of these channels for the manufacturing sector of the United States, Canada, Japan and the United Kingdom. The data shows that these measures of external orientation vary substantially over time in their size and in their implications for the net external orientation from its export and imported input orientation. This pattern suggests the importance of allowing for these variability among industries and across time when trying to draw implications from international economic shocks or from economic policies driven to affect the position of domestic industries relative to their international competitors.

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<u>Appendix</u>: *The Data*

       <u>Canada:</u> The input-output tables used are annual tables for the period 1974-1993 provided by Statistics Canada. Source: System of National Accounts, *The Input-Output Structure of the Canadian Economy* for the period 1974-1993, in millions of Canadian dollars. These tables also report data on exports, imports, employee compensation, and total production for each industry. The imported input series, α^i, is the ratio of imported inputs purchased from agriculture, mining, raw materials and manufacturing industries to total inputs purchased from these industries plus the industry labor costs.

       <u>Japan:</u> The input-output series area annual series from the Ministry of Trade and Industry. Source: International Trade and Industry Statistics Association, *Japan Input-Output Tables Extended Chart*. This source contains 1974-1993 data, in millions of Japanese yen, on annual input-output information as well as export, imports, employee compensation, material costs, and total production. α^i, is the ratio of imported inputs purchased from agriculture, mining, raw materials and manufacturing industries to total inputs purchased from these industries plus the industry labor costs.

       <u>United Kingdom:</u> Only one year of input-output data is used in our calculations, *1990 Input-Output Balances for the United Kingdom* by Central Statistical Office of the United Kingdom (1993). Annual data through 1994 on manufacturing exports, imports, wages and salaries, employee's social security costs, and total production are from *Industrial Structure Statistics* by OECD. α^i includes in the numerator imported inputs from manufacturing industries, assuming $p^j_t q^i_{j,t} = p^j_{90} q^i_{j,90}$ $\forall$ t, and in the denominator $VP^i_t = \Sigma_j p^j_{90} q^i_{j,90}$.

       <u>United States:</u> Industry sales data are from the Bureau of the Census *Annual Survey of Manufactures*. Exports to shipments and imports to new supply data are from the U.S. Department of Commerce. α^i includes in the numerator imported inputs from manufacturing industries, assuming $p^j_t q^i_{j,t} = p^j_{82} q^i_{j,82}$ $\forall$ t, and $VP^i_t = \Sigma_j p^j_{82} q^i_{j,82} + w^i_t$ where w^i_t are wages and salaries in nominal dollars from the National Income and Product Accounts expressed in

1982 dollars by deflating them by the U.S. Producer Price index from the *International Financial Statistics* (series 63).

We have constructed imported inputs shares using two alternative years of input-output data, i.e. 1982 and 1987, from the "Benchmark Input-Output Accounts for the United States Economy" (for example see the *Survey of Current Business*, July 1991, pp. 30-71). The data reported in the tables are based on the 1982 Input-Output tables. The results show virtually no change between using the 1982 and the 1987 Input Output tables, except for in Apparel and in Lumber and Wood industries. Compared with the 1982 input-output structure, the 1987 tables show Apparel (industry 23) as having shifted from purchasing heavily from Chemicals (industry 28) into buying more semi-finished textile products (industries 22 and 23). Also, according to the 1987 tables, Lumber and Wood Products (industry 24) buys much more from itself and purchases reduced input shares from Chemicals, Petroleum, and Rubber Products.

Available from the authors are specifics on Industry Concordances for respective data series from different countries.

EXPORT AND IMPORT SHARE BY INDUSTRY, UNITED STATES

——— Export Share ·········· Import Share

20. Food and Kin. Products

21. Tobacco

22. Textile Mill Products

23. Apparel

24. Lumber & Wood

25. Furniture & Fixtures

26. Paper

27. Printing & Publishing

28. Chemicals

29. Petroleum & Coal

30. Rubber & Plastic

31. Leather Products

32. Stone, Clay, & Glass

33. Primary Metals

34. Fabricated Metals

35. Nonelectrical Machinery

36. Electrical Machinery

37. Transportation Equip.

38. Instruments

39. Misc. Manufacturing
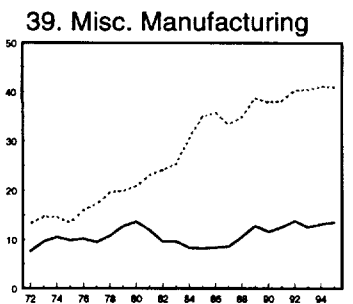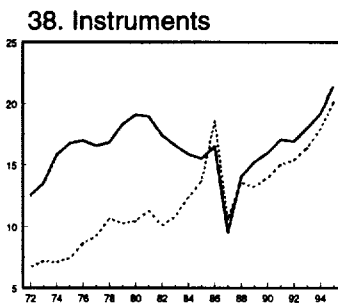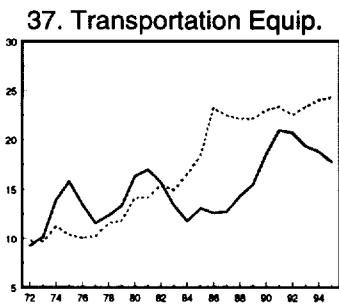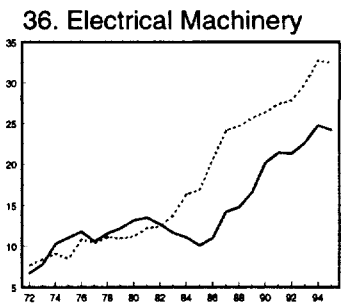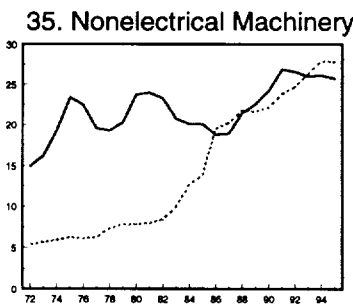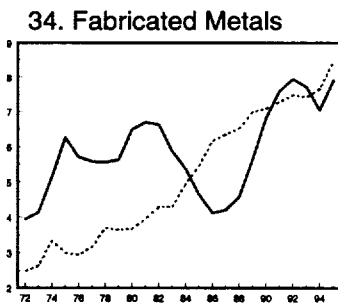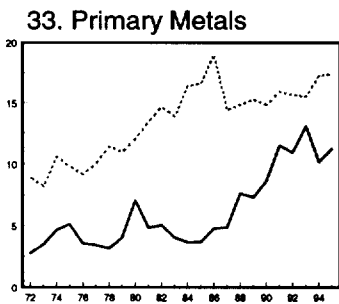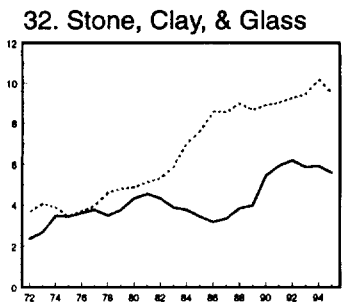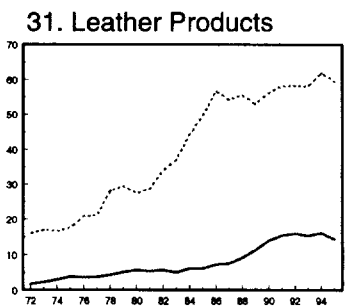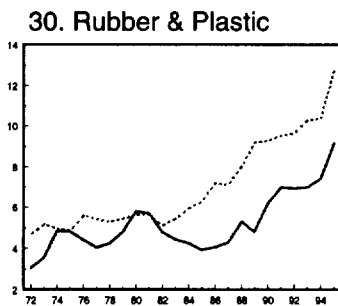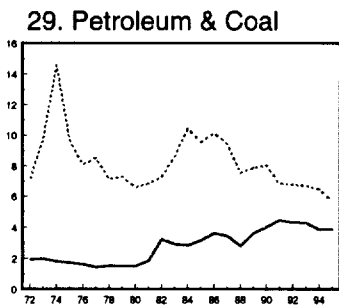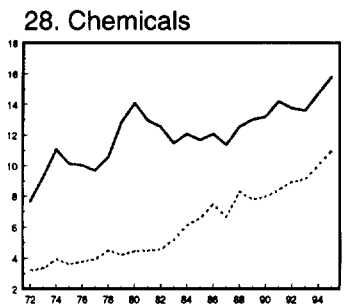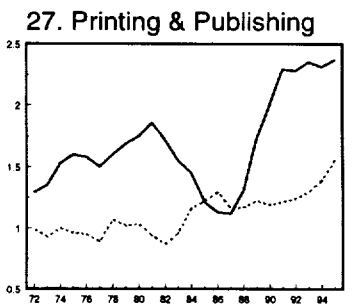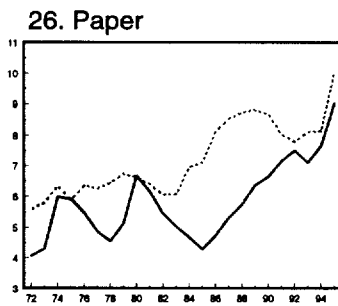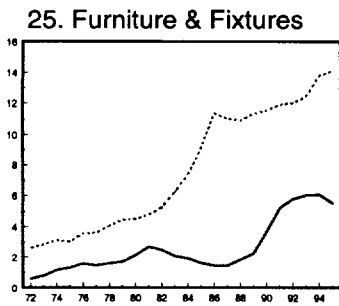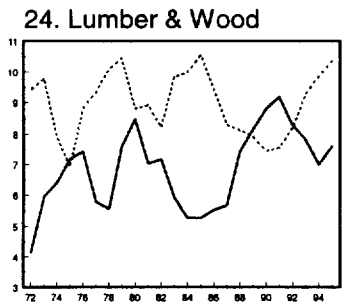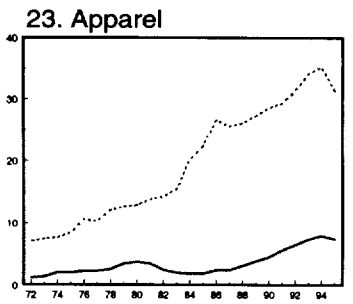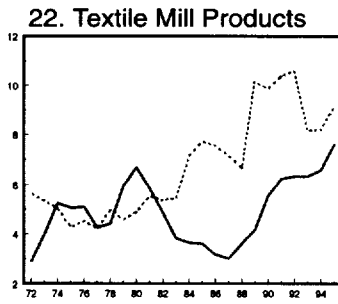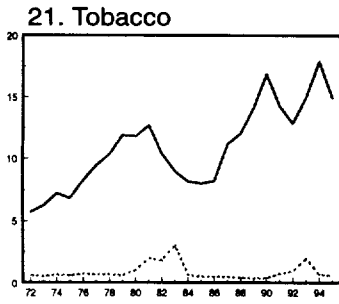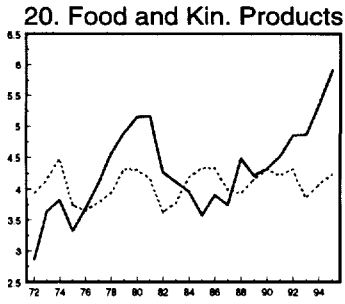
NET EXTERNAL ORIENTATION BY INDUSTRY, UNITED STATES

—— 1982 Input-Output Basis   ········ 1987 Input-Output Basis

20. Food and Kin. Products
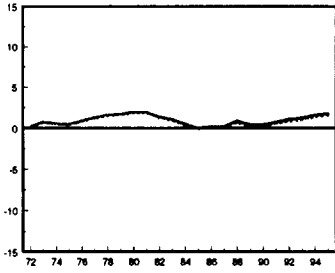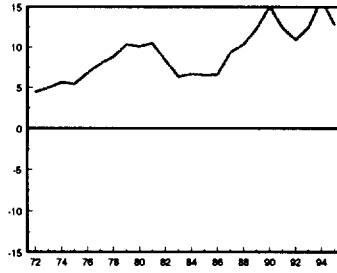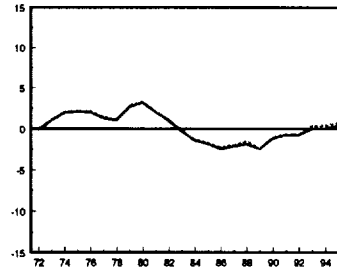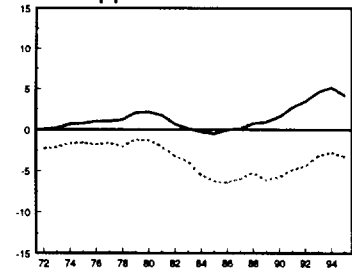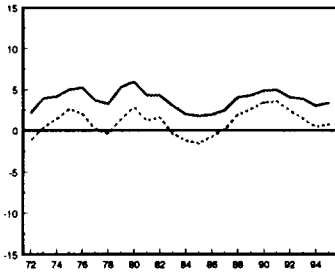
21. Tobacco

22. Textile Mill Products

23. Apparel

24. Lumber & Wood

25. Furniture & Fixtures

26. Paper

27. Printing & Publishing
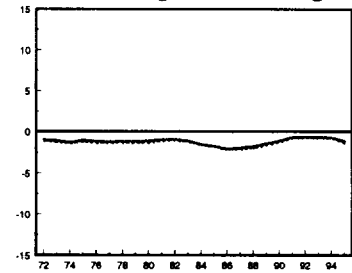
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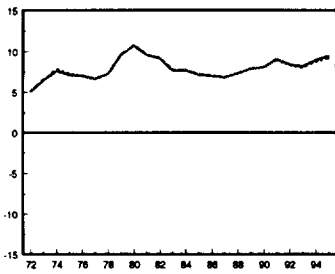
29. Petroleum & Coal
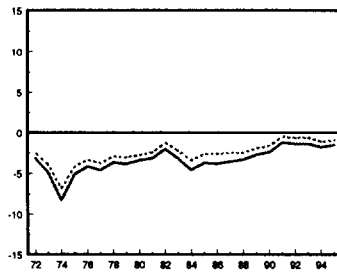
30. Rubber & Plastic
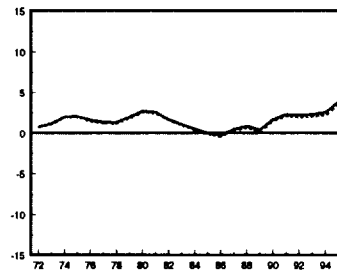
31. Leather Products
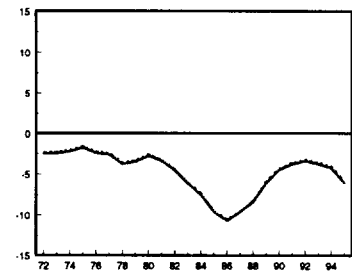
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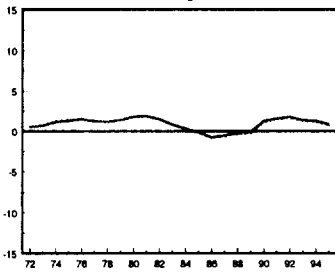
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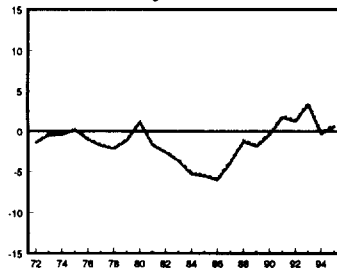
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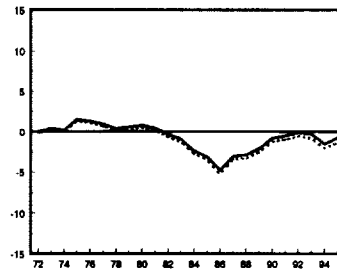
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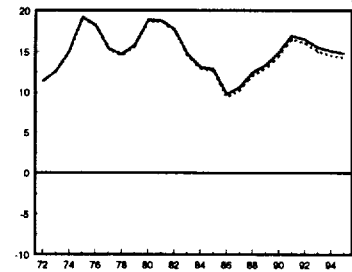
36. Electrical Machinery
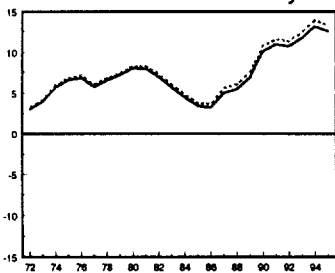
37. Transportation Equip.
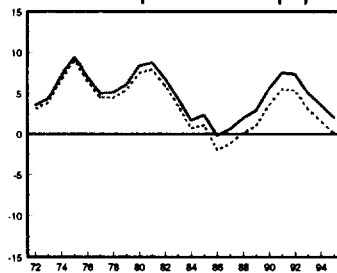
38. Instruments
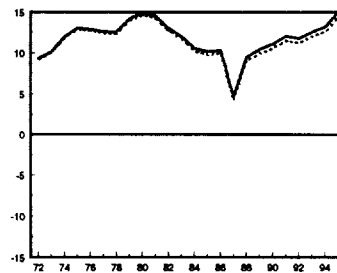
39. Misc. Manufacturing

EXPORT AND IMPORT SHARE BY INDUSTRY, CANADA

——— Export Share	·········· Import Share

1. Food & Beverages

2. Tobacco

3. Rubber & Plastic

4. Leather

5. Textiles

6. Knitting Mills

8. Wood Industries

9. Furniture & Fixtures

10. Paper & Allied Products

11. Printing & Publishing

12. Primary Metals

13. Fabricated Metals

14. Machinery

15. Transport Equip.

16. Electrical Products

17. Non-Metallic Minerals

33. Petroleum & Coal

34. Chemical Industries
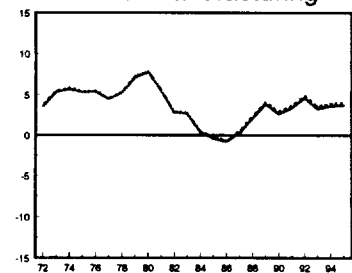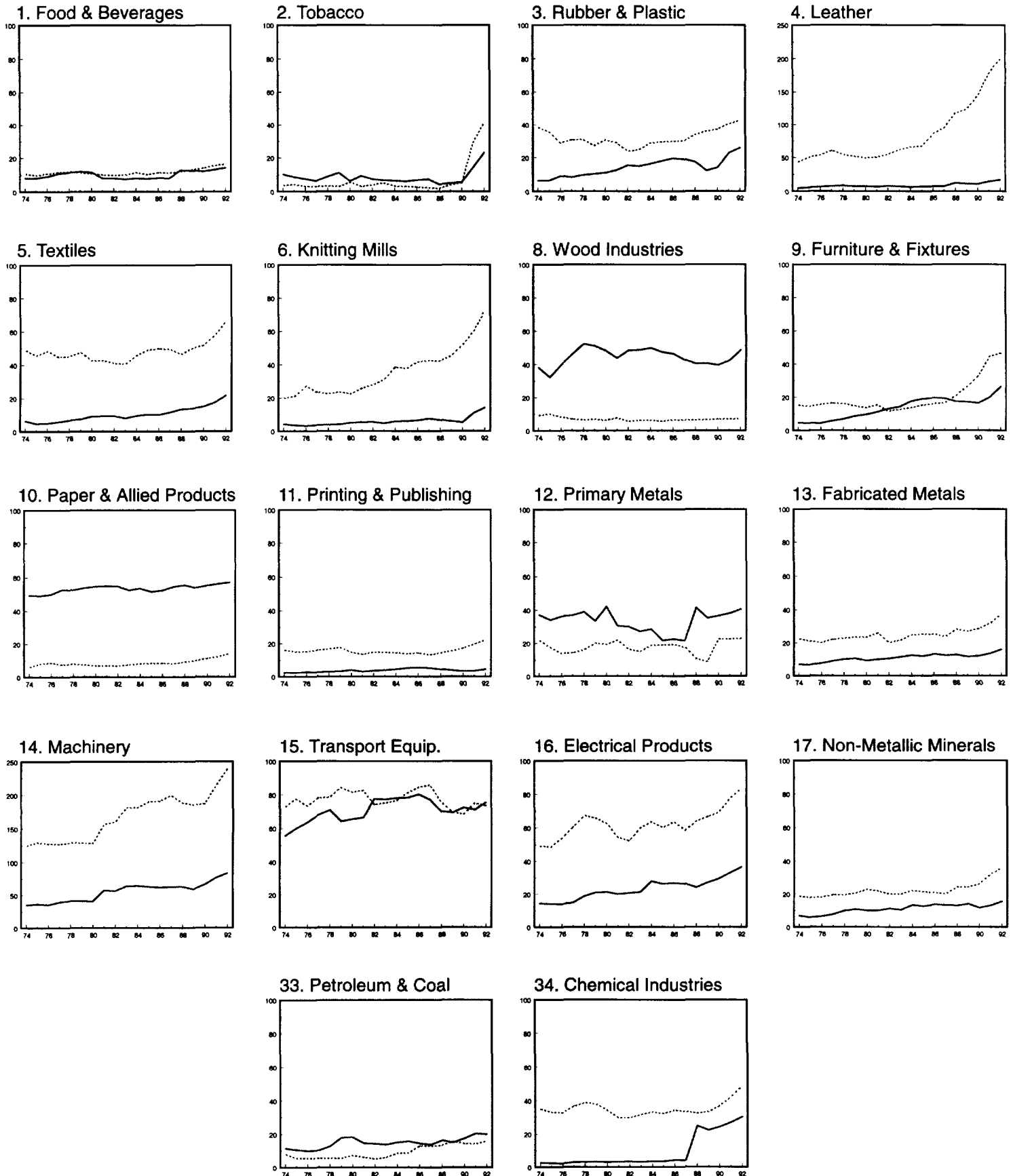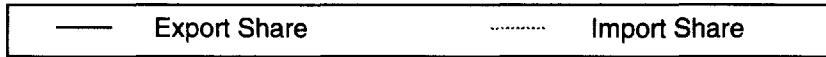
NET EXTERNAL ORIENTATION BY INDUSTRY, CANADA

1. Food & Beverages
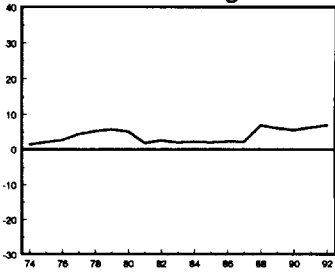
2. Tobacco
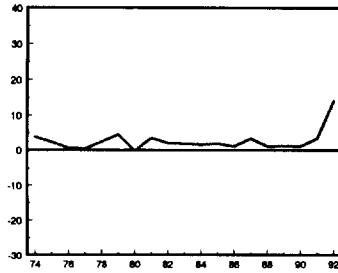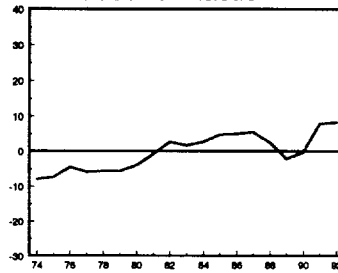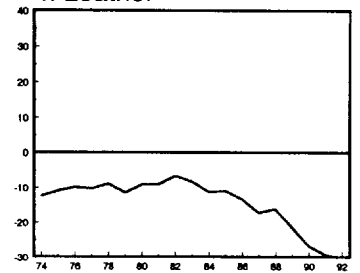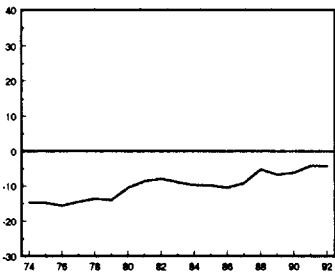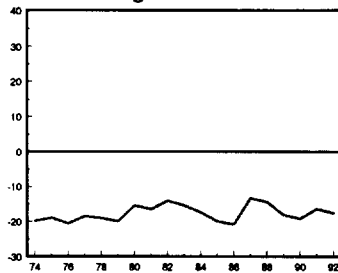
3. Rubber & Plastic

4. Leather

5. Textiles

6. Knitting Mills

8. Wood Industries
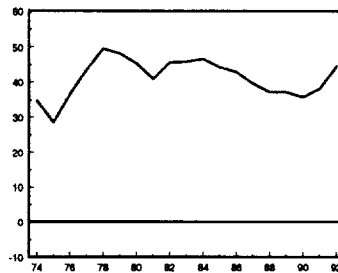
9. Furniture & Fixtures
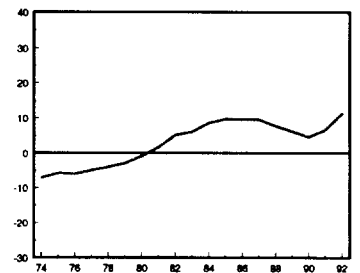
10. Paper & Allied Products
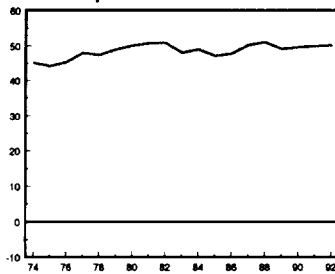
11. Printing & Publishing
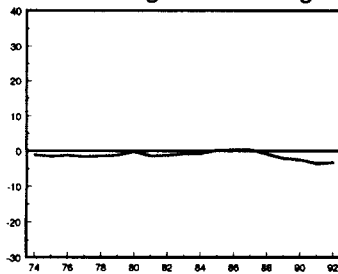
12. Primary Metals
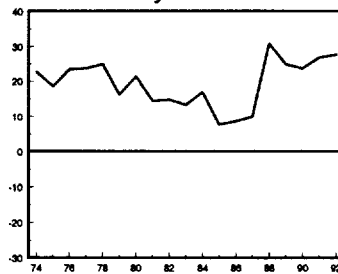
13. Fabricated Metals
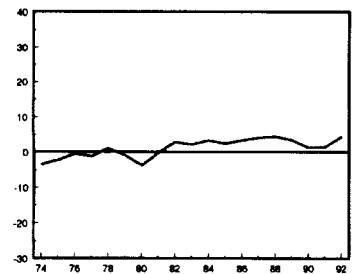
14. Machinery
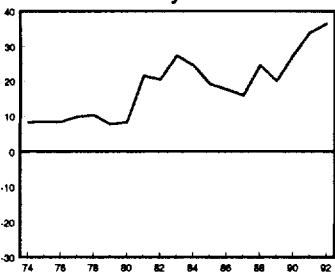
15. Transport Equip.
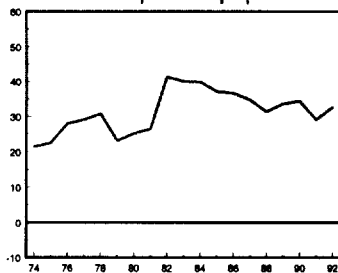
16. Electrical Products
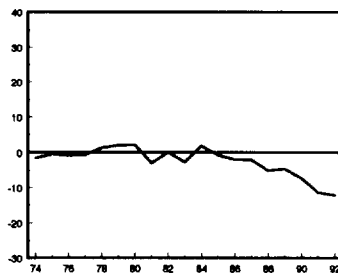
17. Non-Metallic Minerals
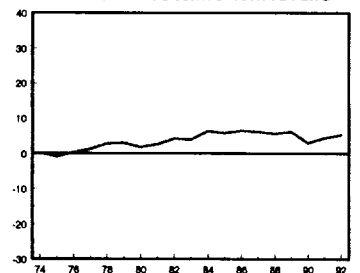
33. Petroleum & Coal
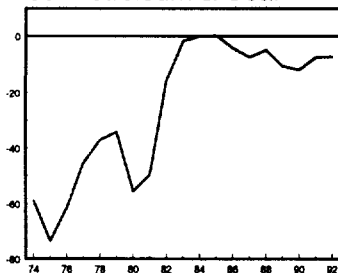
34. Chemical Industries
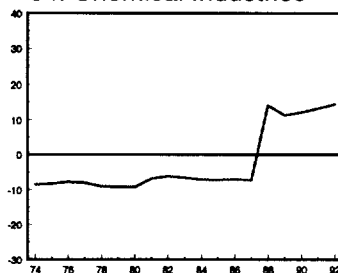
EXPORT AND IMPORT SHARE BY INDUSTRY, UNITED KINGDOM

| Export Share | .... Import Share |
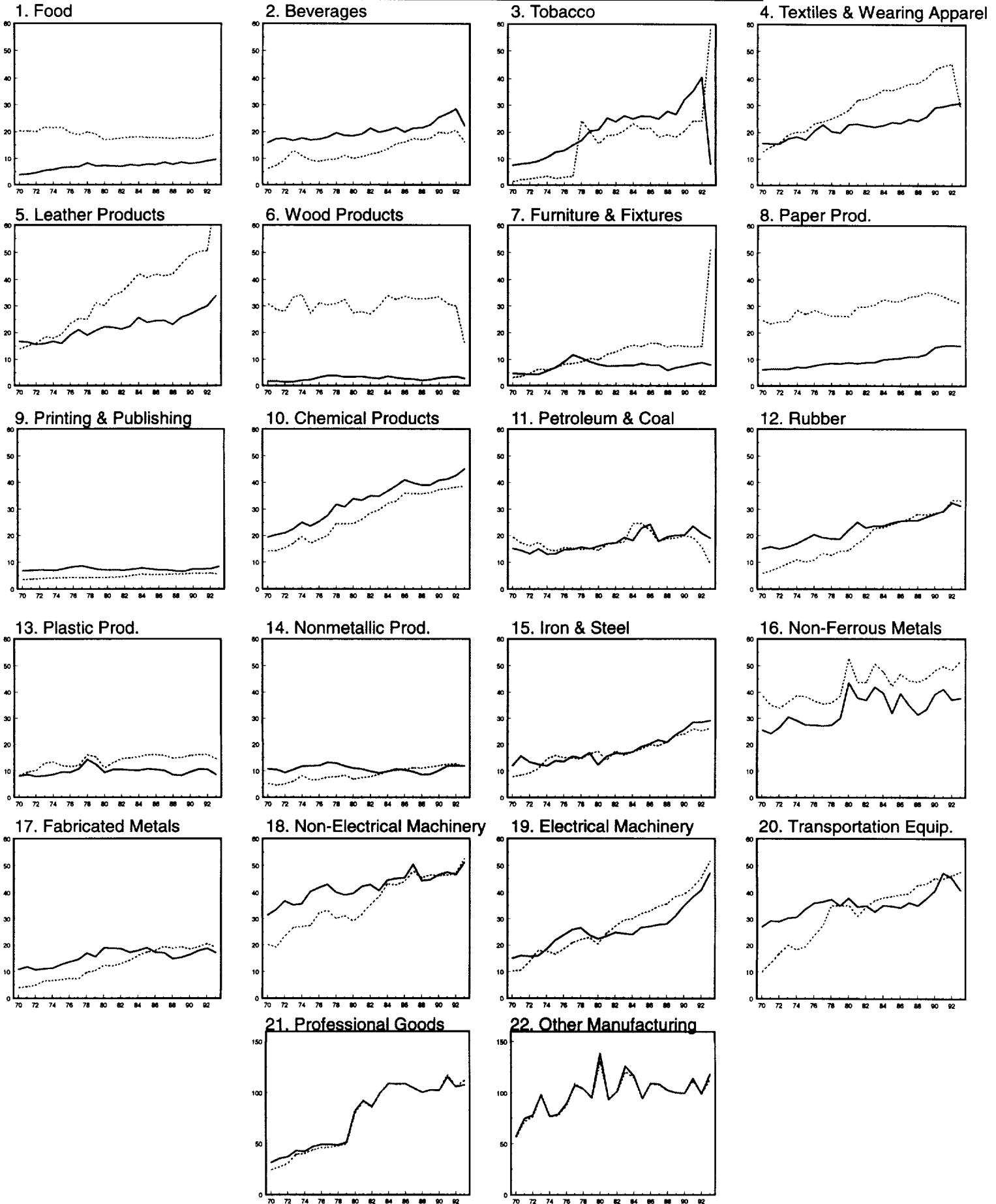
1. Food
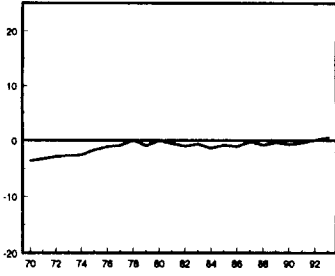
2. Beverages
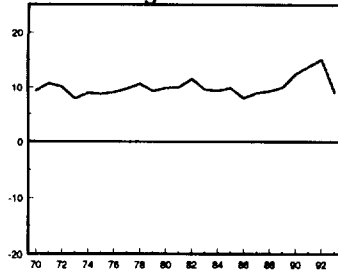
3. Tobacco
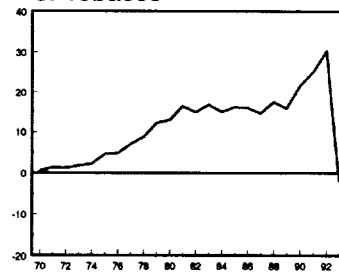
4. Textiles & Wearing Apparel
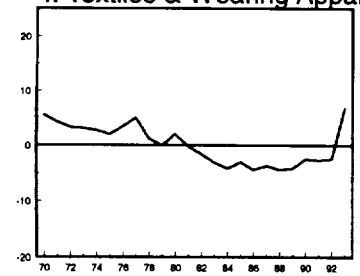
5. Leather Products
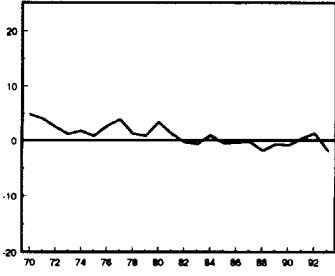
6. Wood Products
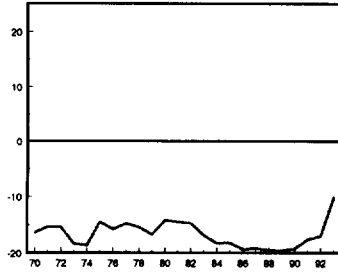
7. Furniture & Fixtures
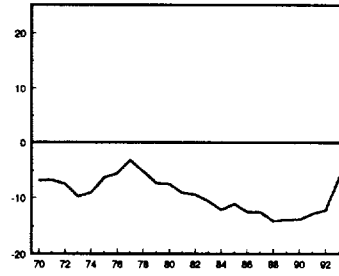
8. Paper Prod.
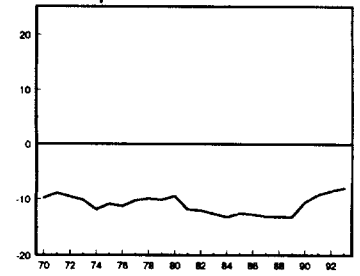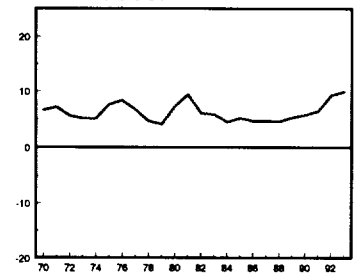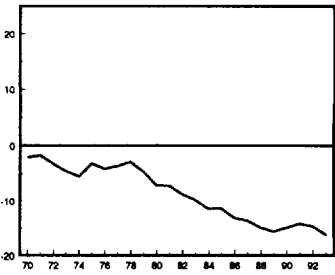

9. Printing & Publishing
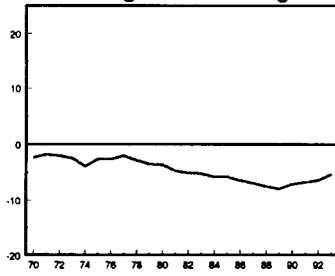
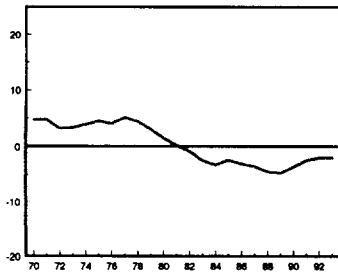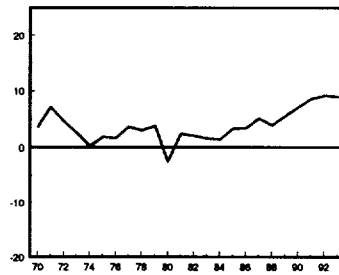### 10. Chemical Products
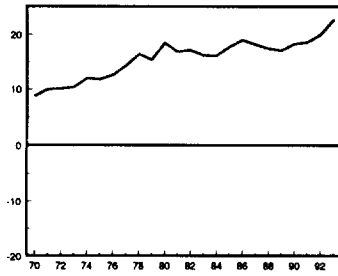
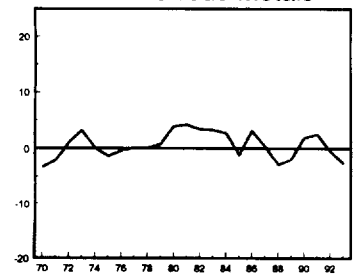### 11. Petroleum & Coal
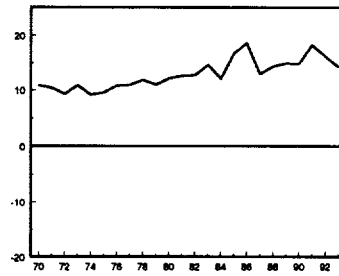
12. Rubber
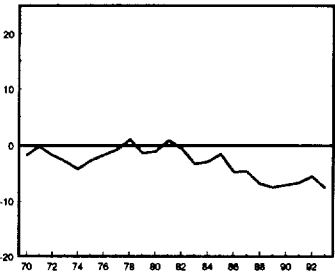

13. Plastic Prod.

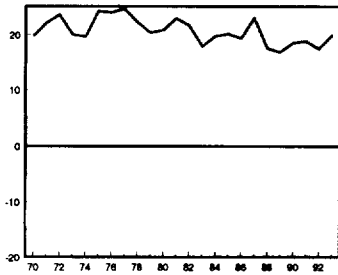### 14. Nonmetallic Prod.

15. Iron & Steel
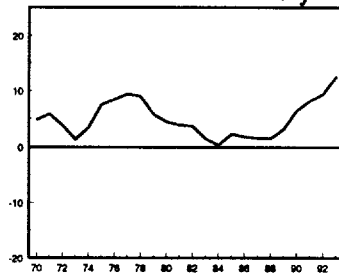

16. Non-Ferrous Metals
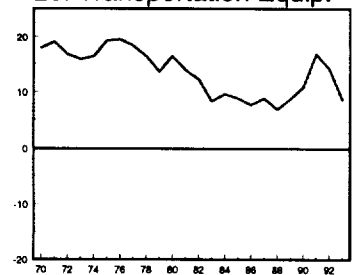

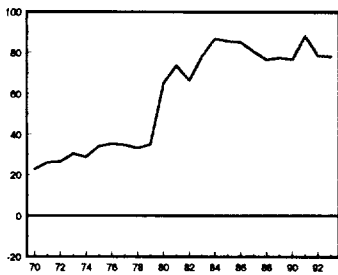### 17. Fabricated Metals

18. Non-Electrical Machinery

19. Electrical Machinery

20. Transportation Equip.

21. Professional Goods

22. Other Manufacturing

NET EXTERNAL ORIENTATION BY INDUSTRY, UNITED KINGDOM

EXPORT AND IMPORT SHARE BY INDUSTRY, JAPAN

| —— Export Share | ·········· Import Share |

1. Food & Beverages

2. Textile Mill Products

3. Lumber & Wood

4. Pulp & Paper Products

5. Chemicals

6. Petroleum & Coal

7. Leather & Rubber

8. Non-Metallic Products

9. Iron & Steel

10. Non-Ferrous Metals

11. Fabricated Metal Prod.

12. Ordinary Machinery

13. Electrical Machinery

33. Transportation Equip.

15. Instruments

16. Other Manufacturing

17. Printing & Publishing

NET EXTERNAL ORIENTATION BY INDUSTRY, JAPAN

1. Food & Beverages

2. Textile Mill Products

3. Lumber & Wood

4. Pulp & Paper Products

5. Chemicals

6. Petroleum & Coal

7. Leather & Rubber

8. Non-Metallic Products

9. Iron & Steel

10. Non-Ferrous Metals

11. Fabricated Metal Prod.

12. Ordinary Machinery

13. Electrical Machinery

33. Transportation Equip.

15. Instruments

16. Other Manufacturing

17. Printing & Publishing