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Toshihiro Okubo

University of Michigan

Institut Universitaire de Hautes Études Internationales, Genève 21, Suisse

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Toshihiro Okubo

University of Michigan, Ann Arbor, MI, 48104, USA

Institut Universitaire de Hautes Études Internationales, Genève 21, Suisse

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Address correspondence to:
Toshihiro Okubo: 611 Tappan St, Ann Arbor, MI, 48109, USA
E-mail: tokubo@umich.edu

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Abstract

This paper uses a Gravity Model to analyze the border effect in the Japanese market, which indicates how biased interregional trade is compared with international trade. The results suggest that the border effect in Japan is much lower than in the United States and Canada, and has declined year by year between 1960 and 1990. Possible reasons for the decline include the reduction of tariff rates and non-tariff barriers, the surge of foreign direct investment, and the appreciation of the yen.

Keywords: Gravity Model; Border effect; Interregional trade; International

trade

JEL Classification Number: F14, F17, R12

1. Introduction

Many economists believe that the border effect found in gravity regressions corresponds to a trade impediment. McCallum (1995) has found that inter-provincial trade in Canada is 22 times as large as Canada's international trade with the United States[1]. McCallum's findings were surprising to those who believe that free international trade would enhance a country's openness compared to its domestic trade. In this regard, Japan has often been singled out as being one of the most closed markets in the world[2]. If McCallum's findings were generally correct, one would expect to find that Japan would have a very sizable national border effect. In this paper, I use a gravity-model approach to investigate the extent to which a border effect exists in Japan and how this effect may have changed over time.

Anderson and van Wincoop (2003) found that relatively smaller economies have a higher border effect, while larger economies have lower effects. They analyzed border effects both in Canada and in United States. Anderson and van Wincoop found that Canada's

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1 McCallum (1995) does not include foreign trade with countries other than the United States. This may result in overestimated values of the border effect.

2 Lawrence (1987) suggested that the Japanese market is closed based on evidence of the lowest level of intra-industry trade compared to other developed countries, as measured by the Grubel-Lloyd index, as well as the low level of imports of manufactured goods.

border effect was around 16 (i.e. all things equal, Canadian provinces trade 16 times more with each other than with US states). This point estimate is smaller than McCallum's estimate, but still high. On the other hand, the U.S. border effect was 1.5, which reflects the relatively larger U.S. economy compared to Canada[3]. In the case of Japan, vis-à-vis all of its trading partners aggregated into 9 areas, Japan can be considered to be relatively small and should have border effects much like Canada. What is more, if the criticisms of Japan being closed are valid, this would also imply a large border effect.

There are two main classes of empirical studies of the national border effect using the gravity model. The first calculates it by comparing international and interregional trade, as McCallum has done. Helliwell (1996; 1998, Ch.2) has extended McCallum's research, using annual time-series data for the 1980s and 1990s. Helliwell concluded that inter-provincial (interregional) trade in Canada is around 20 times as large as the international trade between the United States and Canada, although this deviation diminished recently. Anderson and van Wincoop (2003) analyzed Canada and United States bilaterally by considering inter-provincial trade as well as inter-state trade and by considering 20 industrialized foreign

[3] Anderson and van Wincoop estimated a two- country model and a multi- country model, which includes 20 foreign industrialized countries. The border effects they focus on are between Canada and United States. Therefore, this small value, 1.5 times, cannot be directly used for comparison with Japan.

countries.

The second type of study estimates the border effect from the comparison between foreign trade and all transactions in a country, by using own-country sales data and not using the data on interregional trade. Wei (1996) analyzed home-country bias in the goods market among OECD countries from 1982 to 1994. He concluded that transactions in the home-country market were about 2.5 times as large as imports from foreign countries, but this home-country bias has been slowly but steadily declining in many countries. In particular, the home-country bias of countries in the European Union (EU) have declined by 50%[4]. Helliwell (1998, Ch.3) analyzed the OECD and developing countries. He concluded that the border effect in the OECD countries is around 10 whereas that of the developing countries is around 70 or 80. Also, he concluded that the border effects are smaller for more advanced countries like Korea. The common result of the foregoing two types of studies is that border effects exist, but have been reduced through time.

I propose to apply McCallum's method to Japan by focusing on Japan's interregional trade. I will examine the period from 1960 to 1990, and compare interregional trade with

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[4] Wei's analysis is limited because he conducts a country-level analysis rather than a region-level analysis, and he does not distinguish between interregional trade and intra-regional trade. Therefore, in my view, McCallum's treatment is more sensitive in estimating the border effect.

Japan's trade with all of its trading partners (thus, Japan is treated as a small economy). Finally I will consider some possible factors that may help to explain changes in Japan's border effect.

In what follows, section 2 discusses the data and methodology. Estimation results are provided in Section 3 and more refined results are presented in Section 4, which takes the border effect in Okinawa prefecture into account. In Section 5, I examine some of the factors that may help to explain the estimated changes in Japan's border effect. Conclusions are presented in Section 6.

2. Data and methodology

The data cover every 5 years from 1960 to 1990, from 8 regions in Japan: Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, and Kyushu, and 9 areas in the world[5]. The source of the data on interregional trade is MITI's Input-Output Tables of Interregional Relations, which are published every 5 years[6]. The GDP of the 9 areas in the world is the aggregated nominal GDP of the main trading partners included in the area, and the GDP for

[5] The reason for aggregating foreign countries into 9 areas is to avoid zero values of trade.

[6] I am grateful to Professor Kyoji Fukao (Hitostubashi Univ.) and Professor R.Helg(Bocconi Univ.) for providing these data.

the 8 regions in Japan is the aggregated GDP of each prefecture included in each region. Distance data in interregional trade are measured by the distance between the cities that have the largest total income in each region. Distance data in international trade are defined as the GDP weighted average of the distances from Tokyo to the capitals in countries in each region[7].

Some qualifications concerning the data should be noted. The most serious relates to data availability. That is, there are data on the total value of exports and imports in each region in Japan, as well as exports and imports between Japan and foreign countries. But data on exports and imports between each region in Japan and specific foreign countries are not available. To address this issue, I assume that inhabitants in each region have the same utility function, and that technology is same in all of the regions in Japan. Thus, data on exports and imports between each region in Japan and foreign countries are measured using the exports and imports in each region weighted by the export and import ratios between Japan and the area in the world[8].

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[7] This weighted average is also used in Anderson and Wincoop (2003).

[8] This assumption may be defended on the grounds that, Japan is a geographically confined island country and many companies have many firms and establishments in each region, so that the technology gap among regions is small. Also, because inhabitants move among regions easily and freely, differences in tastes may not be substantial.

A further concern is with the distance data, which is specific to the Gravity Model. That is, distance is measured without regard to differences in geographic characteristics and the differences of transportation-by ship, air, and land[9].

The gravity model used is the familiar log-linear-type function[10].

$$Log(Trade)=c+\alpha Log(GDP_e)+\beta Log(GDP_i)+\gamma Log(distance)+\delta dummy(Japan) \qquad (1)$$

GDP_e refers to the GDP of the region or area that exports goods, and GDP_i refers to the GDP of the region or area that imports goods. The Japan dummy relates to interregional trade. The dummy is set to unity for interregional trade and to zero for international trade. If the coefficient of the Japan dummy is positive and significant, a border effect exists and the interregional trade in Japan is more active than international trade[11].

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[9] In interregional trade, the products are transported by land as well as by sea. On the other hand, international trade is carried out mainly by sea. Since we can distinguish the methods of transportation for each type of trade, this difference will be absorbed in the border effect.

[10] See Tinbergen (1962).

[11] Helliwell (1998) inserted remoteness, which is presumed to reflect the distance of a country from its alternative trading partners (see Wei, 1996). However, because it is atheoretic, following Anderson and Wincoop (2003), I exclude remoteness.

3. Estimation and Analysis

Results

Table 1 shows the OLS results for all tradable goods. In all cases, the coefficients of the Japan dummies are significant and positive. The border effect, calculated in Table 2, reveals that in 1960 interregional trade was 8.57 (=exp2.15) times as large as international trade. In 1965 and 1970, it increased respectively to 8.85 and 10.38 times and fell thereafter to 3.41 in 1990. This result for 1990 corresponds to the 25.3 number for Canada in 1990, according to Helliwell (1998). It thus appears that Japan's border effect became shrank after 1970.

Table 3 presents the OLS results for manufactured goods. The coefficients of the Japan dummies are significant and positive in all of the cases. As noted in Table 4, in 1960, interregional trade was 60.76 times as large as international trade, which is obviously much greater than McCallum found for Canada. In 1965, it increased to 97.51 times. But from 1970 to 1990, the border effect fell remarkably to a level of 7.64 in 1990[12].

We can draw a number of conclusions from the previous results. First, because the coefficients of the Japan dummies are positive and significant in most of the cases, we know

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[12] Helliwell (1998, Ch 2) estimated border effects at the industry level for Canada and obtained rather sizable effects in several sectors.

that interregional trade in Japan is more intense than international trade. But interregional trade is much less in Japan relative to McCallum and Helliwell's findings for Canada. Also, even though Japan is treated as a small economy in this study, the border effect is much smaller than Canada (smaller economy), and is almost the same as the United Sates (larger economy). Second, Japan's border effect has been declining as the Japanese and world market have opened, despite earlier criticism that the Japanese has been closed. Finally, the Japan dummies on tradable goods are always much lower than those on manufactured goods. This implies that the interregional trade in manufactured goods includes large amounts of intra-firm trade and inter-firm trade as intermediate goods. Also the establishments and firms are dispersed in each region in Japan. These factors have increased Japan's interregional trade in manufactured goods. On the other hand, many agricultural and mineral products are directly imported from foreign countries, and some agricultural goods are produced near the cities in each region. These factors have led to an increase in the intensiveness of international trade in agricultural products and minerals[13].

[13] This is in contrast to Helliwell (1998, Ch.2), who found high border effects for several Canadian agricultural products. These higher values may result from the similarity of products between the United States and Canada, that is, a higher elasticity of substitution.

4. Some Additional Estimations for Robustness

In this section, I analyze the border effect in Okinawa prefecture. It will be noted that, in the preceding section, exports and imports between each region in Japan and foreign countries were measured using the value of exports and imports in each region weighted by the export and import ratios between Japan and the area in the world. Okinawa prefecture has been classified as the 9th region in the Input-Output Tables of Interregional Relations since 1975. Since Okinawa is an island that is geographically separated from the rest of Japan, its trade with Japan and foreign countries can be readily identified.

Thus, we can regress the trade to the other 8 regions in Japan and to about 40 foreign countries, unlike the former regressions using the aggregated 9 area data in the world. Distance data are from Naha, where the prefectural office is located, to the capital of foreign countries or to the city where the prefectural office is located in the prefecture that has the highest GDP in each region in Japan. The equation for this estimation is the same as equation (1) in section 2. Table 5 shows the results of the estimation. Interregional trade is, ceteris paribus, 4.7 times larger than international trade. This reinforces the previous results that the border effect in Japan is lower as compared to the Canada-U.S. case.

5. Factors Responsible for Japan's Declining Border Effect

This section analyzes why Japan's border effect has fallen since 1970. One possible explanation is that the reductions in Japan's tariff rates and non-tariff barriers have increased Japan's foreign trade and openness. Also, in the 1980s and 1990s, there were substantial increases in Japan's outward foreign direct investment (FDI). This has spurred trade in intermediate inputs with Japan, which also contributes to the decline in the border effect. The border effect may also reflect changes in the components of imports and exports, depending on the elasticity of substitution between tradable and domestic goods.

Change in Trade

The decline in Japan's tariffs especially after the 1960s is evident in Figure 1, and provides a reason for the relative expansion of Japan's external trade[14]. Evidence on re-imports in Figure 2 shows the importance of FDI particularly in the Asian countries[15].

Evans (2000) has pointed out that the border effect comes not only from trade barriers

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[14] Non-tariff barriers in Japan rather than tariff rate are often said to play a crucial role in trade policy. Furthermore, in considering the influence of tariff rates, we should conduct the analysis at the level of industries and goods, because tariff rates are different in goods and responsiveness to consumption and supply also varies by industries.

[15] Re-imports in Japan are defined as exports to Japan by the Japanese establishments and firms in foreign countries. Fukao and Chung(1997) concluded that Japan's FDI in Asia has encouraged re-imports and intermediate goods trade since around 1986. See also Wall (2002).

but is related to the elasticity of substitution between tradable goods and domestic goods. Figures 3 and 4 depict the changes in the components of Japan's imports and exports. Imports of machinery and equipment have increased, while imports of mineral fuels rose significantly for 1970-1980 and declined thereafter. Exports of machinery and equipment increased substantially from 1970 to 1990. It seems reasonable to assume that differentiated products like machinery and equipment have a lower elasticity of substitution compared to most raw materials except oil[16]. As relative prices have changed due to trade liberalization and FDI has increased especially to the Asian countries, the changes in the composition of Japan's trade may have led to a reduced border effect.

6. Conclusions

This paper has analyzed the border effect in Japan. While it has often been alleged in the past that Japan is one of the world's most closed markets, the results in this paper take issue with this allegation. I have shown in particular that: (1) the border effect in Japan is apparently considerably lower than in Canada and resembles the effect in the United States;

[16]Japan is largely dependent on crude oil from the Middle East. After the conversion from coal to oil in the 1970s, Japan's imports of oil have increased.

and (2) the border effect in Japan has declined remarkably between 1960 and 1990 due to trade liberalization.

Some further research that may help in explaining the change in Japan's border effect would be to analyze the changes in trade at the more disaggregated industry level.

Appendix

Components of Foreign Countries of 9 Areas in the World

This classification of countries is based on World Bank categories:

-**East Asia and Pacific**: South Korea, North Korea, China, Taiwan, Hong Kong, Thailand, Singapore, Malaysia, Vietnam (former North Vietnam), Philippines, Indonesia, Myanmar (former Burma), Australia, New Zealand

-**South Asia**: India, Pakistan, Sri Lanka (former Ceylon)

-**Middle East**: Iran, Iraq, Saudi Arabia, Kuwait, Israel

-**Eastern Europe and Central Asia**: Russia (former USSR)

-**Rest of Europe**: Sweden, UK, Netherlands, Belgium, France, Germany (former West German), Denmark, Switzerland, Spain, Italy

-**Americas**: Canada, US, Mexico, Guatemala, El Salvador, Nicaragua, Venezuela, Peru, Chile, Brazil, Argentina

-**East and South Africa**: South Africa, Zimbabwe, Zambia (former Rhodesia)

-**West Africa**: Liberia

-**North Africa**: Egypt (former United Arab Emirates)

Components of Prefectures of 9 Regions in Japan

This classification is based on Ministry of International Trade and Industry categories;

-**Hokkaido**

-**Tohoku**: Aomori, Akita, Yamagata, Iwate, Miyagi, Fukushima

-**Kanto**: Niigata, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, Yamanashi, Nagano, Shizuoka

-**Chubu**: Toyama, Aichi, Ishikawa, Gifu, Mie

-**Kinki**: Fukui Shiga, Osaka, Kyoto, Hyogo, Wakayama, Nara

-**Chugoku**: Okayama, Hiroshima, Shimane, Tottori, Yamaguchi

-**Shikoku**: Kagawa, Ehime, Kochi, Tokushima

-**Kyusyu**: Saga, Fukuoka, Oita, Nagasaki, Kumamoto, Miyazaki, Kagoshima

-**Okinawa** (1975-) (It was treated as a part of the rest of the world before 1975.)

Components of Foreign Countries in the Regression on Okinawa for 1990

Export Countries from Okinawa: Taiwan, Hong Kong, China, South Korea, US, Philippines, Thailand, Singapore, Malaysia, Indonesia, Myanmar, Pakistan, Iran, Belgium, France, Germany, Italy.

Import Countries to Okinawa: Taiwan, Hong Kong, China, South Korea, Thailand, Singapore, Malaysia, Philippines, Indonesia, Myanmar, Australia, New Zealand, Pakistan, Iran, Iraq, Saudi Arabia, Kuwait, Israel, Oman, Arab, Sweden, Finland, UK, Netherlands, Belgium, France, Germany, Denmark, Greek, Switzerland, Spain, Italy, Canada, US, Mexico, Venezuela, Brazil, Argentina, South Africa

Sources of Data

The data on interregional trade between regions in Japan are from *Input-Output Tables of Interregional Relations(1960-1990)* (Ministry of International Trade and Industry). Nominal GDP in foreign countries is from *World Bank Atlas* (World Bank). GDP in regions in Japan is calculated from *Kenmin Keizai Keisan Nenpou* (Economic Planning Agency). The data on international trade between Japan and foreign countries are from *Gaikoku Boueki Gaikyou* (Ministry of Finance). Foreign trade in Okinawa comes from *Okinawa Keizai Toukei Nenkan* (Okinawa-ken). GDP data are from *Development Indicators 1998* (World Bank).

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Table 1: Gravity Model OLS Results, including Japan Dummy for All Tradable Goods

Independent variables	1960	1965	1970	1975	1980	1985	1990
Constant	-3.48	-3.60	-5.77	-7.04	-11.77	-15.66	-22.35
	[-1.53]	[-1.55]	[-2.31]**	[-2.11]**	[-4.73]**	[-7.02]**	[-6.78]**
GDPe	0.64	0.61	0.69	0.99	0.95	1.01	1.46
	[12.77]**	[12.06]**	[12.06]**	[13.02]**	[14.481]**	[17.98]**	[17.52]**
GDPi	0.46	0.46	0.47	0.43	0.75	0.88	0.91
	[9.19]**	[9.07]**	[8.16]**	[5.69]**	[11.37]**	[15.76]**	[10.88]**
Distance	-0.53	-0.47	-0.35	-0.82	-0.73	-0.72	-1.00
	[-2.88]**	[-2.67]**	[-1.87]*	[-3.26]**	[-4.37]**	[-4.96]**	[-4.44]**
Japan	2.15	2.18	2.34	1.86	1.28	1.52	1.23
Dummy	[3.69]**	[3.86]**	[3.96]**	[2.40]**	[2.44]**	[3.32]**	[1.76]*
R-squared	0.70	0.67	0.67	0.68	0.72	0.81	0.77
Standard Error of Regression	1.16	1.12	1.30	1.68	1.15	1.00	1.56
Observations	200	200	200	200	200	200	200

[ ]: t-value ** represents significance at the 5% level. *represents significance at the 10% level

Table 2 Calculation of Border effect for All Tradable Goods

Border Effect (times) (=exp(the coefficient of Japan dummy))

	1960	1965	1970	1975	1980	1985	1990
Tradable	8.57	8.85	10.38	6.42	3.60	4.58	3.41

Table 3: Gravity Model OLS Results, including Japan Dummy for Manufactured Goods

Independent Variables	1960	1965	1970	1975	1980	1985	1990
Constant	-11.19	-12.43	-12.47	-11.28	-17.73	-22.6	-25.1
	[-2.97]**	[-3.01]**	[-4.47]**	[-3.70]**	[-7.12]**	[-9.20]**	[-8.98]**
GDPe	0.68	0.60	0.76	0.84	0.95	1.06	1.46
	[8.16]**	[6.65]**	[11.94]**	[12.13]**	[14.44]**	[17.14]**	[20.59]**
GDPi	0.69	0.71	0.61	0.57	0.92	1.08	0.95
	[8.28]**	[7.79]**	[9.49]**	[8.18]**	[14.01]**	[17.46]**	[13.38]**
Distance	-0.24	-0.03	-0.08	-0.28	-0.47	-0.51	-0.80
	[-0.79]	[-0.10]	[-0.36]	[-1.24]	[-2.79]**	[-3.16]**	[-4.18]**
Japan	4.11	4.58	3.84	2.82	2.56	2.78	2.02
Dummy	[4.28]**	[4.55]**	[5.84]**	[3.97]**	[4.87]**	[5.52]**	[3.42]**
R-squared	0.57	0.49	0.69	0.66	0.75	0.82	0.83
Standard Error of Regression	1.92	2.14	1.45	1.53	1.16	1.10	1.32
Observation	200	200	200	200	200	200	200

[ ]: t-value **represents significance at the 5% level, *represents significance at the 10% level.

Table 4 Calculation of Border Effect for Manufactured Goods

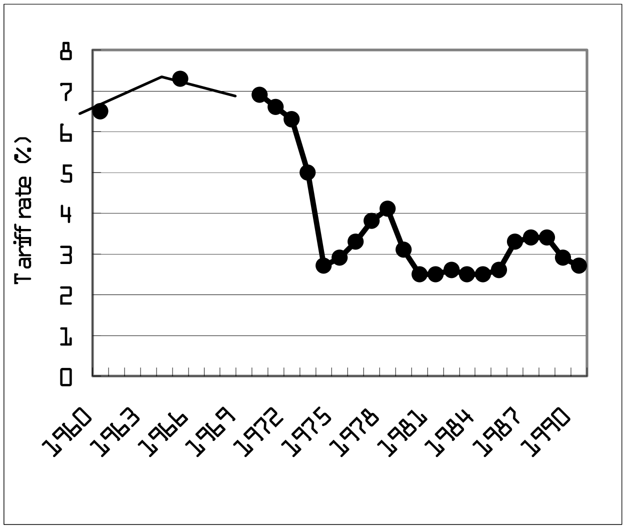
Border Effect (times) (=exp(the coefficient of Japan dummy))

	1960	1965	1970	1975	1980	1985	1990
Manufactured	60.76	97.51	46.45	16.80	12.96	16.17	7.46

Table 5 Estimated Gravity Model for Okinawa in 1990

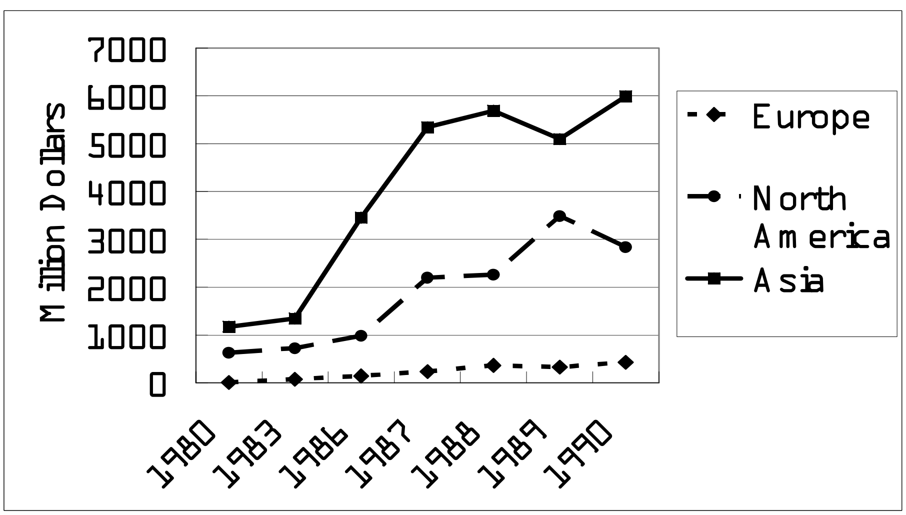
	1990
Constant	0.75
	[1.94]*
GDPe	0.75
	[3.60]**
GDPi	0.07
	[0.34]
Distance	-1.91
	[-6.05]**
Japan	1.55
Dummy	[2.17]**
R-squared	0.623
F-statistics	26.5
Observation	69
Border effect	4.71

Figure 1　Average Tariff Rate in Japan, 1960-1990



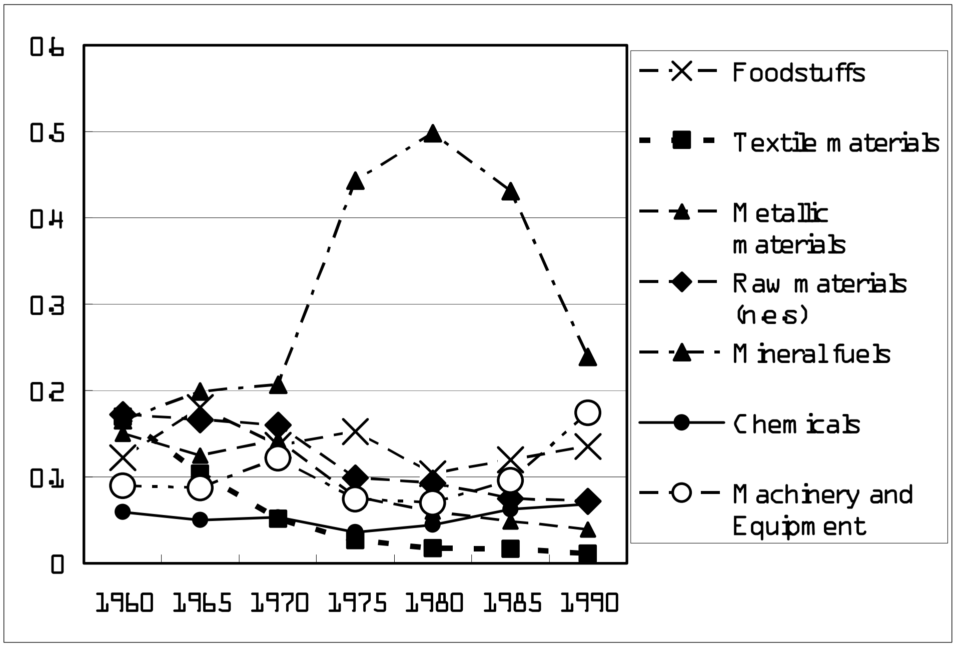
Source　*Nihon no Genkyou*　EPA

Figure 2　Re-imports to Japan by FDI, 1980 -1990



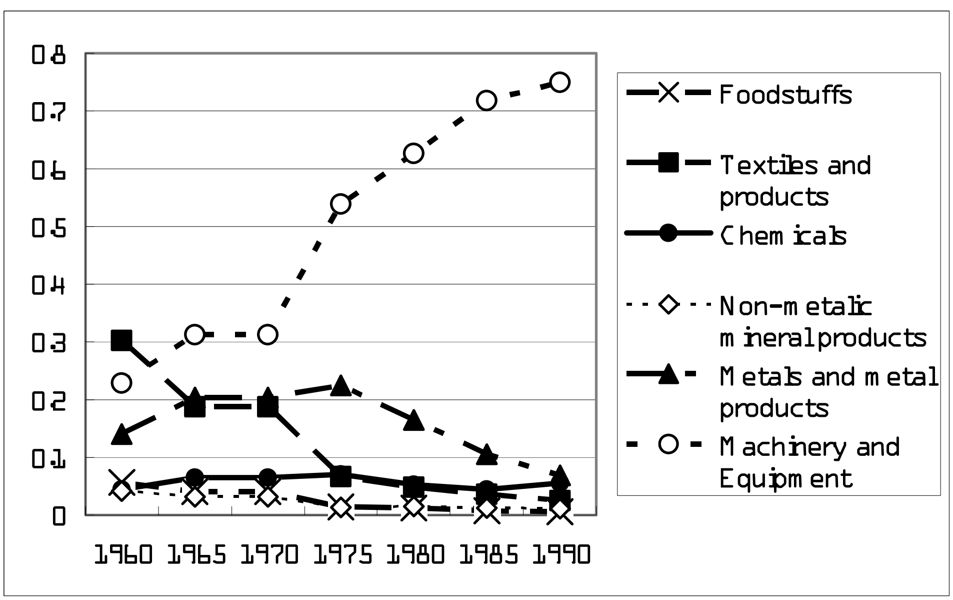
Source: *Kaigai Toushi Toukei Souran, Kaigai Jigyou Katsudou Doukou Tyousa* (MITI)

Figure 3 Commodity Import Ratios, 1960-1990



Source: *Gaikoku Boueki Gaikyou* (Ministry of Finance)

Figure 4 Commodity Export Ratios, 1960-1990



Source: *Gaikoku Boueki Gaikyou* (Ministry of Finance)