Chukyo University Institute of Economics

Discussion Paper Series

October 2012

No. 1206

INPUT-OUTPUT ANALYSIS OF THE INTERDEPENDENCE BETWEEN JAPAN AND CHINA THROUGH JAPANESE OVERSEAS PRODUCTION

MITSUO YAMADA
Chukyo University, Japan

INPUT-OUTPUT ANALYSIS OF THE INTERDEPENDENCE BETWEEN JAPAN AND CHINA THROUGH JAPANESE OVERSEAS PRODUCTION*

MITSUO YAMADA†

Chukyo University, Japan

Abstract

As is well known, China has been expanding for 30 years after opening up her economy and introducing market mechanisms to it. In that process, foreign direct investment has played an important role, and many foreign firms, including Japan, have located their plants and branches in China. These overseas productions alter the pattern of international trade between Japan and China. METI, Japan and the National Bureau of Statistics of China have cooperatively compiled a 2007 Japan-China International Input-Output table, with 77 sectors for each country. That table captures the latest interdependent structure between them. Using a METI Statistics "Survey of Overseas Business Activities," we reconstructed the table as one that extracts Japanese production activities from China. Here we used the micro data of about 3,600 establishments in these Survey Statistics. The table consists of Japan, China (minus Japanese subsidiaries), and Japanese subsidiary activities in China with 30 sectors for each. Using this recompiled input-output table, we discuss two topics. One is the regional contribution of value-added and imports against a one unit increase of final demand in the Japanese subsidiary sector. The other is a simulation analysis of the production shift from Japan to China.

Keywords: Overseas production; Production shift; Micro data; Input-output analysis

---

* This paper was presented at the 20th International Input-Output Conference, held in Bratislava, from 24th to 29th June 2012. We could use some micro data of the METI Overseas Business Survey Database on China for 2006 and 2007 for our study. We express our gratitude for their permission of database usage. This study is financially supported by a Grant-in-Aid for Scientific Research (C) of JSPS, Japan (No. 22530212).

† Address: Department of Economics, Chukyo University, 101-2 Yagoto-Honmachi, Showa-ku, Nagoya City 466-8666, Japan, Email: *yamada@mecl.chukyo-u.ac.jp*

Contents

1 INTRODUCTION

The globalization of economies has prompted firms in developed countries to expand their plants and branches to foreign countries, and to supply their products to countries worldwide. Their motives would include a considered reduction of production costs, a strengthening of competitive advantages, development of new markets, etc. International relocation of production plans introduces segmentation and internationalization of the production process, in which international trade within firms or industries plays an important role.

Figure 1 shows Japanese foreign direct investment and regional shares of her overseas production in 2007. Because the yen gradually appreciated in relation to the dollar in the latter half of the 1980s, Japanese firms started moving their plants and branches abroad to the US, Europe, and Asian countries, especially China.

On the other hand, the Chinese economy has been continuously growing after the introduction of market mechanisms into its own economy. Foreign direct investment from abroad played an important role in this expansion. Figure 2 shows the trend of foreign direct investment in China after 1985, and the shares of investing countries in 2007. Though the FDI ratio to GDP has been declining after the peak of 1994, its values are still growing. The largest investment region is Hong Kong, at 38 percent, with the investments from Asian countries being more than half, while Japan's

investment in China was about 5 percent.

The economic interdependence between Japan and China has been strengthened more and more through international trade and direct investment. The Japan-China Input Output Tables are one of the important tools used to investigate such relations. Here we will focus on the production activities of Japanese subsidiaries in China, and investigate the role of Japanese firms in the economic relation between Japan and China, revising the Japan-China International Input-Output Table to include production activities of Japanese subsidiaries in China as distinct sectors.

FIGURE 1.

FIGURE 2.

The basic idea of revising an international input-output table to include Japanese overseas activities as distinct sectors was proposed in Yamada (2001), and Yamada (2002). In those papers, using the 1995 Japan-US International Input-Output Table of METI, we investigated the impact analysis of Japanese overseas production in the US on the Japanese economy. METI (2005) applied this analytical framework to their research using the 2000 Japan-US International Input-Output Table. Yamada (2004, 2006, 2007) produced a comparative analysis of the overseas production activities of Japanese subsidiaries in the US and Asia, using the 1995 and 2000 IDE Asia International Input-Output Tables. Teng Jiang and Fang Wenhui (2008) applied a somewhat similar analytical framework to Japan-China relations, using 1995 and 2000 Japan-China International Input-Output Tables. This paper does the same using the following two characteristics: to apply the latest economic structures of the 2007 Japan-China International Input-Output Table, and to use the micro data of the Basic Survey of Overseas Business Activities, METI, Japan[1].

In the next section, we discuss the theoretical framework of a revised Japan-China International Input-Output Analysis on Japanese Overseas Production. In the third

[1] Our model, focusing on the overseas production of Japanese firms, differs from the enterprise input output model as Albino, Dietzenbacher, and Kühtz (2003), Marangoni, Colombo, and Fezzi (2004), and Matsumoto and Fujimoto (2008).

section, the method used to reconstruct the input-output table for the analysis will be explained briefly. Value-added and imports, that are induced by a one unit of final demand, are analyzed in section 4. Some simulation analysis on the production shift of Japanese firms from Japan and China are examined in the following sections. Brief concluding comments appear last.

2 THEORETICAL MODEL

A typical international input-output table of two countries is expressed as Table 1. Here, the suffix "j" means Japan, and the suffix "c" China. Vector $\mathbf{x}_i$ means output of the i-th country, and matrix $\mathbf{X}_{ij}$ is an intermediate input matrix, showing the input of i-th country's products in j-th country's activities. Vector $\mathbf{F}_{ij}$ indicates a final demand of the i-th country's products in the j-th country. Vectors $\mathbf{E}_i$ and $\mathbf{M}_i$ mean the export and import of the i-th country's products to the rest of the world (ROW), respectively.

Here we focus on Japanese overseas production in China. Those activities are included in the Chinese transactions. Thus, output vector $\mathbf{x}_c$ can be divided into two vectors; $\mathbf{x}_2$ for non-Japanese subsidiaries and $\mathbf{x}_3$ for Japanese subsidiaries. Intermediate input matrices, final demand vectors, and export vectors of China can also be separated into the production activities of Japanese subsidiaries and others. When we treat Japanese subsidiaries in China as separate activities and express the suffix 1 for Japan, the suffix 2 for China without Japanese subsidiaries, and suffix 3 for Japanese subsidiaries in China, the input-output table in Table 1 is revised as Table 2.

TABLE 1.

TABLE 2.

In Table 2, $\mathbf{X}_{i3}$ shows the intermediate input of Japanese subsidiaries from each country or region. Some inputs are imported from Japan, some are obtained from the local market in China, and some are from the ROW. $\mathbf{F}_{i3}$ designates the investments of Japanese subsidiaries in China. In those investments, some machines are imported

from Japan, while others are obtained in China or from the ROW.

Our purpose is to recompile the input-output table in Table 1 to that in Table 2, using the METI survey database. However, though total investment of Japanese subsidiaries in China can be estimated, it is difficult to subdivide the total value into each product. We have scant information on how much investment is obtained from each region; Japan, China, and the ROW. Thus, we have to concentrate our attention to the input structure of Japanese subsidiaries in China, shown as Table 3, where there is no separation in the final demand of Japanese subsidiaries.

TABLE 3.

The input-output model for table 3 is expressed as follows,

$$\begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix} = \begin{bmatrix} \mathbf{A}_{11} & \mathbf{A}_{12} & \mathbf{A}_{13} \\ \mathbf{A}_{21} & \mathbf{A}_{22} & \mathbf{A}_{23} \\ \mathbf{A}_{31} & \mathbf{A}_{32} & \mathbf{A}_{33} \end{bmatrix} \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix} + \begin{bmatrix} \mathbf{F}_{11} \\ \mathbf{F}_{21} \\ \mathbf{F}_{31} \end{bmatrix} + \begin{bmatrix} \mathbf{F}_{12} \\ \mathbf{F}_{22} \\ \mathbf{F}_{32} \end{bmatrix} + \begin{bmatrix} \mathbf{E}_1 \\ \mathbf{E}_2 \\ \mathbf{E}_3 \end{bmatrix} \quad (1),$$

where matrix $\mathbf{A}_{ij}$ means input coefficient matrix of the j-th country on the i-th country's product. Solving the equation (1), we obtain the output determined by final demands as equation (2):

$$\begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix} = \begin{bmatrix} \mathbf{B}_{11} & \mathbf{B}_{12} & \mathbf{B}_{13} \\ \mathbf{B}_{21} & \mathbf{B}_{22} & \mathbf{B}_{23} \\ \mathbf{B}_{31} & \mathbf{B}_{32} & \mathbf{B}_{33} \end{bmatrix} \left(\begin{bmatrix} \mathbf{F}_{11} \\ \mathbf{F}_{21} \\ \mathbf{F}_{31} \end{bmatrix} + \begin{bmatrix} \mathbf{F}_{12} \\ \mathbf{F}_{22} \\ \mathbf{F}_{32} \end{bmatrix} + \begin{bmatrix} \mathbf{E}_1 \\ \mathbf{E}_2 \\ \mathbf{E}_3 \end{bmatrix} \right) \quad (2).$$

In this equation, matrix $\mathbf{B}_{ij}$ is the Leontief inverse matrix. Multiplying the value-added coefficient matrix $\hat{\mathbf{V}}_i$ and the import coefficient matrix $\mathbf{A}_{4j}$ to the output vector, the corresponding value-added vectors and import vectors are reduced, respectively.

$$\begin{aligned} \begin{bmatrix} \mathbf{V}_1 \\ \mathbf{V}_2 \\ \mathbf{V}_3 \end{bmatrix} &= \begin{bmatrix} \hat{\mathbf{V}}_1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{V}}_2 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{V}}_3 \end{bmatrix} \begin{bmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \end{bmatrix} \\ &= \begin{bmatrix} \hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13} \\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23} \\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33} \end{bmatrix} \left(\begin{bmatrix} \mathbf{F}_{11} \\ \mathbf{F}_{21} \\ \mathbf{F}_{31} \end{bmatrix} + \begin{bmatrix} \mathbf{F}_{12} \\ \mathbf{F}_{22} \\ \mathbf{F}_{33} \end{bmatrix} + \begin{bmatrix} \mathbf{E}_1 \\ \mathbf{E}_2 \\ \mathbf{E}_3 \end{bmatrix} \right) \end{aligned} \quad (3),$$

$$\begin{bmatrix}\mathbf{M}_1\\ \mathbf{M}_2\\ \mathbf{M}_3\end{bmatrix}=\begin{bmatrix}\mathbf{A}_{41} & \mathbf{0} & \mathbf{0}\\ \mathbf{0} & \mathbf{A}_{42} & \mathbf{0}\\ \mathbf{0} & \mathbf{0} & \mathbf{A}_{43}\end{bmatrix}\begin{bmatrix}\mathbf{x}_1\\ \mathbf{x}_2\\ \mathbf{x}_3\end{bmatrix}$$
$$=\begin{bmatrix}\mathbf{A}_{41}\mathbf{B}_{11} & \mathbf{A}_{41}\mathbf{B}_{12} & \mathbf{A}_{41}\mathbf{B}_{13}\\ \mathbf{A}_{42}\mathbf{B}_{21} & \mathbf{A}_{42}\mathbf{B}_{22} & \mathbf{A}_{42}\mathbf{B}_{23}\\ \mathbf{A}_{43}\mathbf{B}_{31} & \mathbf{A}_{43}\mathbf{B}_{32} & \mathbf{A}_{43}\mathbf{B}_{33}\end{bmatrix}\left[\begin{bmatrix}\mathbf{F}_{11}\\ \mathbf{F}_{21}\\ \mathbf{F}_{31}\end{bmatrix}+\begin{bmatrix}\mathbf{F}_{12}\\ \mathbf{F}_{22}\\ \mathbf{F}_{33}\end{bmatrix}+\begin{bmatrix}\mathbf{E}_1\\ \mathbf{E}_2\\ \mathbf{E}_3\end{bmatrix}\right] \quad (4).$$

Here, the sum of the value-added and import demands induced by some independent change in the final demand equals the value of the total change. We can evaluate the contributions of each region in terms of the induced value-added and import demands.

Furthermore, $\mathbf{F}_{31}$, $\mathbf{F}_{32}$, $\mathbf{E}_3$ exhibits the export to Japan of final goods produced by Japanese subsidiaries, the sales of final goods by Japanese subsidiaries to Chinese local markets, and the export to the ROW, respectively. If we set all other final demands as zero in equations (2), (3), and (4), we are able to acquire the output, the value-added, and the import demands that are induced by the final goods produced by Japanese subsidiaries.

$$\begin{bmatrix}\mathbf{x}_1\\ \mathbf{x}_2\\ \mathbf{x}_3\end{bmatrix}=\begin{bmatrix}\mathbf{B}_{11} & \mathbf{B}_{12} & \mathbf{B}_{13}\\ \mathbf{B}_{21} & \mathbf{B}_{22} & \mathbf{B}_{23}\\ \mathbf{B}_{31} & \mathbf{B}_{32} & \mathbf{B}_{33}\end{bmatrix}\left[\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{31}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{32}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{E}_3\end{bmatrix}\right],$$

$$\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\\ \mathbf{V}_3\end{bmatrix}=\begin{bmatrix}\hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13}\\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23}\\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33}\end{bmatrix}\left[\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{31}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{33}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{E}_{31}\end{bmatrix}\right],$$

$$\begin{bmatrix}\mathbf{M}_1\\ \mathbf{M}_2\\ \mathbf{M}_3\end{bmatrix}=\begin{bmatrix}\mathbf{A}_{41}\mathbf{B}_{11} & \mathbf{A}_{41}\mathbf{B}_{12} & \mathbf{A}_{41}\mathbf{B}_{13}\\ \mathbf{A}_{42}\mathbf{B}_{21} & \mathbf{A}_{42}\mathbf{B}_{22} & \mathbf{A}_{42}\mathbf{B}_{23}\\ \mathbf{A}_{43}\mathbf{B}_{31} & \mathbf{A}_{43}\mathbf{B}_{32} & \mathbf{A}_{43}\mathbf{B}_{33}\end{bmatrix}\left[\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{31}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{F}_{33}\end{bmatrix}+\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{E}_{31}\end{bmatrix}\right].$$

On the other hand, in equation (2), the final goods produced in Japan are comprised of three parts; a demand of domestic markets in Japan $\mathbf{F}_{11}$, exports to China $\mathbf{F}_{12}$, and exports to ROW $\mathbf{E}_1$. Any change to these three parts affects not only the Japanese production but also the production in China, as well as Japanese subsidiaries. Such impacts on value-added, directly and indirectly, are evaluated from the following equation,

$$\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\\ \mathbf{V}_3\end{bmatrix}=\begin{bmatrix}\hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13}\\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23}\\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33}\end{bmatrix}\begin{bmatrix}\mathbf{e}_1\\ \mathbf{0}\\ \mathbf{0}\end{bmatrix} \qquad (5),$$

where $\mathbf{e}_1$ shows a one-unit change of some sectors in Japan.

Similarly, expressing a one-unit change of some sectors in China, and Japanese subsidiaries as $\mathbf{e}_2$ and $\mathbf{e}_3$, respectively, we can evaluate the effects on value-added as the follows,

$$\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\\ \mathbf{V}_3\end{bmatrix}=\begin{bmatrix}\hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13}\\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23}\\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33}\end{bmatrix}\begin{bmatrix}\mathbf{0}\\ \mathbf{e}_2\\ \mathbf{0}\end{bmatrix} \qquad (6),$$

$$\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\\ \mathbf{V}_3\end{bmatrix}=\begin{bmatrix}\hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13}\\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23}\\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33}\end{bmatrix}\begin{bmatrix}\mathbf{0}\\ \mathbf{0}\\ \mathbf{e}_3\end{bmatrix} \qquad (7).$$

Here we obtain the effect of a production shift by Japanese firms to China, reducing one unit of final demand in Japan, and increasing one unit of final demand in the corresponding sector of a Japanese subsidiary in China.

$$\begin{bmatrix}\mathbf{V}_1\\ \mathbf{V}_2\\ \mathbf{V}_3\end{bmatrix}=\begin{bmatrix}\hat{\mathbf{V}}_1\mathbf{B}_{11} & \hat{\mathbf{V}}_1\mathbf{B}_{12} & \hat{\mathbf{V}}_1\mathbf{B}_{13}\\ \hat{\mathbf{V}}_2\mathbf{B}_{21} & \hat{\mathbf{V}}_2\mathbf{B}_{22} & \hat{\mathbf{V}}_2\mathbf{B}_{23}\\ \hat{\mathbf{V}}_3\mathbf{B}_{31} & \hat{\mathbf{V}}_3\mathbf{B}_{32} & \hat{\mathbf{V}}_3\mathbf{B}_{33}\end{bmatrix}\begin{bmatrix}-\mathbf{e}_1\\ \mathbf{0}\\ \mathbf{e}_3\end{bmatrix} \qquad (8).$$

Here the production shifts of Japanese firms to China include the following cases: (1) the case in which Japanese firms change domestically supplied final goods to import goods produced in China, (2) the case in which they change the exported goods from Japan to local production in China, and (3) the case in which they change the final goods, which are exported from Japan to world markets such as the US, to those that they produce in China and export to third markets.

On the other hand, the final goods that are produced in Japan might be substituted by those that are produced by Chinese firms. Such an effect is calculated as follows:

$$\begin{bmatrix} \mathbf{V}_1 \\ \mathbf{V}_2 \\ \mathbf{V}_3 \end{bmatrix} = \begin{bmatrix} \hat{\mathbf{V}}_1 & \mathbf{0} & \mathbf{0} \\ \mathbf{0} & \hat{\mathbf{V}}_2 & \mathbf{0} \\ \mathbf{0} & \mathbf{0} & \hat{\mathbf{V}}_3 \end{bmatrix} \begin{bmatrix} \mathbf{B}_{11} & \mathbf{B}_{12} & \mathbf{B}_{13} \\ \mathbf{B}_{21} & \mathbf{B}_{22} & \mathbf{B}_{23} \\ \mathbf{B}_{31} & \mathbf{B}_{32} & \mathbf{B}_{33} \end{bmatrix} \begin{bmatrix} -\mathbf{e}_1 \\ \mathbf{e}_2 \\ \mathbf{0} \end{bmatrix} \quad (9).$$

Here the following cases are considered: (1) the case where the final goods produced in Japan are replaced by import goods from Chinese firms, (2) the case in which the final goods exported from Japan to China are substituted by the local goods of Chinese firms, and (3) the case where the exported goods from Japan to the world market are replaced by those of Chinese firms.

3 RECONSTRUCTION OF JAPAN-CHINA INTERNATIONAL INPUT-OUTPUT TABLE

In this section, we discuss the method used to reconstruct an input-output table suitable to treat Japanese overseas production as an explicit sector. Table 4 shows the relation between the original input-output table in Table 1 and the modified table in Table 3. Here, the values of the shaded area have to be estimated in some way. Comparing each definition of sectors between the 2007 Japan-China International Input-Output Table and the Survey of Overseas Business Activities of METI, we first compiled the input-output table from 77 sectors to 63 sectors. Then, applying the information of the METI survey micro data on sales and procurement of Japanese subsidiaries in China, we reconstructed the table[2].

TABLE 4.

From the METI survey database, we were able to acquire the following information.

[2] Sample sizes for China (mainland) are 3521 and 3781 for the 2006 and 2007 Overseas Business Surveys, METI, respectively. Survey data are fiscal years. Among them we chose the 3332 and 3648 samples, respectively, omitting the data that lack information on sales values. We calculated, for each year, the sales and purchasing of intermediate goods by region for 63 sectors. There are differences in sample sizes by sector for two years. So we calculated the sales and purchasing values of calendar years as a weight average of two year values, after adjusting the size of 2006 to suit that of 2007.

First, we regarded the sales values for each sector of a Japanese subsidiary as product values, $\mathbf{X_3}$, ignoring the change of inventory[3]. Then we obtained the output of non-Japanese subsidiaries in China, $\mathbf{X_2}$, by subtracting the output of Japanese subsidiary, $\mathbf{X_3}$ from Chinese output, $\mathbf{X_c}$.

Assuming the ratio of the purchase values of intermediate goods to total sales values to be equal to the intermediate input ratio, we were able to estimate the total value of the intermediate input for each sector of a Japanese subsidiary. That was equal to the total value of column-sums of $\mathbf{X_{13}}$, $\mathbf{X_{23}}$, $\mathbf{X_{33}}$, and $\mathbf{X_{43}}$ for each sector. We obtained the column sum of the value-added, $\mathbf{V_3}$, subtracting the sum of each intermediate input from the output value, $\mathbf{X_3}$.

We were then able to acquire each sectoral input value from Japan, China, and the ROW, multiplying the regional purchasing ratio (which is calculated from the METI survey database), to the total intermediate input values by sector. They are the column-sums of $\mathbf{X_{13}}$, $\mathbf{X_{c3}}$, $\mathbf{X_{43}}$, respectively. From the METI database, we were able to obtain more detailed information on the purchasing of intermediate input goods from Japanese or non-Japanese firm[4]. Using that information, we could divide the total purchasing value in China, $\mathbf{X_{c3}}$, into two parts; one from Japanese subsidiaries, which is the column-sum of $\mathbf{X_{33}}$, and the other from non-Japanese firms, *i.e.* the column-sum of $\mathbf{X_{23}}$.

To estimate each cell value of the input structure, we needed more detailed information. Thus, we used the elements of the actual input vector as reference indices to share the total value into each cell value. For example, each cell value of $\mathbf{X_{13}}$ was obtained by multiplying the column share $a_{jc}/\sum_j a_{jc}$ of $\mathbf{X_{jc}}$, which we had already estimated, to the column sum of $\mathbf{X_{13}}$. Similarly, each cell value of $\mathbf{X_{43}}$ was calculated by multiplying the column share $a_{wc}/\sum_w a_{wc}$ of $\mathbf{X_{wc}}$, which was also already estimated, to the column sum of $\mathbf{X_{43}}$.

---

[3] The difference between sales and products is a change in inventory of products. However, since we were unable to acquire the information of the inventory on Japanese subsidiaries. We adopted the assumption that there was no change in inventory, which stated that sales value was equal to product value. However, for the "Wholesale and retail trades" sector, we established the product value as the difference between the sales value and purchasing goods.

[4] This ratio is also the value for the 2009 survey data. Thus, we applied similar modification as we used for the ratio sold for Japanese subsidiaries.

Returning to the row-wise aspect of demand-supply, we were able to acquire regional sales shares[5] by sector from the METI survey database. Using those shares, we estimated the regional sales values to Japan, China, and the ROW, which corresponded to the row-sum values of ($\mathbf{X}_{31}$ and $\mathbf{F}_{31}$), ($\mathbf{X}_{c3}$ and $\mathbf{F}_{32}$), and $\mathbf{E}_{3}$, respectively. The METI database gave us the information on how much the share of intermediate goods to the total output for each sector[6] was. We could then divide the sum value of ($\mathbf{X}_{31}$ and $\mathbf{F}_{31}$) into the sum of the intermediate demand $\mathbf{X}_{31}$ and the sum of the final demand $\mathbf{F}_{31}$. Similarly, for the sales in China, we could set separate values for $\mathbf{X}_{c3}$ and $\mathbf{F}_{32}$. Further information on how much Japanese subsidiaries sell to other Japanese subsidiaries in China by sector was available from the METI database[7]. Thus here we used these sales ratios to separate the row-sum values of $\mathbf{X}_{32}$ and $\mathbf{X}_{33}$ from the row-sum values of $\mathbf{X}_{c3}$ by sector.

We calculated the value for each cell of $\mathbf{X}_{31}$ by assuming that the export pattern of intermediate goods from China to Japan showed no difference between Japanese subsidiaries and the other firms. Also, the values for each cell of final goods $\mathbf{F}_{31}$, $\mathbf{F}_{32}$ were determined by assuming that the shares of consumption and investment were the same for any suppliers, whether Japanese subsidiaries or the other firms[8]. For $\mathbf{X}_{33}$, which is the transaction matrix of intermediate goods between Japanese subsidiaries in China, both the column-sum and the row-sum were independently estimated for

---

5 There are firms that do not fill sales values by regions, but that answer the value for total sales. We have calculated the regional sales ratio by excluding such firms.

6 The information of "the share of intermediate goods and final goods among sales" is obtained only after 2008 survey. We applied the METI for us to use micro data of 2008 and 2009 surveys. However, we were not able to obtain permission, so we had to use published data from the 2008 and 2009 survey reports. Two problems must be improved. First, these data are more aggregated by sector than that we defined. So we used these data with some modifications. Second, the published data on the share of intermediate goods and final goods show those of firms that produce mainly intermediate goods or final goods. We had better use these shares as weighted value with the product values as the weight, which are only possible by using the micro data.

7 "Sales to Japanese subsidiaries in China" were newly added as an item in the 2009 questionnaire. This information is very important for estimating the transaction among Japanese subsidiaries in China. Unfortunately, we were not able to acquire permission to use the micro data of 2009 survey in spite of our application. So we had to use the officially aggregated data in the 2009 survey report with the same modifications.

8 The final demand parts, consumption and investment, of Japanese subsidiary sectors were shared by using actual consumption and investment in Japan and China. The change in inventory was assumed to be zero for each sector with some exceptions. The final demand parts of non-Japanese firms were obtained by subtracting the estimated value of the Japanese subsidiaries from the value in China.

each sector. So we applied the RAS method[9] to acquire the cell values of the matrix, with the corresponding input coefficients of the original input-output table as initial values, after arranging both sum values so that their sum is equal to their average.

The intermediate transaction matrices of non-Japanese firms in China, $\mathbf{X}_{21}$, $\mathbf{X}_{33}$, and $\mathbf{X}_{33}$ were obtained by subtraction of Japanese subsidiaries' values from Chinese values for each corresponding matrix just as $\mathbf{X}_{21}=\mathbf{X}_{cj}-\mathbf{X}_{31}$. However, since such an estimation gives inconsistent values in some sectors, we made some modifications. For example, for imports of Japan from Japanese subsidiaries, we did not use the METI survey's shares but the actual import shares in the original input output table.

For each value-added sector, we estimated the sectoral compensation of employees by multiplying the ratio of the total salary of employees to the sales values from the METI survey database to the corresponding output value. The information on depreciation and indirect tax and subsidies was not available, so we estimated them by the actual ratio-to-output value for the corresponding sectors in China. The business surplus was estimated as the residual of the value-added sectors, by subtracting the item values cited above.

The reconstructed Japan-China input output tables, transactions and input coefficients, are shown in Table 5, where all sectors are aggregated to one for each region. The transaction flows, output and value-added, appear in Figure 3, where the output of Japan amounts to 8,190.0 billion US dollars, and the value-added was 4,197.4 billion US dollars. The exports from Japan to China except for Japanese subsidiaries were 29.9 billion US dollars and 89.4 billion US dollars for final goods and intermediate goods, respectively. Japan also imported final goods and intermediate goods, of 63.1 billion US dollars and 40.2 billion US dollars, respectively, from China except for Japanese subsidiaries. The exports of intermediate goods of Japanese subsidiaries in China to Japan amounted to 20.3 billion US dollars, while the imports of final intermediate goods were 11.3 billion US dollars and 15.6 billion US dollars, respectively.

[9] Here we used the domestic input coefficient of China as our initial value, applying the same coefficient when we estimated the input coefficient of Japanese subsidiaries in China.

The output of China (except for Japanese subsidiaries) was 10,705.5 billion US dollars, and the value-added was 3,455.8 billion US dollars. On the other hand, the output of Japanese subsidiaries was 141.3 billion US dollars, and its value-added was 43.0 billion US dollars with purchases from Chinese firms of 50.7 billion US dollars, imports from Japan of 20.3 billion US dollars, and imports from the ROW of 10.1 billion US dollars. Japanese subsidiaries supplied intermediate goods and final goods to China, 35.9 billion US dollars and 38.8 billion US dollars, respectively. They exported intermediate goods and final goods to Japan, 15.6 billion US dollars and 11.3 billion US dollars, respectively, and exported to the ROW 228 billion US dollars.

TABLE 5.

FIGURE 3.

Figure 4 shows the final goods of Japanese subsidiaries by 30 sectors; the domestic demand of China, exports to Japan, and exports to the ROW. Figure 5 shows their shares by sector. From the figures, we observed the following characteristics. First, the dominant sectors are “General machinery,” “Household electronic equipment, and communications equipment,” “Household electric and non-electric equipment,” “Electronic components,” “Industrial electric equipment,” and “Motor vehicles.” Though “General machinery” and almost all sectors in electrical machinery industries supply almost equally to all regions; China, Japan, and the ROW. The “Electronic components” sector sells only to the ROW because the products of this sector are mainly intermediate goods rather than final goods. In contrast, sales of “Motor vehicles,” which is mainly final goods, are concentrated in the Chinese market. “Food” supplies are sold mainly to the Chinese market, while “Textiles, apparel and leather products” are sold mostly to Japan. “Chemical products” and “Steel, non-steel metals, and metal products” do not supply the Japanese market, but rather the Chinese and the ROW markets.

FIGURE 4.

FIGURE 5.

4 CONTRIBUTION OF VALUE-ADDED AND IMPORTS AGAINST ONE-UNIT INCREASE OF FINAL DEMAND

In this section, we discuss the contribution of value-added and imports against a one-unit increase in the final demand. It is well known that a one-unit increase in the final demand in one sector induces both direct and indirect products of each sector in the economies, and that the induced value-added and imports, if aggregated for all sectors of both countries, yields the same value as all initial increases in the final demand.

Figure 6 shows that the contribution of value-added and imports against a one-unit increase in the final demand in Japan. As expected, the value-added in Japan has the dominant share for almost all sectors. The exception is the "Petroleum and coal product" sector. Imports from the ROW are largely induced against an increase in the final demand in the "Petroleum and coal products" sector. "Chemical products," "Steel, non-steel metals, and metal products," "Household electronic equipment, and communications equipment," "Electronic computing equipment and accessories," and "Electricity, gas, water" sectors also induce higher import demands from the ROW. Imports from China, both Japanese subsidiaries and non-Japanese firms, are not induced as much as that from the ROW, because the import share from China is not dominant. However, examining each sector, there are several sectors that induce a relatively strong effect such as "Textiles, apparel and leather products," "Household electronic equipment, and communications equipment," "Industrial electric equipment," "Electronic computing equipment and accessories," "Motor vehicles," and "Precision instruments."

FIGURE 6.

Figure 7 shows the contribution of value-added and imports against a one-unit increase in the final demand in China, except in Japanese subsidiaries. Value-added in

China (except in Japanese subsidiaries) has the dominant share for almost all sectors with three exceptions, *i.e.*, "Household electronic equipment, Communications equipment," "Electronic computing equipment and accessories," and "Precision instruments."

As China has greater energy resources, especially coal, the induced imports from the ROW are not as large in Japan in the "Petroleum and coal product" sector. On the other hand, imports from the ROW are largely induced against an increase in the final demand in several manufacturing sectors. The Japanese contribution is also large in the case of manufacturing; "Precision instruments," "Electronic computing equipment and accessories," "Household electronic equipment, and communications equipment," "Electronic components," "Motor vehicles," "Other transportation equipment," and "Plastic and rubber products." The major contribution of Japanese subsidiaries appears in the case of "Motor vehicles," and "Motor vehicle parts."

FIGURE 7.

Figure 8 shows that the contribution of value-added and imports against a one-unit increase of the final demand in Japanese subsidiaries in China. Induced value-added in Japanese subsidiaries is dominant in limited cases, *i.e.*, "Agriculture, Forestry, Husbandry," "Wholesale and retail trades," and "Financial services, real estate." However, if we consider the increased value-added of both Japanese subsidiaries and non-Japanese firms in China as a whole, the effects seem similar to those of the Chinese cases. Of course, there are distinguishing characteristics. First, the relation between Japan and its subsidiaries is relatively strong. The induced imports from Japan are large in the case of "Precision instruments," "Household electronic equipment, and communications equipment," "Electronic components," "Textiles, apparel and leather products," "Industrial electric equipment," and "Electronic computing equipment and accessories" sectors, in which the foreign direct investments from Japan are large. If foreign direct investments and overseas productions are increased in the cases above, exports from Japan to China would increase. However,

the output of the corresponding sectors in Japan might be reduced at the same time, if some independent final demand does not appear in the same sector. In such a case, the reduced output might offset the induced import, which we will discuss in the next section.

FIGURE 8.

5 SIMULATION ANALYSIS OF A PRODUCTION SHIFT TO CHINA

5.1 Motor vehicles

First, we consider the effect of a production shift in the "Motor vehicles" sector by comparing the reduction of value-added, which stems from a one-unit reduction in the final demand of this sector in Japan, to the increase of value-added, which is induced by a one-unit increase in the final demand of a Japanese subsidiary in China.

Figure 9a shows the value-added of Japan, China (except for Japanese subsidiaries), and Japanese subsidiaries, which is induced by a one-unit increase of the final demand in "Motor vehicles," in Japan, according to equation (7).

Augmentation of the final demand of the "Motor vehicles" sector causes an additional demand in "Motor vehicle parts," "Steel, non-steel metals, and metal products," "Plastic and rubber products," and "Electronic components," as intermediate inputs. Inputs of "Wholesale and retail trades," "Financial services, real estate," "Services," and "Transportation" also loom relatively large in Japanese Motor vehicle production. However, inputs from China, including Japanese subsidiaries, are relatively small. Among imported intermediate inputs, the relatively large effects are observed in "Mining," "Steel, non-steel metals, and metal products," "Chemical products," "Electronic components," and "Industrial electric equipment."

Figure 9b shows the induced value-added and imports, caused by a one-unit increase of the final demand in the "Motor vehicles" sector in Japanese subsidiaries in China, which is computed by equation (9). Intermediate inputs in this sector are large in "Motor vehicles" and "Motor vehicle parts" sectors. The values in these two inputs

differ relatively little between Japan and China. However, their total sum yields almost the same values, and the patterns of the other inputs are also similar. Inputs of "Motor vehicle parts" are purchased from Japan and within the Chinese market, and inputs of "Steel, non-steel metals, and metal products" are also purchased within the Chinese market. There are enormous reserves of coal in China, so the share of domestic supplies in this sector is great compared to Japan.

FIGURE 9a.

FIGURE 9b.

FIGURE 9c.

Figure 9c shows the effect of the production shift of the "Motor vehicles" sector from Japan to China, computed by equation (10). Naturally, a one-unit reduction of final demand in Japan's "Motor vehicles" sector has negative impacts on Japan, especially on the "Motor vehicles" and "Motor vehicle parts" sectors. On the other hand, the increase in "Motor vehicles" final demands in a Japanese subsidiary has positive impacts on those sectors of the Japanese subsidiaries in China. Increased outputs of Motor vehicles in China positively affect production in Japan through its intermediate import inputs. However, negative impacts on Japanese production offset such positive effects because of the decrease in the final demand of Japan[10].

5.2 Household electric and non-electric equipment

A similar simulation is applied to the "Household electric and non-electric equipment" sector, which includes Figure 10a, Figure 10b, and Figure 10c,

[10] In the 1980's, the exports of motor vehicles from Japan to the US vastly increased, and the share of Japanese motor vehicles in the US market became much larger. At that time, Japanese automobile companies assumed voluntary control of exports, and shifted to local production in the US. However, the exports of "Motor vehicles" from Japan to China were not as much as those from Japan to the US. Thus, the purpose of overseas production is mainly a new expansion into the China market for motor vehicles. So there is no evidence that the export of motor vehicle is directly affected by this expansion. Here our simulation shows the opportunity cost in the sense of how much "Motor vehicles" in Japan might lose potential production for export to China, if the overseas production would not start up in China.

FIGURE 10a.

FIGURE 10b.

FIGURE10c.

In Figure 10a, we are able to observe the impacts on value-added by sectors, brought about by a one-unit increase in a final demand in the "Household electric and non-electric equipment" sector in Japan. Figure 10b causes similar impacts due to a one-unit increase in the final demand in the same sector in a Japanese subsidiary in China. In both cases, the production of "Household electric and non-electric equipment" sector suffers the largest impact. The "Steel, non-steel metals, and metal products," and "Electronic components" then follow. Figure 10c shows the effect of a production shift from Japan to China. In this case, Japanese value-added decrease mainly in the "Household electric and non-electric equipment" sector, which cannot be offset by the increasing effects brought by the shift of production in a Japanese subsidiary in China.

5.3 Household electronic equipment, and communications equipment

Here, we discuss the effects of the production shift in the "Household electronic equipment, and communications equipment" sector. Figure 11a shows the impacts on the value-added by sector, caused by the change in the Japanese final demand. The value-added in "Household electronic equipment, and communications equipment," and "Electronic components" has a great impact. Especially, in the "Electronic components" sector, the import from the ROW shows almost the same value as that from Japan, and the input from the Japanese subsidiary in China is small in both cases.

FIGURE 11a.

FIGURE 11b.

FIGURE 11c.

Figure 11b shows the effects of the Japanese subsidiaries in China. Similarly, a

major increase in the value-added appears in the "Household electric and non-electric equipment" and "Electronic components" sector. As for the "Electronic components" sector, we recognize significant effects in Japan and the ROW.

Figure 11c shows the effects of the production shift, in which the "Household electronic equipment, and communications equipment" sector is mainly affected in its value-added. However, a production shift shows no effect on the value-added in the "Electronic components" sector. This means that the main features of the production in the "Household electric and non-electric equipment" sector are readily supplied from both Japan and the ROW actually in Chinese Taipei or Korea, which is a very interesting result.

5.4 Production shift in manufacturing sectors

So far we have discussed the effects of production shifts for three main sectors, in terms of the changes in value-added and imports by sector and regions. The aggregation by sectors reports the effects on Japan, China (except for Japanese subsidiaries), Japanese subsidiaries in China, and the ROW. Figure 12 shows the regional impacts brought by the production shift from Japan to China in each sector[11].

Observing this figure for the cases of "Household electric and non-electric equipment," "Electronic components," "Electronic computing equipment and accessories," and "Industrial electric equipment," the Japanese decrease in value-added is relatively small, though a relatively large decrease appears in the case of "Motor vehicles" and "Motor vehicle parts."

Figure 13 shows the impact on the compensation of employees for the production shift in each manufacturing sector. For almost all sectors except "Petroleum and coal products," the decrease in the Japanese compensation of employees is significant in value compared to the Chinese increase in the compensation. This means that production shifts to China make room to cover that cost. Actually, in comparing each sector, "Motor vehicles" and "Motor vehicle parts" sectors have a major reduction effect

[11] Because the total change of final demands is zero for each sector, the sum of the induced value-added and induced imports will also be zero, when the induced change of international freight and insurance are included.

on saving labor costs. However, how much effect this has on employment should be investigated by an analysis using employment coefficient data in both countries, a topic of our future research.

FIGURE 12.

FIGURE 13.

6 CONCLUDING REMARKS

The production shift of firms from one country to another changes the pattern of trade between them. There is an increasing concern that such changes in the international trade structure between Japan and China might lead to the demise of the manufacturing industry. On the other hand, it is widely recognized that foreign direct investment plays an important role in Chinese economic development. Input Output Analysis is one of the important tools used to investigate such issues.

For the purpose stated above, by using information of METI overseas business survey database, we tried to reconstruct the 2007 Japan-China International Input Output Table so as to include the production activities of Japanese subsidiaries in China as explicit sectors. The reconstructed table captures how Japanese firms contribute to Chinese economic development by supplying final goods to the Chinese domestic market, exporting to overseas markets, and supplying intermediate goods to support the production of firms in China.

The continuous appreciation of the Yen and the rapid aging of the Japanese population have forced Japanese firms to shrink domestic production and to enlarge overseas production, by reducing production costs and seeking new markets. According to our simulation of the production shift from Japan to China, which is induced from pairwise assumptions, a one-unit decrease of final goods in Japan and a one-unit increase of final goods produced by Japanese subsidiaries in China, we are able to observe the following: (1) A reduction in Japanese value-added occurs in almost all sectors in Japan, but dominantly in the corresponding sector. (2) An increase of

value-added, through which the production shift induces Japanese subsidiaries and non-Japanese firms in China, is smaller than the reduction of value-added in Japan. (3) A change in the compensation of employees is also similar to that of value-added, which suggests that the production shift might be related to the cost reduction.

The effect on employment brought about by a production shift is also an import issue, which we should plan to investigate after developing the employment table. It is important to capture the characteristics of an input structure for Japanese overseas production. Should the cost structure resemble a Japanese or a Chinese one? From where and for how much should they purchase intermediate goods; Japan, China, or the ROW? A METI "overseas business survey" is important to supply such detailed information. We expect expansions and improvements in such survey statistics from both countries. Finally, because the economic development of China includes regional inequality, we have to investigate production shifts, using a Japan-China transnational interregional input output table, like IDE (2007).

References

Alnino, V., E. Dietzenbacher, and S. Kühtz (2003) "Analysis materials and Energy Flows in an Industrial District using an Enterprise Input-Output Model," *Economic Systems Research*, Vol.15, No.4, 457-480.

Kinoshita, Soshichi ed., *Econometric Modeling of Japan and Asia-Pacific economies*, World Scientific Publishing Co., 2012.

Institute of Developing Economies (2007) *Transnational Interregional Input-Output table between China and Japan 2000*, Asian International Input-Output Series, No. 68.

Narangori, G., G. Colombo, and G. Fezzi (2004) "Modelling Intra-Group Relationships," *Economic Systems Research*, Vol.16, No.1, pp.87-106.

Matsumoto, M. and J. Fujimoto (2009) "The Development of an Enterprise Input Output Model and its Application to Intdusrial Environment Management," *Journal of Applied Input-Output Analysis*, Pan Pacific Association of

Input-Output Studies, Vol.13 & 14, pp.123-143.

METI, Research and Statistics Department, Economic and Industry Policy Bureau, (2005) "Analysis of Japanese Overseas Firms Using Recompiled 2000 Japan-US International Input Output Table," in *2000 Japan-US International Input Output Table, Analysis Part,* Chapter 4, pp.28-53 (in Japanese).

Miller, Ronald E., and Peter D. Blair (2009) *Input-Output Analysis: Foundations and Extensions*, Cambridge University Press.

Teng Jian and Fang Wenhui (2008) "An Input-Output Analysis of the Economic Dependence between Japanese Enterprise and Non-Japanese Enterprise in China and Japan," *Journal of Applied Input-Output Analysis*, Pan Pacific Association of Input-Output Studies, Vol.13 & 14, pp.33-60.

Yamada, M. (2001) "Overseas Production of Japanese Firms and the Japan-US interdependence: An Input-Output Analysis", *Chukyo Economic Review*, Department of Economics, Chukyo University, No. 12, pp.23-61 (in Japanese).

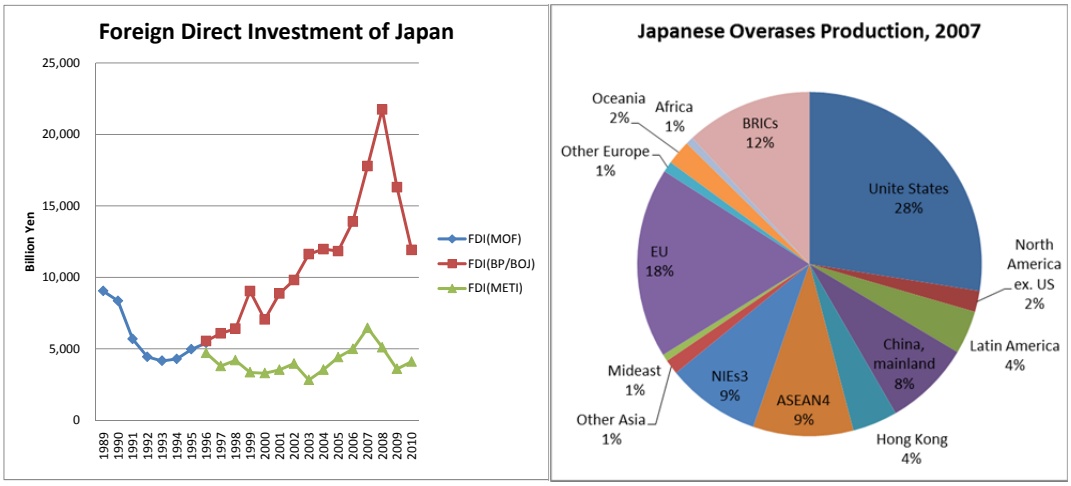
Yamada, M. (2002) " Overseas Production of Japanese Firms and Japan-US Interdependence: An Input-Output Analysis", *Journal of Applied Input-Output Analysis*, Pan Pacific Association of Input-Output Studies, Vol. 8, pp.15-36.

Yamada, M. (2004) "Japanese Overseas Production within the Asia International Input-Output Framework: Japan, the US, and Asia", *Journal of Econometric Study of Northeast Asia*, Economic Research Institute for Northeast Asia, Vol. 5, No. 1, pp.27-42.

Yamada, M. (2006) "Input-Output Analysis on Overseas Production of Japanese Firms" in Mitsuo Yamada, and Soshichi Kinoshita eds., *Macro-econometric Analysis of Economic Development in East Asia*, Chapter 7, Keiso Shobou, pp.167-188 (in Japanese)

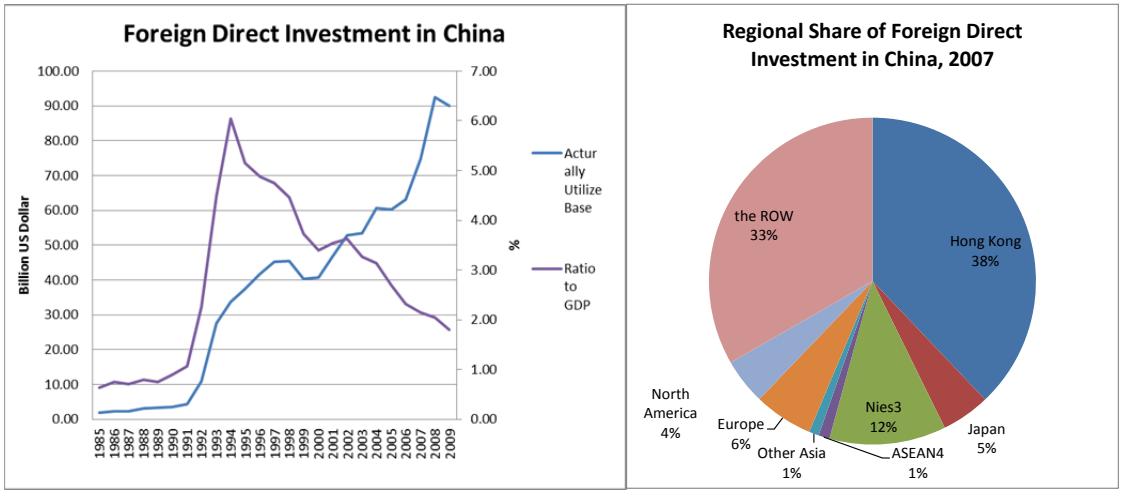
Yamada, M. (2007) "Overseas Production of Japanese Firms" in Mitsuo Yamada, *Econometric Analysis on the Economic Linkage of East Asian Economies*, Chapter 4, Keiso Shobou, pp.93-124 (in Japanese).

FIGURE 1.



Data Source: Ministry of Finance, *Foreign Direct Investment of Japan*, Bank of Japan, *Balance of Payment*, and Ministry of Economy, Trade, and Industry, *Overseas Business Survey*.

FIGURE 2.



Data Source: National Bureau of Statistics of China, *China Statistical Yearbook*

TABLE 1. Japan-China International Input-Output Table

		Intermediate Demands		Final Demands		Exports	Imports	Output
		Japan	China	Japan	China			
Inter-mediate Inputs	Japan	X_{jj}	X_{jc}	F_{jj}	F_{jc}	E_j	-	X_j
	China	X_{cj}	X_{cc}	F_{cj}	F_{cc}	E_c	-	X_c
	ROW	X_{wj}	-	F_{wj}	-	-	$-M_j$	0
		-	X_{wc}	-	F_{wc}		$-M_c$	0
Value-Added		V_j	V_c	-	-	-	-	-
Output		X_j	X_c	-	-	-	-	-

TABLE 2. Japan-China International Input-Output Table

		Intermediate Demands			Final Demands			Exports	Imports	Output
		Japan	China, Non-Japanese	Japanese Subsidiaries	Japan	China, Non-Japanese	Japanese Subsidiaries			
Inter-mediate Inputs	Japan	X_{11}	X_{12}	X_{13}	F_{11}	F_{12}	F_{13}	E_1	-	X_1
	China, Non-Japanese	X_{21}	X_{22}	X_{23}	F_{21}	F_{22}	F_{23}	E_2		X_2
	Japanese Subsidiaries	X_{31}	X_{32}	X_{33}	F_{31}	F_{32}	F_{33}	E_3	-	X_3
	ROW	X_{41}	-		F_{41}	-		-	$-M_1$	0
		-	X_{42}	-	-	F_{42}	-	-	$-M_2$	0
		-	-	X_{43}	-	-	F_{43}		$-M_3$	0
Value-Added		V_1	V_2	V_3	-	-		-	-	-
Output		X_1	X_2	X_3	-	-		-	-	-

TABLE 3. Japan-China International Input-Output Table

		Intermediate Demands			Final Demands		Exports	Imports	Output
		Japan	China, Non-Japanese	Japanese Subsidiaries	Japan	China, Non-Japanese			
Inter-mediate Inputs	Japan	X_{11}	X_{12}	X_{13}	F_{11}	F_{12}	E_1	-	X_1
	China, Non-Japanese	X_{21}	X_{22}	X_{23}	F_{21}	F_{22}	E_2		X_2
	Japanese Subsidiaries	X_{31}	X_{32}	X_{33}	F_{31}	F_{32}	E_3	-	X_3
	ROW	X_{41}	-	-	F_{41}	-	-	$-M_1$	0
		-	X_{42}	-		F_{42}	-	$-M_2$	0
		-	-	X_{43}	-	-	-	$-M_3$	0
Value-Added		V_1	V_2	V_3	-	-	-	-	-
Output		X_1	X_2	X_3	-	-	-	-	-

TABLE 4. Decomposition of Input-Output Table

		Intermediate Demands		Final Demands		Exports	Imports	Output
		Japan	China	Japan	China			
Inter-mediate Inputs	Japan	$X_{jj} = X_{11}$	$X_{jc} \rightarrow X_{12}, X_{13}$	$F_{jj} = F_{11}$	$F_{jc} = F_{12}$	$E_j = E_1$	-	$X_j = X_1$
	China	$X_{cj} \rightarrow \begin{matrix} X_{21} \\ X_{31} \end{matrix}$	$Xcc \rightarrow \begin{matrix} X_{c2} \\ X_{c3} \end{matrix} \rightarrow \begin{matrix} X_{22}, X_{23} \\ X_{32}, X_{33} \end{matrix}$	$F_{cj} \rightarrow \begin{matrix} F_{21} \\ F_{31} \end{matrix}$	$F_{cc} \rightarrow \begin{matrix} F_{22} \\ F_{32} \end{matrix}$	$E_c \rightarrow \begin{matrix} E_2 \\ E_3 \end{matrix}$	-	$X_c \rightarrow \begin{matrix} X_2 \\ X_3 \end{matrix}$
	ROW	$X_{wj} = X_{41}$	-	$F_{wj} = F_{41}$	-	-	$-Mj = -M_1$	0
		-	$X_{wc} \rightarrow X_{42}, X_{43}$	-	$F_{wc} = F_{42}$		$-M_c \rightarrow -M_2, -M_3$	0
Value-Added		$V_j = V_1$	$V_c \rightarrow V_2, V_3$	-	-	-	-	-
Output		$X_j = X_1$	$X_c \rightarrow X_2, X_3$	-	-	-	-	-

TABLE 5. Reconstructed Input-Output Table

Unit: Billion US dollars		Intermediate demand				Japan			China					Imports	Total Output
		Japan	China, ex. JS	Japanese Subsidiaries	Total Inter-mediate Demand	Domes-tic Final Demand	Exports to ROW	Final Demand	Domes-tic Final Demand	Exports to ROW	Errors	Final Demand	Total Final Demand		
Inter-mediate Input	Japan	3,452.3	89.4	20.3	3,562.0	3,952.8	645.8	4,598.6	29.3	0.0	0.0	29.3	4,628.0	0.0	8,190.0
	China, ex. JS	40.2	6,349.8	50.7	6,440.7	63.1	0.0	63.1	2,987.5	1,192.7	23.6	4,203.8	4,266.9	0.0	10,707.5
	Japanese Subsidiaries	15.6	35.9	16.8	68.4	11.3	0.0	11.3	38.8	22.8	0.0	61.6	72.9	0.0	141.3
	Imports from ROW	460.4	760.4	10.1	1,231.0	131.1	0.0	131.1	129.0	0.0	0.0	129.0	260.1	1,491.1	0.0
	Freight and Insurance (Japan-China)	1.6	2.4	0.1	4.1	1.5	0.0	1.5	0.5	0.0	0.0	0.5	2.0	6.1	0.0
	Duties and Import Commodity Taxes	32.4	13.9	0.3	46.6	17.0	0.0	17.0	6.9	0.0	0.0	6.9	23.9	70.5	0.0
	Total Intermediate Input	4,002.6	7,251.8	98.4	11,352.7	4,176.7	645.8	4,822.5	3,192.1	1,215.5	23.6	4,431.2	9,253.7	1,567.6	19,038.8
Total Value-Added		4,187.4	3,455.8	43.0	7,686.1										
Total Input		8,190.0	10,707.5	141.3	19,038.8										

		Intermediate demand				Japan			China					Imports	Total Output
		Japan	China, ex. JS	Japanese Subsidiaries	Total Inte-rmediate Demand	Domes-tic Final Demand	Exports to ROW	Final Demand	Domes-tic Final Demand	Exports to ROW	Errors	Final Demand	Total Final Demand		
Inter-mediate Input	Japan	0.422	0.008	0.144	0.187	0.946	1.000	0.954	0.009	0.000	0.000	0.007	0.500	0.000	0.430
	China, ex. JS	0.005	0.593	0.358	0.338	0.015	0.000	0.013	0.936	0.981	1.000	0.949	0.461	0.000	0.562
	Japanese Subsidiaries	0.002	0.003	0.119	0.004	0.003	0.000	0.002	0.012	0.019	0.000	0.014	0.008	0.000	0.007
	Imports from ROW	0.056	0.071	0.072	0.065	0.031	0.000	0.027	0.040	0.000	0.000	0.029	0.028	0.951	0.000
	Freight and Insurance (Japan-China)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000
	Duties and Import Commodity Taxes	0.004	0.001	0.002	0.002	0.004	0.000	0.004	0.002	0.000	0.000	0.002	0.003	0.045	0.000
	Total Intermediate Input	0.489	0.677	0.696	0.596	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Total Value-Added		0.511	0.323	0.304	0.404										
Total Input		1.000	1.000	1.000	1.000										

FIGURE 3. Demand and Supply of Products Between Japan and China

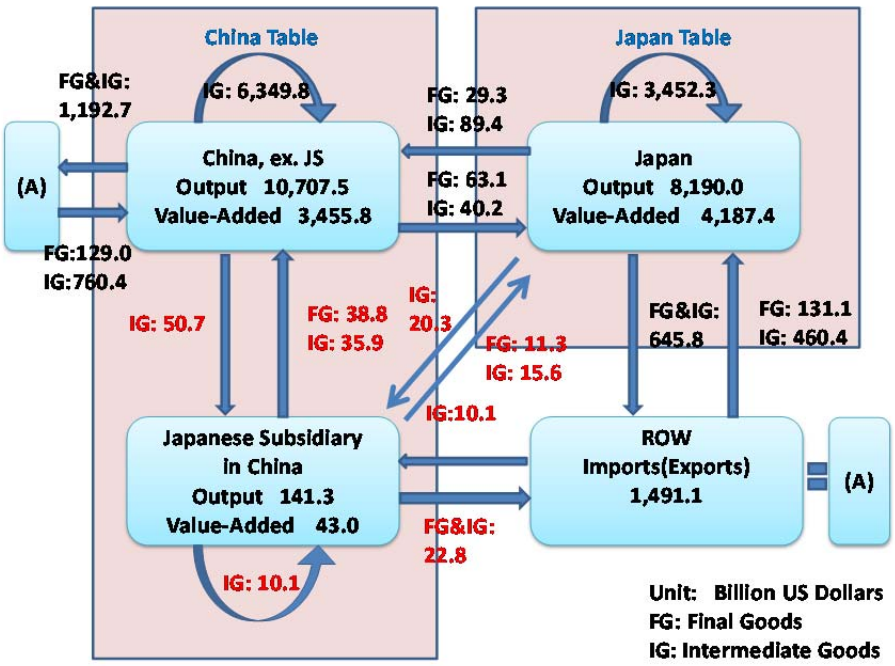


FIGURE 4. Final Products of Japanese Subsidiaries in China

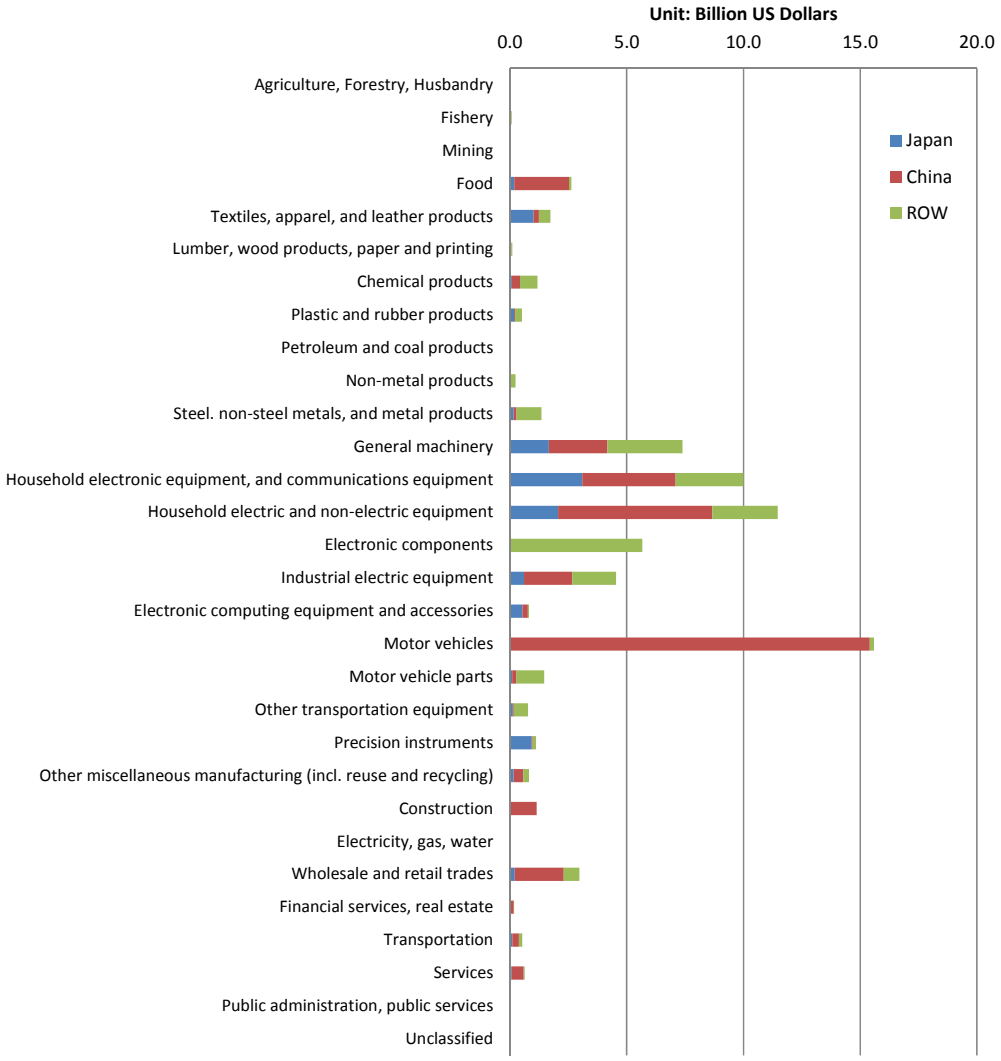


FIGURE 5. Final Products of Japanese Subsidiaries in China: Regional Shares of Each Sector

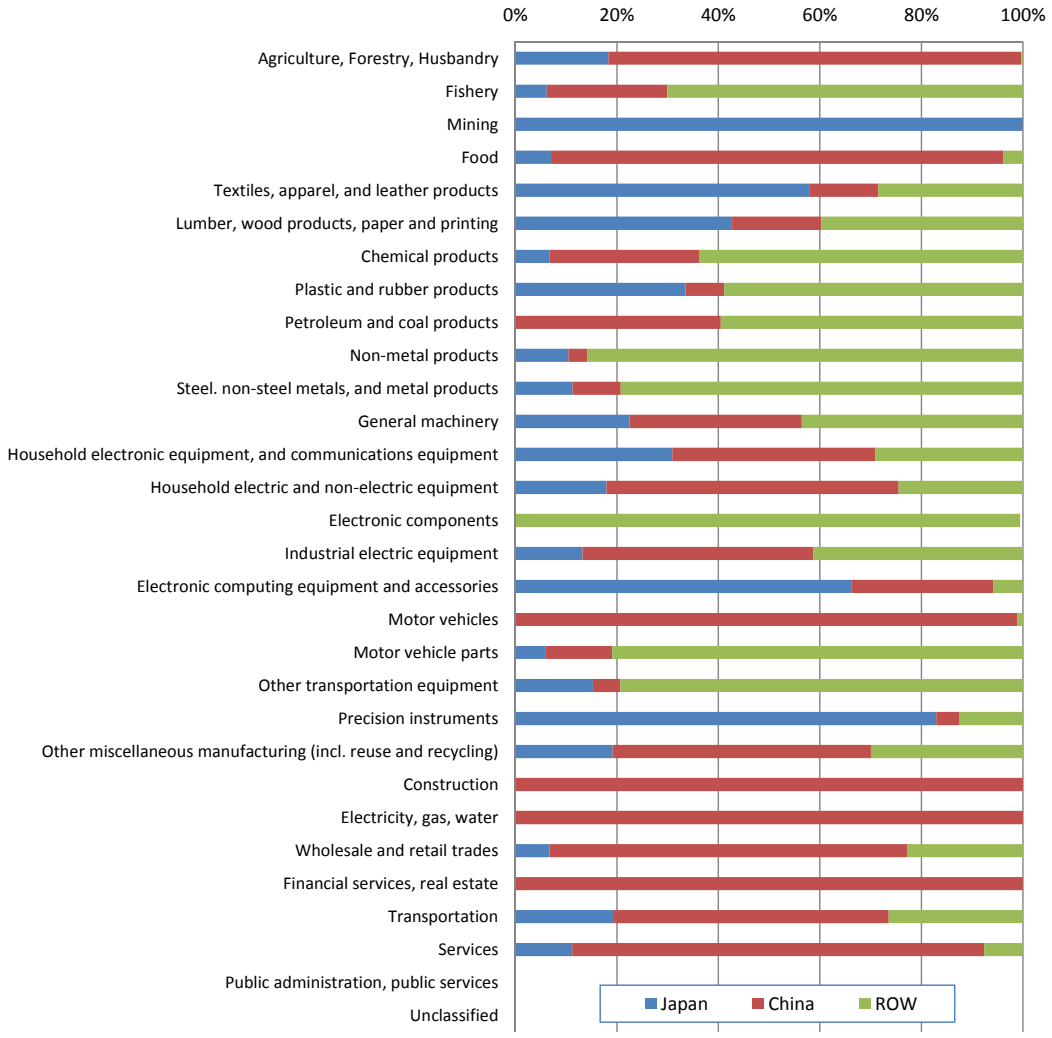


FIGURE 6. Contribution of Value-Added and Import by Sector, Japan

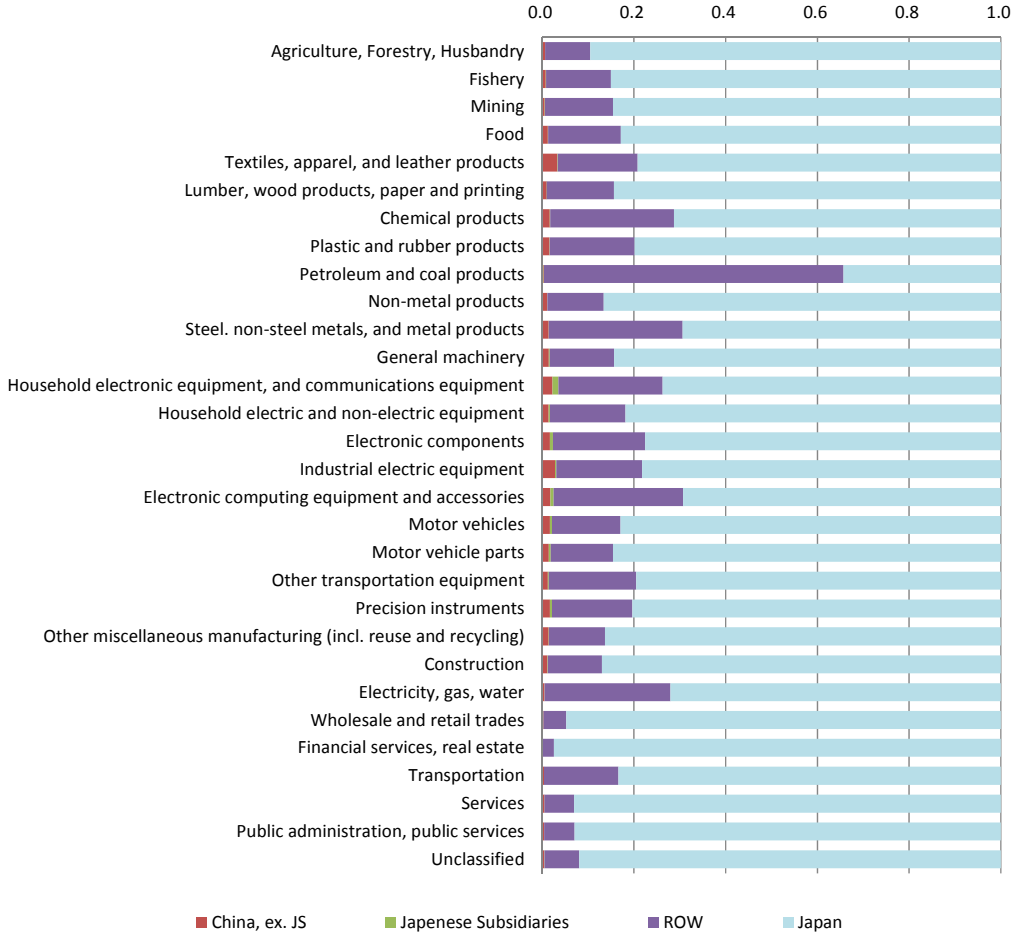


FIGURE 7. Contribution of Value-Added and Import by Sector, China Except Japanese Subsidiaries

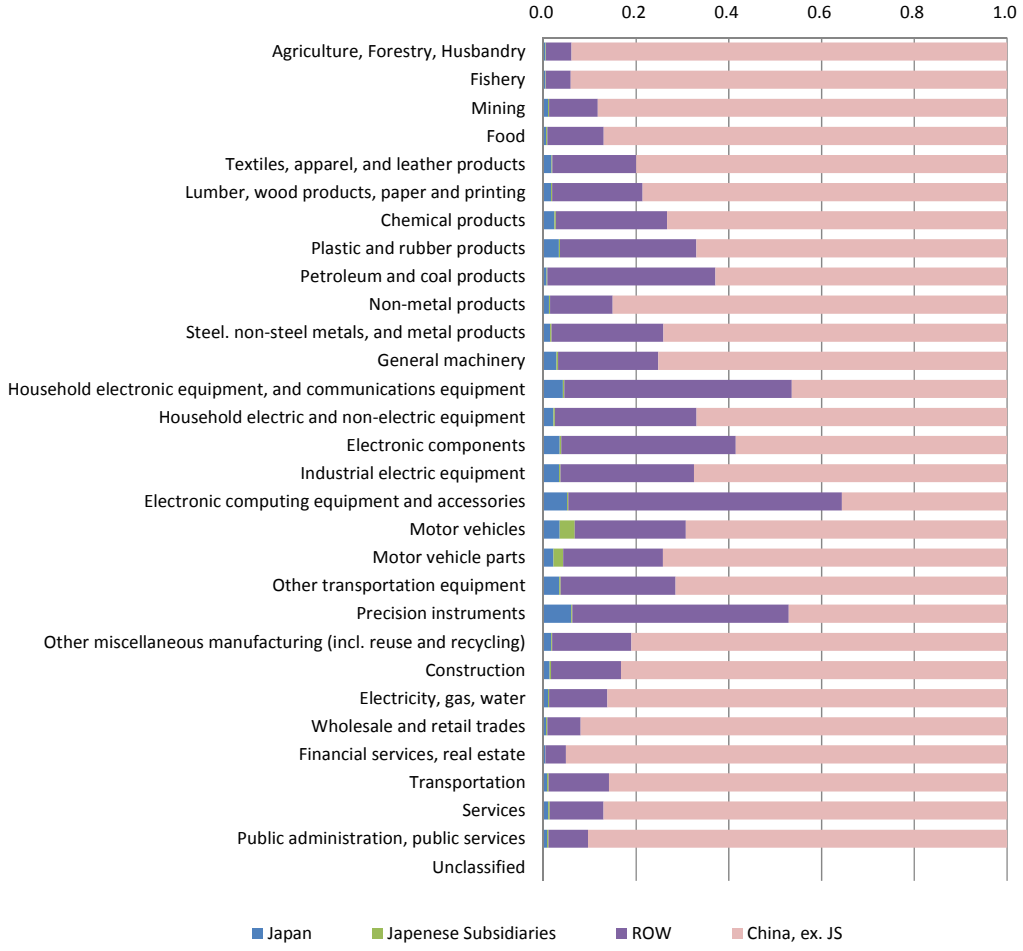


FIGURE 8. Contribution of Value-Added and Import, Japanese Subsidiaries in China

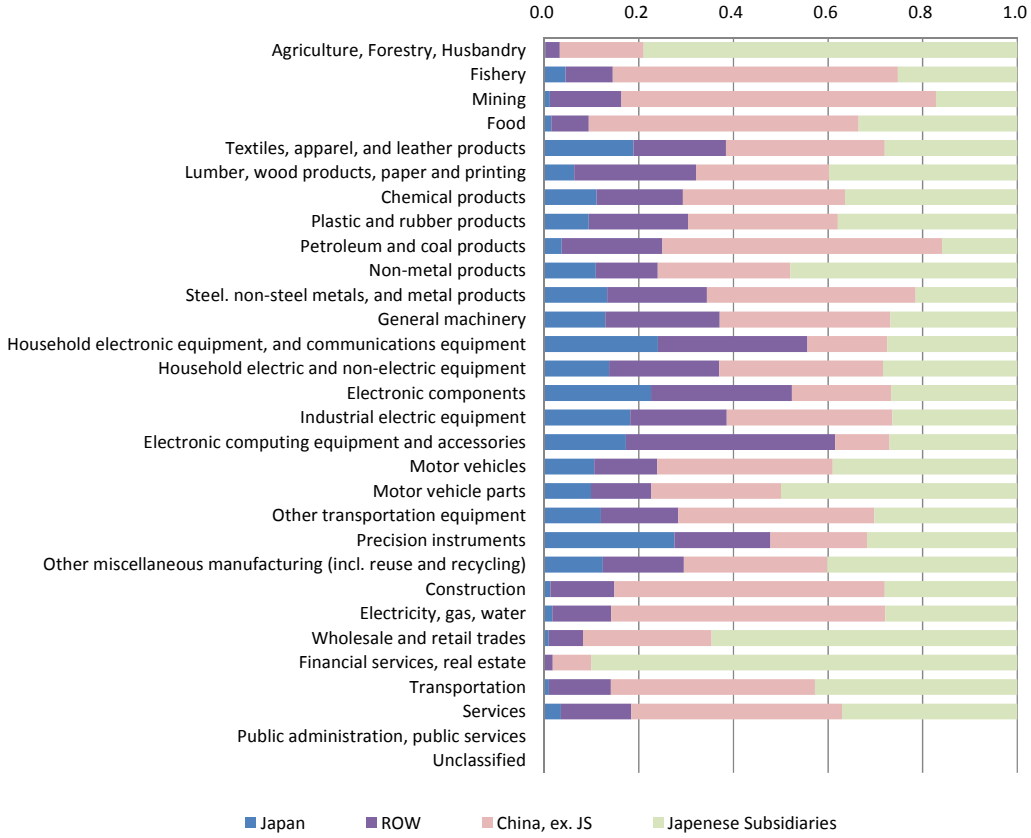


FIGURE 9a. Induced Value-Added and Imports by One-Unit Increase of Final Demand in "Motor vehicles" Sector, Japan

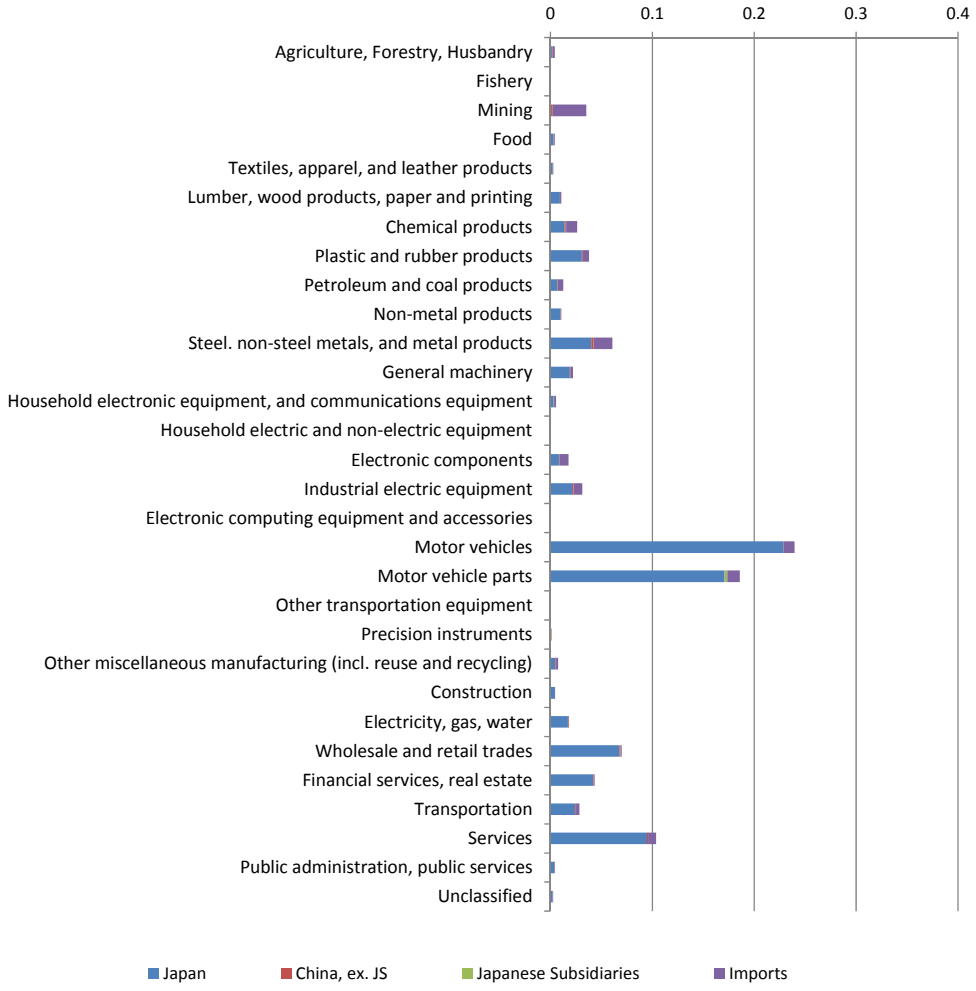


FIGURE 9b. Induced Value-Added and Imports by One-Unit Increase of Final Demand in "Motor vehicles" Sector, Japanese Subsidiaries in China

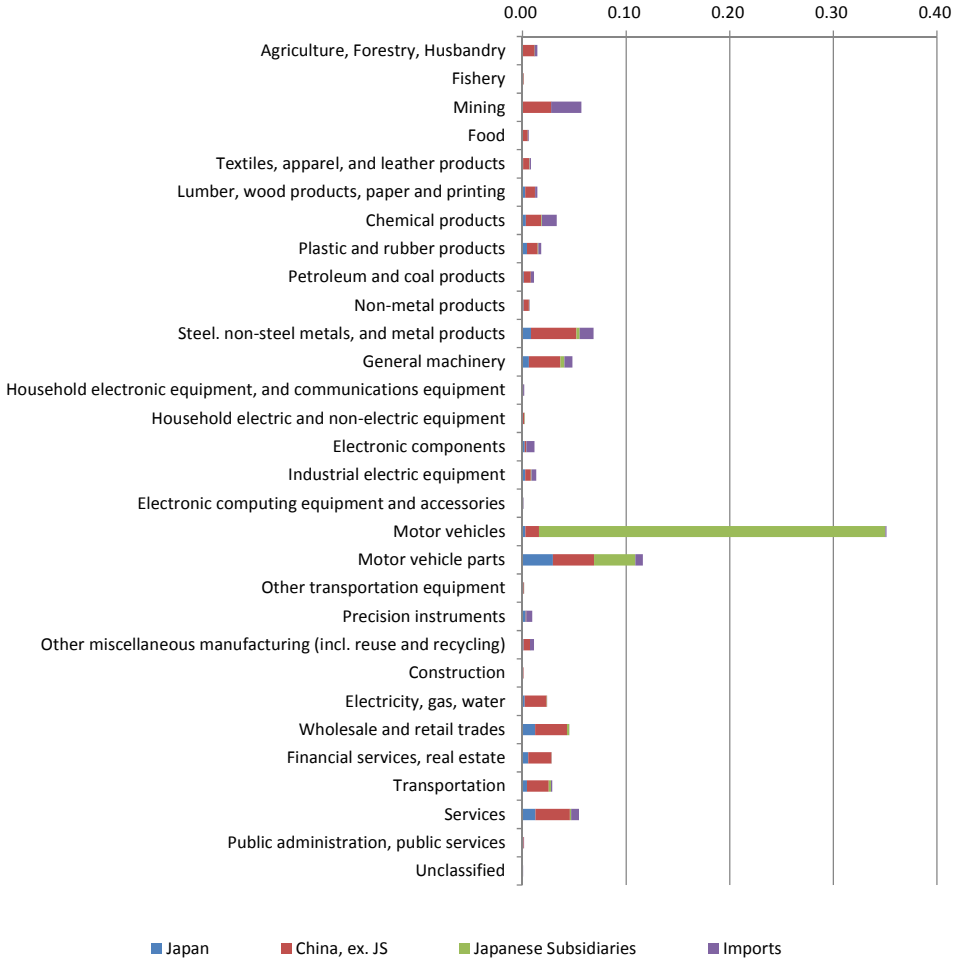


FIGURE 9c. Induced Value-Added and Imports by Production Shift from Japan to China, in "Motor vehicles" Sector

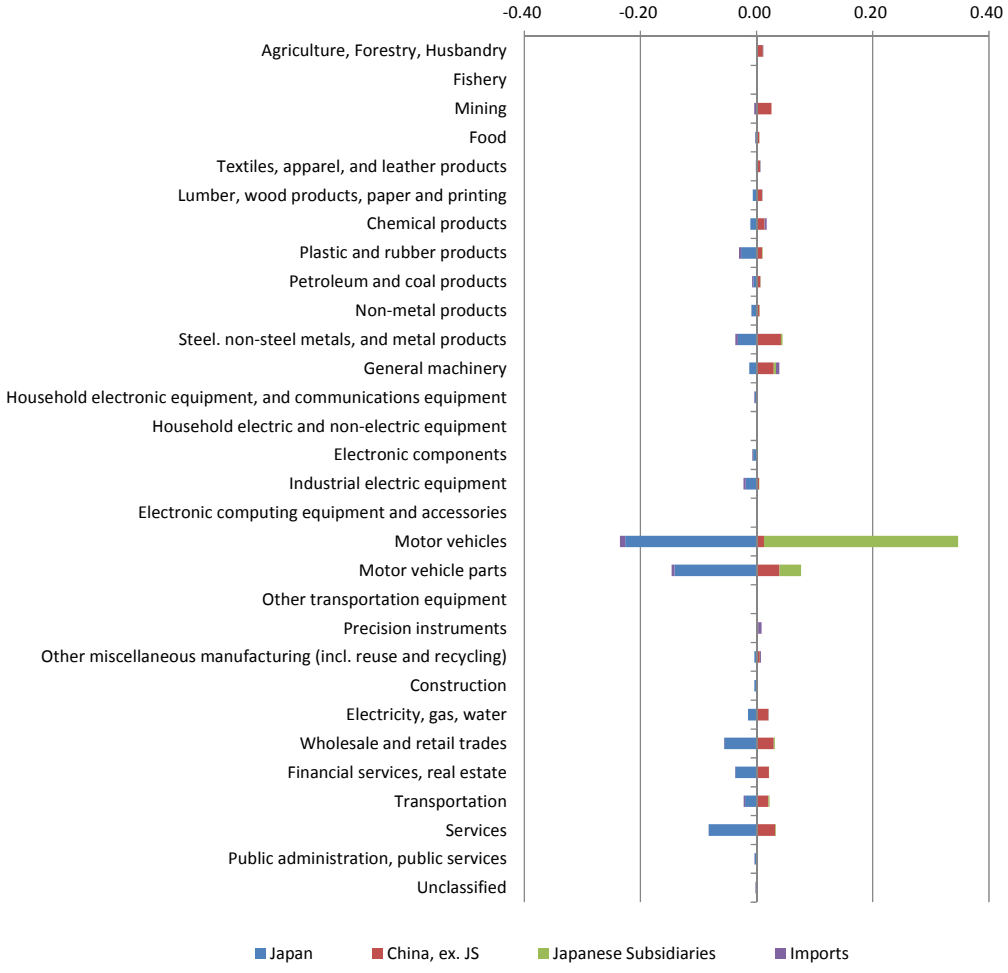


FIGURE 10a. Induced Value-Added and Imports by One-Unit Increase of Final Demand in "Household electric and non-electric equipment" Sector, Japan

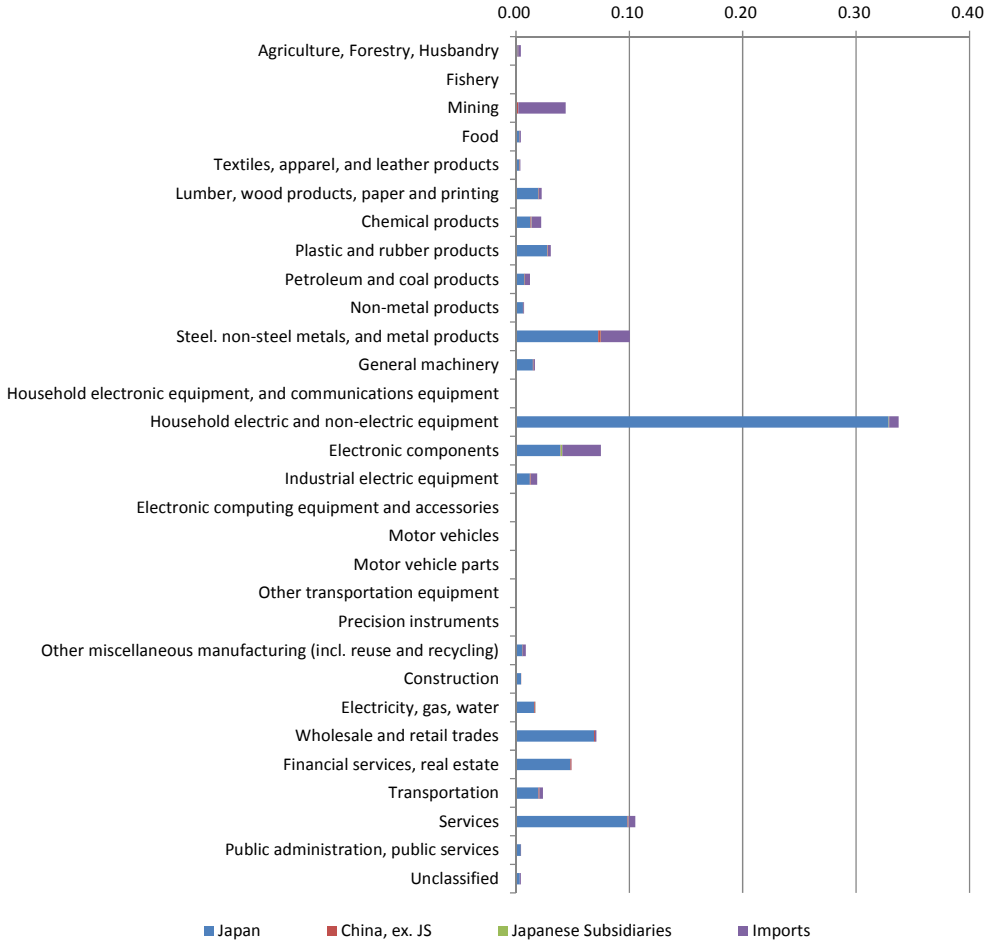


FIGURE 10b. Induced Value-Added and Import by One-Unit Increase of Final Demand in "Household electric and non-electric equipment" Sector, Japanese Subsidiaries in China

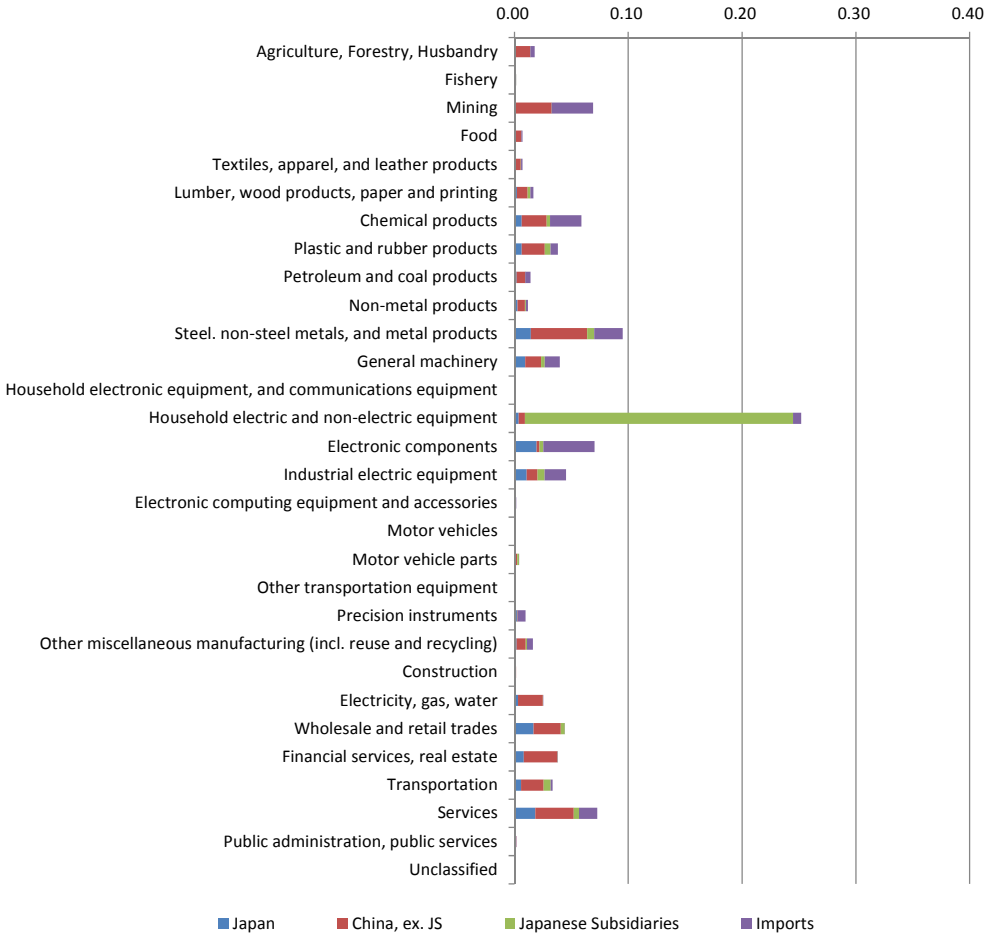


FIGURE 10c. Induced Value-Added and Imports by Production Shift from Japan to China, in "Household electric and non-electric equipment" Sector

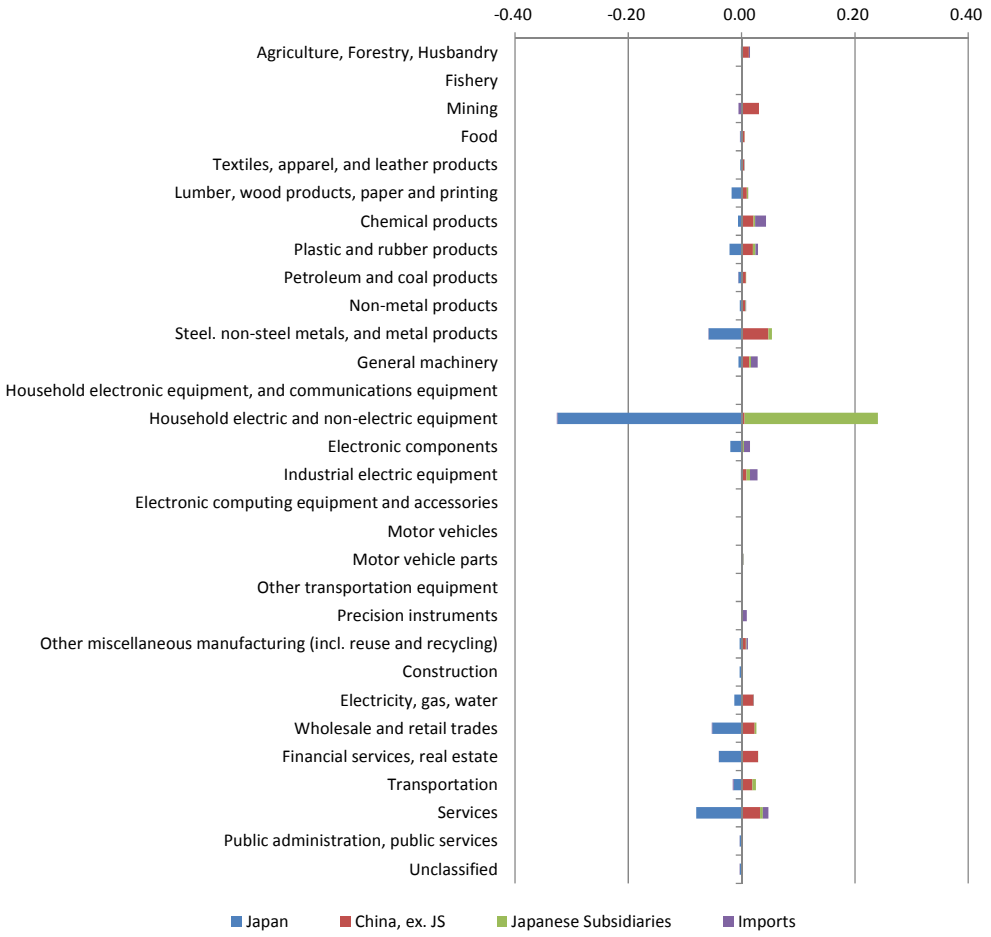


FIGURE 11a. Induced Value-Added and Imports by One-Unit Increase of Final Demand in "Household electronic equipment, and communications equipment" Sector, Japan

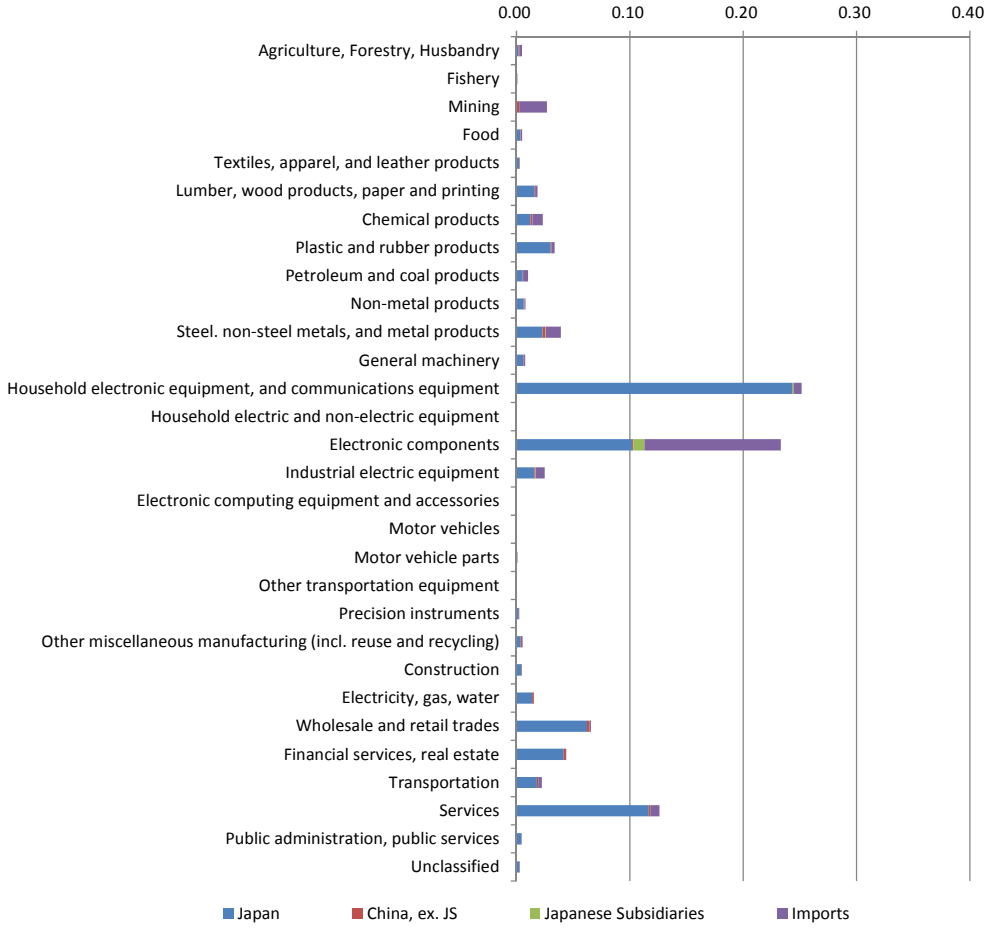


FIGURE 11b. Induced Value-Added and Imports by One-Unit Increase of Final Demand in "Household electronic equipment, and communications equipment" Sector, Japanese Subsidiaries in China

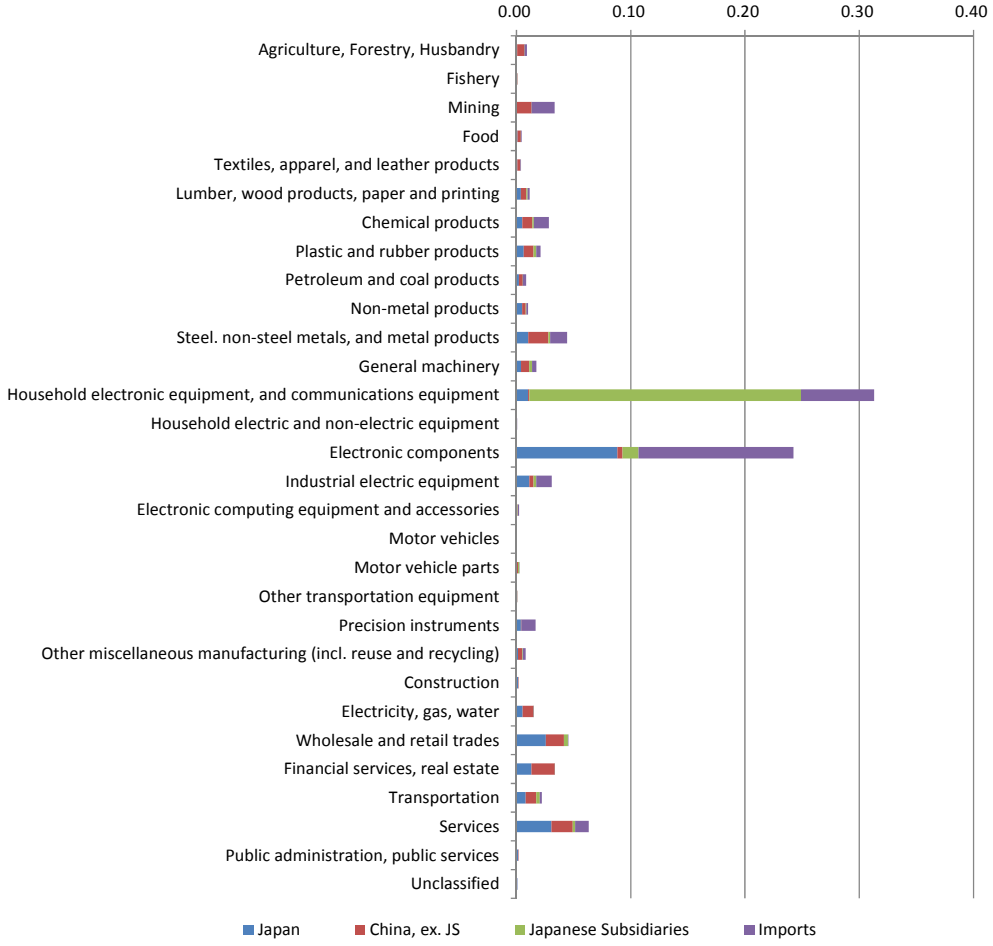


FIGURE 11c. Induced Value-Added and Imports by Production Shift from Japan to China, in "Household electronic equipment, and communications equipment" Sector

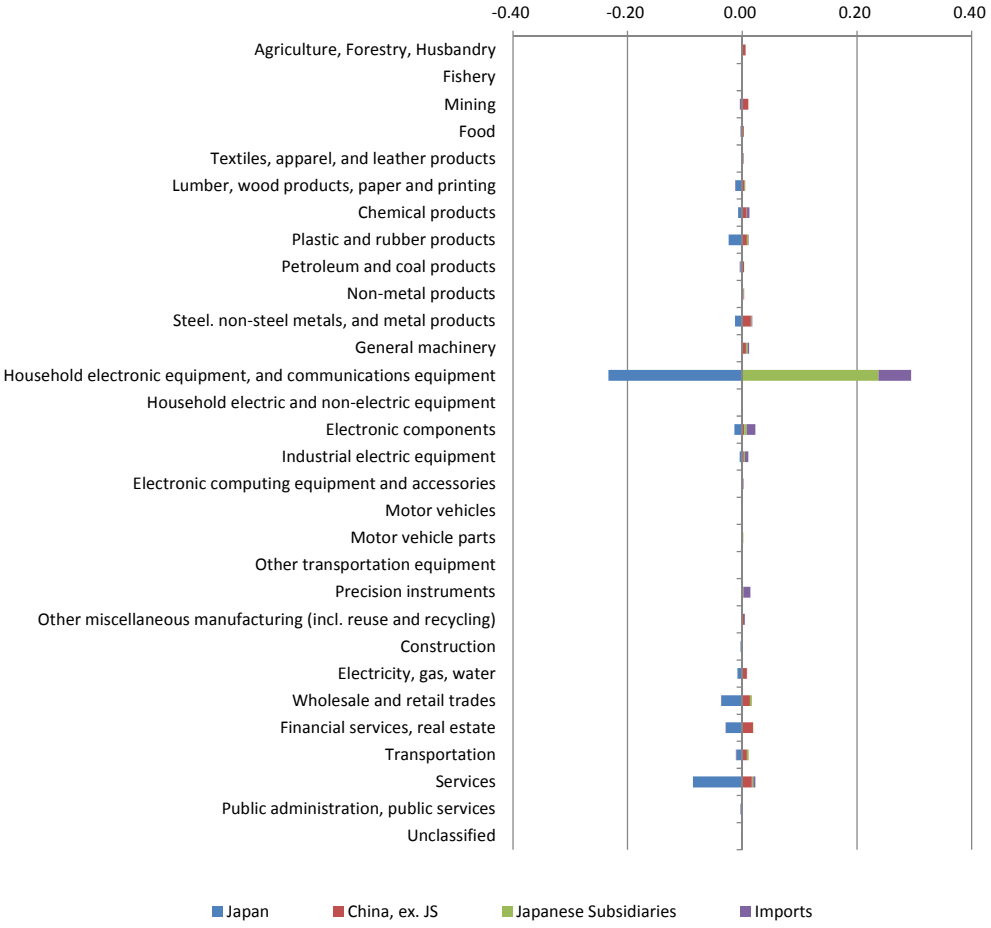


FIGURE 12. Comparision of Total Induced Valued-Added and Imports by Production Shift of Each Manufacturing Sector

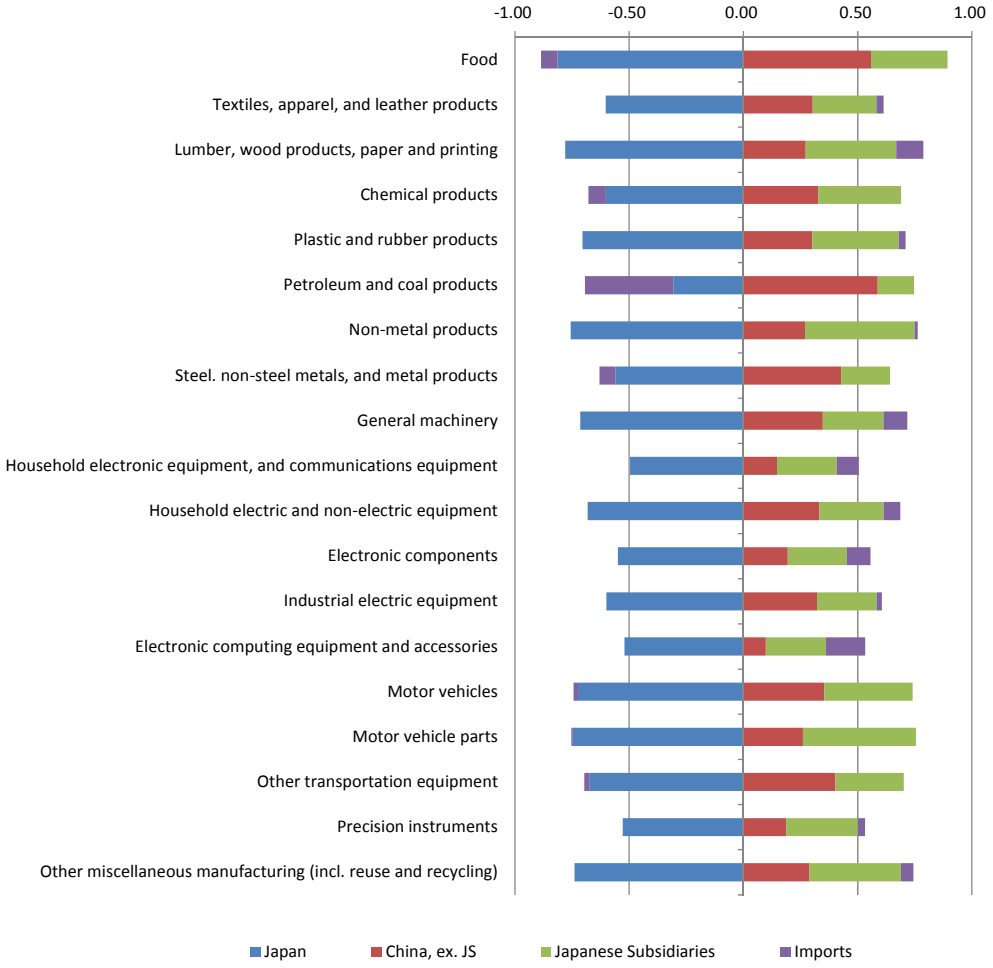


FIGURE 13. Comparison of Induced Compensation of Employees by the Production Shift of Each Manufacturing Sector