THE EFFECT OF INTERNATIONAL SPECIALIZAION ON LABOR PRODUCTIVITY: THE CASE OF JAPANESE ELECTRICAL MACHIENRY INDUSTRY

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การศึกษาผลของความชำนาญเฉพาะอย่างระหว่างประเทศต่อผลิตภาพของแรงงาน: กรณีศึกษาอุตสาหกรรมเครื่องจักรและอุปกรณ์ไฟฟ้าของญี่ปุ่น

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรศิลปศาตรมหาบัณฑิต
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Field of Study	International Economics and Finance
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มาซาฮิโกะ ยากิทานิ: การศึกษาผลของความชำนาญเฉพาะอย่างระหว่างประเทศต่อผลิตภาพของแรงงาน: กรณีศึกษาอุตสาหกรรมเครื่องจักรและอุปกรณ์ไฟฟ้าของญี่ปุ่น. (THE EFFECT OF INTERNATIONAL SPECIALIZATION ON LABOR PRODUCTIVITY: THE CASE OF JAPANESE ELECTRICAL MACHIENRY INDUSTRY)
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การศึกษานี้เป็นการหาความสัมพันธ์ระหว่างความชำนาญทางการผลิตและการค้า และประสิทธิภาพของแรงงาน ในอุตสาหกรรมเครื่องใช้ไฟฟ้าของประเทศญี่ปุ่นโดยใช้ข้อมูลในช่วงปี ค.ศ. 1990 – 2010 การคำนวณดัชนีความชำนาญทางการค้า (Trade Specialization Index) แสดงให้เห็นว่าประเทศญี่ปุ่นมีความสามารถทางการแข่งขันกับประเทศในกลุ่มเอเชียตะวันออกในการส่งออกชิ้นส่วนและส่วนประกอบในอุตสาหกรรมเครื่องใช้ไฟฟ้า การวิเคราะห์ในรายละเอียดใช้การวิเคราะห์สินค้าตามระบบฮาร์โมไนซ์ (Harmonized System: HS85) ในระดับ 8 หลัก โดยแบ่งแยกสินค้าออกเป็น 2 กลุ่ม ได้แก่ กลุ่มชิ้นส่วนและส่วนประกอบ และกลุ่มสินค้าขั้นสุดท้าย การวิเคราะห์ในส่วนแรกเป็นการวิเคราะห์รูปแบบทางการค้า ซึ่งทำโดยผ่านดัชนี 3 ประเภท ได้แก่ ดัชนีการค้าทางเดียว (one-way-trade index: OWT) ดัชนีการค้าภายในอุตสาหกรรมเดียวกันแบบแนวตั้ง (vertical intra-industry trade index: VIIT) และ ดัชนีการค้าภายในอุตสาหกรรมเดียวกันแบบแนวนอน (horizontal intra- industry trade index: HIIT)

ข้อสรุปจากการคำนวณดัชนีดังกล่าวพบว่า ชิ้นส่วนและส่วนประกอบในอุตสาหกรรมเครื่องใช้ไฟฟ้าของญี่ปุ่น มีค่าดัชนี VIIT เพิ่มสูงขึ้นในขณะที่ดัชนี OWT ลดต่ำลง ในขณะที่สำหรับสินค้าขั้นสุดท้าย ค่าดัชนี VIIT มีค่าเพิ่มสูงขึ้นในขณะที่ดัชนี OWT มีค่าคงตัวอยู่ในระดับสูง แสดงให้เห็นว่าประเทศญี่ปุ่นมีแนวโน้มนำเข้าสินค้าเหล่านี้จากประเทศในกลุ่มเอเชียตะวันออกมากยิ่งขึ้น การคำนวณสัดส่วนการจ้างผลิตนอกองค์กร (Outsourcing Ratio) แสดงให้เห็นว่าอุตสาหกรรมเครื่องใช้ไฟฟ้ามีการพึ่งพิงชิ้นส่วนและส่วนประกอบจากประเทศในเอเชียตะวันออกมากยิ่งขึ้น การวิเคราะห์ในส่วนที่สอง เป็นการวิเคราะห์หาความสัมพันธ์ผ่านสมการถดถอยโดยใช้ สัดส่วนการจ้างผลิตนอกองค์กร และ VIIT เป็นตัววัดระดับความชำนาญของประเทศ เพื่อหาความสัมพันธ์กับผลิตภาพของแรงงาน ผลจากสมการถดถอยพบว่าสัดส่วนการจ้างผลิตนอกองค์กร มีความสัมพันธ์เชิงบวกกับผลิตผลของแรงงานอย่างมีนัยสำคัญ ในขณะที่ VIIT ไม่มีนัยสำคัญในกำหนดผลิตผลของแรงงาน

สาขาวิชา เศรษฐศาสตร์และการเงินระหว่างประเทศ ลายมือชื่อนิสิต .....
ปีการศึกษา 2555 ..... ลายมือชื่อ อ.ที่ปรึกษาวิทยานิพนธ์หลัก .....

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MASAHIKO YAGITANI: THE EFFECT OF INTERNATIONAL SPECIALIZATON ON LABOR PRODUCTIVITY: THE CASE OF JAPANESE ELECTRICAL MACHINERY. ADVISOR : DANUPON ARIYASAJJAKORN, Ph.D., 110 pp.

Main purpose of this thesis is to prove that there is a linkage between international specialization and labor productivity in electrical machinery industry of Japan with data between 1990 and 2010 using quantitative analyses. Trade specialization index shows that Japan is competitive in the trade of parts and components to East Asia countries. Moreover, parts and components are analyzed separately from final goods when we classify trades into 3 patterns in HS85 (6digits level). Those patterns are one-way-trade (OWT), vertical intra-industry trade (VIIT), and Horizontal intra- industry trade (HIIT). VIIT has been increased whereas OWT has decreased in the case of parts and components. For the case of final goods, VIIT has increased and OWT has still remained at high level, which means that East Asia countries export them to Japan more than before. Moreover, outsourcing ratio has shown upward trend during the period, which means that Japan has relies more on parts and components from East Asia. In regression model, we have used outsourcing ratio and VIIT ratio as the indices of international specialization which may influence on labor productivity. The results show that outsourcing ratio has positive influence on labor productivity, although the VIIT coefficient does not statistically significant.

Field of Study : International Economics and Finance Student's Signature .....
Academic Year : 2012 Advisor's Signature .....

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CONTENTS

Page

LIST OF TABLES

TABLE Page

LIST OF FIGURES

FIGURE Page

FIGURE Page

CHAPTER I

INTRODUCTION

1.1 Introduction

Reciprocal trade relationship between Japan and East Asia[1] (ASEAN4, NIEs3, China and Hong Kong) has been getting deeper and deeper. U.S. had taken the position as the main trade and investment partner of Japan. However, as ASEAN and China have developed their economy, their importance as trade partners has been increased. How has Japan been trading with East Asia?

As we will see details later, recently vertical intra-industry trade (VIIT) pattern and fragmentation which means decomposition of production processes and the rearrangement of them into the most suitable places have been seen more in this area. Actually, this trade pattern and production pattern has been caused by the differences of skill and income level in this area. Ishido et al. (2003) claims that the increase of vertical intra-industry trade has been caused by FDI, and as income difference between host countries and investment countries become bigger, vertical intra-industry trade will be increased. Jones and Kierzkowski (2001) (2005) say that one of the reasons of expansion of trade amount is fragmentation taking advantage of differences in production skills. If firms really use these differences to establish the most suitable production systems with fragmentation, outsourcing, and VIIT, in other words, they progress their specialization of production, firm's productivity can be influenced by it. Since they aim at decreasing production cost by their activity, their

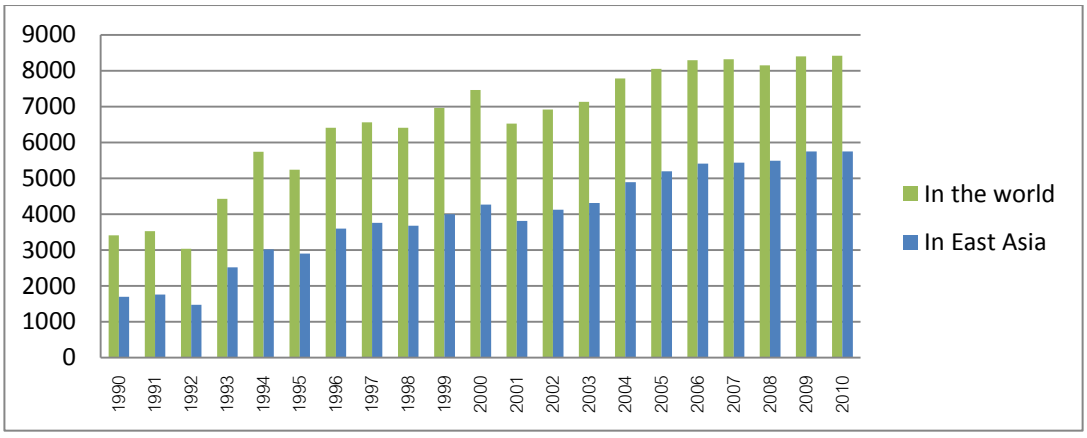
[1]In this thesis, East Asia includes 9 countries, China, Hong Kong, Taiwan, Korea, Thailand, Indonesia, Philippines, Malaysia and Singapore as East Asia. Fukao and Ito (2009) have also called above 9 countries East Asia.

productivity can be raised, we guess. We will focus on answering this question in this thesis. What we do first is that we will see how economy in the area has been developed as the background of the thesis. It is very useful to tell why we have above differences of each country in East Asia.

1.2 Background

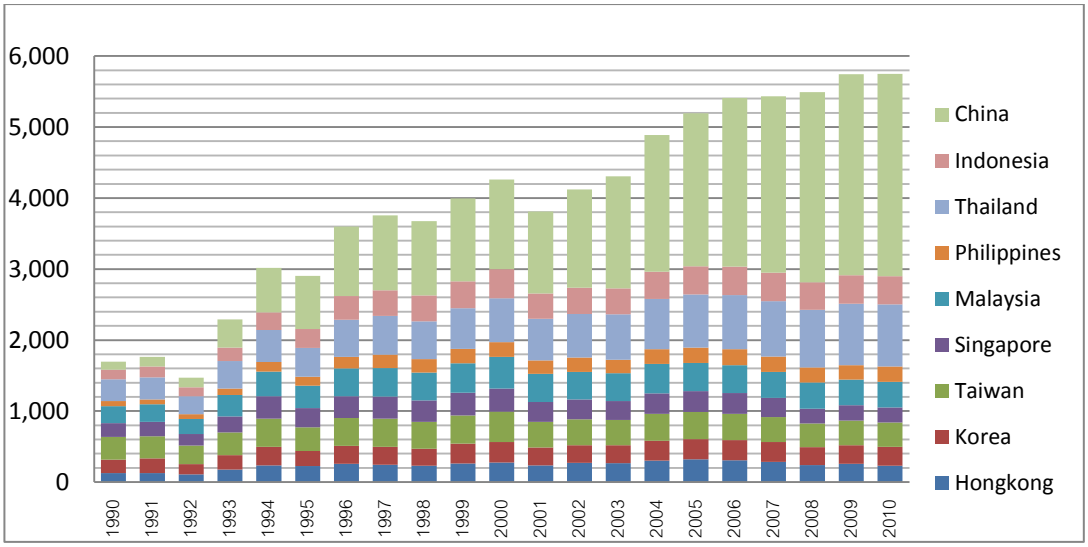
In East Asia, Japan developed first and it started to invest other countries. Japanese FDI to East Asia has been expanded since 1980s. At the beginning, it was actually headed for developed countries such as U.S. and E.U. in order to avoid trade barriers mainly, however, it has been headed for developing countries in East Asia to seek for lower labor costs, especially after Plaza agreement. In1990s, China started to attract FDI from many developed countries dramatically. We can see how Japanese FDI has been attracted by East Asia through figure1.2.1 and1.2.2. The number of MNEs of manufacturing sector in East Asia is about to reach to 6,000. Especially, China has dramatically attracted Japanese FDI. We look at the graphs of the number of Japanese MNEs of electrical machinery in 9 countries later, too.

Figure 1.2.1 No. of Japanese MNEs of Manufacturing Sector



Data source: Ministry of Economics, Trade and Industry in Japan

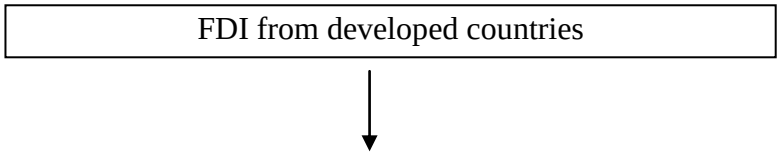
Figure 1.2.2 No. of Japanese MNEs of Manufacturing Sector in East Asia

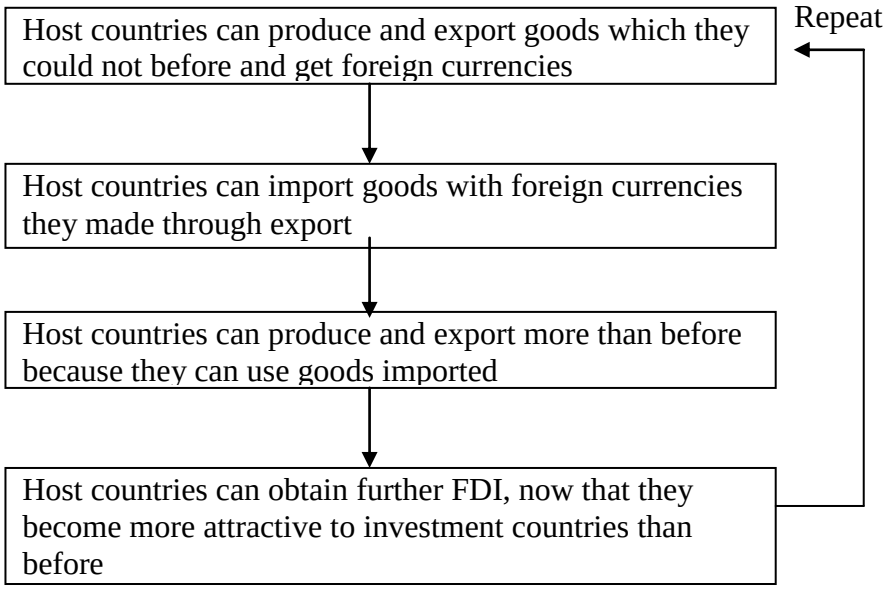


Data source: Ministry of Economics, Trade and Industry in Japan

According to the research paper written by Japan Bank for International Cooperation, Urata (2005), host countries can obtain many benefits from FDI to promote their economy, because FDI to host countries can bring investment in plant and equipment which they have not had before and they can start a new business. And also they can learn skills and management knowhow taking advantage of sales and supply networks. Host countries which are successful in increasing export can get foreign currency and they can import necessary goods, which promotes further economic development. This can attract further FDI from developed countries and host countries can export and import more than before. Economy of host countries has been developed by repeating this cycle over and over again. FDI and trade have brought economic development in this area. Below figure 1.2.3 is the summary of the above explanation.

Figure1.2.3 Relationship in FDI and Trade

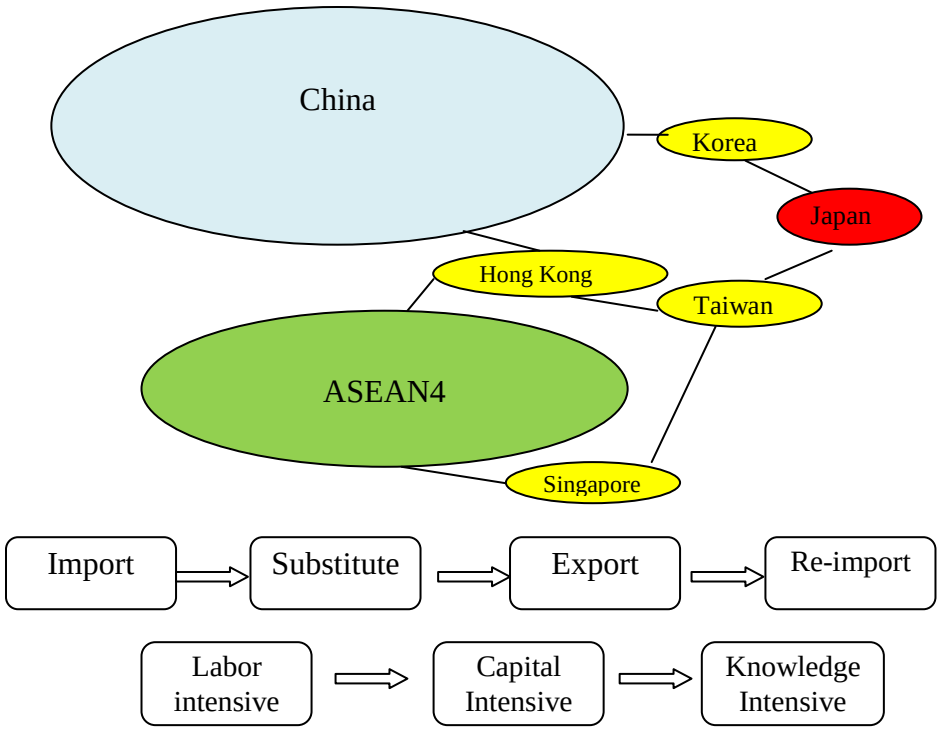




Data Source: Made by author depending on Urata (2005)

Also Kojima (1998) states economic development in East Asia in his model which is called geese model. There seems to have 3 important points. ①Each country in East Asia develops their economy following the life cycle. First they import a specific industry. Second they substitute domestic products for products imported. Third they start to export domestic products. Forth, they re-import products from the less developed countries with less production cost. ②They improve their industrial structure from labor intensive to capital intensive, and then to knowledge-skill intensive by repeating above process. ③As the result, Nowadays we have multilayered and complementary production and trade structure depending on comparative advantage in the area where Japan has developed first, then NIEs4, ASEAN, and China have been following Japan in order just like flying geese. Each economic area takes advantage of the difference of developing level and co-operates and complements each other.

Figure1.2.4 Flying Geese Model

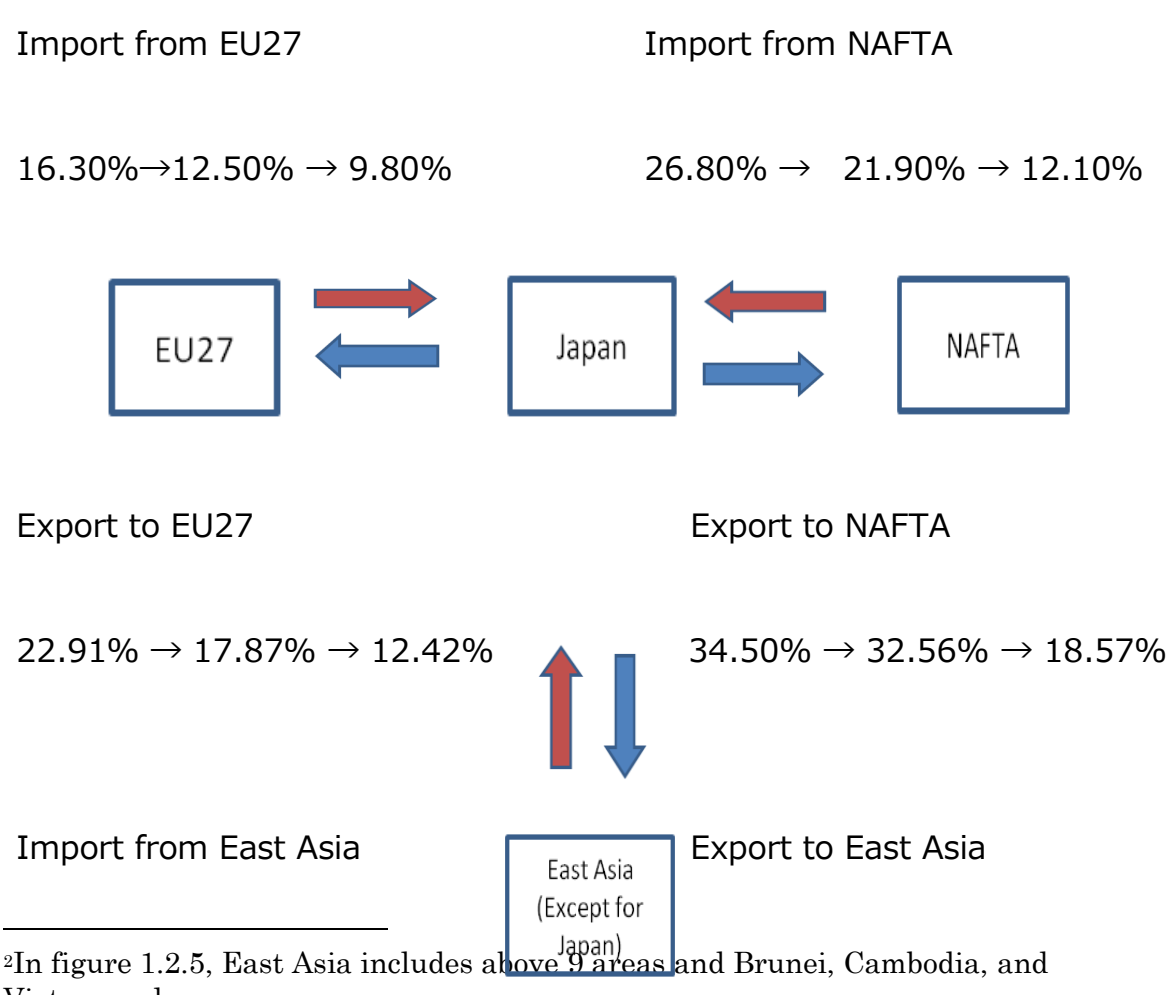


Data source: Made by author depending on Kojima (1998)

In addition, Shinozaki, Inui, and Nosaka (1998) says that firms develop their internationalization by taking 4 steps, export, organization of offshore sales network, start of offshore production, establishment of global production and sales networks. Ito (2003) says that most of Japanese firms have already reached to the fourth step. She says that labor- intensive goods such as textile and clothes are produced in Asia countries with lower labor cost and exported to Japan, at the same time capital intensive goods such as machine parts which need higher skill used in electrical and automobile industry are exported from Japan to the countries where assembly lines are located.

As we see above, many firms have shifted their production base to abroad and co-operated with foreign firms in the process to establish the most suitable production and sales systems. These activities of Japanese firms in East Asia have resulted in the increase of intra-industry trade and intermediate good trade as we see later. Here we can see how Japanese trade relationship with EU, NAFTA, and East Asia has been changed from 1990 to 2010 with figure1.2.5. Share of the trade between Japan and East Asia has been rapidly increased.

Figure 1.2.5 Shares of Total Trade Amount among 3 Economic Areas[2]



[2]In figure 1.2.5, East Asia includes above 9 areas and Brunei, Cambodia, and Vietnam, also.

32.19% → 41.07% →

27.50% → 40.70% → 42.60%

56.67%

Data Source: Author made depending on RIETI-TID2011

As we also see below table 1.2.1 showing sales figure of Japanese foreign affiliates in East Asia, the total sales figures in the areas has been 94227.5 billion in 2001. However, it has been increased to 120205.9 billion in 2010 although its peak has been 144035.2 billion in 2007. The sales figures of Japanese affiliates in the areas have been increased by about 28% during this period.

Table 1.2.1 Sales Figures of Japanese Affiliates in 9 Countries

Unit : Billion Yen

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
China	23085.8	16022.0	23800.9	31047.2	37507.6	45483.3	59909.1	51780.0	44875.1	44294.5
Hong Kong	12319.5	13730.7	17028.2	20528.6	19423.3	19948.2	19101.4	16542.0	16037.4	16025.5
Indonesia	4780.3	5365.5	5320.0	5636.1	6128.2	5113.9	5077.2	4212.7	4305.9	4792.8
Korea	2805.2	3195.6	3722.0	3116.7	3882.8	6952.4	4412.2	3790.5	3933.9	5219.2
Malaysia	14417.1	15067.2	26413.7	16010.2	14449.3	14982.8	13158.5	9532.5	8115.9	11419.8
Philippines	8496.3	8270.9	7767.1	7239.3	7618.8	7831.1	7187.0	6758.9	5246.5	5094.7
Singapore	13096.6	12260.2	14339.7	15211.8	16211.7	15529.0	10367.1	7696.5	8025.4	10053.0
Taiwan	7157.9	8044.3	8909.1	8794.4	10794.8	10431.7	7836.5	6661.5	5821.5	8925.4
Thailand	8068.7	8974.9	9276.0	12166.1	13211.2	14332.8	16986.2	14426.0	11740.9	14381.0
Total	94227	90931	116576	119750	129227	140605	144035	121400	108102	120205

.5 .3 .6 .3 .5 .2 .2 .5 .5 .9

Data source: Survey on Overseas Business Activities by Ministry of Economy, Trade and Industry

We also show the table of trends in the overseas production ratio by sector to tell how electrical machinery industry does overseas production at below table 1.2.2.

Table1.2.2 Trends in Overseas Production Ratio by Sector

(calculated based on the total number of domestic companies (manufacturing industries))

(Fiscal Year) (%)

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Manufacturing Total	11.4	11.8	14.3	14.6	15.6	16.2	16.7	18.1	19.1	17.0
Food	2.8	2.7	4.5	4.6	4.9	4.4	4.2	4.2	4.9	3.8
Textiles	8.2	8.0	6.7	6.6	8.4	7.3	6.3	9.0	11.1	9.5
Lumber, wood, paper, and pulp	3.4	3.8	3.8	4.3	3.8	4.2	3.0	4.7	4.2	3.7
Chemicals	10.3	11.8	12.6	13.4	13.6	15.3	14.8	17.9	16.6	17.4
Petroleum and coal	1.2	1.4	1.5	2.0	1.6	1.8	2.6	4.4	2.5	1.3
Ceramic, stone, and clay products	7.5	8.1	5.2	5.8	5.3	6.3	6.6	12.0	10.7	11.8
Iron and steel	8.9	14.0	16.2	8.9	9.4	10.6	9.6	10.6	11.7	10.3
Non-ferrous metals	9.0	9.4	10.2	10.1	7.9	9.4	10.2	10.3	12.1	11.0
Metal products	1.3	1.6	1.8	1.9	1.6	1.7	2.2	2.6	3.4	2.5
General machinery	11.0	10.8	10.2	10.1	10.7	11.7	13.1	14.3	14.4	12.8
Electrical machinery	**17.6**	**18.0**	**21.6**	**21.0**	**23.4**	**42.6**	**45.9**	**45.8**	**43.7**	**41.1**
Transportation equipment	23.4	23.7	30.6	32.2	32.6	36.0	37.0	37.8	42.0	39.2
Precision instruments	11.0	11.2	12.0	12.9	12.8	12.4	13.8	8.9	9.4	7.9
Miscellaneous manufacturers	4.9	4.6	5.2	6.1	6.0	7.9	9.4	9.7	9.3	9.1

Note 1: Overseas production ratio based on all domestic companies

= Sales of overseas affiliates (manufacturing industries) / (Sales of overseas affiliates (manufacturing industries)

+ Sales of domestic companies (manufacturing industries)) × 100.0
Note 2: Since the overseas production ratios by sector for FY2007 and FY2008 were aggregated by rearranging the survey results
with old sector classifications for business statistics, the survey results have been incorporated into the old sector
classifications, aggregated, and calculated. In FY2009, the table displays sectors in the new classification.
Note3:Since 2001, electrical machinery has been decomposed to electrical machinery and information and communication electronics equipment, however author combines them and show above table as electrical machinery.
Source: Summary of the 39th and 40th Survey on Overseas Business Activities

We can see that the ration has been rapidly increased. In 2008 it has reached to 41.1% although it has been in decreasing trend since 2005. However, we can at least say that it is meaningful to focus on electrical machinery industry.

1.3 Objective and Questions

1.3.1 Objective

As we said in introduction part, we will research that how specialization of production in electrical machinery has proceeded and how it influenced on labor productivity. We recognize production specialization as exporting up-grade goods and importing down-grade goods. To research it, we focus on vertical intra-industry trade and intermediate trade, especially imported intermediate goods (outsourcing) to know how the trend has influenced on labor productivity in Japanese firms because are the very ways that we know that international specialization has been proceeded.

1.3.2 Questions

Questions to fulfill our objective will be like below.

Question1

How have trades between Japan and East Asia (9 areas) been in electrical machinery industry? In the trades, in what production stage goods has Japan had comparative advantages of the industry?

To answer this question, first we will obtain both trade specialization index, using the data from RIETI-TID2011. This data search engine provides us the amount of primary, intermediate, and final goods from 1980 to 2010 of each country which we want to analyze, which means that it is very suitable to use it for the research for intermediate goods trades. We will understand more the surroundings of trade in East Asia through the analysis of production stage level than when we just do industry analyze only because we can see it not only from industry's point of view but also from production stage level's view. We will see the answer through graphs, tables, and figures in descriptive ways. We will obtain outsourcing ratio in electrical machinery when we research intermediate goods trade, too.

Question2

Is vertical intra- industry trade pattern still now being expanded in East Asia?

We will use the data from trade statistics of Japan to answer this question, and ask for the share of 3 trade patterns, horizontal, vertical, and one-way trade depending on each unit price. If Japan has exported up-graded goods and imported down-graded ones, production specialization has been progressed in East Asia.

Question3

Do the growth of imported intermediate goods and from East Asia and VIIT with East Asia increase labor productivity in electrical machinery industry of Japan?

We will run regression model to obtain the answer. We find the determinants of labor productivity first. We will see if they are in a positive relationship with labor productivity or not. If Japan specializes in export of up-graded products and it imports down-graded products or if Japan focuses on capital-intensive goods, importing labor-intensive goods, firms in Japan may increase their productivity.

1.4 Scope

At first, we would like to explain the definition of electrical machinery industry in this thesis. Since we will use some statistics data and their ranges of electrical machinery industry differ from each other, we have to adjust them as fit as possible. In order to do it, we combine household appliances industry with electrical machinery industry in RIETI-TID2011 and we call it electrical machinery industry. When we use the statistics data of basic survey of overseas activity and Survey of Overseas Activities, we combine electrical machinery industry with information and communication equipment industry and recognize it electrical machinery industry manufacturing. We will adjust 2 different statistics like above. Regarding to trade statistics, we will deal chapter 85 of the statistics as electrical machinery industry, electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles. And also we will use financial statements statistics of corporations by industry from ministry of finance of Japan.In the statisticswe will combine electrical machinery industry with information and communication equipment industry. We can see the summary of above explanation in the below table 1.4.1.Regarding to time range of our research is between 1990 and 2010.

Table 1.4.1 Summary of Statistics Data in this Thesis

Statistics Name	Conducted by	Electrical Machinery Industry in the Thesis
RIETI-TID2011	Research Institute of Economy, Trade, and Industry of Japan	Household Appliances + Electrical Machinery
Basic Survey of Japanese Business Structure and Activities	Ministry of Economy, Trade, and Industry of Japan	Electrical Machinery + Information and Communication Equipment
Survey of Overseas Activities	Ministry of Economy, Trade, and Industry of Japan	Electrical Machinery + Information and Communication Equipment
Yearbook of Machinery Industry	Ministry of Economy, Trade, and Industry of Japan	Questionnaire numbers 28-39
Financial Statements Statistics of Corporation	Ministry of Finance of Japan	Electrical Machinery + Information and Communication Equipment
Trade Statistics	Ministry of Finance of Japan	Chapter 85, electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles.

Data source: Made by Author

CHAPTER II

BACKGROUND OF BILATERAL TRADE OF JAPAN WITH EAST ASIA

In this chapter, we will see bilateral trade between Japan and 9 countries which are our research object because we think that to get overview or picture of trades with them is also important. After we see the survey of it from the industry level of data, we will also see it from the production stage base data and we will obtain trade specialization index with production stage base data. Through this processes, we believe that we can get overview as background. And through this chapter we can answer our question1 in this thesis.

2.1Background of Bilateral Trades between Japan and 9 Countries

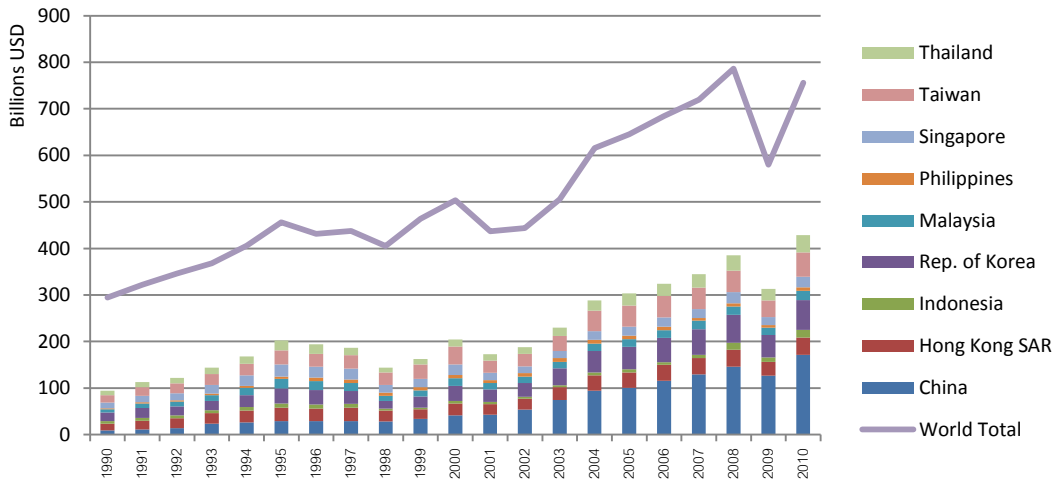
We will see in this part not only trade amount in bilateral trade between Japan and 9 economic areas but also see export and import to deepen our understanding on it with comparing electrical machinery to other industries. We would like to take 3 steps, export, import, and trade amount in this part. We have also prepared appendix A and appendix B. We can see how the position of electrical machinery industry in each country between 1990 and 2010 has been from the perspective of both export and import. Through appendix A and B, we can say that products in electrical machinery industry are traded actively in most of countries.

2.1.1 Japanese Export to 9 Countries

At first, we will show export of the total industry to each country and its ratios. Second, we will show export of electrical machinery industry and its ratios by area. At last, we will show ratios of electrical machinery of each country to total industry by country (Japanese export of electrical machinery industry to each country / Japanese export of total industry to each country).

As figure2.1.1 shows, Japanese total export to 9 areas has been less than 100 billion in 1990, however it increased to about 200 billion in 2000 and it has peaked to around 430 billion in 2010. In these 21 years, it has been more than 4 times larger and no area has decreased Japanese export. Especially, export to china has been expanded rapidly since 2000.

Figure 2.1.1 Japanese Export to 9 Countries in Whole Industry



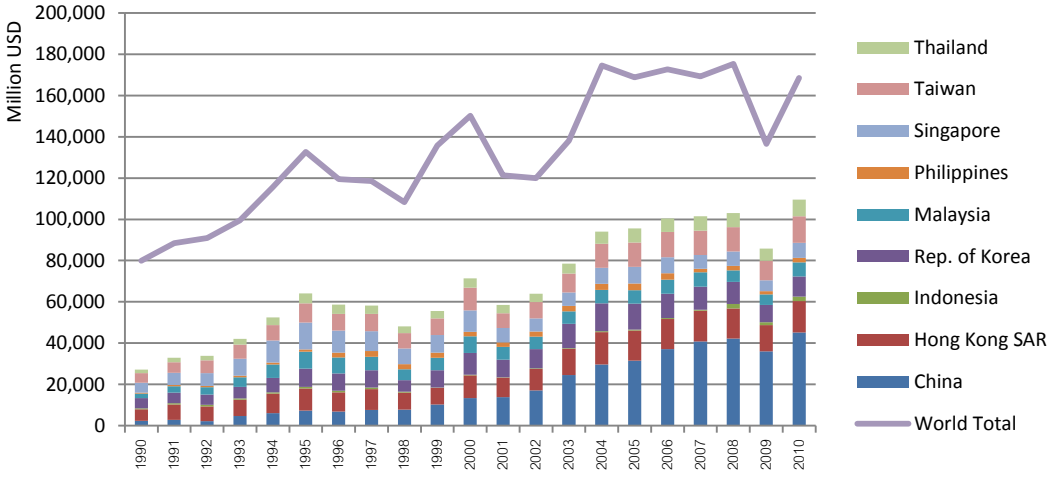
Data Source: Author made depending on RIETI-TID2011

Ratio of Japanese export to China in total industry in East Asia Trade in 1990 has been less than 10%, but it has kept increasing to nearly 40% in 2010. As the result, ratios of other area have been decreased. Korea, Taiwan, and Thailand have still been important export partners for Japan during the period in East Asia. Export of Japan to

East Asia has taken more than 50% share to world export in 2010. In the next figure 2.1.2, we will see export of electrical machinery industry.

In electrical machinery industry, Japanese export has been about 27 billion in 1990. However, it has been over 70 billion in 2000. Furthermore, it has kept increasing to almost 110 billion USD in 2010. We can see the dramatic increase of Japanese export to China here in figure 2.1.2, too. About 2 billion's export to China has been increased to 45 billion in 2010. All areas have increased Japanese export in electrical machinery industry in these 21 years. Hong Kong, Korea, Taiwan, and Thailand have also been major export partners, too. The increase of Japanese export to China has been prominent and Chinese ratio has been over 40% in 2010 in East Asia as we can see it in figure 2.1.2. Hong Kong and Taiwan have been around 10% in 2010. And Korea has been about 9 %.areas following China in 2010. Ratios of Japanese export to East Asia to the world have been taken large shares. In 2010, export to the world has been about 170 billion and 110 billion out of it has been headed for East Asia.

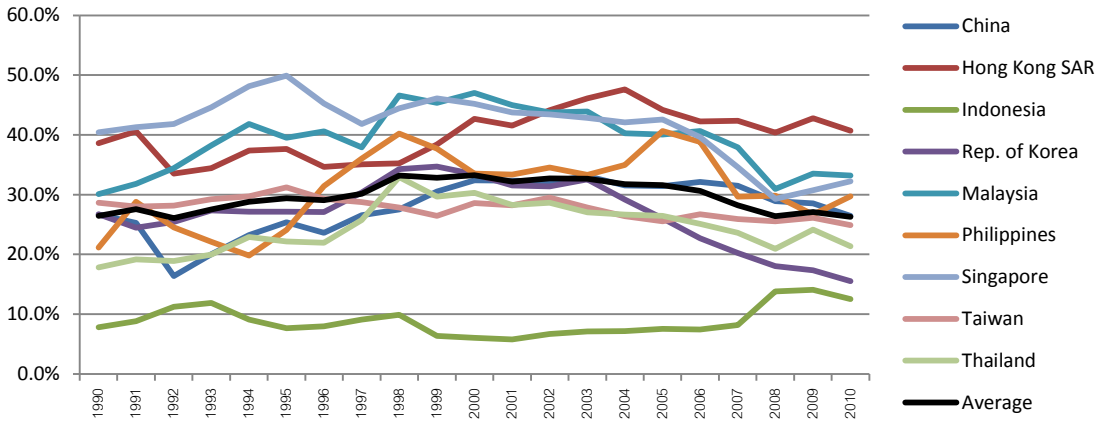
Figure 2.1.2Japanese Export to 9 Countries in Electrical Machinery



Data Source: Author made depending on RIETI-TID2011

In the below figure 2.1.3, apart from Indonesia, ratios of Japanese export of the industry have been large during the period. Between 1993 and 2007, all areas except Indonesia have taken more than 20%. Since 1996, their ratios have increased and most of areas have been over or almost 30%. After 2004, the ratios have shown down-ward trend, but except for Korea and Indonesia, export ratios of the industry have still been over 20% in all areas in 2010. The ratio of Hong Kong has been at the level of 40%, and Malaysia, Singapore, and Philippines have still been at the standard of 30%. The average percentage of 9 countries in 2010 has been more than 26%. Therefore, we can say that electrical machinery industry has taken a big role in export. As we said, we can see the position of the industry in total export, comparing other industries in appendix A.

Figure 2.1.3 Ratios of Japanese Export of Electrical Machinery to Total Export



Data Source: Author made depending on RIETI-TID2011

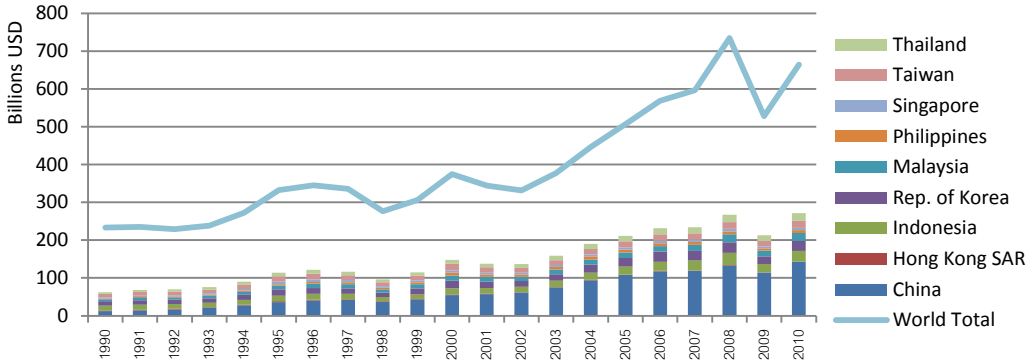
2.1.2 Japanese Import from 9 Countries

First, we will show import of the total industry to each area and its ratios by area. Second, we will show import of electrical machinery industry and its ratios by

area. At last, we will show ratios of electrical machinery of each country to total industry by country (Japanese import of electrical machinery industry from each country / Japanese import of total industry from each country).

In the below Figure2.1.4, Japanese import in total industry from 9 countries has increased dramatically during the period as well as export. In 1990, it has been at the level of just 60 billion, but it has been increased to about 150 billion in 2000 and almost 270 billion in 2010 which has been the peak. Apart from Hong Kong, all areas have expanded its export to Japan. Hong Kong has shown down-ward trend although export has expanded. Areas following China have been Indonesia, Korea, Malaysia, Taiwan, and Thailand. Indonesia and Korea have exported approximately 300 billion and Malaysia, Taiwan, and Thailand have done 200 million to Japan in 2010. Regarding to Ratios, In 2010 Japanese import from China has remarkably been over 50% in 2010 although it has been less than 20% in 1990.

Figure2.1.4 Japanese Import from 9 Countries in Whole Industry

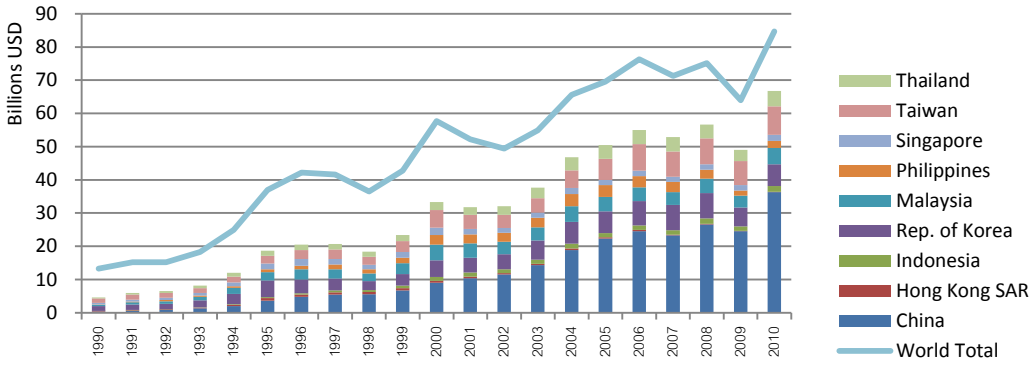


Data Source: Author made depending on RIETI-TID2011

Next we will focus on electrical machinery industry. As we can see in figure 2.1.5, Japanese import from 9 areas has been quite small. It has less than 5 billion USD in 1990, but it has increased to more than 30 billion USD in 2000 and it has become almost twice larger in 2010, 66 billion USD which has been the peak. Expect

for Hong Kong, all areas have increased their export to Japan in the industry. About ratios, Almost 60% has been occupied by Korea and Taiwan in 1990 on the other hand, China has been very small, less than 10 %. However, the shares of Korea and Taiwan have gradually been decreased to around 25% and China has taken more than 50% of the share in 2010. Japanese import of the industry from the world has been almost 85 billion and approximately 67 billion out of it has been from East Asia which means that around 80% of the whole import has come from East Asia, remarkably.

Figure 2.1.5 Japanese Import from 9 Countries in Electrical Machinery

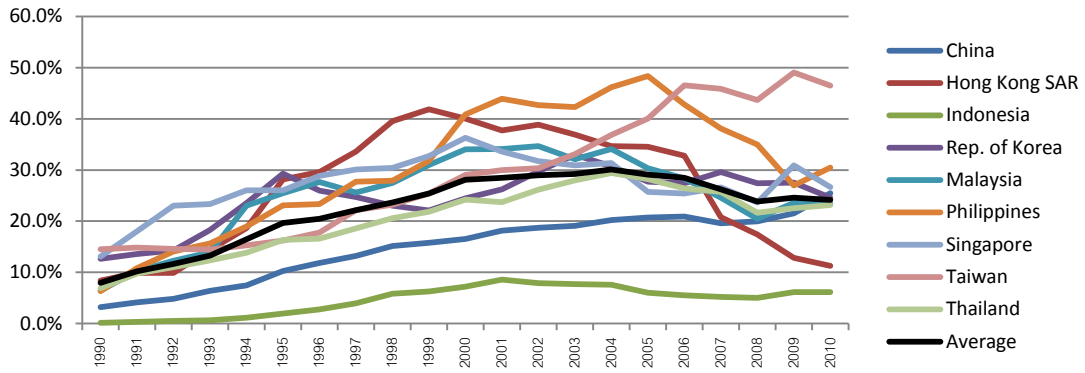


Data Source: Author made depending on RIETI-TID2011

In the below figure 2.1.6, we can tell how the industry has taken the position in total industry of import by area. The ratios of all areas have been at the standard of less than 20% in 1990. However, they have kept showing up-ward trend. All areas except for China and Indonesia have reached to more than 20% in 1998. After it, they have been increased. In all countries except for China and Indonesia, import of the industry has been taken around 30% to import of total industry around 2004 as we can say it the line of average of 9 countries. After 2004, they have shown down-ward trend, but they have been taken about 25% in all areas except for Hong Kong and Indonesia in

2010. The average has shown 24% in 2010.Therefore, we can say that electrical machinery industry has taken a big role in import, too.

Figure2.1.6 Ratios of Japanese Import of Electrical Machinery to Total Import



Data Source: Author made depending on RIETI-TID2011

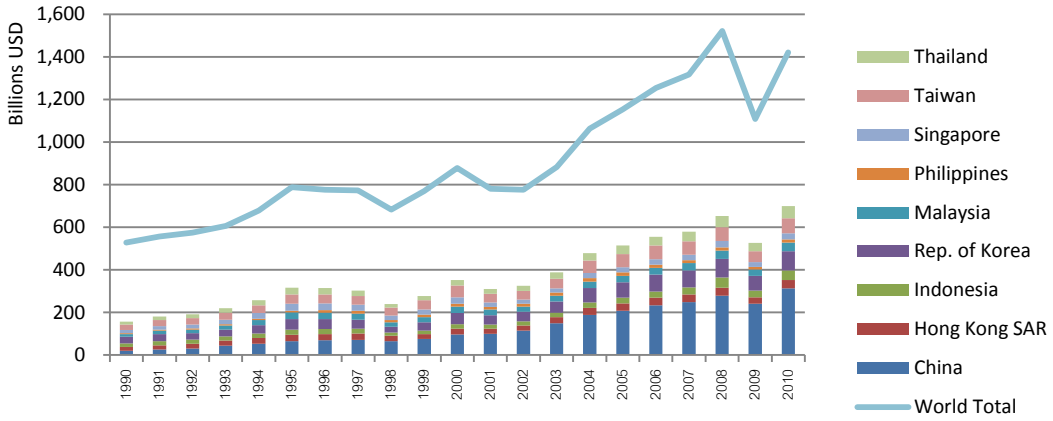
2.1.3 Trade Amount between Japan and 9 Countries

So far, we have seen Japanese export and import in bilateral trades with the 9 countries separately. Now we will see the trade amount which can be asked for by combining them. We follow the way which we have done in this part, too. First, we will see total industry trade and its ratio by the areas. Second we will move on to electrical machinery industry. Third, we will show ratios of electrical machinery trade of each country to total industry trade by area (electrical machinery industry trade / total industry trade).

As we can see the below figure 2.1.7 which we have simply combined Japanese export and its import in the trades with 9 countries, trade amount in total industry has been only about 180billion in 1990. It has increased to almost 350 billion in 2000 and has reached to approximately 700 billion in 2010 when it has peaked.The largest trade partner has been China, and the second and the third largest trade partners have been

Korea and Taiwan in these 9 countries. Trade amount with China has been over 300 billion, about 90 billion in trade with Korea, and 70 billion in trade with Taiwan in 2010. These 3 areas have occupied approximately 70% out of total trade amount in these 9 countries in 2010 when trade with the world has been about 1400 billion and half of it has been headed for East Asia.

Figure2.1.7 Trade Amount in Whole Industry



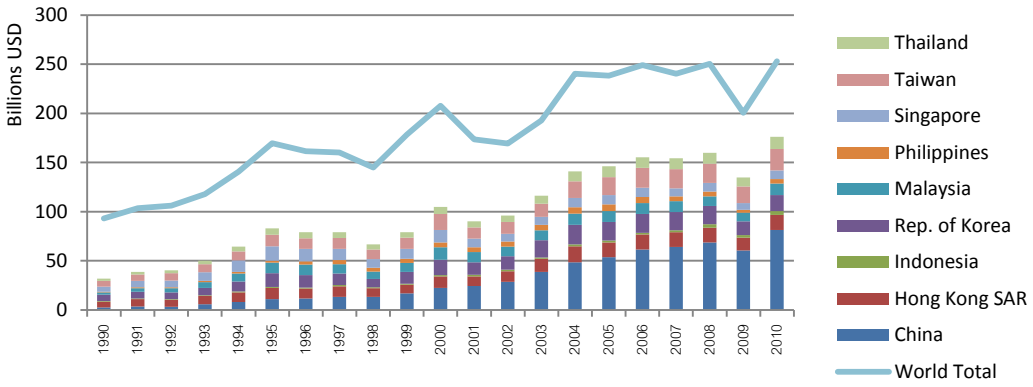
Data Source: Author made depending on RIETI-TID2011

In the next figure 2.1.8, trade amount in electrical machinery has been just over 30 billion USD in 1990. However it has expanded to more than 100 billion USD in 2000 and it has kept increasing to over 170 billion USD in 2010 when it has peaked.

In electrical machinery trade, China has been the largest trade partner in 9 countries and its trade share has been beyond 45 % in East Asia in 2010 although its share was very small in the beginning of 1990s. The second largest one has been Taiwan whose share has been nearly 12% and the third largest one has been Korea whose ratio has been over 9% in the area in 2010 when Hong Kong has been the fourth largest trade partner for Japan. Although its share has been almost 9% in trade shares in 2010, it mainly has come from Japanese export. Import from Hong Kong to Japan in the

industry has been less than 1 % in 2010. About 70% of world trade has been occupied by 9 countries in 2010.

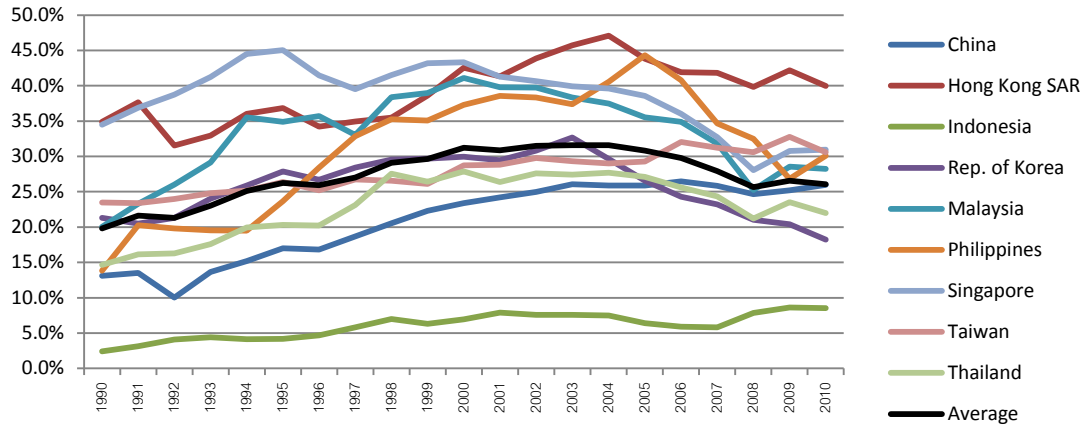
Figure 2.1.8 Trade Amount in Electrical Machinery



Data Source: Author made depending on RIETI-TID2011

In figure 2.1.9, at the time of 1990, there has been a wide range from 3% to 35%. For Korea and Singapore, all areas have increased their ratios during the period. However, in most of areas, their ratios have shown down-ward trend since around 2004. Only China, Taiwan, and Indonesia have shown up-ward trend after 2004, too. As long as we see the average of 9 countries, it seems like that the peak of the ratio has already passed by except for above 3 areas. However, the ratio of the average has still been at the level of more than 25%. Hence, we can say that the industry has still taken the important role in trades of East Asia.

Figure2.1.9 Ratios of Electrical Machinery Trade to Total Industry Trade



Data Source: Author made depending on RIETI-TID2011

2.1.4 Summary of Background

So far, we have seen the background of bilateral trades between Japan and 9 countries. In this section, we would like to summarize it.

1. Export from Japan to 9 countries in East Asia has been larger than that of import in total industry as well as electrical machinery.
2. Both export and import have been increased during the period of 21 years. The increase in both export and import has been drastic.
3. The increase of trade with China has been significant. Trade between Japan and China in electrical machinery industry has been almost 80 billion USD and it has taken the share of about 45% in 2010.
4. Japanese Export to Hong Kong has been increased to 36 billion in 2010, whereas its import from Hong Kong has decreased to 100 million in 2010 from 170 million in 1990.

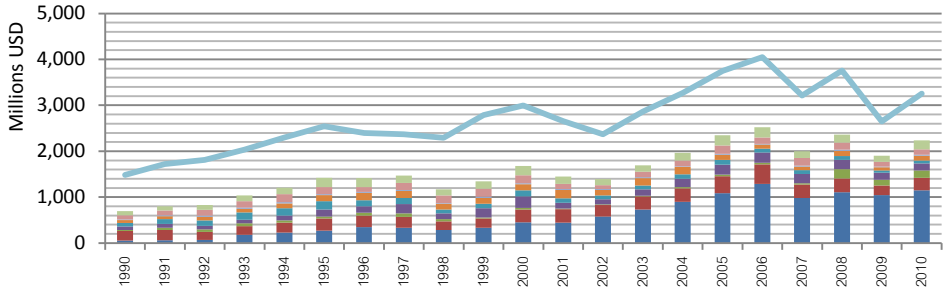
5. Although it seems like that we have had its peak around 2004 in East Asia, electrical machinery industry of each area has still taken a big role in bilateral trades between Japan and East Asia. As appendix A has shown, precision and general machinery industry have taken big shares in some countries.
6. Comparing other areas, Indonesia has always had less trade amount of electrical machinery through the period. However it has become larger gradually.
7. For Japan, shares for East Asia in the world trade have been quite large, which means that these economic areas in East Asia have been quite important trade partners.

2.2 Background of Bilateral Trades by Production Stage in Electrical Machinery

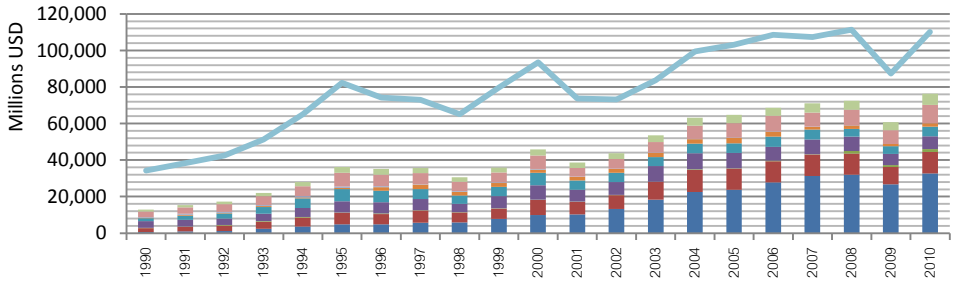
So far, we have seen the survey of electrical machinery industry in bilateral trades between Japan and her trade partners. In this section, we will see it from the production stage base's point of view. Firstly, we will see export, import and trade of it. Secondly, we will see the ratio of them. Thirdly, we will see a table showing the transition classified by 3 areas, China, NIEs4, and ASEAN4. Lastly, we will show trade specialization index with production stage base data to grasp the trade structure well. In the below figure 2.2.1, Japan has increased its export to 9 countries and the world too.

Figure 2.2.1 Japanese Export to Each Country by Production Stage Base

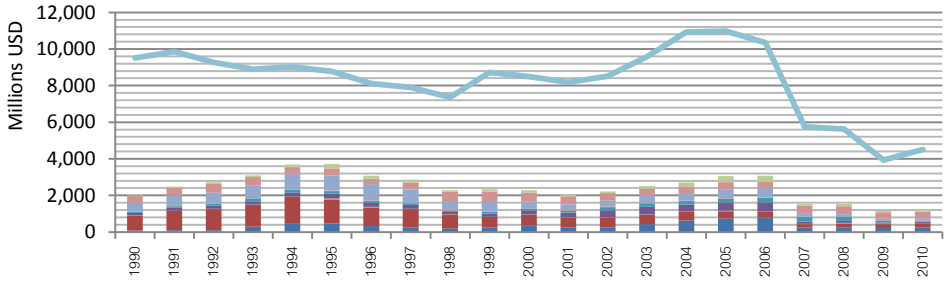
(a) Processed Goods



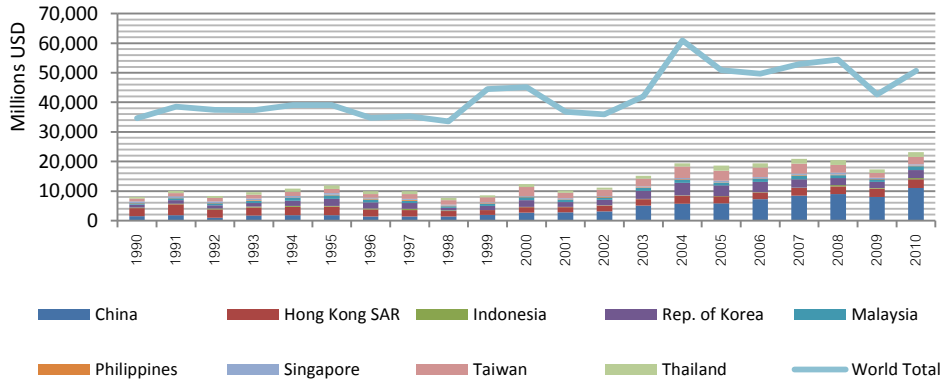
(b) Parts and Components



(c) Consumption Goods



(d) Capital Goods



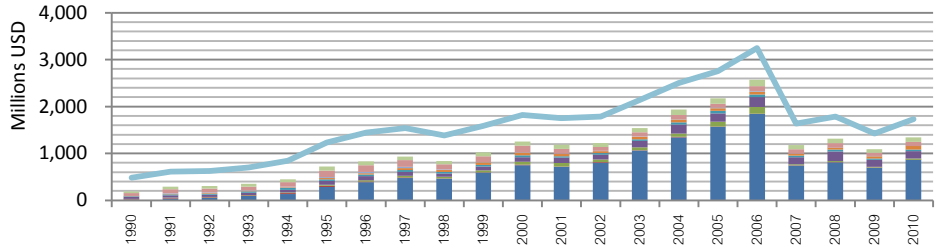
Data Source: Author made depending on RIETI-TID2011

Regarding to Consumption goods, Japan has decreased its export to 1.2 billion in 2010 but other production goods has been increased. Especially, parts and components have been drastically increased to 76 billion in 2010 although they have been only about 10 billion in 1990. Capital goods have been at the standard of less than 10 billion in 1990, but they have shown a gradual increase during the period and have reached to more than 20 billion in 2010 when they have peaked. Processed goods have also been increased to 2 billion in 2010 although the scale of export has been the smallest compared to other production stages. As we can see, exports of processed goods and parts and components from Japan have been mainly headed for East Asia. Consumption goods and capital goods which are called final goods have not been actively exported very much compared to parts and components and processed goods which are called intermediate goods.

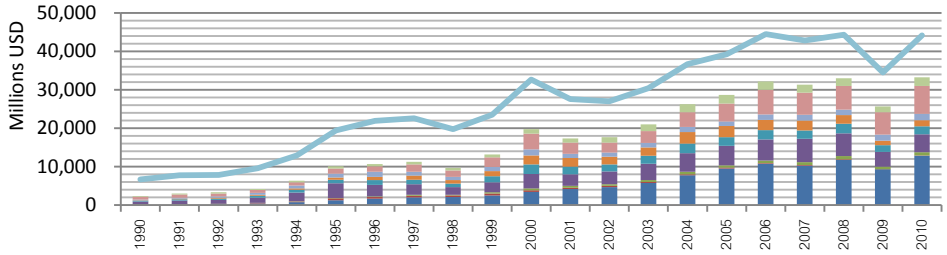
Regarding to Japanese import form 9 areas, as we can see it in the below figure 2.2.2, consumption goods and capital goods have been showing their rapid increase during the period of 21 years. In the beginning of 90s, import of them has been smaller than export of them. However, import of them has increased and become larger than export in 2010 when they have peaked. And most of them have been imported from East Asia. Especially, consumption goods imported from 9 areas have been at the almost same standard as world total in 2010. Japan has not exported actively final goods compared to intermediate goods, but instead increased their import during the period. And import of parts and components have also been increased to about 32 billion in 2010 which they have peaked, which implicates that outsourcing ratio to total domestic product in electrical machinery industry has been increased.

Figure 2.2.2 Japanese Import from Each Country by Production Stage Base

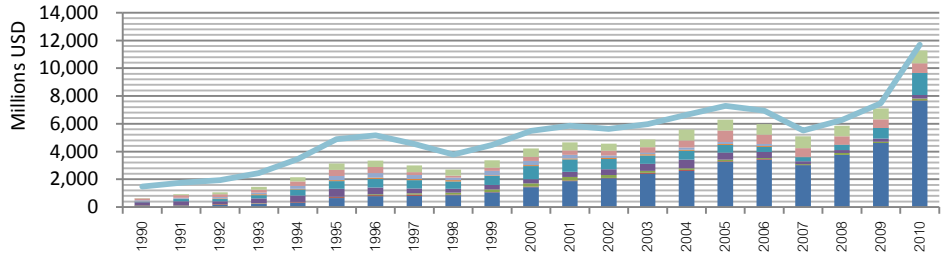
(a) Processed Goods



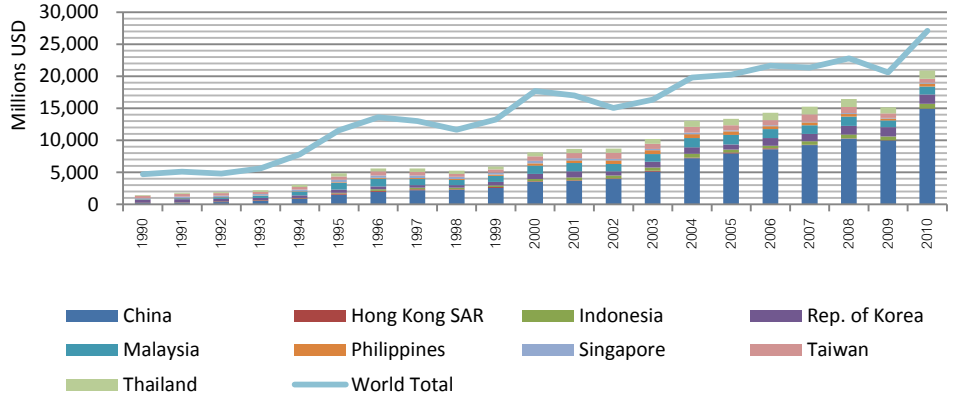
(b) Parts and Components



(c) Consumption Goods



(d) Capital Goods

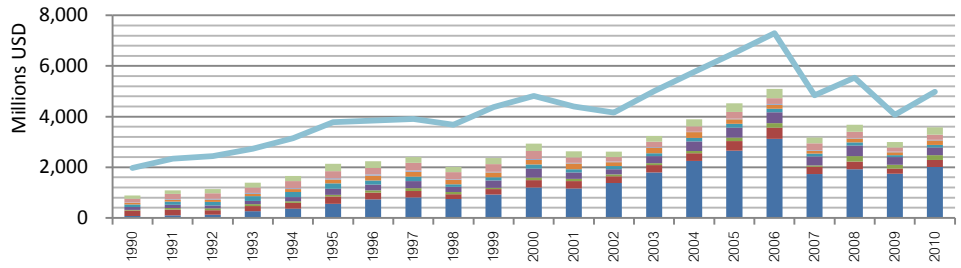


Data Source: Author made depending on RIETI-TID2011

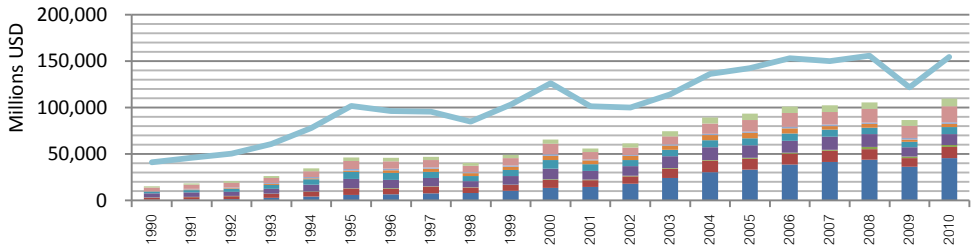
The next figure 2.2.3 shows bilateral trade (export + import) in each production stage base. We can tell that how East Asia has become important trade partners of Japan in electrical machinery. In process, parts and components and consumption goods, more than 2/3 in these trades is taken by East Asia. And more than 1/2 in capital goods is done in capital goods.

Figure2.2.3 Bilateral Trade by Production Stage Base

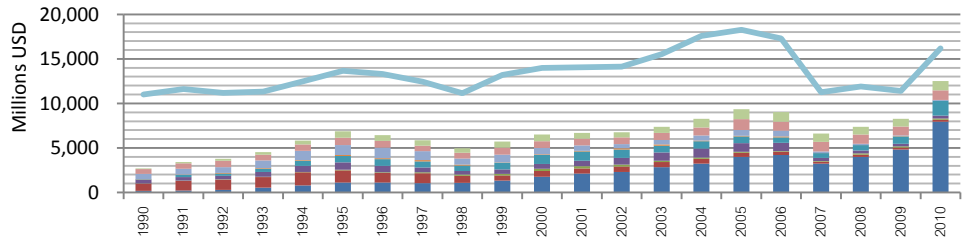
(a) Processed Goods



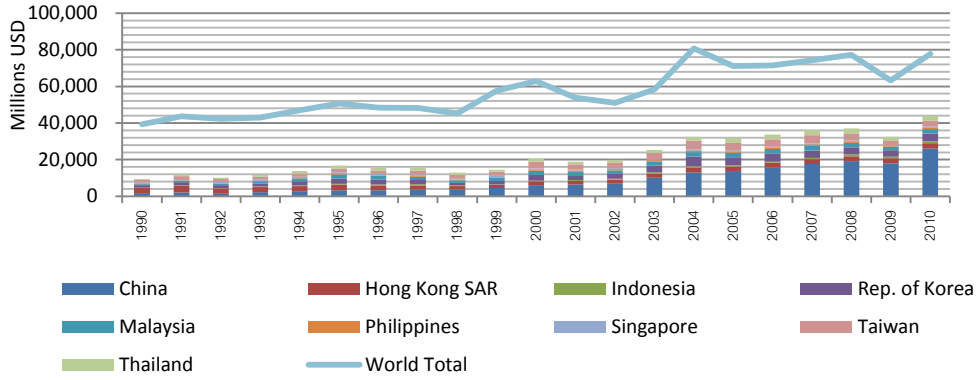
(b) Parts and Components



(c) Consumption Goods



(d) Capital Goods



Data Source: Author made depending on RIETI-TID2011

So far, we have seen both Japanese export and import. We can summarize it like below.

1. Japanese export of intermediate goods (especially, parts and components) has increased significantly, but on the other hand capital goods have not actively exported.
2. Japanese import of final goods has increased drastically as well as parts and components.
3. Parts and components have increased in both export and import.

2.3 Ratios of Each Production Stage in Electrical Machinery

At first, we will survey the ratios of each production stage in each country. We have prepared the figures of production stage ratio in bilateral trades of electrical machinery industry between Japan and each country in Appendix C, we will see the ratios of each production stage of East Asia which we have combined 9 countries. Through the ratios, we will deepen our understanding of bilateral trades by production

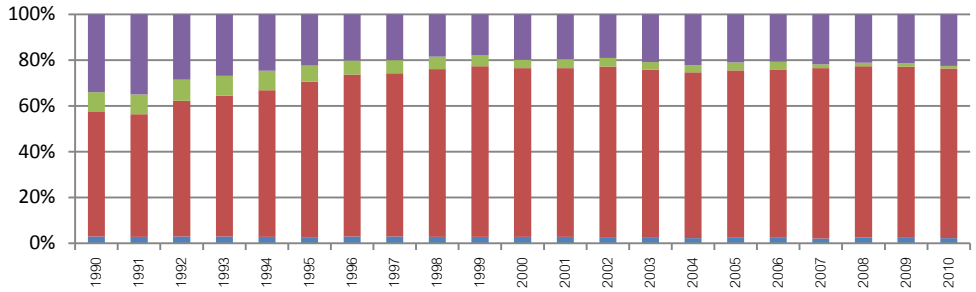
stage base between Japan and the whole East Asia from the perspectives of export, import, and total.

As we can see appendix C, shares of intermediate goods (parts and components and processed goods) have become larger in each country through the time. In the beginning of 90s, shares of final goods (capital and consumption goods) have taken somewhat in China, Hong Kong, Philippines, Singapore, and Taiwan but the shares have been taken by intermediate goods, mainly parts and components. In 2010, around 60% of trade share in each country has been taken by parts and components.

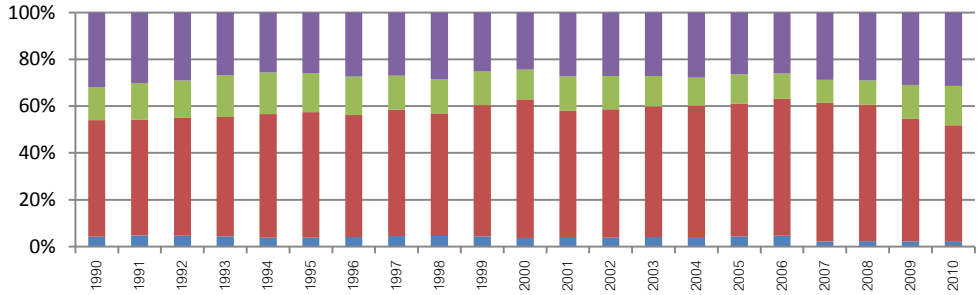
In the below figure 2.3.1 which shows ratios of each production stage in bilateral trade between Japan and East Asia, shares of final goods of Japanese export have become smaller to about 20% in 2010 although it has been more than 40% in 1990. In Japanese import, shares in 2010 have not shown prominent changes compared to 1990. Approximately 50 % of parts and components have been exported to East Asia in 2010. Since 2006, import of final goods from East Asia to Japan has shown its increase. Import of parts and components has been smaller than that of export but it has taken a big role of it. Parts and components have taken around 65 % of share in trade (export and import). We have also prepared table 2.3.1 which shows us ratios of intermediate and final goods to 3 areas, China, ASEAN4, and NIEs4 in both export and import.

Figure 2.3.1Ratios by Production Stage in Electrical Machinery

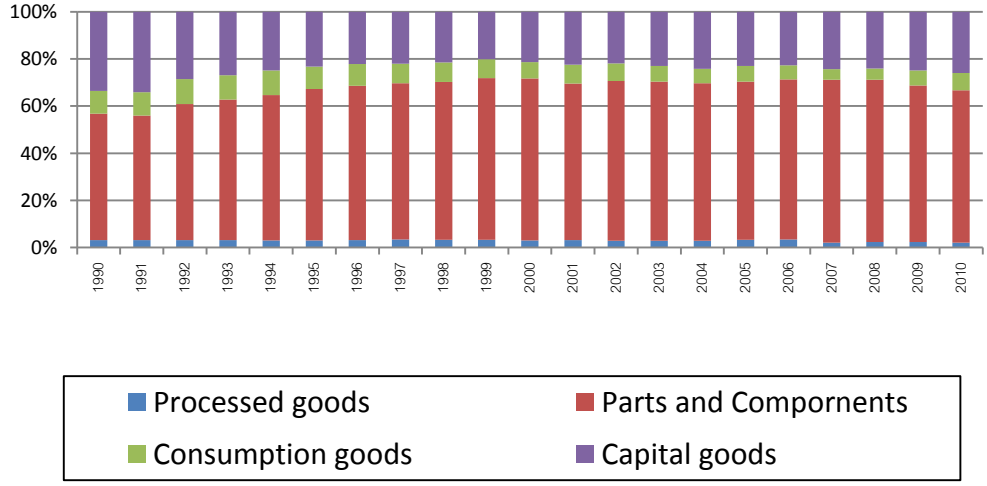
(a) Export



(b) Import



(c) Trade (Export + Import)



Data Source: Author made depending on RIETI-TID2011

Table 2.3.1 Japanese Export and Import Ratios to 3 Areas[3]

(a) Export

Area	Type of Goods	1990	2000	2010
China	Intermediate	3%	17%	**33%**
	Final	7%	5%	11%
ASEAN4	Intermediate	14%	20%	15%
	Final	6%	4%	4%
NIEs4	Intermediate	40%	39%	28%
	Final	30%	15%	**9%**

(b) Import

Area	Type of Goods	1990	2000	2010
China	Intermediate	2%	12%	**21%**
	Final	6%	15%	**34%**
ASEAN4	Intermediate	11%	21%	10%
	Final	6%	13%	10%
NIEs4	Intermediate	41%	30%	**20%**
	Final	34%	9%	**5%**

Data Source: Author made depending on RIETI-TID2011

In export, intermediate goods have been only 3 % but it has increased to 33% in the 20 years. On the other hand, final goods to NIEs4 have been decreased to 9% from 30% in 1990.

Regarding to import, both intermediate and final goods from China have been increased. Intermediate goods have been only 2% and final goods have been 6% in

[3]ASEAN4 includes Indonesia, Malaysia, Philippines, and Thailand.
NIEs4 consists of Korea, Hong Kong, Singapore, and Taiwan.

1990 but the former has been 21% and the latter has been 34% in 2010. On the other hand, NIEs has decreased its ratio in both intermediate and final. As we can see, both export and import ratios to China have been increased.

2.4 Trade Specialization Index

At last, we would like to show trade specialization index in this section to grasp the bilateral trade structure of electrical machinery industry between Japan and her trade partners. White paper by Ministry of Ministry of International Trade and Industry of Japan (2012) also shows it of many industries. We focus on production stage base data. At first, we will show methodology of it and show the result with figures. Since the index has nothing to do with our regression model and the index is useful to grasp the structure as review, we will show it in this chapter.

2.4.1 Methodology of Trade Specialization Index in Electrical Machinery

So far, we have seen export, import, and ratio to each production stage base. In this part, we will obtain trade specialization index to grasp trade structure of electrical machinery industry between Japan and East Asia. Trade specialization index is show in the below equation.

$$\text{Trade Specialization Index} = \frac{\text{Export} - \text{Import}}{\text{Export} + \text{Import}}$$

Since we will utilized 4 production stage base data and obtain the index, we can tell which production base goods are specialized by Japanese firms. As the index comes closer to one, goods of a certain production stage are competitive. If it is zero, export is equal to import. If it has a negative sign, a country has less competitive in a certain

commodity trade. The index which we can get does not consider openness of trade, neither price gap between export and import in a certain commodity. However this is still useful in the sense we will get a picture or an overview of the trade. Our goal is to get a picture of it in this chapter therefore we will obtain the index.

2.4.2 Trade Specialization Index by Production Stage of Each Country

As we can see the below figure 2.4.1, Japan has been competitive in processed goods, parts and components, and capital goods to 9 areas and they have shown down-wards trend since the middle of 90s as the overall trend. In processed goods which have had the smallest trade amount, although the indices to China and Indonesia have been shown negative signs between 1996 and 1997, Japan has had competitiveness to all areas except Korea in 2010.

Regarding with parts and components which is the largest export in electrical machinery industry, they also have been very competitive in early 90s. However, they have been shown downward trend. To Indonesia, Philippines, and Singapore, all indices of the 3 countries have had negative sings from 2000 to 2007. Since all areas except for Singapore have had positive signs, Japan has had competitiveness in parts and components.

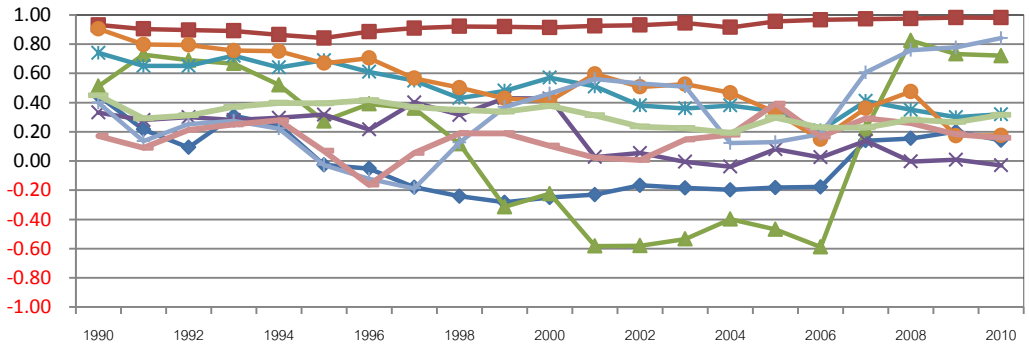
About consumption goods, Japan has not had competitiveness in it since the middle of 90s. Only Hong Kong, Philippines, and Singapore have had positive signs in 2010. Other areas have not had positive sings. The indices have been at quite low standard in 2010.

In Capital goods, Japan has been quite competitive in the early 1990s. However, China, Indonesia, and Philippines have had negative signs in 2010 and

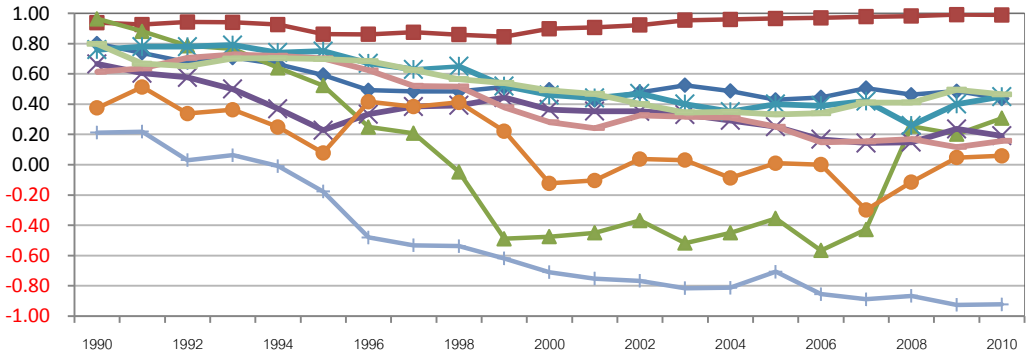
other areas have had positive signs. The competitiveness has been shown downward trend since the beginning of 2000s.

Figure 2.4.1Trade Specialization Index by Production Stage

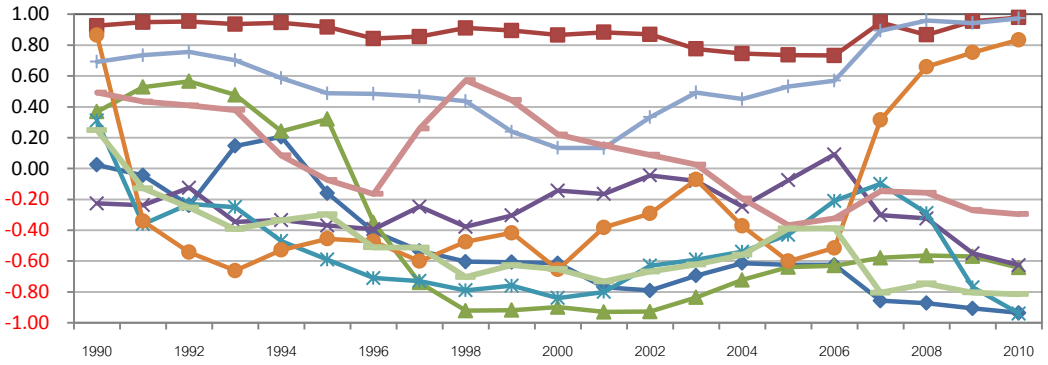
(a) Processed Goods



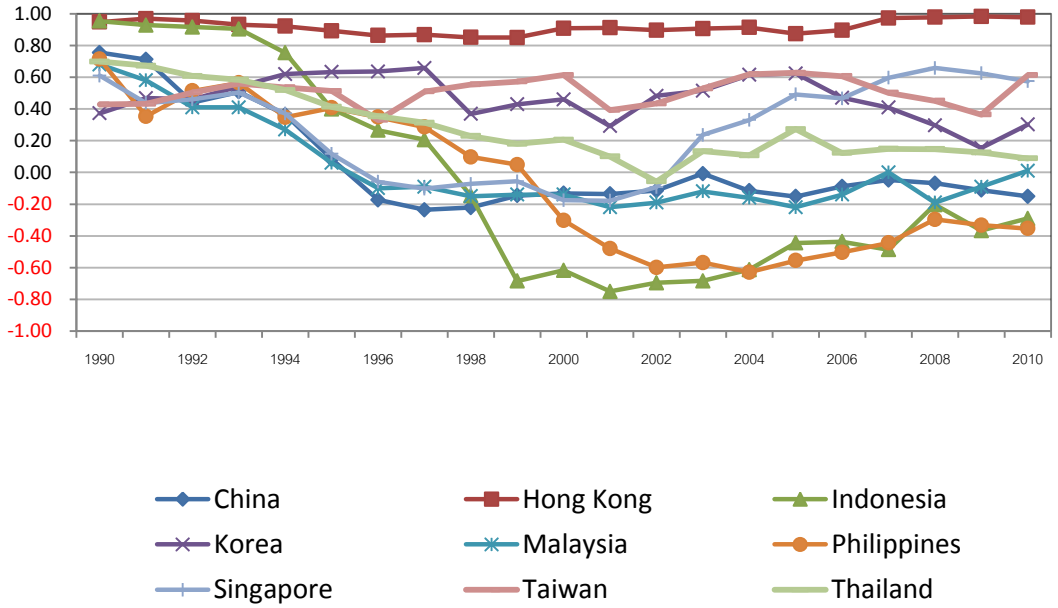
(b) Parts and Components



(c) Consumption Goods



(d) Capital Goods



Data Source: Author made depending on RIETI-TID2011

CHAPTERIII

LITERATURE REVIEWS

In the section, we would like to introduce past literatures on the impact of international specialization. In analyzing, they use some different indices representing the specialization. As we will see later, many researchers use outsourcing as the index of specialization but others use vertical FDI, import and export fragmentation, and import penetration so on. And actually the specialization is used to see the relationship with not only productivity but also non-production wage share by many researchers. We will see their methods and results briefly.

3.1 Reviews of Impacts of Specialization on Non-Production Wage Rate

Feenstra and Hanson (1999) have used outsourcing ratio as the index of specialization and analyzed relationship between specialization and non-production wage rate with the data of 447 four-digit SIC industries not including SIC (2067, 2794

and 3483) from 1979 to 1990. They have asked for outsourcing ratio by dividing imported intermediate input by total non-energy intermediate which can be got from input-output table (IO table). They have concluded that outsourcing can account for from about 13% to 22% of change of non-production workers wage share. Actually many researchers have also utilized the same index showing specialization as Feenstra and Hanson (1999).

Sakurai (2000) has analyzed the impact of outsourcing to overseas on domestic labor market, especially demand for non-production worker employing the outsourcing ratio. Since he uses the data of only 3 years which is quite small number of samples, he cannot obtain clear results, but the results implies that outsourcing ratio has positive relationship with share of non-productive workers. He has concluded that outsourcing level data has contributed 45% of change to skilled worker wage share. Ito and Fukao (2005) have also used the outsourcing ratio. However, outsourcing is not at significant level in their research. Actually they have also utilized index of VIIT with 9 countries in East Asia and VIIT with the rest of countries and then they have obtained the interesting result. The index of VIIT with 9 countrieshave positively effected on demand for skilled-labors, however VIIT with the rest of countries negatively effects on it. They have claimed that international specialization where they import down-grade goods from East Asia whereas they specialize in up-graded goods which need high-technologies has been progressed. And also they have said that as activities of Japanese affiliates abroad become more active, head-offices' function such as making business strategies and research and development become more important. They have also claimed that the increase of demand for skilled-labors come from 2 points, the increase of activities of Japanese affiliates such as

VIIT, and the increase of importance of head-office's functions.

Ahn et al. (2008) have also utilized the outsourcing ratio asked for by following the way of Feenstra and Hanson (1999) as the index. Their research objectives are manufacturing industry of Japan and Korea. Their results were quite interesting. 1% increase of total narrow outsourcing increases the demand for workers with tertiary education by 0.9% in Japan. However, outsourcing does not have significant effect on demand for them in Korea.

As other index of specialization, we can raise Sasaki and Sakura (2004), Head and Ries (2002), and Yamashita (2008).

Sasaki and Sakura (2004) have utilized import penetration index. Their index is obtained by a simple way of dividing import by domestic demand. They have not considered price gaps between export and import in a commodity trade. In their research, they have said that one of the reasons why demand for skilled labors has been getting higher is the impact of economic globalization, especially expansion of trade with developing countries. They have used 13 industries data in manufacturing sector in Japan from 1988 to 2003.They have concluded that there is a positive relationship between import from Asia countries and demand for skilled-labors.

Head and Ries (2002) have utilized vertical FDI as the index. They have obtained the index by dividing overseas affiliate employment by worldwide employment. They have claimed that overseas employment in low-income countries positively affects on demand for skilled labor but in high –income countries it negatively affects.

Yamashita (2008) has also utilized interesting indices representing specialization. He has used fragmentation import and fragmentation export. The

former is obtained by dividing import of parts and components by intermediate input. The latter is asked for by dividing export of them by gross output. He concluded that both fragmentation import and export have positively worked on non-production wage share in the trades with East Asian countries. However, in the trades with OECD countries, they have decreased the demand for skilled workers share.

As we have seen above reviews, impact of specialization has been seen in labor market. However, as Yamashita (2008) and Head and Ries (2002) have claimed, relationship between specialization and demand for skilled labors depends on trade partners or host countries economic level. If they are developing countries, demand for skilled workers is increased. Next we will see relationship between specialization and productivity.

3.2 Review of Impacts of International Specialization on Productivity

Ito and Tanaka (2008) have utilized outsourcing ratio following Feenstra and Hanson (1999)'s way to see the relationship between it and total factor productivity and labor productivity. They analyzed with the data of Japanese manufacturing industry of IO table of Japan industry productivity database from 1988 to 2004. They have concluded that material outsourcing has positive effect on both TFP and labor productivity but service outsourcing has negative effect on it in manufacturing sector. And they have also claimed that material outsourcing from Asia countries positively effects on productivity growth at a significant level but outsourcing from North America and Europe does not have any significant effect.

Matsuura (2008) has analyzed the impact of FDI in electrical machinery industry to East Asia countries on productivity. In the thesis they have classified FDI

pattern into 2 patterns which are horizontal FDI and vertical FDI. The former is FDI done in order to avoid shipping costs and trade barriers by shifting economic activity in domestic to host countries. The latter is FDI done by shifting one or more production processes to host countries. In most of cases firms tend to shift their down-stream process to host countries where their labor costs are lower than Japan. Therefore they complement up-stream process. They have claimed that vertical FDI has had positive impact on productivity in a significant level. However, although horizontal FDI also has had positive coefficient sign, it has not been statistically significant. We think that this thesis is very similar with our thesis because if vertical FDI has been increased, VIIT and outsourcing have also increased it. In this thesis, they have utilized total factor productivity and yearly data.

Hijzen et al. (2006)has also analyzed impacts of offshoring on firm productivity growth with firm-level data for the Japanese manufacturing industries from1994 to 2000. Offshoring is that firm contracts out of business activities to foreign providers in their definition. They have asked for it as ratio of the value of subcontracting to foreign providers to value added. They have found that offshoring has a positive influence on productivity growth. According to their result, 1% increase of offshoring intensity increases productivity growth by 0.17%. In this thesis they have used total factor productivity as the index and also they also put R&D as the factor which effect on it. Actually coefficient sign of it has shown positive to total factor productivity.

Holger and Aoife (2003) have analyzed relationship between labor productivity and specialization with international outsourcing ratio in Ireland. They have asked for the ratio by dividing total imported input by total input distinguishing raw material input from service input. Their results have shown that in the level data of labor

productivity, both service and material outsourcing have shown positive signs but in the growth data, although service shows positive, material shows negative at significant level.

Holger et al. (2005) have analyzed relationship between TFP and international outsourcing in Ireland. In this work, imported materials and imported service have been utilized. They have claimed that both types of outsourcing have positively worked on TFP. However, for non-exporters outsourcing has negatively worked on TFP and for foreign owned plants either international outsourcing has worked positively on TFP. According to their estimation, if either international outsourcing increases by 1 %, TFP improves by about 1.5%.

We can see a brief summary of previous literatures at table 3.1. We would like to summarize them briefly. At first, many researchers have used outsourcing ratio which is obtained by dividing imported intermediate input by intermediate input. And it has positively affects on non-production wage rate share and productivity too. However, outsourcing to developed countries such as North America and Europe has negatively worked on them as Ito and Tanaka (2008) claims. Impact of outsourcing on them depends on to where they outsource. At second,Fukao and Ito (2005) have utilized VIIT as index and they analyzed relationship between skilled worker's demand and it. However, VIIT has not been decomposed its import and export although it is integrated by them. And the index is not utilized for analysis on productivity. I believe that it is worth to use the index in our analysis. In the next chapter V, we will run regression models and grasp how international specialization effect on labor productivity with it.

Table 3.2.1 Summary of Literature Reviews

Author	Country	data	Index of Specialization	Object	Result
Sakurai (2000)	Japan	1987-1990, 39 industries from census of manufacturesby METI and input-output table	Outsourcing (Imported intermediate input (or from the same industry)) / total nonenergy intermediates) x 100	Non-production wage share	Outsourcing level data has contributed 45% of change to skilled worker wage share but outsourcing ratio does not work positively on it. Anyway, NO. of observation is very small and R square is quite low.
Sasaki and Sakura (2004)	Japan	1988-2003, 13 manufacturing industry from IO table.	Import penetration ratio (import from East Asia / domestic demand)*100	Non-production wage share	Import penetration ratio affect positively on skilled worker wage share. It accounts for from10.8% to 12.7%. In addition, R&D ratio explains wage payment growth rate for graduates from 5.5%to 6.6%
Ito and Fukao (2005)	Japan	1988-2002, 35 manufacturing Industries from Japan Industry Productivity Database	VIIT (total VIIT/ domestic output) and Outsourcing (Imported intermediate input (or from the same industry)) / total nonenergy intermediates) x 100	Non-production wage share	Outsourcing is not significant although its coefficient sign is positive. VIIT is significantly positive. VIIT with Asian countries is positive but negative with other countries.
Ahn et al. (2007)	Japan and Korea	1988 - 2002,Manufacturing Industry from IO Table of Japan Industry Productivity Database. 1993-2003,National Accounts, Census of Manufactures, and UN COMTRADE data for Korea	Outsourcing (Imported intermediate input (or from the same industry)) / total nonenergy intermediates) x 100	Non-production wage share	1% increase of total narrow outsourcing increases the demand for workers with tertiary education by 0.9 percent in Japan total narrow outsourcing does not have significant effects on the demand for workers in Korea.
Yamashita (2008)	Japan	Each 5 year from 1980 to 2000, 52 manufacturing industries from Japan Industry Productivity Database and United Nations (UN) Comtrade database.	Fragmentation of Import ,parts and components /intermediate input and Fragmentation of Export, export of them / gross output	Non-production wage share	1% increase of components imports ratios from East Asian countries increases skilled workers' share by 6%. 1% increase of exports intensity of components to East Asian countries increase it to by 2.7%. However in trade with OECD countries. they decrease skilled worker's share.
Feenstra and Hanson (1999)	USA	1979-1990, 447 four-digit SIC industries not including SIC (2067, 2794, and 3483)	Outsourcing (Imported intermediate input (or from the same industry)) / total nonenergy intermediates) x 100	Non-production wage share	Outsourcing can explain about 13-22% of change of nonproduction workers wage share.
Head and Ries (2002)	Japan	1965-1990,1070 firms from Japanese Overseas Investment by Toyo Keizai, Inc	VerticalFDI and Horizontal FDI. overseas affiliate employment / worldwide employment	Non-production wage share	Overseas employment in low-income countries positively influences on demand for skilled- labor but in high-income negatively works.
Ito (2003)	Japan	1980-2000, 34 industrie in manufacturing originally from IO table	Outsourcing (Imported intermediate input / Domestic Product)	Labor Productivity	Outsourcing works negatively on it at a significant level.
Hijzen et al.	Japan	1994-2000, Japanese firm-level data from	Offshoring (Ratio of the value of	Total Factor	If they are put in regression model separately, offshoring and

(2006)		Basic Survey of Enterprise Activities	subcontracting to foreign providers to value added) and International Insourcing(defined as the ratio of purchases from the firm's own foreign subsidiaries to value added)	Productivity	international insourcing inflence positively on TFP growth at significant level. If we put them together, the result is not .1% percent increase of offshoring intensity leads to 0.17% of TFP growth.
Ito and Tanaka (2008)	Japan	1988-2004, Japanese Manufacturing Industry from IO Table of Japan Industry Productivity Database	Outsourcing (Imported intermediate input / Domestic Product)	Total Factor & Labor productivity	Material Offshoring has positive impact on both TFP and labor productivity but service offshoring does not.
Matsuura (2008)	Japan	1981-2003, Japanese Electrical Machinery Industry from census of manufacture and Basic survey of Overseas Activity from METI	VerticalFDI and Horizontal FDI	Total Factor Productivity	VFDI has worked positively on TFP and HFDI's coefficient sign is positive but not significant.
Holger and Aoife (2003)	Ireland	1990-1995, plant level data for the electronics industry in Ireland from Irish Economy Expenditure Survey by the government agency	international outsourcing (the ratio of total imported inputs / total inputs) distinguishing raw material input from service input.	Labor Productivity in both level and growth	In level data, both service and material outsourcing show positi signs but in growth data, although service shows positive, material shows negative at significant level.
Holger et al.(2005)	Ireland	1983-1998, Irish Economy Expenditure Survey by the government agency with responsibility for enterprise development, science and technology	2 types of International out sourcing, the ratio of imported materials over total wages and the ratio of imported services inputs over total wages	Total Factor Productivity	Both types of outsourcing positively work on TFP. However, in non-exporter, outsourcing has negative relationship with TFP. In foreign-owned plant, if either international outsourcings increases by 1%, TFP improve by about 1.5 %.

CHAPTER IV

METHODOLOGY

4.1 Conceptual Framework of International Specialization

Our purpose of this thesis is to see how international specialization has been developing in East Asia and to see if labor productivity has been increased by specialization or not. In this thesis, we suppose that the progress of specialization has been brought by the increase of vertical intra-industry trade and intermediate goods trade caused by decomposition of production plants (fragmentation and outsourcing) because they all are aimed at using the differences of production skill and production elements to seek for the most suitable production networks. And as we said, seeing trades from commodity base and production base will give us deeper understanding. Here, we will see what intra-industry trade, fragmentation, and outsourcing with figures, at first. We will also see their details later, in previous literature part.

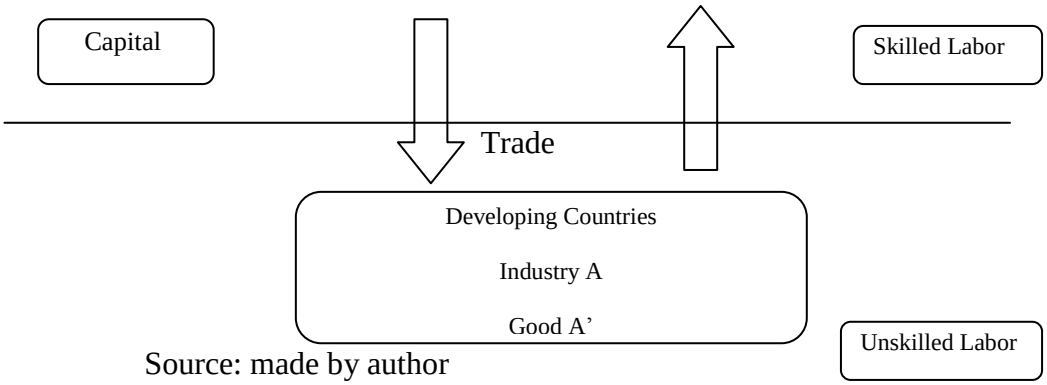
4.1.1 Intra-Industry Trade

Intra-industry trade is that 2 countries bilaterally trade goods which belong to the same commodity classification. Beer, for example, is produced by many countries which export their own beer and import from abroad. As the result consumers can have more goods to choose and their welfare can be increased. Intra-industry trade can be divided into 2 patterns, vertical and horizontal.

Horizontal-intra industry trade (HIIT) is to trade goods which do not differ in quality, but differ in design or function.

Vertical-intra industry trade (VIIT) is to trade goods which have difference in quality. Falvey (1981) says that even if commodities belong to the same classification, in the case that there exists the difference in quality of commodities traded, the ratio of input elements can be different from each country. If developed countries produce and export goods(up-grade) which are capital intensive, and developing countries do goods(down-grade) which are labor intensive goods, each country specializes to produce goods which they have comparative advantages. Hence, we can distinguish VIIT and HIIT with the difference in prices. As we will see details of VIIT, a good trade can be recognized as VIIT, if the price of Good A is 1.25 times as expensive as that of Good A', this trade is recognized as VIIT, if not, HIIV. If VIIT has been increased, we can say that specialization has been progressed. We will use the growth ratio of VIIT as an independent variable in the regression model where we see if the determinants have positive relationship with it or not. And also this specialization can influence on labor productivity because firms seek for the most suitable production network.

Figure4.1.1 Vertical Intra-Industry Trade



Source: made by author

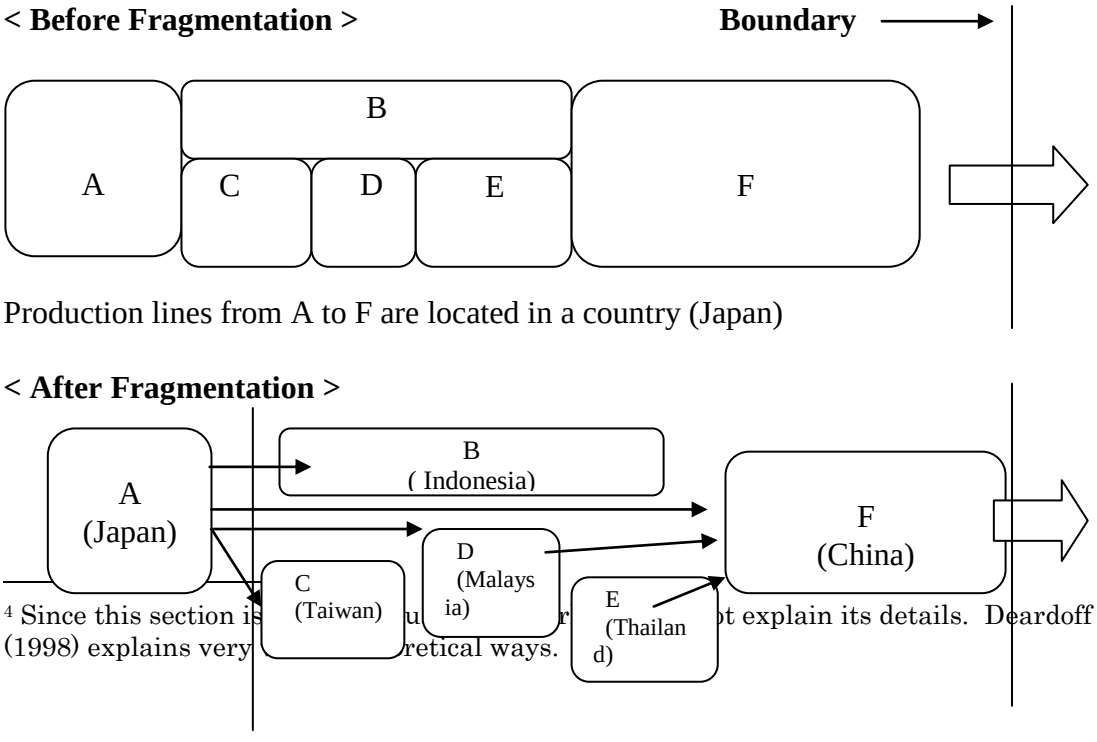
4.1.2 Intermediate Goods Trade

Intermediate goods are not final goods and they are utilized to produce final goods at the end. To research intermediate goods trade, therefore, means to tell how specialization in production processes or stages has progressed, or how decomposition of production plants has progressed. We can see some terminologies involved with intermediate goods trade, let's say, intra-product trade, vertical specialization, outsourcing, and fragmentation so on. Here we will focus on outsourcing and fragmentation because they originally duplicate themselves in some parts and we can deepen our understandings enough of how intermediate goods trade has expanded. Fukao, K. and Ito, K. (2009) also says that intermediate goods trade has been increased with fragmentation and outsourcing. It says that a phenomenon called fragmentation which firms segment their production processes and relocate them in the most suitable location to minimize production cost and outsourcing (import of intermediate goods) within East Asia have expanded since 1990s. We will start with fragmentation.

4.1.2.1 Fragmentation[4]

Ishido(2012) says that fragmentation is to achieve minimum production costs by locating production processes in the country or countries where abundant production elements used for them exist, considering the difference in given conditions for them and the difference in production skills of each production process. Wakasugi (2003) say that head offices and production plants in capital and skilled-labor abundant countries are connected with plants in labor abundant countries as a production line to produce final goods. In other words, production plants in each country can be recognized as a production process to produce final goods. Intermediate goods produced in countries are exported and used to produce final goods, and then final goods can also be exported to countries. Hence, the increase of fragmentation results in the increase of intermediate goods trade. And Wakasugi (2005) also says that it is remarkable that the trade in East Asian has increased more than proportionately to the economy growth.

Figure 4.1.2 Before and After Fragmentation



[4] Since this section is u r t explain its details. Deardoff (1998) explains very retical ways.

Boundary ⟶

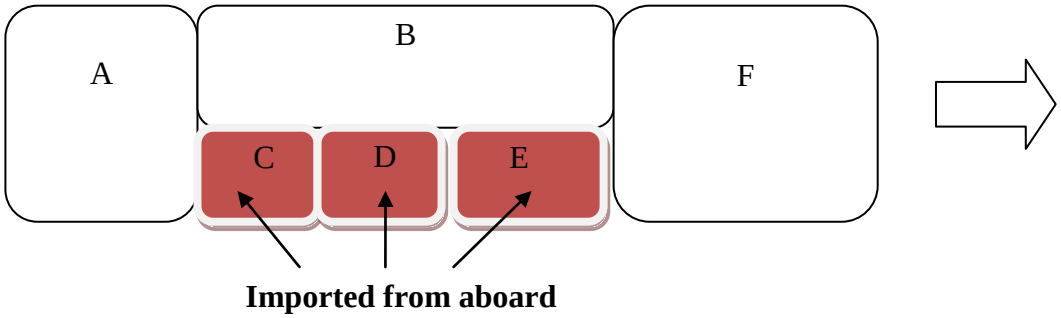
Source: Made by author depending on Inoue et al. (2007)

Production lines from A to F are relocated into countries where they operate the most suitably over boundary to minimize production cost. If Japan is the most suitable place for production line A, it will be left in Japan, other lines are relocated abroad. Goods produced in Japan are exported to B or C if they need to be processed, if not, they directly go to F for assembly process. Therefore, intermediate goods trade is increased.

4.1.1.2 Outsourcing

We can find some definitions of outsourcing defined by researchers. For example, Feenstra and Hanson (2001)say that outsourcing is to distribute production activity of a good into 2 or 3 countries. However this can be applied to fragmentation too, therefore we define the definition of outsourcing like below. Outsourcing is the contracting out of one or more production processes which an organization had previously performed internally to firms abroad. In this thesis, we can simply say that outsourcing is to import intermediate goods from abroad.

Figure4.1.3Outsourcing (From Firms in Foreign Countries)



Data source: Made by author depending on the definition

Suppose that production lines from A to F are located in Japan, and then the firm starts outsourcing to minimize production cost. Now goods or services which had produced in the production lines C, D, and E in Japan are substituted by outsource from abroad. Goods produced in C, D, and E are not final goods, but intermediate goods. As the result, intermediate goods trade is increased because these goods come from aboard beyond boundary. And this outsourcing can influence on labor productivity because now the firm uses substitutions from abroad instead of producing them, which he can decrease the production cost. He can invest to R&D with the cost he could save by outsourcing. In real world, there are cases of combination of outsourcing and fragmentation.

4.1.3 Examples of Intermediate Goods Trade

We will see the examples of intermediate goods trade. These examples are from the report made by Japan Finance Corporation for Small and Medium Enterprise (JASME) (2003). They made it depending on their inquiring survey to Japanese electrical and electronic firms (total 98 firms) in which set up their affiliate in East Asia in order to tell how they decompose or divide production processes and distribute its roles among Japan, host countries, and the third countries. As we can imagine, we have plenty amount of goods and their production processes differ from each other hence we cannot explain how production processes of all commodities are decomposed and distributed in the thesis. We will just see some examples of it in order to obtain its features with figures depending on 6 stages of value-chain, marketing, planning and development of products, development of parts, production

of parts, production of products, and sales which are called international division system. What we will see below are examples generalized by classifying the result of inquiring survey into the type of business and products.

Example 1 TV-set and Audio Equipment (Final Goods) in ASEAN

According to the report, these commodities have been worked on by Japanese affiliates as well as household appliances sincethe early time of off-shore production. As we can see the below table 4.1.1, in upstream processes, head office has been involved with it and local affiliate has also taken role of it somewhat. Affiliate in host country has designed small-sized or popular edition products. Advanced parts of these commodities are developed and produced in Japan and export to host country and produced final products there with other parts purchased in host country or imported from other ASEAN countries. Final goods are purchased in host country, other ASEAN countries, and Japan after they have been re-imported to.

Table 4.1.1 TV-set and Audio Equipment

		Upstream Processes				**Downstream Processes**	
		Marketing	**Planning and Development of Products**	**Development of Parts**	**Production of Parts**	**Production of Products**	**Sales**
In-house-division	**Japan**	Planning and development department in head office	Design department in head office	Factory in Japan (For advanced parts)			Parent firm
	Host country	Local affiliate's own	Original design by affiliates (Small sized and popular edition)			Firm's own	Host country
	Third country	Sales operation base in Asia such as Singapore					ASEAN countries, EU, and US
Outsource				Other parts are purchased from Japanese affiliates in host country or ASEAN			

			countries. Secondary suppliers can be local firms		

Data Source: Made by Author depending on JASME (2003)

Example 2 Information and Communication Equipments (Final Goods)

Since these commodities are sold in many countries, marketing is also conducted in countries. Works from planning and development of products to production of parts are conducted by head office in Japan. Some parts are purchased from Japanese local affiliates or EU or US affiliates in host country or ASEAN. Assembly process (production of products) is done in a host country. After it, they are exported to the third countries or to parent firm, otherwise they are sold in host country's market as shown in the below table 4.1.2. As the above example1, head office takes the roles in upstream processes. Intermediate goods (advanced parts in the example) are exported to host country from Japan.

Table 4.1.2 Information and Communication Equipment in ASEAN

		Upstream Processes				**Downstream Processes**	
		Marketing	**Planning and Development of Products**	**Development of Parts**	**Production of Parts**	**Production of Products**	**Sales**
In-house-division	**Japan**	Planning and development department in head office	Design department in head office	Head office			Parent firm
	Host country	Local affiliate				Firm's own	Host country
	Third countries	Sales operation base in Asia such as Singapore					All over the world
Outsource				Other parts are purchased from Japanese local affiliates			

			or EU or US affiliates in host country or ASEAN			

Data Source: Made by Author depending on JASME (2003)

Example 3 Electronic Parts, IC, relay, and chip- condenser so on (Intermediate Goods)

These products are mainly sold to assembly makers in host country or in Asia, otherwise they are brought back to parent firm in Japan. Marketing is conducted by head office, local affiliate's own, or sales operation base in Asia. Planning and development of products are conducted by head office but sometimes it is done with assembly makers although it depends on parts. In most cases, designs of parts are taken as the work of head office and main raw materials of parts products are purchased in Japan or imported from E.U. or U.S. and then supplied to affiliate in host country to produce by the affiliate in host country. Necessary supplemental parts such as coil, plastic and metal parts are purchased from local part's firms at the same time. Completed parts are brought back to Japanese parent firm or set makers there or in Asia, as the below table 4.1.3 shows. Parts produced in ASEAN countries are exported to Japan and then they are utilized to produce final goods.

Table 4.1.3 Electronic Parts, IC, Relay, and Chip- Condenser so on in ASEAN

		Upstream Processes				**Downstream Processes**	
		Marketing	**Planning and Development of Products**	**Development of Parts**	**Production of Parts**	**Production of Products**	**Sales**
In-house-division	**Japan**	Planning and development department in	Design department in head office	Head office Raw materuals are supplied from Japan, EU, and US			Parent firm

		head office (General purpose parts)				
	Host country	Local affiliate's own			Firm's own	
	Third countries	Sales operation base in Asia such as Singapore				
Outsource			Assembly makers (set makers)	Japanese local affiliate's parts firms in host country or parts firms of host country (mainly supplimental parts such as coil, plastic and metal parts)		Set makers in host country or in Asia

Data Source: Made by Author depending on JASME (2003)

Example4. Household Appliances (Air Conditioner) in ASEAN

So far, we have seen 3 examples of international division system. They are actually the products which head office takes big roles. However, this is the product which head office takes little smaller roles. As I mentioned before, household appliances are products which Japanese affiliates have produced since the earlier time of off- shore production. Not like above examples, development of parts and production of parts are conducted by the affiliate in host country. Regarding to design, although head office makes basic design, affiliate also modifies the design. In marketing, head office does not take any part of it. Compared to above examples, roles of affiliate in host country are bigger as the below table4.1.4 represents.

Table 4.1.4 Household Appliances, Air Conditioner (Final Goods)

		Upstream Processes				**Downstream Processes**	
		Marketing	**Planning and Development of Products**	**Development of Parts**	**Production of Parts**	**Production of Products**	**Sales**
In-house-division	**Japan**		Basic design by head office				Parent firm
	Host	Local Affiliates	Modification	Some parts are developed		Firm's own	Host

	country		design	and produces in-house		country market
	Third countries	Sales operation base in Asia such as Singapore				ASEAN countries, EU, and US
Outsource				Other parts are purchased from Japanese local affiliates in host country or other ASEAN countries. Secondary suppliers can be local firms too.		

Data Source: Made by Author depending on JASME (2003)

From these 4 examples, we can see how intermediate goods trade occurs. Parent firms export parts which are necessary in production of host country. And local Japanese affiliates also produce parts and export them to Japan. Hence we have intermediate goods trade. We could make sure it through the inquiring survey.

4.1.4 Quality of Products Produced by Japanese Affiliates in Host Countries

Quality control is the problem not only for Japanese affiliates, but also for parent firms in Japan because most of firms have established their supply chain management (SCM) system meaning combination of fragmentation and outsourcing. If the parts which parent firms purchased from affiliates or other firms in East Asia have problems in quality, it will cause problems in final goods produced in Japan. Therefore, they have to control quality of goods which they purchase. In order to do it, almost all of firms have prepared their own procurement guideline which depends on the guideline drawn up by Japan electronics and information technologies industry association (JEITA) which has had 404 members and tell their suppliers to follow the rules. In most of cases, parent firms tell suppliers both domestic and foreign suppliers to draw up the quality management systems which can fulfill requirements from

parent firms or just to be certificated ISO9000 and ISO14000. We can see that if top 20th firms in capital size base in the industry ask suppliers to have management system in their quality controls from the below table 4.1.5. Panasonic says on its website that suppliers have to obtain them to be their suppliers.

Table 4.1.5 Top 20thFirms (Capital Size) in Electrical Machinery Industry[5]

Firms	(Billions Yen) Capital	Acquisition of ISO9000	Requirements to Procurement firms
Sony	630923	All (electronics sector)	1 & 2
Toshiba	439901	Not all	1
Hitachi	427775	Not all	1 & 2
NEC	397199	Not all	1 & 2
Fujitsu	324625	Not all	1 & 2
Panasonic	258740	All	3
Elpida	215663	Not all	-
SHARP	204676	Not all	1 & 2
Denso	187457	Not all	1 & 2
Mitsubishi	175820	Not all	2
Renesas	153255	Not all	1 & 2
SUMCO	114107	Not all	-
Pioneer	87257	Not all	1 & 2
Rome	86969	Not all	1 & 2
Murata	69376	All	1 & 2
Fanuc	69014	-	-
Nidec	66551	Not all	2
Omron	64100	Not all	1 & 2

[5]Except for Nidec and Fanuc, all firms are members of JEITA. And almost all of them have shown procurement guideline from the association in their website page of procurement in order suppliers to keep the rules to have a good quality control system of their products. 37 firms out of top 50 firms (capital base) are also members of JEITA.

Seiko-Epson	53204	Not all	1 & 2
Casio	48592	Not all	1 & 2
Fuji	47586	93%	1 & 2
1.Recommendation of ISO9001		2.Requirements of his own	
3.ISO9000 & 14000		- is Unknown	

Data Source: Author made by visiting their websites.

Hitachi has set corporate social responsibility (CSR) committee and it has checked their candidates of suppliers if they fulfill requirements or not. Although not all offices of the top 20th firms have been certificated ISO 9000, most of factories have been certificated with it and their overseas factories too. And they also have said that they will work on it and expand it. In 2010, there are 1832 firms in electrical machinery industry. Top 20th firms have taken only about 1%. However, as Wakasugi et al. (2008) says, only a handful firms in Japan take most share of export. They say that top 1 % of firms (export base) took 60.3% of it in 2005. We have checked basic survey of Japanese business structure and activities to make sure if it can also be applied to import or not. The statistics data from METI[6] says that share of import of firms with capital over 10 billion Yen have taken about 70% of it in 2005. Number of

[6]The statistics data from METI has just classified firms into 7, depending on capital sizes (million Yen),30 - less than 50, 50 - less than 100,100 - less than 500, 500 - less than1000, 1000 - less than 5000, 5000 - less than 10000, and more than 10000. Number of firms with capital over 10 billion Yen has taken 5% on the whole. The statistics does not provide the ranking of export and import, neither firm's names.

the firms has been 104 firms taking 5% on the whole. From the fact that above 20 firms have had capital which is far larger than10 billion Yen hence we can estimate that their import also have taken large share on the whole and from another fact that 404 members such as associations and firms have joined the association (JEITA), we can say that quality of most of products imported are in the good standard that firms in Japan can utilize them. Furthermore, from the quantity point of view, we can say that most of goods produced in Asia have been export back to Japan or have been purchased by other Japanese firms in host countries. According to the below table 4.1.6, in 2009 about 40% of sales have been headed for Japan and another 20% of it has been for Japanese affiliates in the host country.

Table 4.1.6 Sales of Products Produced in Host Countries

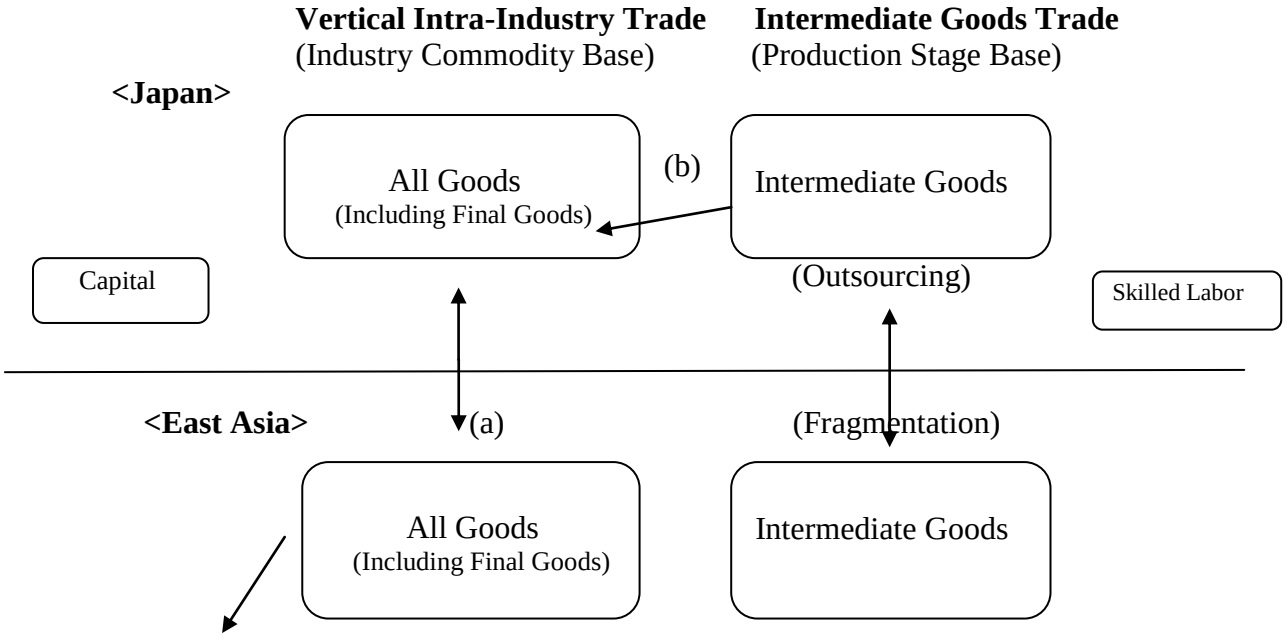
Year	**Value of goods sold**	(Millions Yen)					
		Export to Japan	1 Parent firm	2 Other firm	Sold in host country	3 Japanese firm	4 Other firm
2001	8,514,241	2,961,465			2,648,357		
2002	9,184,697	2,961,172			3,171,107		
2003	11,757,872	3,500,216			4,305,515		
2004	12,116,789	3,652,265			3,588,600		
2005	13,073,676	4,181,267			4,118,305		
2006	14,245,760	4,469,199			4,673,001		
2007	14,609,287	5,081,866			4,988,149		
2008	12,324,964	5,136,151			3,995,275		
2009	10,998,289	4,043,177	3,843,258	199,919	4,086,540	2,064,466	2,022,074
2010	12,221,360	4,372,588	4,196,772	175,816	4,680,807	2,222,067	2,458,740

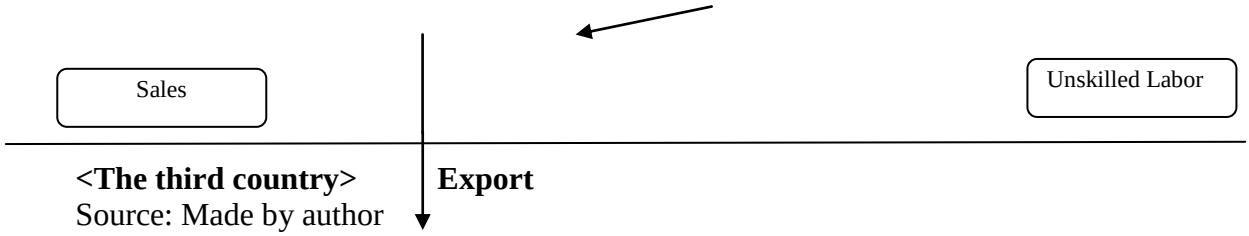
Data Source: Basic Survey of Japanese Business Structure and Activities (METI)

4.1.5 Summary of Conceptual Framework

So far, we have learned basic knowledge about VIIT and intermediate goods trade. We have learned it from both fragmentation and outsourcing's point of views. In this thesis, we take outsourcing as import of intermediate goods and fragmentation as decomposition of production lines and their relocation. As we have seen in background part, the fact that economy levels of each country in East Asia have differed and they have complemented each other through trade promotes VIIT and intermediate goods trade. And firms can expand their productions which are competitive and productive by shifting productions which are not to the countries where production costs are lower. As the result, their productivity can be increased. Here we will see a figure summarizing above descriptions of VIIT and intermediate goods trade in the below figure 4.1.4.

Figure4.1.4 Vertical Intra-Industry Trade and Intermediate Goods Trade

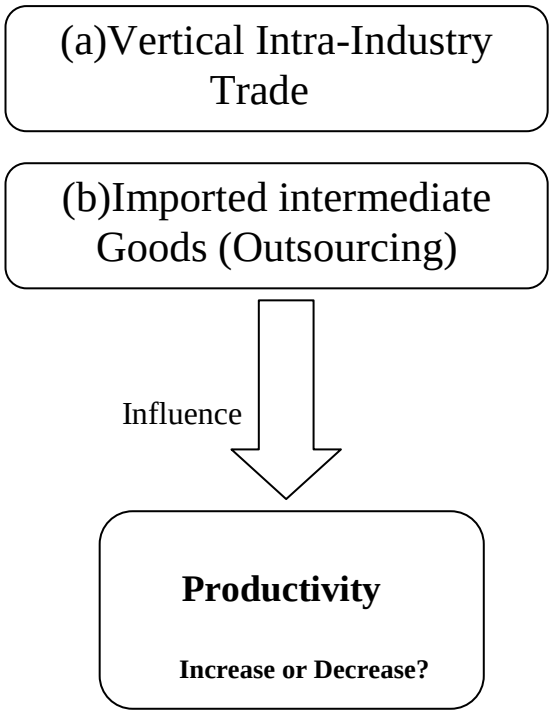




Source: Made by author

Through outsourcing and VIIT, we can tell Japanese firms repeat their choices and intension. Outsourcing and VIIT ratio can be indices of this kind of firm's activities. They may choose to start import products which they have purchased domestic before from trade partners. And then they may start to intensify production of up-graded products which only firms with high technologies can produce. Some may shift their production bases to a country where labor costs are lower than domestic to stay competitive leaving up-stream production in Japan as we saw so far. These kinds of firm's activities can be influenced on labor productivity because firms try to be more competitive.

Figure 4.1.5 Relationship between Specialization of Production and Productivity



Source: Made by author

4.2 Methodology

In this section, we will explain our methodology of VIIT and outsourcing. And then we will show our regression model.

4.2.1Methodology of Vertical Intra-Industry Trade

As we said before, we will see how vertical intra- industry trade has progressed in East Asia. We employ method used by Nuno et al. (2009),Ishido et al. (2003), Haishan (2010), Imre (2002), Yu (2007), E M(2009) and so on.

We classify trade flow into 3 patterns which are inter industry trade which is also called one way trade (OWT), intra- industry trade where commodities are distinguished by their features or horizontally (HIIV), and intra-industry trade where commodities are classified by their quality or vertically (VIIT). Here, there is an important hypothesis in HIIV. We suppose that the difference between unit prices of imported commodity and exported one between 2 countries reflects the difference of the quality in the commodity. At first, in order to classify, we check if overlapping ratio of a certain commodity's trade is more than 0.1 or not. Next, if not, we tell the trade is VIIT or HIIV. Now we set X_{ijt} and M_{ijt} as below.

X_{ijt}: Export of commodityifrom Japanto country j in time t.

M_{ijt}: Import of commodity i from country j to Japan in time t.

At first step, we set what is smaller as a numerator, larger as a denominator.

And the ratio asked for will tell us how much the trade of the commodity is overlapped.

Overlapping Ratio = $\text{Min}(X_{ijt}, M_{ijt}) / \text{Max}(X_{ijt}, M_{ijt})$

We will judge that a trade is VIIT or HIIT, if overlapping ratio > 0.1 because the commodities are imported and exported by 2 countries together to some extent. The trade will be OWT, if the overlapping ratio is≦0.1 because the ratio of less than 0.1 is judged that it is too small to say that the trade is intra industry (commodities) trade.

Next, we suppose that commodities traded between 2 countries show quality-difference in prices or value. We will judge which trades are VIIT or HIIT with the value gaps. We set as UVX_{ijt}andUVM_{ijt} like below.

UVX_{ijt}: Unit value of commodityiexported from Japan to country j in time t.

UVM_{ijt}: Unit value of commodity i imported to Japan from country j in time t.

They are going to be asked for with trade amount or trade weight by commodity.

We divide $UVX_{ijt}$by UVM_{ijt} to obtain the value of estrangement.

Estrangement Value = UVX_{ijt} / UVM_{ijt}

A trade is HIIT, if we have the case which is $1/1.25^{7} \leqq UVX_{ijt} / UVM_{ijt} \leqq 1.25$.

A trade is VIIT, if we have the case which $UVX_{ijt} / UVM_{ijt} < 1/1.25$ or

$UVX_{ijt} / UVM_{ijt} > 1.25$. Below table 4.2.1 shows the summary of the explanation.

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[7]Unit price difference of ±25% is adopted in the thesis, although we don't have any clear rules of classification. Actually, Fontagne et al. (1998) adopts ±15%, on the other hand, Ishido et al. (2003) adopts±25%. We would like to adopt ±25 because trade partner of Japan in the thesis are developing countries and if we adopted ±15%, we might overestimate VIIT ratio.

Table 4.2.1 Classification of Trade

Overlapping Ratio	Trade Pattern	Estrangement Value
Overlapping Ratio <0.1	One-Way Trade(OWT)	-
Overlapping Ratio > 0.1	Horizontal Intra-Industry Trade (HIIT)	$1/1.25 < UVX_{ijt} / UVM_{ijt} > 1.25$
Overlapping Ratio > 0.1	Vertical Intra-Industry Trade (VIIT)	$UVX_{ijt} / UVM_{ijt} < 1/1.25$ or $UVX_{ijt} / UVM_{ijt} > 1.25$.

Source: Made by Author depending on Ishido (2003) and Ando (2006)

The trade share of each trade pattern classified as above table 4.2.1 will be asked for like below. We put w to show each trade type.

$$\Sigma_i(X^w_{ijt} + M^w_{ijt}) / \Sigma_i(X_{ijt} + M_{ijt})$$

The data used in this analysis come from Trade Statistics of Japan. In this data set every commodity is given 6 digits number followingHS treaty (International Convention on the Harmonized Commodity Description and Coding System). The 6 digit numbers given to each commodity are unified in the world. Hence, we can say that it is very useful data set in analyzing intra-industry trade. We will analyze bilateral trade of electrical machinery industry from 1990 to 2010 with HS85. HS85 can be classified into electrical machinery parts and components and electrical machinery goods. We followed Ando (2004)'s way and processed the data[8]. At first, we will see the result of parts and components and then final goods.

[8] The next numbers are parts and components in his thesis. We have also followed his way of classification.
8503,850490,8505,850690,8507,850890,850990,851090,8511,8512,851390,851490,851590, 851690,851790,8518,8522,8529,853090,8531,8532,8533,8534,8535,8536,8537,8538,8539,8 540,8541,8542,854390,8544,8545,8546,8547,8548. The rests are final goods in the thesis.

4.2.2 Methodology of Outsourcing Ratio

Since we have the data from trade statistics, we would like to utilize it. We have asked for the ratio with the below equation. With the ratios we can tell how much Japan has been rely on imported parts and components from East Asia.

$$\text{1st Outsourcing ratio} = \frac{\text{Imported Parts and Components}}{\text{Domestic Parts and Components} + \text{Imported Parts and Components}}$$

$$\text{2nd Outsourcing ratio} = \frac{\text{Imported Parte and Components in VIIT (EX price} > \text{IM price)}}{\text{Domestic Parts and Components} + \text{Imported Parts and Components}}$$

Since we are supposed to obtained import value of parts and components in VIIT where import price is smaller than export price, we will see the ratio with it. If the second outsourcing ratio has been increased, production specialization has been under process because it means that firms purchase cheaper imported parts and components more instead of domestic as long as they fulfill their quality demand. Data of domestic parts and components is from yearbook of machinery statistics in Japan published by METI[9]. First outsourcing does not consider price gaps between export price and import price. Hence ratio will be larger than second outsourcing ratio. In Tomiura (2002), he has asked for import penetration ratio by dividing import by domestic demand. Actually this is similar with our outsourcing ratio however he has not extracted parts and components. Since we have supposed that parts and components would be utilized for producing final goods in domestic, importing them can be called outsourcing.

[9] In the statistics data, questionnaire numbers 28-39 fall under electrical machinery industry in 2010. Questionnaire numbers of 35 and 36 are judged commodities of parts and components, the rest numbers are done products of final goods in the thesis.

4.2.3 Regression Model on Labor Productivity

To analyze the influence of VIIT and outsourcing on productivity, we will use labor productivity as an independent variable. As we said many times, the progress of VIIT and the increase of imported intermediate goods may influence on labor productivity because firms can specialize to produce their competitive products. In other words, growth of VIIT that downgrade goods are imported to Japan and upgrade goods are exported to abroad and the increase of imported labor intensive intermediate goods probably can promote Japanese firms to have more advanced skill and skilled labors. As the result, we can guess that labor productivity can be increased. Here, we suppose a homogeneous production function which formed by two production elements capital (K) and labor (L). $Y/L = A \cdot (K/L)$

Where Y/L is labor productivity, A is skill-level, and K/L is capital-labor ratio.
We suppose that the factors explaining skill-level, Aconsists of intangible fixed assets and outsourcing ratio and VIIT ratio asked for in the previous chapter. We explain what intangible assets are and why we use it as a variable. As firms formulate their tangible fixed assets by accumulating their capital investment flow, intangible assets can also be formulated by accumulating expenditures flow of research and development, marketing, advertisement, brand strategy, licenses, patents and designs so on. The more it is accumulated, the more productivity can be increased because it is what firms have been investing to add more value on their products, or to be competitive. We will use intangible fixed assets as one of our variables. It consists of patents right, design rights, trade mark rights, and utility model rights so on. It is very natural for firms to obtain patent rights after they developed their technologies after

they invest R&D so we will use this data as a variable in the below model. We will use below regression model. We also put lag variable of Y / L.

$$(Y/L) = \alpha_1(K/L) + \alpha_2 INTANGIBLEFIXEDASSET + \alpha_3 OUTSOURCING + \alpha_4 VIIT + (Y / L)$$

Although above model does not have R&D expenses, intangible fixed assets can be taken a proxy of it because intangible fixed assets are increased when firms get patent rights, trade rights and so on. Patents rights are generally obtained to protect their competitiveness after firms invest to R&D. Since there are other factors which may influence on labor productivity, we prefer to use intangible fixed assets. We will analyze 3 capital sizes of firms, all sizes firms, firms with capital over 100millions yen, and firms with capital 1 billion yen. In the regression, we will use quarterly data from 1990 to 2010.

4.2.3.1 Data Sources and Description

In this part, we will explain data set which we will use in the above regression model. At second, we will show expected signs of variables and the reasons why we expect that these variables work positively or negatively on the independent variable. Regarding to variables of outsourcing and VIIT, since we have already gotoutsourcing ratio and data on VIIT in chapter III, we would like to use them as variables in our regression model. In our model, we will use quarterly data. We will explain variables one by one.

1. Labor Productivity (Dependent Variable)

It is obtained by the simple equation of Y / L. Y is added-value and L is number of labors in electrical machinery industry in Japan. Since we cannot obtain the

data of added value, we will use data that we have got by minus costs of sales from total sales figure as the proxy of it. The data source is Financial Statements Statistics of Corporations from Ministry of Finance of Japan.

2. Capital Labor Ratio

It is obtained by K / L. K means capital and L does number of labors, hence K / L means capital equipped per labor. The data comes from the same source as labor productivity.

3. Intangible Fixed Assets

As we mentioned, it consists of patents right, design rights, trade mark rights, utility model rights, trade rights (goodwill) and so on. There are many items consisting of it, however they are not itemized hence we cannot tell its details. The data source is also the same statistics.

4. Outsourcing

We have already explained about it in chapter 5. In our regression model, we will use 2nd outsourcing ratio only because what we want to know is whether increases of cheaper parts and components imported from trade partners of our research object influenced on labor productivity or not. The data comes from trade statistics of Japan and yearbook of machinery statistics in Japan published by METI originally.

5. VIIT

Regarding to VIIT, we have prepared 2 types of data. These VIIT data are asked for by the below equations.

$$\text{1st VIIT ratio } = \frac{\text{Exported Parts and Components in VIIT (EX price} > IM\ price)}{\text{Domestic Production of Parts and Components}}$$

$$\text{2nd VIIT ratio } = \frac{\text{Exported Final Goods in VIIT(EX price} > IM\ price)}{\text{Domestic Production of Final Goods}}$$

We have also utilized the data from yearbook of machinery statistics in Japan by METI.

6. Labor productivity of last period

We put last period of labor productivity in the model because we think that it can be affected on current productivity.

In the regression, we will use the growth ratio of each variable. In order to adjust seasonal effect, we have used year-on-year data. We have not compared the first quarter data with the last quarter data of last year. Instead, we have compared it with the first quarter data of last year. The next table 4.2.2 represents expected signs of each control.

Control variables	Expected sign	Explanation

Table 4.2.2 Expected Signs and Explanation

Capital-Labor Ratio, K/L	+	If capital-labor ratio is increased, labor productivity will be increased because labors can be equipped more capital. They may use advanced machines which are more productive with less labors, therefore we can expect that labor productivity will be increased.
Intangible Fixed Assets	+	It consists of patents right, design rights, trade mark rights, utility model rights, trade rights (goodwill) and so on. All of them are what firms have been investing to add more value on their products, or to be competitive. Hence, we can expect that it can positively influence on labor productivity.
Outsourcing	+	If the outsourcing ratio is increased, domestic labor productivity can be increased because it means that they have utilized cheaper parts and components instead of domestic ones produced in Japan where labor costs are higher than trade partners to produce their products and their surplus can be increased.
VIIT (both 1st and 2nd)	+	If Japanese firms specialize in producing high value-added products (advanced products) and if its ratio to domestic production, labor productivity can be increased because firms can get more surplus by selling them at the higher prices. In order to keep producing high added-value products, firms need to hire more educated labors and keep providing them with education too. That can increase labor productivity too.
Labor Productivity of last period, Y / L_{t-1}	+	If labor productivity of last period is increased, current period of labor productivity may be influenced positively because upward trend can be continuous.

CHAPTER V

RESULTS

5.1 Results of Analysis

In this section, we will show the results of our analysis. At first, we will show the result of trade classification, the result of outsourcing ratio and the result of VIIT ratios. And then we will show the result of regression model.

5.1.1 Result of Trade Classification

Table 5.1.1 shows shares of each trade pattern in bilateral trades between Japan and 9 countries. The result has been obtained with trade statistics from 1990 to 2010 in 9 countries total. In parts and components, VIIT has been only total 30% in 1990, however the ratio has been increased to total 61% in 2010. VIIT (EX price > IM price) has been 18% and it has increased to 28%. VIIT (EX price < IM price) has dramatically increased to 33% in 2010. The former's share had been larger than that of latter between 1990 and 1994 however it has been surpassed since 1995. On the other hand, OWT's share has been decreased to 24% in 2010 from 56% in 1990.The share of OWT (EX < IM) has been very small but it can be said that it has been increased slightly. Share of HIIT has been fluctuated in the period. Its average has been around 12%. In final goods, we can see a little bit different trend from parts and components in OWT. OWT (EX > IM) has been decreased to 12% in 2010 from 58% in 1990. The share has shown downward trend as well as parts and components. However, OWT (EX < IM) has been increased to 42% while OWT (EX >IM) has been decreased. We can say that Japan has depended more on imported final goods.

Table 5.1.1 Trade Patterns' Share in Bilateral Trade with 9 Countries

(a) Parts and Components

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	2384	2023	362	**18**	**12**	14	1	**55**	0
1991	2761	2313	448	22	18	7	1	51	0
1992	2972	2510	463	18	17	11	1	53	0
1993	3273	2768	505	23	14	11	1	51	0
1994	4026	3343	683	23	16	13	1	47	0
1995	5040	4028	1012	22	19	17	1	41	0
1996	5511	4271	1240	20	33	8	1	38	0
1997	6197	4783	1414	21	30	10	2	37	0
1998	5710	4355	1355	20	33	13	3	31	0
1999	6060	4465	1595	18	41	7	3	32	0
2000	7702	5460	2242	19	33	14	2	31	0
2001	6973	4742	2231	18	36	11	4	31	0
2002	7722	5354	2369	23	36	10	3	28	0
2003	8675	5993	2682	29	34	6	3	27	0
2004	9808	6621	3187	23	33	13	4	27	0
2005	10302	6754	3549	23	37	11	4	24	0
2006	11808	7618	4190	26	35	13	4	23	0
2007	12000	7815	4185	21	29	23	4	22	0
2008	10837	6990	3847	25	31	17	4	22	0
2009	7838	5210	2628	36	30	8	3	23	0
2010	9512	6311	3201	**28**	**33**	13	3	**21**	0

(b) Final Goods

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	1295	1050	**246**	26	**4**	2	**3**	**58**	7
1991	1472	1174	297	23	2	4	6	61	4
1992	1524	1218	306	22	2	3	6	62	6
1993	1542	1198	344	22	3	3	7	60	5
1994	1655	1192	462	26	3	5	10	54	3
1995	1726	1084	642	29	5	6	14	38	7
1996	1898	1061	837	34	8	5	20	34	0
1997	2032	1144	888	30	9	5	19	37	0
1998	1788	904	884	27	8	6	28	30	0
1999	1707	808	899	36	7	4	24	28	0
2000	2050	912	1138	31	8	3	30	28	0
2001	2231	872	1360	29	7	6	37	22	0
2002	2299	950	1348	26	11	4	36	23	0
2003	2503	1095	1408	28	15	7	28	21	0
2004	2789	1186	1603	28	16	8	27	22	0
2005	2931	1197	1734	26	11	9	32	21	0
2006	3201	1342	1859	29	14	3	34	20	0
2007	4431	1849	2582	34	9	8	31	17	0
2008	4271	1777	2495	33	12	8	30	18	0
2009	3508	1306	2202	37	13	4	32	14	0
2010	4475	1453	**3022**	29	**14**	3	**42**	**12**	0

Data source: Author's calculation from trade statistics

Actually the import value has been increased to 3022 Billion yen in 2010 although export value has shown a moderate upward trend. Considering the rapid

increase of share of VIIT (EX price < IM price) in parts and components, we may say that Japan export cheaper parts and components more and more to trade partners and import cheaper final goods from them. If Japan imports cheaper final goods with exporting cheaper intermediate and exporting more expensive final goods with advanced technologies, through this way firms can specialize their production process and focus on developing their more advanced technologies. This kind of activities of firms can increase productivity. We will analyze on it in our next chapter.

In regard with VIIT, VIIT (EX price > IM price) has been increased to 29% in 2010 at the same time VIIT (EX price < IM price) has shown upward trend. Its share has increased to 14% in 2010 from only 4% in 1990. Both type of VIIT's share has been increased HIIT's share has stayed in a low level through the period.

Regarding to unit discord, unluckily there are some codes which do not have the common unit. They actually belong to intra-industry trade but we cannot compare their unit value therefore we could not classify them.

In the next table 5.1.2, we can see the trade patterns of parts and components by country in each 5 year. In each country except for Hong Kong, VIIT (EX price < IM price) has been increased. VIIT (EX price > IM price) has been mixed. Some countries have increased it but other countries have not. OWT (EX > IM) has been decreased during the period in above all countries except for Hong Kong. And OWT (EX < IM) has been a quite low level but it has been increased in some countries.

Table 5.1.2 Parts and Components by 5 Year

(a) Korea

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	569	439	130	28	17	27	3	25	0
1995	922	547	375	17	52	3	1	27	0
2000	1226	811	415	27	48	3	1	20	0
2005	1470	893	577	25	56	3	1	14	0
2010	933	509	424	25	56	1	2		0

(b) China

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	85	69	16	19	9	8	3	60	1
1995	398	261	137	30	15	21	2	32	1
2000	1176	712	464	30	6	42	9	13	0
2005	3047	1833	1214	43	26	19	6	6	0
2010	3513	2229	1284	52	31	6	5	6	0

(c) Taiwan

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	521	422	100	19	12	18	2	48	1
1995	816	676	140	14	12	34	1	39	0
2000	1128	691	437	19	46	9	0	25	0
2005	1516	826	691	18	64	1	4	12	0
2010	1629	902	727	9	36	44	0	10	

(d) Hong Kong

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	308	299	9	4	1	0	0	95	0
1995	611	567	44	6	35	1	0	59	0
2000	980	934	46	3	0	0	0	97	0
2005	1343	1320	23	0	0	0	0	100	0
2010	1023	1017	6	0	0	0	0		0

Table 5.1.2: Continued

(e) Thailand

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	162	137	26	25	16	8	0	50	0
1995	373	311	62	24	12	9	0	55	0
2000	463	349	114	41	8	29	3	19	0
2005	709	455	254	25	7	53	3	11	0
2010	689	489	200	22	40	24	4	11	0

(f) Singapore

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	402	371	31	8	1	13	0	77	0
1995	898	797	101	14	1	48	0	37	0
2000	947	783	164	10	53	5	0	31	0
2005	674	541	133	8	64	1	0	28	0
2010	554	415	139	32	28	19	0	21	0

(g) Malaysia

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	222	189	33	27	25	1	0	46	0
1995	670	581	89	49	5	3	0	42	0
2000	878	594	284	16	52	2	1	30	0
2005	644	399	246	17	51	8	2	22	0
2010	545	365	179	15	51	4	3	28	0

(h)Philippines

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	79	63	16	4	25	0	0	70	0
1995	244	191	53	43	10	0	7	39	0
2000	670	415	255	8	54	21	4	13	0
2005	669	345	325	9	57	14	7	12	0
2010	405	250	155	7	57	3	14		

Table 5.1.2: Continued

(i) Indonesia

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	36	35	1	4	0	0	0	94	0
1995	109	98	11	10	13	4	1	71	1
2000	236	172	64	16	18	38	7	22	0
2005	229	142	87	20	33	8	18	20	0
2010	222	135	87	26	28	6	18	21	0

Data source: Author's calculation

Trade between Japan and China increased dramatically, and VIIT has been taken the share of more than 80% in 2010. VIIT (EX price > IM price) has been taken over 50% of the trade share. China is a country of production base and has large demand of consumption. We will also see the trade pattern of final goods by country in the next table 5.1.3.In final goods, share of OWT (EX < IM) has been increased except for Philippines and Indonesia although they also have shown upward trend compared to the standard of 1990s, which means that Japan has more depended on imported final goods especially from Korea, China, Taiwan. Share of VIIT (EX price > IM price) has been decreased except for China in 2010 compared to the standard of 1990. However, bilateral trade between Japan and China has been very large in value, therefore the share has been at 29% of standard in the total 9 country's data which we have already looked at.

Table 5.1.3 Final Goods by 5 Year

(a) Korea

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	167	95	72	50	4	4	3	24	15
1995	198	117	81	28	4	10	20	39	0
2000	262	164	98	48	4	7	3	38	0
2005	317	195	122	27	27	21	9	17	0
2010	383	179	203	39	21	2	27	11	0

(b) China

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	154	115	38	10	2	3	18	66	0
1995	340	158	182	44	1	6	12	14	22
2000	563	130	433	40	6	0	41	13	0
2005	1308	311	997	34	8	13	39	5	0
2010	2672	586	2085	33	14	3	48	2	0

(c) Taiwan

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	208	148	60	43	8	3	1	32	13
1995	149	92	57	54	3	6	6	21	9
2000	223	136	87	44	13	7	10	26	0
2005	295	154	141	30	14	2	31	23	0
2010	285	106	179	29	9	8	43	11	0

(d) Hong Kong

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	288	274	14	14	2	1	0	82	0
1995	318	303	14	10	0	4	0	86	0
2000	217	207	10	10	3	0	0	87	0
2005	225	214	11	7	1	0	0	92	0
2010	282	272	10	2	14	0	0	84	0

Table 5.1.3: Continued

(e) Thailand

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	98	85	13	27	8	1	1	60	3
1995	145	73	71	31	11	7	21	30	0
2000	187	63	123	33	17	0	35	15	0
2005	218	85	133	26	16	7	33	17	0
2010	232	88	144	25	18	15	26	16	0

(f) Singapore

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	283	254	29	20	6	0	0	64	10
1995	273	218	55	28	12	8	0	44	8
2000	180	119	60	25	12	14	9	40	0
2005	165	141	23	14	9	1	5	71	0
2010	129	106	23	15	14	0	4	67	0

(g) Malaysia

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	57	42	14	31	0	10	53	2	5
1995	209	61	149	23	7	6	55	9	0
2000	264	35	228	14	6	1	73	6	0
2005	235	39	196	14	7	1	70	8	0
2010	309	36	274	14	5	4	73	4	0

(h) Philippines

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	19	16	3	18	0	14	68	0	0
1995	49	30	19	24	28	0	2	38	8
2000	84	44	40	16	19	7	22	37	0
2005	102	38	65	10	14	9	41	27	0
2010	101	44	57	17	26	0	28	29	0

Table 5.1.3: Continued

(i) Indonesia

(Billions Yen, %)

Year	Trade Value	Export	Import	VIIT		HIIT	OWT		Unit Discord
				EX price > IM price	EX price < IM price		EX < IM	EX > IM	
1990	22	20	2	6	2	0	88	4	0
1995	44	31	14	20	4	0	15	61	0
2000	71	12	59	4	3	2	81	10	0
2005	66	19	47	31	1	0	46	21	0
2010	82	34	48	17	14	6	33	30	0

Data source: Author's calculation

5.1.2 Result of Outsourcing Ratio

The table 5.1.4 shows the transition of above 2 types of outsourcing ratio. First outsourcing does not consider price gaps between export price and import price. Hence ratio is larger than second outsourcing ratio as we can see. As we mentioned before, 1st outsourcing ratio does not consider price gap between export and import. We just put value of imported parts and components into numerator of the first equation above. And in the 2nd outsourcing, we put value of imported parts and components in VIIT where export price is larger than import price. As we can see, imported parts and components have been increased to 753 Billion Yen in 2010.And first outsourcing ratio is 27.6% which is about 7 times larger than the standard of 1990. Share of imported parts and components have been increased rapidly through the period. Regarding to 2nd outsourcing ratio, it has shown upward trend. Its share has been around 9% in 2010. From the transition of the ratio, we can say that cheaper parts and components' share has been expanded. Since cheaper intermediate goods have been increased, firms can decrease their production costs to produce final goods in Japan. In addition, they may focus on more advanced products. Actually, we can see that how firms increased their export of parts and components which are advanced through the table5.1.4. VIIT (EX price > IM price) in parts and components have been

increased. We would like to address that we judge that a certain product is advanced one depending on price gap between imported and exported. Therefore, in our analysis we have judged products classified as VIIT only. We have not compared products classified as OWT because overlapping ratio is quite low and there are 100% OWT products too.

Table 5.1.4 Outsourcing Ratio from 1990 to 2010[10]

(Millions Yen, %)

	A	B	C	D	B/C	D/C
Year	Domestic Production of parts and components	Imported parts and components	A + B	Imported parts and components in VIIT (Ex price > IM price)	1st Outsourcing Ratio	2nd Outsourcing Ratio
1990	1822513	78335	1900848	30612	4.1	1.6
1991	2072982	96769	2169751	35208	4.5	1.6
1992	1841237	111744	1952981	42493	5.7	2.2
1993	1789625	110484	1900109	39266	5.8	2.1
1994	1917341	153977	2071318	50409	7.4	2.4
1995	2165288	200758	2366046	63583	8.5	2.7
1996	2309362	338541	2647903	70204	12.8	2.7
1997	2342709	318325	2661034	90867	12.0	3.4

[10]Since we have obtained the ratios with quarterly data, we have shown the 1st quarter's ratio of each year in the table.

1998	2333448	342040	2675488	97568	12.8	3.6
1999	2284385	328654	2613039	70519	12.6	2.7
2000	2662909	464107	3127016	85476	14.8	2.7
2001	2582873	638092	3220965	114884	19.8	3.6
2002	1850296	525162	2375458	107471	22.1	4.5
2003	2092447	587349	2679796	166151	21.9	6.2
2004	2415816	753882	3169698	196768	23.8	6.2
2005	2211466	786888	2998354	218670	26.2	7.3
2006	2459222	1001153	3460375	300395	28.9	8.7
2007	2493187	1035865	3529052	283019	29.4	8.0
2008	2569184	1021452	3590636	275365	28.4	7.7
2009	1295583	512669	1808252	216751	28.4	12.0
2010	1976833	753777	2730610	253544	**27.6**	**9.3**

Data source: Author's calculation from trade statistics and yearbook of machinery statistics.

5.1.3 Result of VIIT Ratios

The below table 5.1.5 shows the result of VIIT. As we can see, both ratios have been increased. In 1st VIIT ratio, it was only 4% in 1990 but it has shown upward trend and it has increased to about 16% in 2010. Its peak has been about 24%

in 2007. Domestic production of parts and components has not shown very big change in the period but the export in VIIT (Exp > Imp) has dramatically increased, therefore the ratio has been increased too. In VIIT 2nd, it was quite low in 1990, only 0.7% in 1990. However it has increased very slowly to3.9% in 2010. Domestic production of final goods has actually shown downward trend. Around 5327 billion yen was the production of it in 1990 but it has decreased to 3182 billion yen. Export in VIIT (Exp > Imp) has been increased to 124 billion yen in 2010 from 36 billion yen in 1990.

Table 5.1.5 1st and 2nd VIIT Ratio

(Millions Yen, %)

	Domestic Production		Export in VIIT(Exp > Imp)		VIIT Ratio	
Year	Parts and Components	Final Goods	Parts and Components	Final Goods	1st VIIT	2nd VIIT
1990	1822513	5326892	74397.162	36689.826	4.1	0.7
1991	2072982	5775136	95900.188	42360.828	4.6	0.7
1992	1841237	5423398	93201.141	43079.87	5.1	0.8
1993	1789625	5046375	93101.257	51008.146	5.2	1.0
1994	1917341	4820420	135512.246	45699.532	7.1	0.9
1995	2165288	4899977	201912.708	52100.012	9.3	1.1
1996	2309362	5125330	137751.452	65617.722	6.0	1.3
1997	2342709	5771280	230035.61	65391.148	9.8	1.1
1998	2333448	5485222	200109.445	44075.407	8.6	0.8
1999	2284385	5195789	157432.685	49999.362	6.9	1.0
2000	2662909	5325346	234944.165	44245.733	8.8	0.8
2001	2582873	5280557	249444.809	63807.715	9.7	1.2
2002	1850296	3887286	237545.089	52408.084	12.8	1.3
2003	2092447	3923715	369640.509	45655.086	17.7	1.2
2004	2415816	4049786	374393.269	65406.985	15.5	1.6
2005	2211466	3956552	330744.14	69545.295	15.0	1.8
2006	2459222	4183104	421368.757	75929.15	17.1	1.8
2007	2493187	4015010	591824.896	139518.771	23.7	3.5
2008	2569184	4120052	347786.66	186994.332	13.5	4.5
2009	1295583	2845697	274063.203	110548.56	21.2	3.9
2010	1976833	3182204	319225.923	124072.731	16.1	3.9

Data source: Same as Table 5.1.4

5.2 Results of Regression Model

Data set which we have actually used in the regression can be seen at Appendix D. We have used growth ratio of each variable. As we mentioned, we have obtained them in year-on-year's way to adjust seasonal effect since trade statistics and yearbook of machinery do not show the data adjusted it. And some variables may need time lags to influence on labor productivity so we have checked partial correlation of each variable in correlogram to get the most suitable lag length of variables. We would like to see the result of estimations in the order of all sizes of firms, firms with capital 100 million yen, and firms with capital 1 billion yen. Although we have changed variables of labor productivity, capital-labor ratio, and intangible fixed assets, we put the same data of outsourcing ratio and VIIT both 1st and 2nd since we cannot tell VIIT and outsourcing ratio of each size of firm. In the short, these 3 types of result are depending on the hypothesis that if all sizes of firms[11] import and export, if only firms with capital of 100 million yen import and export, and if only firms with capital of 1 billion yen import and export. However these results also can tell some important things because increases of outsourcing ratio and VIIT may not work positively on labor productivity of firms which do not import and export, or do less. For this type of firms (in most of cases small-sized firms without high advanced technologies), increase of outsourcing ratio and VIIT cannot be preferable because their market share can be replaced by imported products from trade partners. As the result, they may decrease their labor productivity too. In order to tell the overall effects of outsourcing and VIIT, it is very useful to use different size of firm's data too. Likewise, it is also preferable to see the effects of them on large-sized firms which mainly enjoy foreign commodities trades too.

[11]In Financial Statements Statistics of Corporations from Ministry of Finance of Japan, firms with capital over 10 million yen are objects of the statistics.

5.2.1 Analysis on Result of Estimation of Firms of All Sizes

First we will see the trend of labor productivity, Y / L, capital labor ratio, K / L , and Intangible fixed assets in the below table 5.2.1. Number of labors in all sizes of firms has shown its up-ward trend in the 1990s but it has started to decrease. Labor productivity's increase can be mainly seen between 2003 and 2008.Capital has been kept up-ward trend through the period hence capital labor ratio has increased very much. The standard of 2010 has been 2 times larger than that of 1990, 5.5million yen per labor. Intangible fixed assets have also shown its rapid increase since 2000.

Table 5.2.1 Variables in All Size Firms[12]

(Person, Milliion yen)

Year	NO. of labors	Added Value	Capital	Intangible Fixed Assets	Y / L	K / L
1990	1663144	3361651	4386749	124797	2.021263	2.637624
1991	1832051	3721019	4789966	166906	2.031067	2.614537
1992	2039663	3592805	5013305	157288	1.76147	2.457908
1993	2008603	3366086	5124500	182255	1.675834	2.551275
1994	1974821	3225184	5291324	178347	1.633153	2.679394
1995	2047975	3587827	5527801	175605	1.75189	2.699154
1996	1994844	3998249	5745730	233017	2.004292	2.880290
1997	1984797	4287503	5762767	176159	2.160172	2.903454
1998	2043248	4179780	6026474	179223	2.045655	2.949457
1999	1988111	3676510	6134749	201917	1.849248	3.085717
2000	2047107	4174425	6444656	723063	2.039183	3.148177
2001	1861702	4080652	6512219	804068	2.191893	3.497992
2002	1716128	2981813	6794731	946563	1.737524	3.959338
2003	1597152	3210071	6953394	942712	2.009872	4.353620
2004	1626288	3480318	6864277	963410	2.140038	4.220825
2005	1557172	3522017	6957465	1137540	2.261803	4.468013
2006	1700489	3838185	7368233	1092060	2.257107	4.333008
2007	1532775	3890990	7545538	1120554	2.538527	4.922795
2008	1688040	3914972	7582390	1196656	2.319241	4.491830
2009	1596692	1487830	7626040	1152154	0.93182	4.776149
2010	1499175	3142953	8222847	1117397	2.096455	5.484914

Data Source: Author's calculation depending on Financial Statements Statistics

The result of the estimation can be seen in the below table 5.2.2. As the result of seeing the partial correlation, we have decided to adopt the data of 1 period ago to

[12] In the table, we put the first quarter's data in each year. In the regression we have used quarterly data. And quarterly data is represented in Appendix C.

variable intangible fixed assets and 2nd VIIT and the data of 4 periods ago to variable outsourcing and 1stVIIT. This is the reason why the below table 5.2.2 says them.

Table5.2.2 Estimation Result of All Sizes of Firms

Variable	Coefficient		Std. Error		t-Statistic		Prob.	
	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT
C	-6.8532	-7.4259	2.2814	2.5599	-3.0040	-2.9008	0.0037	0.0050
Y / L(-1)	0.6745	0.6799	0.0763	0.0757	8.8438	8.9860	0.0000	0.0000
K / L	0.8829	0.9406	0.3338	0.3463	2.6453	2.7164	0.0101	0.0083
Intangible Fixed Assets(-1)	0.0564	0.0578	0.0338	0.0338	1.6701	1.7096	0.0994	0.0918
Outsourcing(-4)	6.2127	6.2325	2.3411	1.8158	2.6538	3.4323	0.0098	0.0010
1st (-4) / 2nd (-1)	0.0734	1.6648	0.7662	3.3380	0.0958	0.4987	**0.9240**	**0.6195**
R-squared	0.6406	0.6418						
Adjusted R-squared	0.6149	0.6162						

As we can see, we have got all what we have expected in coefficient sing both in 1st VIIT and 2nd VIIT, however variable of both 1stand 2nd VIIT's p valuesare quite high at 0.92 in 1stVIIT and about 0.62 in 2nd VIIT hence they are not at significant level. Others are statistically significant at 10% level. As long as we see the result of estimation of all sizes of firms, outsourcing increases labor productivity, and their coefficients are more than 6.0. And p values of outsourcing ratios are quite low. Both of them are statistically significant at 1 % level. R-squares show more than 60%.

5.2.2 Analysis on Result of Estimation of Firms Capitalized over 100 Million Yen

We would like to show the trend of labor productivity, Y /L, capital labor ratio, K / L, and intangible fixed assets from 1990 to 2010 with yearly data in the below table 5.2.3 at first. Compare to all sizes firm's data, labor productivity of firms with capital over 100 million yen has been higher as well as capital labor ratio. And we cannot see fluctuation in their trends like the data of all sizes of firms have

shown in the last table. Both of labor productivity and capital over ratio has been increased in a steady way. The result of the estimation can be seen in the table 5.2.4.

Table 5.2.3 Variables in Firms Capitalized over 100 Million Yen

(Person, Milliion yen)

	NO. of labors	Added Value	Capital	Intangible Fixed Asset	Y / L	K /L
1990	1140720	2861203	4179277	70334	2.508243	3.663719
1991	1219110	3069845	4573639	103682	2.5181034	3.751621
1992	1302447	2811716	4780229	111932	2.1587949	3.670191
1993	1293138	2713206	4869334	129299	2.0981566	3.765518
1994	1304922	2789746	5023166	133792	2.1378642	3.849399
1995	1284371	3049231	5203863	149756	2.3741045	4.051682
1996	1282407	3266503	5414769	143725	2.5471656	4.222348
1997	1258315	3622505	5474500	145336	2.8788539	4.350659
1998	1251450	3333913	5683768	154876	2.6640401	4.541746
1999	1249450	2997302	5784188	182773	2.3988971	4.629387
2000	1212455	3366972	6071268	620993	2.7769872	5.007417
2001	1160412	3389330	6150279	735458	2.9207988	5.300082
2002	1110571	2508587	6441118	867658	2.2588263	5.799825
2003	1024285	2881667	6591203	909318	2.8133449	6.434931
2004	955078	2873371	6512689	860921	3.0085197	6.819013
2005	933743	2822865	6612478	1071072	3.0231713	7.08169
2006	949254	3209491	7027597	1055010	3.3810666	7.403284
2007	971466	3361891	7202488	1071985	3.4606368	7.41404
2008	969231	3178522	7247360	1131373	3.2794267	7.477433
2009	966258	1054027	7288386	1106660	1.0908339	7.542898
2010	967445	2636724	7899353	1058685	2.7254511	8.16517

Data Source: Author's calculation depending on Financial Statements Statistics

Table 5.2.4 Estimation Result of Firms Capitalized over 100 Million Yen

Variable	Coefficient		Std. Error		t-Statistic		Prob.	
	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT
C	-11.8006	-11.9662	3.0328	3.2020	-3.8910	-3.7371	0.0002	0.0004
Y / L(-1)	0.5966	0.5948	0.0756	0.0741	7.8948	8.0287	0.0000	0.0000
K / L	1.8344	1.8437	0.5134	0.5146	3.5730	3.5828	0.0006	0.0006
Intangible Fixed Assets(-1)	0.0554	0.0566	0.0401	0.0405	1.3797	1.3991	**0.1721**	**0.1662**
Outsourcing(-4)	9.1554	8.9662	2.4435	1.9598	3.7469	4.5749	0.0004	0.0000
1st (-4) / 2nd (-1)	**-0.1107**	0.5233	0.8435	3.5820	-0.1312	0.1461	**0.8960**	**0.8843**
R-squared	0.6211	0.6212						
Adjusted R-squared	0.5941	0.5941						

We could get the positive signs of all variables except for 1st VIIT. As we have got positive sign of outsourcing in the estimation of all sizes of firms, we have got

positive sign here too. Although we have got a negative sign of coefficient in 1st VIIT and positive sign in 2nd VIIT, p values of them are quite high. They are at a level of around 0.9 hence this is not statistically significant. In intangible fixed assets, although we have got a positive sign but the p values are too large to be statistically significant just like VIIT. They are more than 15% in the result. P values of outsourcing ratios are quite low and they are significant level at 1% as we have got the result in all sizes of firms. R-squares in this analysis are around 60%.

5.2.3 Analysis on Result of Estimation of Firms with Capital over 1 Billion Yen

We would like to show the trend of labor productivity, Y /L, capital labor ratio, K / L, and Intangible Fixed Assets from 1990 to 2010 first with yearly data in the below table 5.2.5

Table 5.2.5 Variables in Firms Capitalized over 1 Billion Yen

(Person, Million yen)

	NO. of labors	Added Value	Capital	Intangible Fixed Asset	Y / L	K / L
1990	888404	2415038	3737499	56563	2.718401	4.206981
1991	930603	2627820	4298819	74314	2.823782	4.619391
1992	984244	2466182	4560437	97884	2.505661	4.633442
1993	1008087	2069673	4622121	106702	2.05307	4.585042
1994	1005121	2147370	4755308	113971	2.136429	4.73108
1995	997315	2449291	4915006	118329	2.455885	4.928238
1996	977026	2793080	5043041	124773	2.858757	5.161624
1997	975652	2842265	5295620	132572	2.913195	5.427775
1998	960362	2677699	5382922	135859	2.788218	5.605097
1999	936773	2119515	5441151	147043	2.262571	5.808399
2000	921999	2505714	5644741	549238	2.717697	6.122285
2001	897351	2920674	5879179	643393	3.254773	6.551705
2002	874518	1744667	6104722	765931	1.995004	6.98067
2003	791493	2256227	6309640	782503	2.850596	7.97182
2004	720155	2197150	6255722	771188	3.05094	8.686633
2005	716256	2350731	6217297	886221	3.28197	8.680272
2006	719239	2587238	6601143	1006628	3.597188	9.177955
2007	717837	2840523	6913507	962615	3.957058	9.631026
2008	719717	2826280	6960187	1055808	3.926932	9.670728
2009	723070	1569449	7040149	1107325	2.170535	9.736469

2010	729615	2011690	7558506	1005318	2.757194	10.35958

Data Source: Author's calculation depending on Financial Statements Statistics

As we can see from the above table, both labor productivity and capital labor ratio are at higher level than both firms of all sizes and firms capitalized more than 100 million yen. Especially, capital labor ratios of this table are much higher than other sizes of firms. We can also tell how much the firms take the share of number of labors, added value, capital, and intangible fixed assets by minus the data shown in above tables. Most of intangible fixed assets are accumulated by the firms. Since large-sized firms can purchase machines which are expensive but can increase labor productivity well, and invest many things which can increase their added-value, such as R&D, launching advertisements, and so on, they can increase their productivity. The result of estimation is shown in the table 5.2.6.

Table 5.2.6 Estimation Result of Firms Capitalized over 1 Billion Yen

Variable	Coefficient		Std. Error		t-Statistic		Prob.	
	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT	1st VIIT	2nd VIIT
C	-11.1004	-11.8912	2.9029	3.1568	-3.8239	-3.7669	0.0003	0.0003
Y / L(-1)	0.5876	0.5861	0.0754	0.0734	7.7937	7.9825	0.0000	0.0000
K / L	1.6394	1.7096	0.4756	0.4857	3.4471	3.5198	0.0010	0.0008
Intangible Fixed Assets(-1)	0.0552	0.0581	0.0337	0.0338	1.6362	1.7166	**0.1063**	0.0905
Outsourcing(-4)	8.6467	8.4741	2.3505	1.8762	3.6786	4.5167	0.0005	0.0000
1st (-4) / 2nd (-1)	**-0.0881**	2.1481	0.8122	3.5034	-0.1085	0.6131	**0.9139**	**0.5418**
R-squared	0.6283	0.6302						
Adjusted R-squared	0.6018	0.6038						

As we can see, 1st VIIT's coefficient sing shows negative. Except for the sign, all of them are positive. Regarding to p value, in intangible fixed assets it represents more than 10% but it is actually very close to 10% although we cannot say that it is statistically significant unluckily. In VIIT ratio, both 1st and 2nd VIIT are not significant level in this analysis too. However, outsourcing has positive coefficient

sign and it is statistically significant at 1 % level. We could get the results of significant level through our 3 types of estimations. In the next chapter, we would like to summarize the result of estimations in this part.

CHAPTER VI

POLICY IMPLICATION AND LIMITATION

6.1 Conclusion

In the thesis, we have done trade classification and decomposed into 3 patterns which are VIIT, HIIT, and OWT after we have got an overview as background. Both in parts and components and final goods, HIIT has not been dominant through the period. OWT used to be very dominant in parts and components but VIIT has been dominant although OWT is still dominant in final goods. We have obtained outsourcing and VIIT ratios depending on the data which we have got through trade classification as the indices of specialization in the thesis. As we have seen, outsourcing ratio and VIIT ratio have been increased. What can we say with the results of these indices? Since these indices are originally obtained with the data of trade classification and we have considered price gaps between import and export to ask for the indices, we can say that specialization in Japanese electrical machinery industry has been under process. Firms in Japan have imported cheaper parts and components more than before and at the same they have exported more expensive products (both parts and components and final goods) to East Asia. Increasing ratio of more expensive products exportedto domestic products and increasing ratio of cheaper products imported to domestics demand represent that specialization has been progressed. In our regression model, we have used the data of 3 types of firm which are all sizes, firms capitalized over 100 million yen, and capitalized over 1 billion yen with the common data of outsourcing ratio and both 1^{st} and 2^{nd} VIIT. We have found variables of labor productivity, capital labor ratio, and intangible fixed asset and labor productivity of last period work positively on current labor productivity. As we have expected, outsourcing has positive relationship with labor productivity. In the all above regressions, outsourcing

has had positive sign and statistically significant. Our result is consistent with the result of Hijzen et al (2006) because it is true that their offshoring are asked for as ratio of the value of subcontracting to foreign firms to value add, therefore this differs from our outsourcing ration, however, the offshoring is very similar with our outsourcing in the sense that they allow firms with advanced technologies to make a more efficient use of production. Likewise, our results are consistent with Ito and Tanaka (2008) where they have asked for outsourcing ratio by dividing imported intermediate goods by intermediate goods in input-output table in the same sense.And our results can also be consistent with Matsuura (2008). As we have seen, it has claimed that vertical FDI has positive influence on productivity. It is natural that VIIT is increased if vertical FDI is done. Our outsourcing ratio with consideration of VIIT also has positive impact on productivity.

Regarding to the variable of VIIT, we could not get the results which are significant through all regressions although we have got a positive sign in most of regressions. Therefore, we cannot say that Japanese firms have raised their productivity by exporting more expensive products to trade partners although the ratios of VIIT has been increased as we could see at previous chapter. The reason why we could not get significant level's results can be that we have considered only our research objects which are 9 countries in Asia. I mean that if we consider other trade partners also because they are not all trade partner of Japan, especially US and EU, the results can be different. In our method, we have just divided export in VIIT (Ex price > Im price) from our research object countries by domestic production however if we add more export partners of Japan, the ratio become higher and it can influenced on labor productivity.

We would like to raise some policy implications and the limitation of this thesis, possible extensions in this section.

Although we could not get the clear result on both 1st and 2nd VIIT, we could get clear result on outsourcing at statistically significant level. Outsourcing works on labor productivity positively. Since the outsourcing ratio is originally from import of VIIT (Ex price > Im price) in parts and components, we suggest that government should make policy to expand the trade.

There are many past literatures on VIIT. For example, Ishido (2003) claims that FDI has positively work on VIIT in the thesis. And he also says that if distance between Japan and trade partners becomes further, VIIT will be decreased because shipping costs and transaction costs will become higher. And also he claims that VIIT share will be increased in the trade between Japan and trade partners in the case that there is 10 thousand USD's gap of per capita GDP. We think that the effective way of increase of VIIT for Japan is to invest to East Asia countries because they are geographically not very far from Japan and there are many countries which potentially fulfill above conditions. It can be very effective for government to make a suitable investment surrounding in potential host countries in East Asia to encourage firms to do FDI. For example, to offer assistance of infrastructure such as bridges, highways, sea port and air ports as ODA to arrange the environment for business to do smoothly is effective. If shipping costs become lower, trade will be increased.

Second, since intangible assets have also work positively on labor productivity, firms should invest for intangible assets. Especially, it is very important to invest to R&D. To stay competitive, firms need to innovate their products constantly. As long as we have the trend of increase in imported goods which are

cheaper than domestic price, firms have to confront it improving their products and putting more values on them hence R&D investment is necessary. And also R&D may bring benefit to other firms because of spilled-over effects. Since spilled-over effects have a side of public goods, it is better for government to support firms which have invested to research which will contribute the society.

As we mentioned many times, one of our purposes of the thesis is to see if labor productivity is affected on outsourcing and VIIT or not. And the reason why we use outsourcing and VIIT is that we think that they can be indices of specialization of production where we say that Japan produce advanced products more or focus more on advanced products importing less advanced products. Since most of electrical products are imported from East Asia as we have already made it sure with data from RIETI-TID 2011 in chapter 5, we have decided to 9 countries as our research object. We believe that our research results are persuasive to considerable extent. However in our research, we have not considered developed countries such as EU, US, and so on. If we consider these developed country, the result may be changed, I mean that VIIT can be explained as a statistically significant factor which influence on labor productivity as we mentioned in the last chapter. Concretely speaking, we check commodities which are classified as VIIT in bilateral trades between Japan and US and Japan and EU, and then ask for export value of it, and we can add it up on. Or we may add up export value of commodities which are classified as HIIT (Ex price >Im price) in the bilateral trade with developed countries as long as they are done as VIIT between the trades with 9 countries. This can be raised as the first extension.

The second is related to industry division. Actually HS 85 which we have used in this thesis are mainly used in electrical machinery industry but some may be

used in general machinery, and others are utilized in another industry. Therefore outsourcing and VIIT ratio may be overestimated or underestimated. In order to solve this problem, we would like to suggest summing up machinery industries such as electrical machinery industry, general machinery industry, and precision machinery industry in the statistics you may use. And As Ando (2004) analyzed, it is be better to use trade statistics data from HS84 to HS92 because they are correspond to overall machinery industry. Research object range is wider but we can solve the problem. And third one is to use another index of productivity. Total factor productivity (TFP) can be also influenced by specialization. However, this is depended on how you estimate. Actually JIP data base 2012 has shown the data of it, but they show only yearly data of it.

The third is a little similar with the second one. We have used industry level data. It actually includes some categories of business in electrical machinery industry. In a business, they might be motivated to do FDI to East Asia countries and import and export more than another business category as the result they may increase their labor productivity whereas there may be categories which do not run their business well and decrease labor productivity. If we can choose the data of category which export more expensive goods importing cheaper products, the result can show that VIIT (Ex price >Im price) is significant and it positively affects on labor productivity.

The fourth one is about OWT. We have only used trade value of VIIT as the index of specialization. However, in final goods, OWT ratio is still high as we have seen in table 5.4. We have not considered export of OWT. As long as we see table 5.4, OWT (EX < IM) is very dominant, 42% in 2010, which means that Japan import more than export because OWT (EX > IM) is only 12% in final goods. Originally,

Commodities we have classified as OWT is based on trade value. There can be many commodities which are advanced although trade overlapping values are less than 0.1. If we expand our research object to OWT, export value of advanced goods from Japan will be increased. However in the thesis we have not included it because there are 100% pure OWT in both export and import direction and we cannot tell that they are advanced goods or cheaper goods. We have to admit that there is limitation where we judge if commodities are advanced one or not in the way we have used in the thesis.

The last one is about small-sized firms. As long as we have seen the result of all sizes of firms, outsourcing works positively on labor productivity. However, if we choose only small-sized firms, the result may be different because generally small-sized firms do not enjoy benefit of export and import. Considering the facts that only large-sized firms take big share of import and export, outsourcing may rather work negatively on labor productivity because increase of cheaper products will give consumers more choices to purchase and their products produced domestic may not be competitive. We could not make it sure in the thesis.

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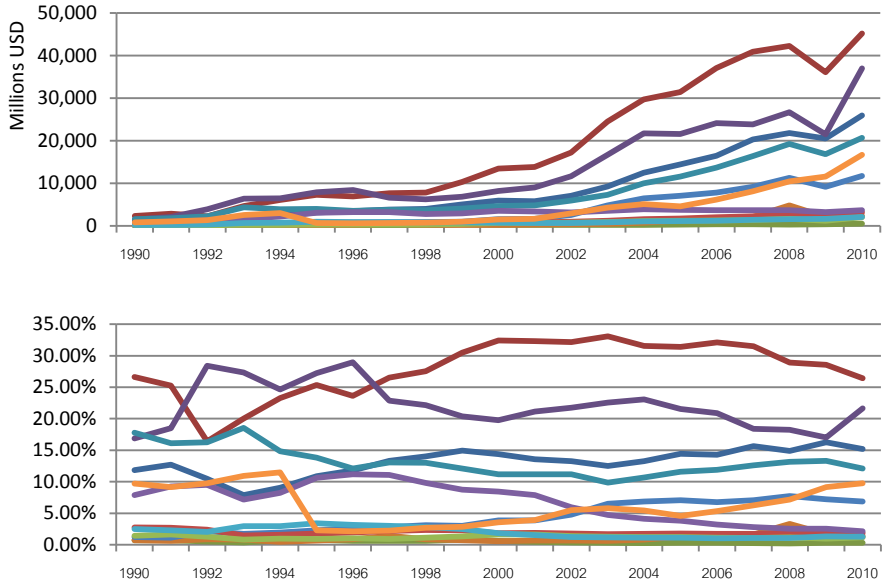
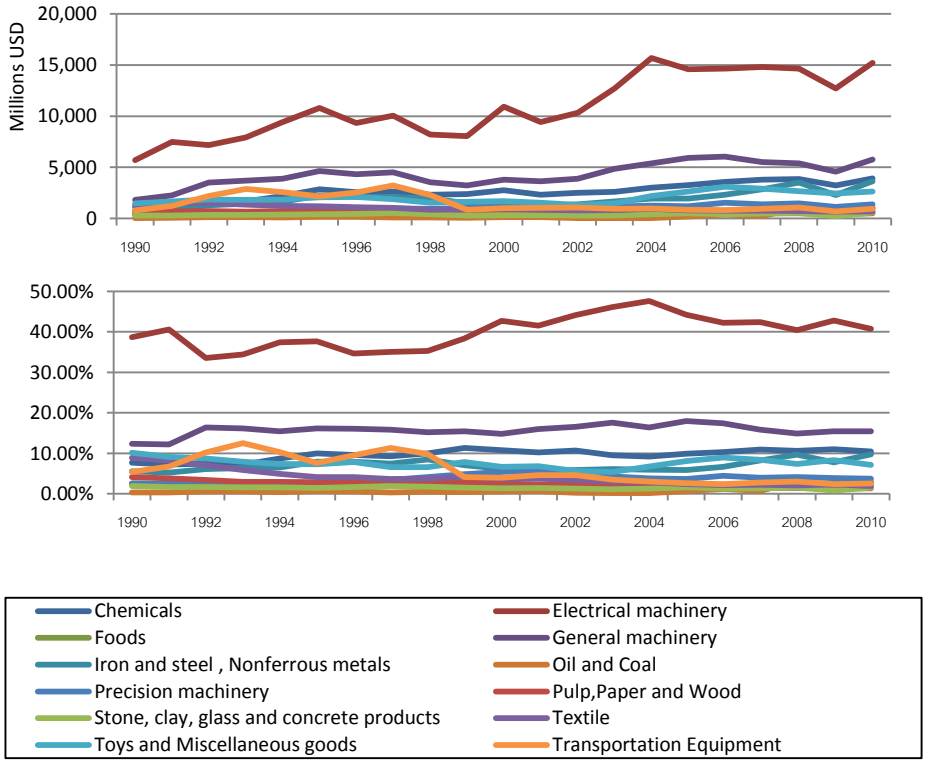
APPENDICES

Appendix A: Japanese Export to 9 Countries and Ratios by Industry

(a) China



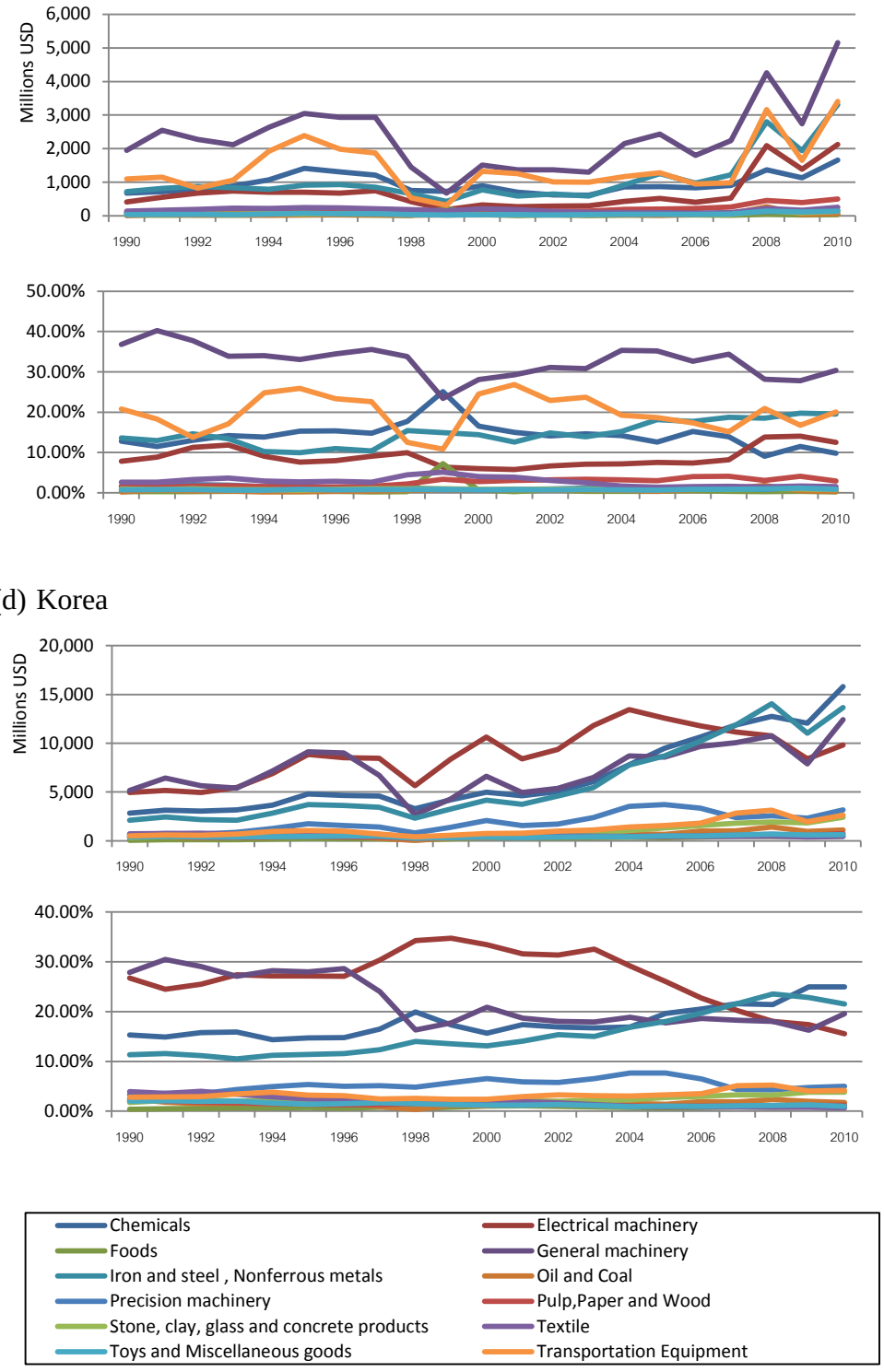
(b) Hong Kong



Data Source: Made by Author depending on RIETI-TID2011

Appendix A: Continued

(c) Indonesia

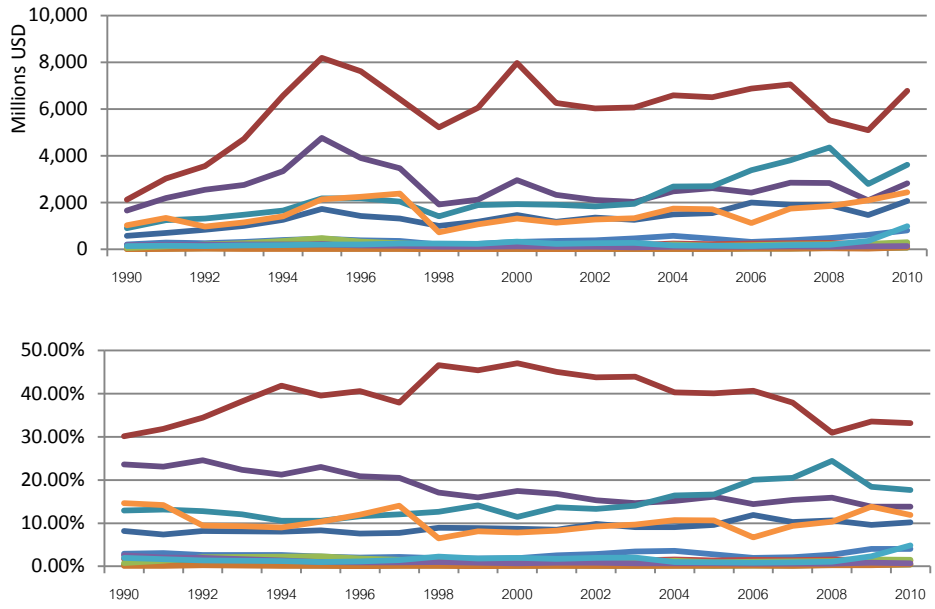


(d) Korea

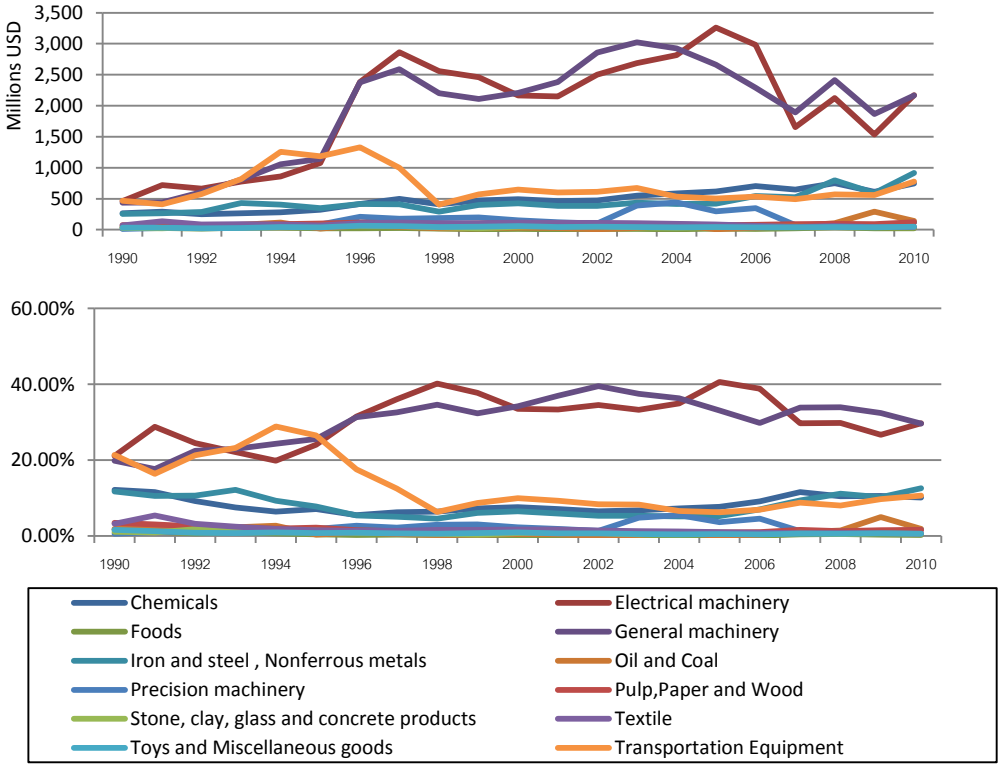
Data Source: Made by Author depending on RIETI-TID2011

Appendix A: Continued

(e) Malaysia



(f) Philippines



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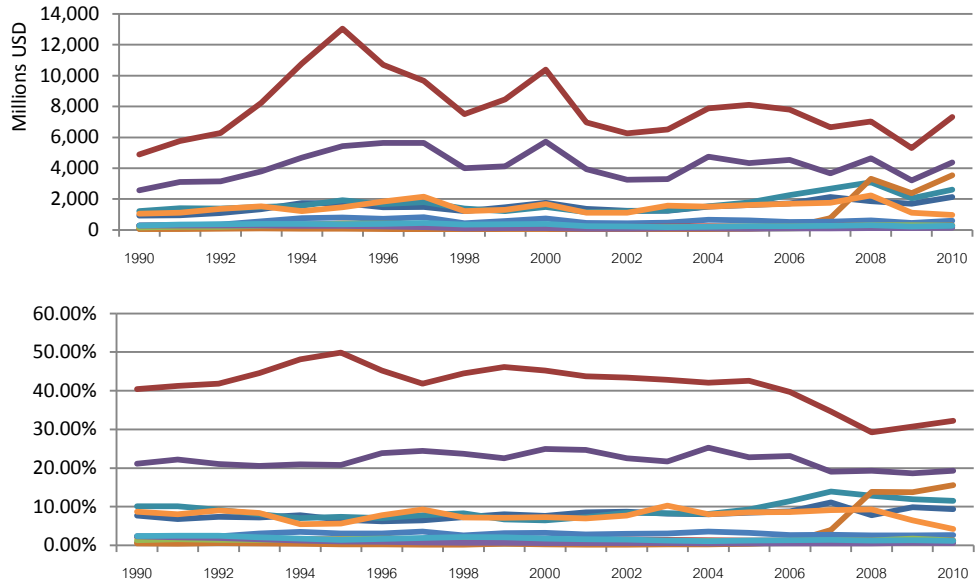
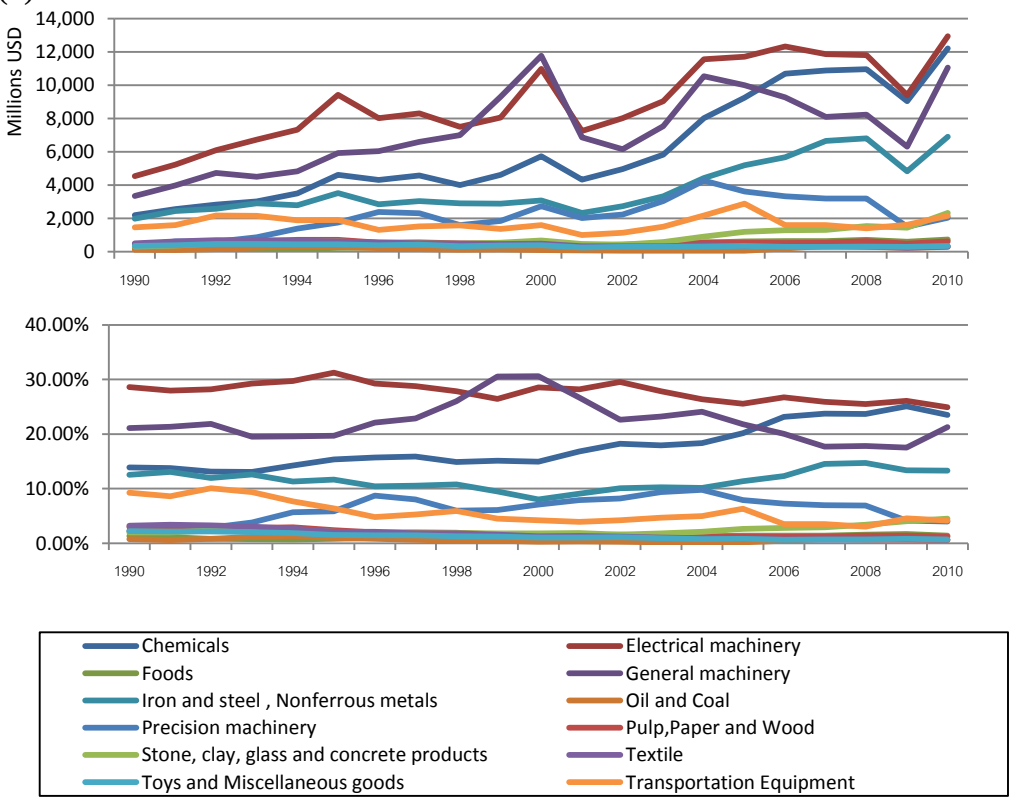
Appendix A: Continued

(g) Singapore



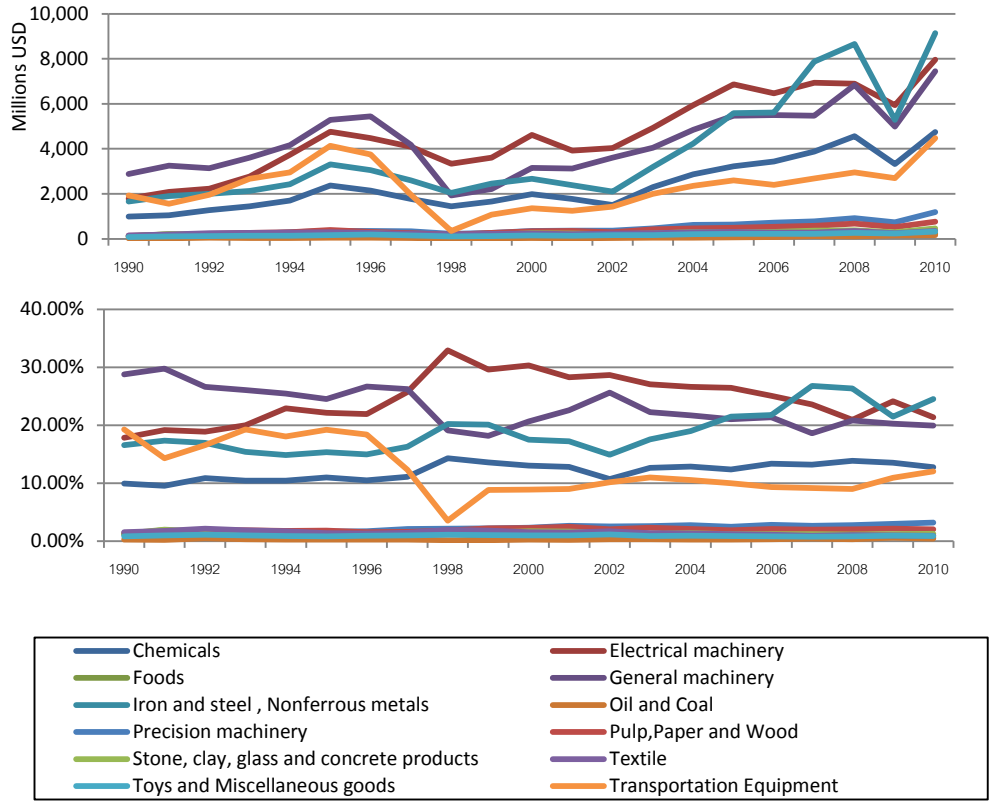
(h)Taiwan



Data Source: Made by Author depending on RIETI-TID2011

Appendix A: Continued

(i) Thailand



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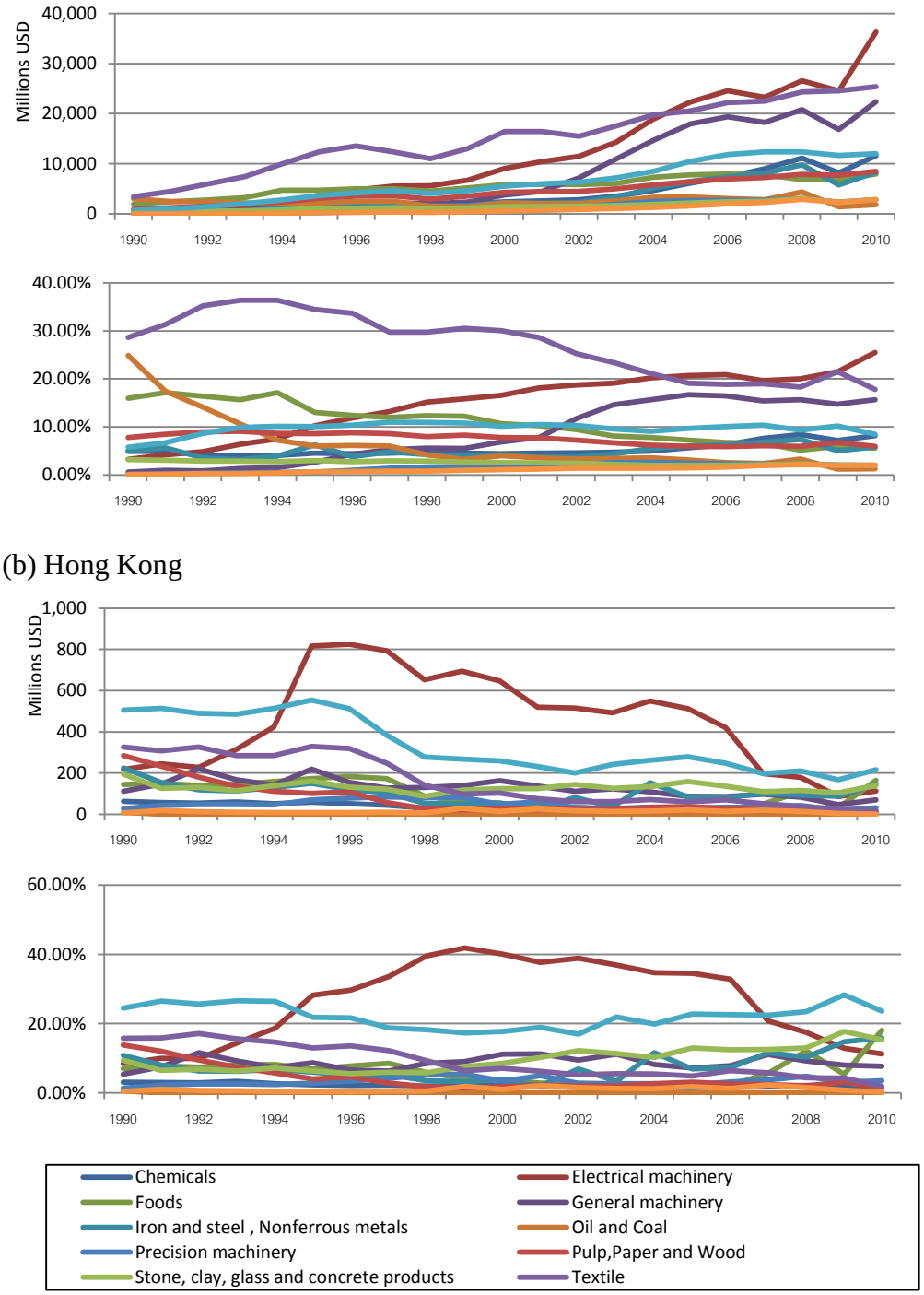
Appendix B: Japanese Import from 9 Countries and Ratios by Industry

(a) China

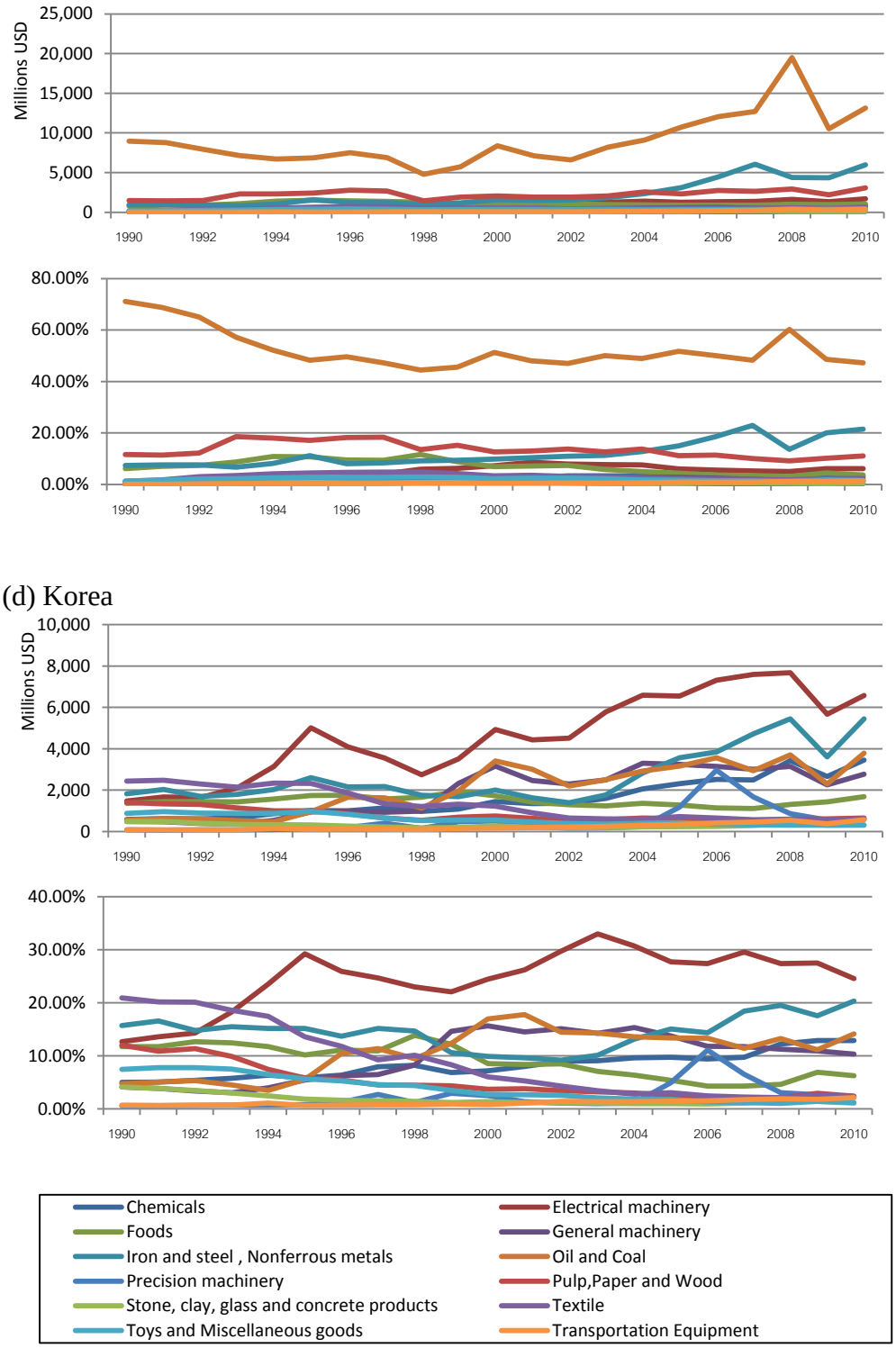


(b) Hong Kong

Data Source: Made by Author depending on RIETI-TID2011

Appendix B: Continued

(c) Indonesia

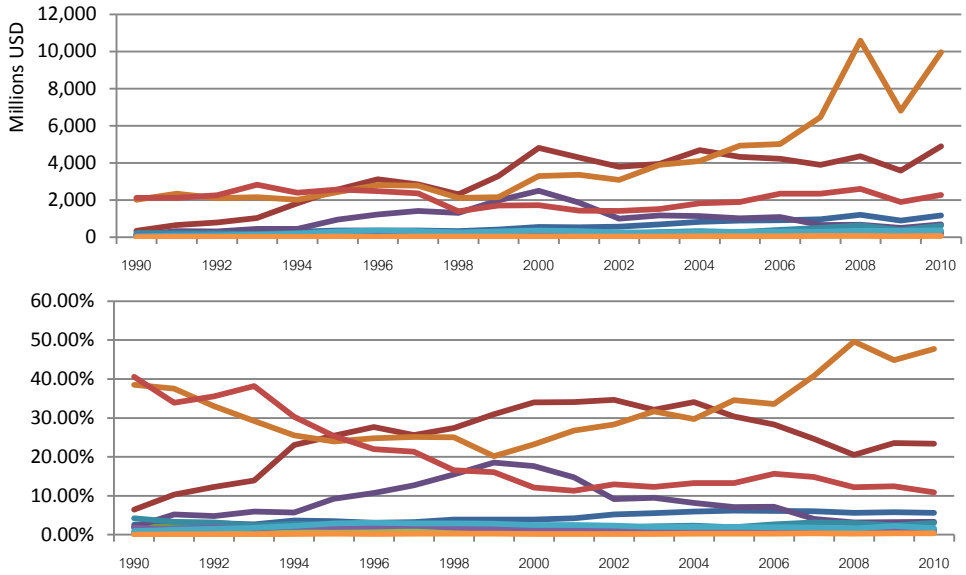


(d) Korea

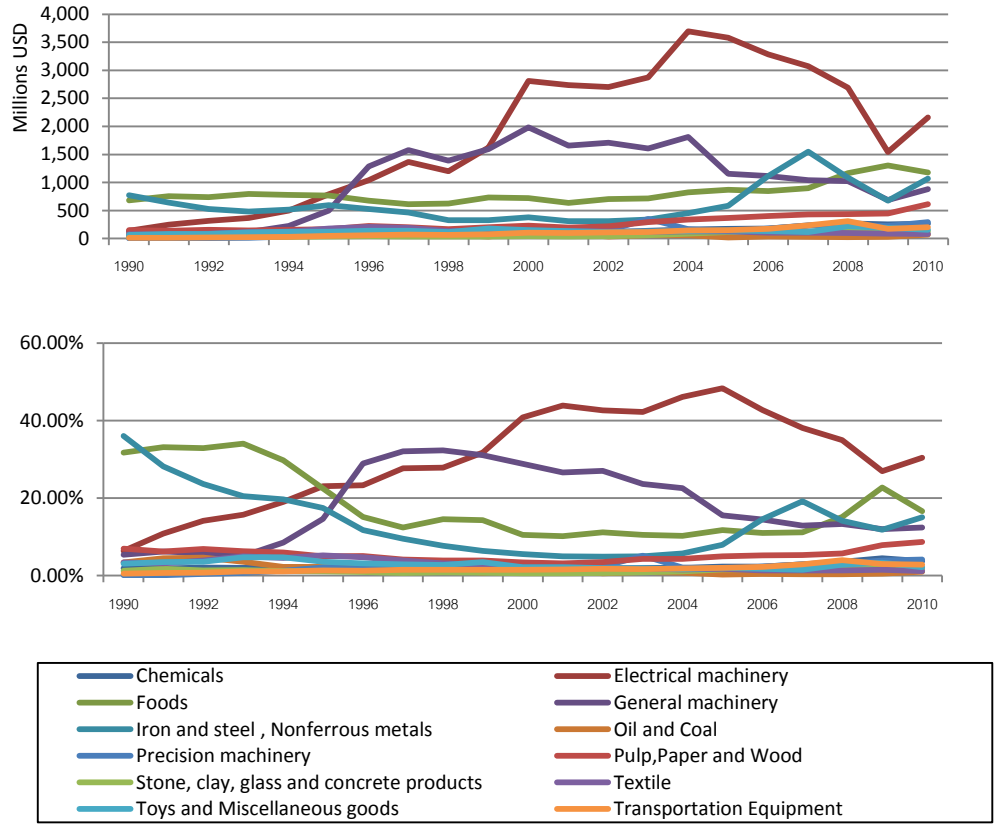
Data Source: Made by Author depending on RIETI-TID2011

Appendix B: Continued

(e) Malaysia



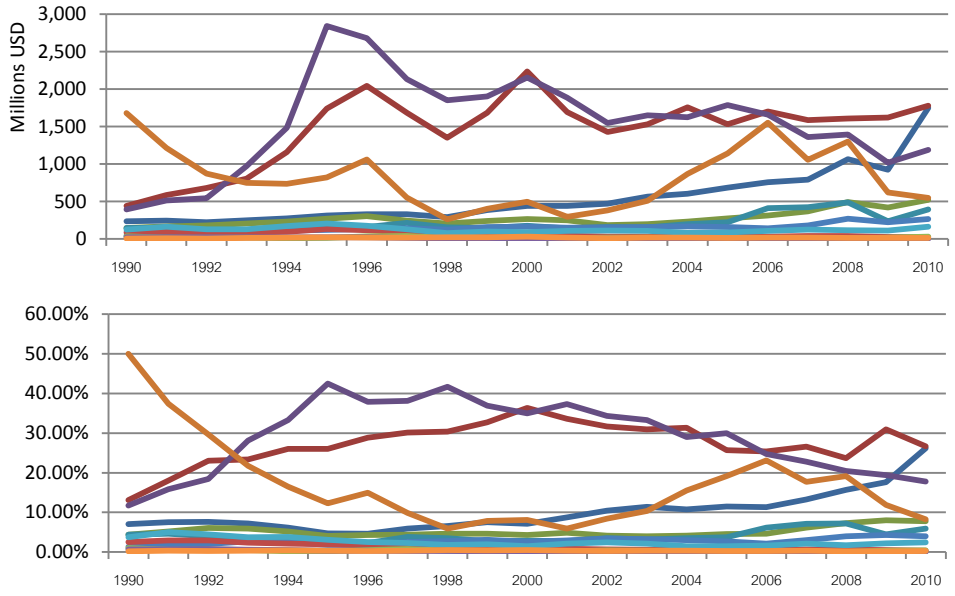
(f) Philippines



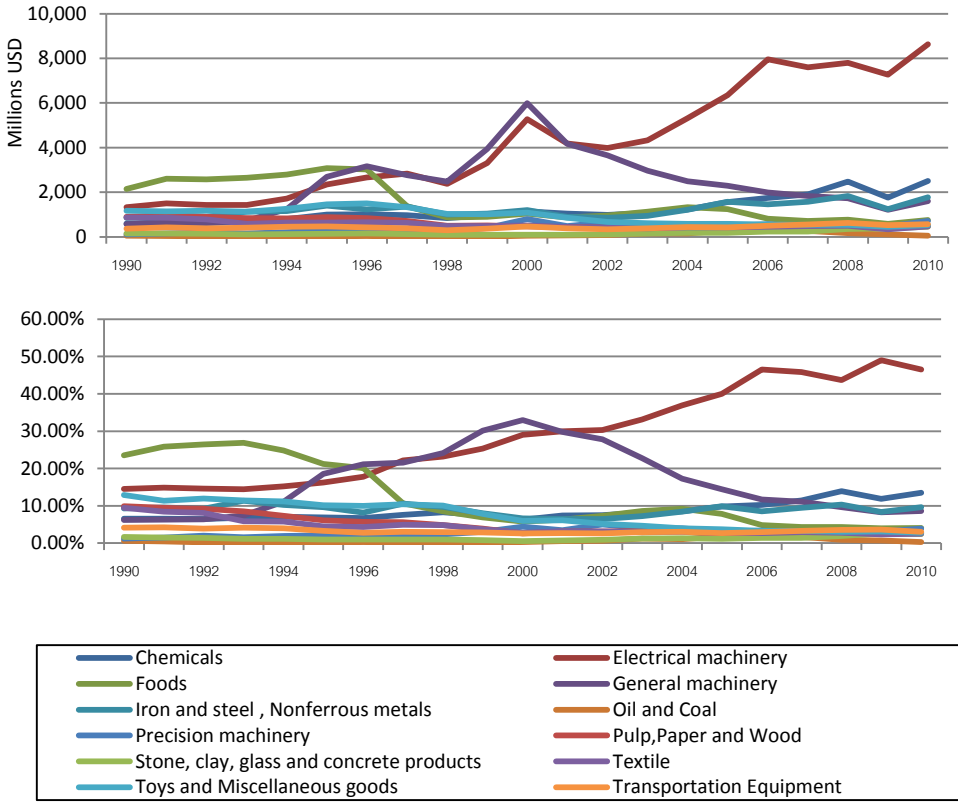
Data Source: Made by Author depending on RIETI-TID2011

Appendix B: Continued

(g) Singapore



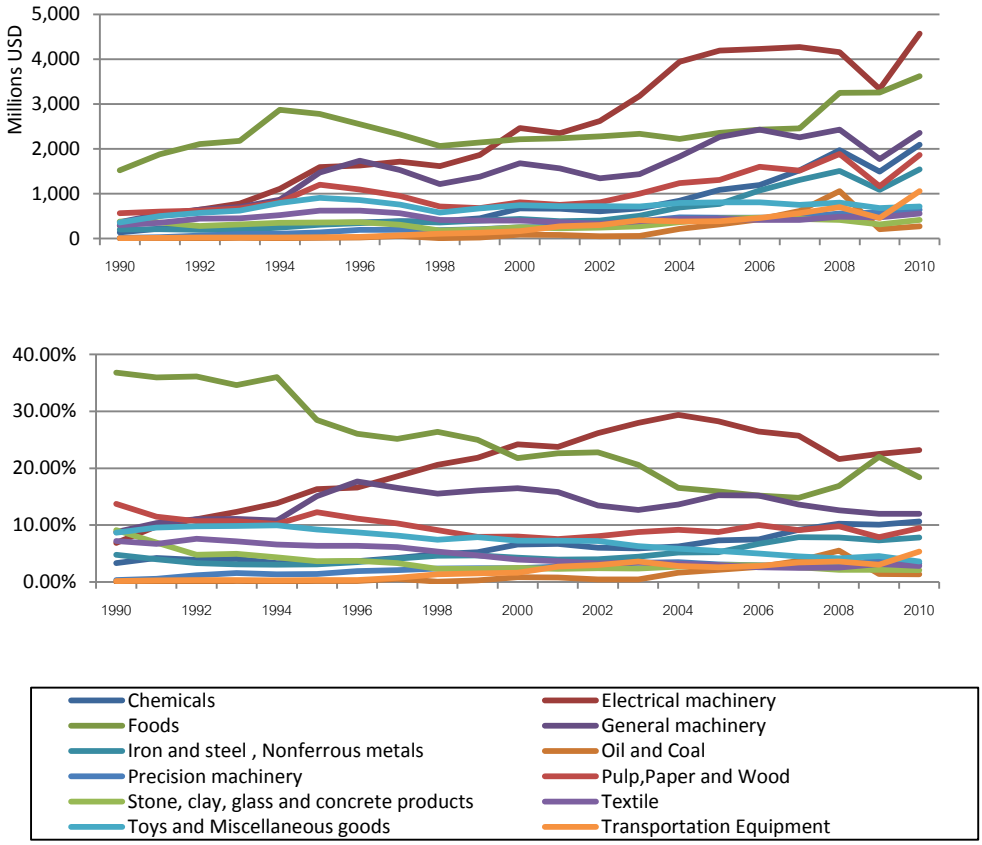
(h) Taiwan



Data Source: Made by Author depending on RIETI-TID2011

Appendix B: Continued

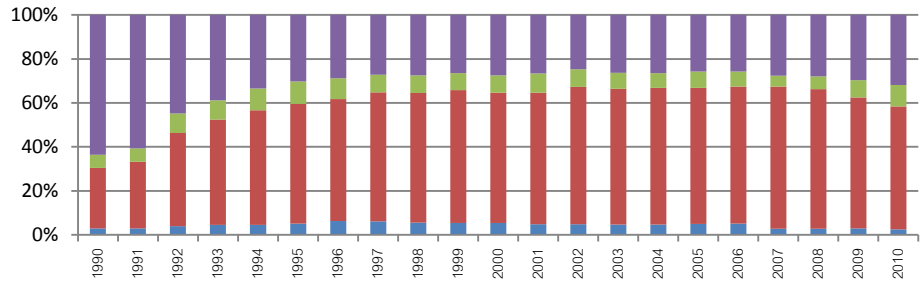
(i) Thailand



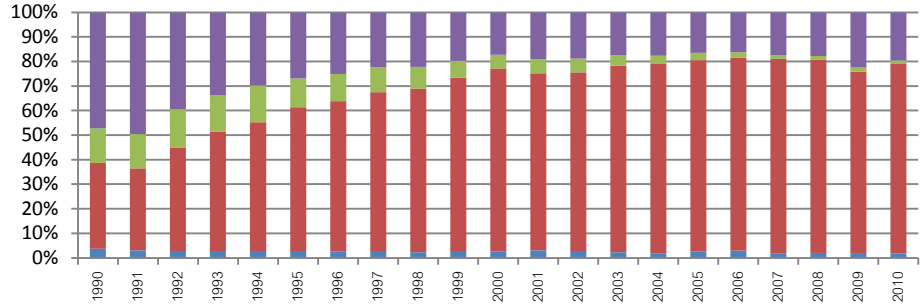
Data Source: Made by Author depending on RIETI-TID2011

Appendix C: Ratios of Each Production Stage in Electrical Machinery Trade

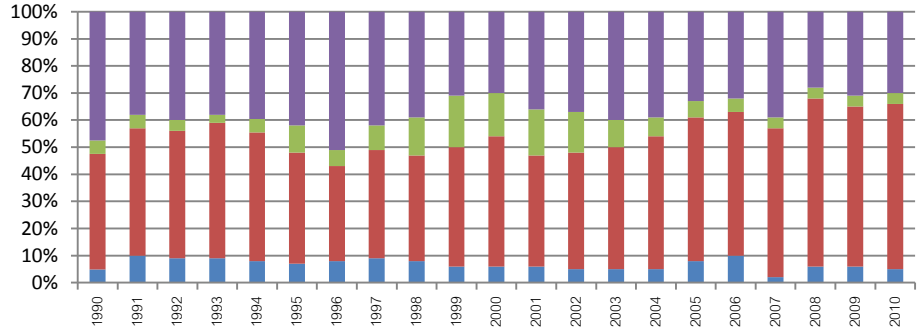
(a) China

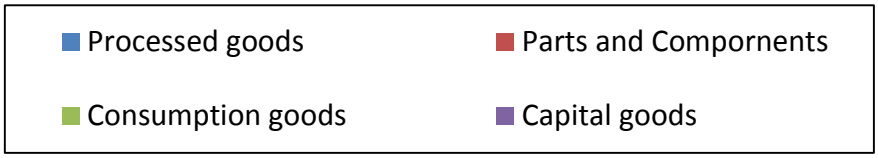


(b) Hong Kong



(c) Indonesia

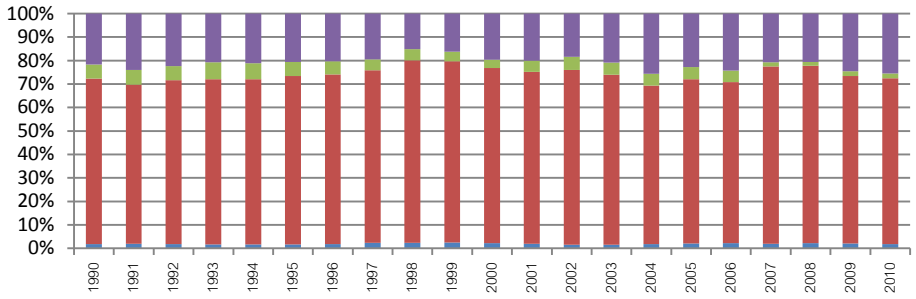




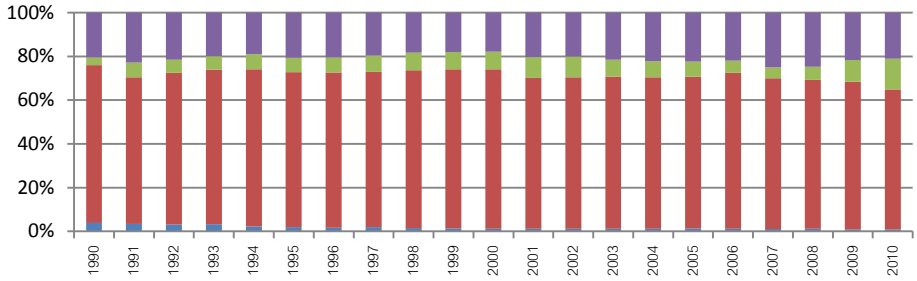
Data Source: Made by Author depending on RIETI-TID2011

Appendix C: Continued

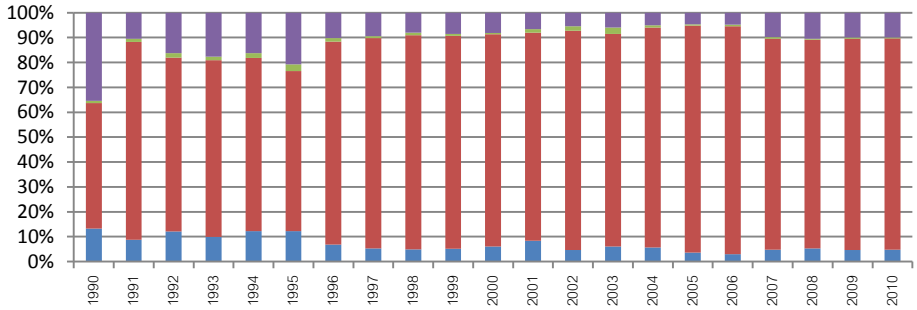
(d) Korea



(e) Malaysia



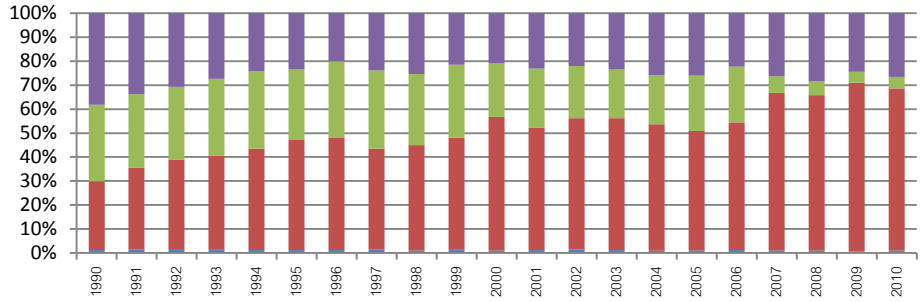
(f) Philippines



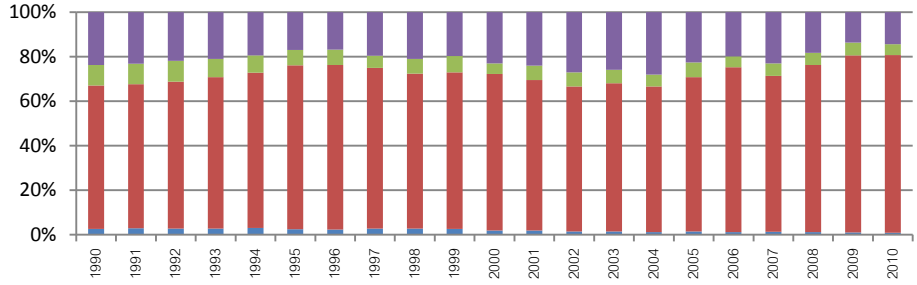
Data Source: Made by Author depending on RIETI-TID2011

Appendix C: Continued

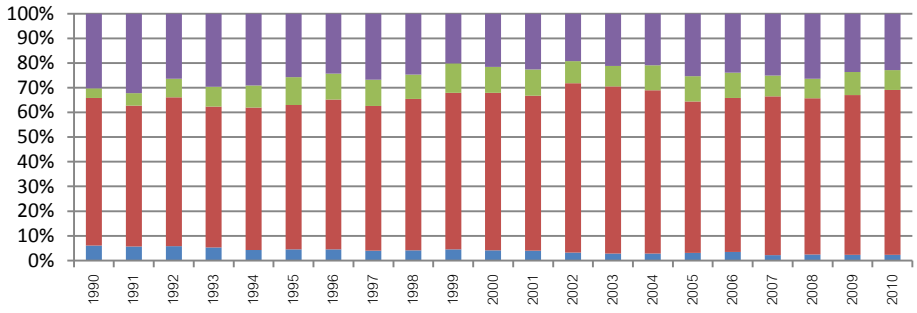
(g) Singapore

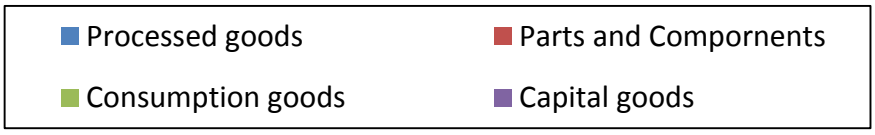


(h) Taiwan



(i) Thailand





Data Source: Made by Author depending on RIETI-TID2011

Appendix D: Raw Data Utilized in Regression Model

a) Firms of All Sizes

(%)

	Growth of Labor Productivity	Growth of Capital Labor Ratio	Growth of Intangible Fixed Assets	Growth of Outsourcing	Growth of 1st VIIT	Growth of 2nd VIIT
19911	3.07504032	4.359925687	55.47796013	0.012263035	0.544075233	0.044737463
19912	-4.545867385	2.155260454	28.47796605	0.066264723	1.144599901	-0.083729241
19913	-6.097676607	-0.158082258	28.14209581	0.268727684	1.166955068	0.047369255
19914	-11.26577057	0.30416643	31.71676938	0.505167337	0.653700079	-0.095277126
19921	-13.70265229	-0.222117268	6.663743503	0.553126738	0.43568147	0.060829995
19922	-18.26263177	-1.159296685	20.04523837	0.686366018	2.067844199	0.102576259
19923	-12.84642173	-1.22250632	17.00846121	-0.083630101	-1.000927248	0.039846091
19924	-18.06275221	-1.044574256	9.008622451	-0.27923148	-0.658900019	0.253074597
19931	-4.828277849	-0.155516087	12.27428136	-0.109293894	0.140401014	0.21645431
19932	-7.657565491	2.629587443	11.22706322	-0.550257645	-1.838758529	0.020359334
19933	-6.286952018	2.113430363	8.3334119	0.287058343	2.850442424	0.020406272
19934	4.060237991	3.185104494	6.812430882	0.5907942	2.420699862	-0.026978453
19941	2.268891319	3.18642236	4.400825155	0.367144198	1.865440127	-0.062747401
19942	15.5115079	4.258671189	1.162366432	0.787050112	3.317739916	0.155468252
19943	10.81491254	5.176251642	2.761387569	0.527543232	1.885691309	0.179003281
19944	14.95278591	4.167297435	3.823779733	0.418628458	2.592466698	0.360123952
19951	10.00041923	4.682396223	10.43821157	0.253633979	2.257264087	0.115230081
19952	9.938981375	5.143447021	11.8739695	0.182188183	0.997617786	0.005233871
19953	9.64863606	4.635809709	6.978378882	0.480018096	1.538338282	0.033613975
19954	16.40435222	4.735684808	5.445833228	-0.084053532	-2.143825072	0.114807772
19961	9.558758546	5.655652723	-0.274184804	-0.035986374	-3.360067846	0.216992817
19962	4.345306339	4.351503345	1.315678373	0.250997001	-1.374106505	0.060568233
19963	4.709686128	4.493169282	5.300073623	-0.0094615	-2.143194045	0.009554273
19964	1.904268069	5.156348392	6.250551001	0.476853536	2.518308262	-0.068435472
19971	11.15766468	0.894141035	2.226692348	0.763401758	3.854300223	-0.147219251
19972	12.12055389	4.025214563	-1.028115979	0.560697112	2.424014327	0.091391456
19973	7.944071607	5.128043745	1.415640459	0.19539307	0.379955765	-0.097109301
19974	-4.290034203	3.26692494	2.479407416	-0.010940975	-1.597708673	-0.165968208
19981	-6.56248446	6.187318312	5.36000547	0.232011808	-1.243516358	-0.32951406
19982	-18.21368796	4.886273935	5.191683508	-0.321640149	-1.950599367	-0.119494362
19983	-6.311055811	3.890617338	6.534615299	-0.064516376	1.398489373	-0.021129768
19984	-18.85246338	3.627087947	8.232064125	-0.407530191	-1.89758975	0.149077579
19991	-9.373488947	2.740848603	16.11070249	-0.947969914	-1.684009721	0.158775426
19992	-2.079491676	4.521545888	42.27807938	-0.462007384	-0.936776391	0.266466457
19993	-2.296603759	3.092643026	288.4957415	-0.303224488	-2.854850747	0.002422772
19994	20.11546306	5.404015515	273.522031	-0.42347791	1.011488668	-0.264124725
20001	14.00983532	7.39932734	268.4573345	0.034717761	1.931150754	-0.131453677
20002	20.55694135	7.955342994	209.5780267	0.289803995	1.860087874	-0.305283247
20003	20.87693852	7.654484306	14.98168597	0.178250118	2.976469715	-0.110173199
20004	19.76217758	7.014040572	17.14284154	0.583065653	1.620960356	0.008950647
20011	6.149128391	6.378873053	16.90539197	0.833271588	0.834810351	0.377500181
20012	-11.59122303	1.801846797	16.47633398	0.683356009	-0.191107094	0.38941047
20013	-30.68042422	4.355083993	20.42977756	1.040724363	-0.043132364	0.326411939
20014	-38.70528074	6.547387814	19.04559111	1.5231552	1.859240584	0.027673371
20021	-25.04383923	6.6490688	18.95130827	0.957478422	3.180571945	0.139840153
20022	2.797720341	16.08573243	8.103492298	0.529558865	3.247140229	0.068070148
20023	15.7010078	15.5982077	2.986893215	0.108202647	4.558482793	0.208300028
20024	42.88673747	14.19849068	2.163641372	1.308912911	7.191995367	0.526330275
20031	27.17708999	12.89962425	5.32900542	1.675932262	4.827244826	-0.184624289
20032	1.857272982	3.121452215	-0.291297296	1.693459191	1.857507738	0.142165936
20033	5.37973748	7.281100185	-3.191648361	1.904525214	-0.558125762	0.366774874
20034	7.028148669	8.966739882	-1.446000846	1.204117015	2.567918595	0.382580727
20041	5.472952845	6.900623974	-6.892881226	0.007624272	-2.167875371	0.45150478
20042	27.45666591	12.60664155	10.5491862	1.418929126	6.150161431	0.278667604
20043	16.93621605	2.774004882	17.63811461	-0.294158175	-0.05184521	-0.48095352

20044	7.572418935	-0.073222866	14.91633687	-0.392432879	-4.752352926	-0.146088093
20051	1.981531961	4.02771147	26.77570977	1.085225089	-0.541713188	0.142652158
20052	-5.279729594	3.1215509	17.36337123	-0.001499172	-3.844052794	-0.097673054
20053	1.786723684	7.059275978	11.65091801	1.650500404	2.856222902	0.383943756
20054	9.604526753	5.733490952	13.58656588	1.583992241	2.144585953	0.420011223
20061	11.47694044	5.738371568	-1.731333738	1.387998459	2.178352902	0.057414168
20062	15.44930859	2.627326173	-1.446885165	0.904521533	1.867290607	0.885431495
20063	13.03834649	8.583152819	-2.438788291	0.852565203	2.463075718	1.136172755
20064	10.00421283	4.936519309	-4.372320261	0.386794012	-0.125627701	0.112562833
20071	3.787644038	2.256820757	0.667472237	-0.661301143	6.603455647	1.659790652
20072	1.070306365	-0.244478553	5.420698485	-1.46652332	-2.96965321	2.143306583
20073	-0.414055069	-7.956652469	13.33788263	-1.674784928	-2.88963394	1.549211886
20074	-0.761325745	0.412222513	9.681232892	-1.234600993	-3.0562735	2.606120887
20081	-6.471397058	-2.05670673	6.094549182	-0.350720572	-10.20083283	1.063710493
20082	-3.568165525	3.458120858	8.248919279	1.967734595	1.303288986	-0.732287054
20083	-14.32134278	4.949242624	-0.933773793	1.996043472	1.066683633	0.333083752
20084	-44.72694868	0.67980383	4.87939095	2.247284863	1.776633211	-0.226454644
20091	-65.79789144	1.945244165	-3.184983168	4.317786108	7.616805523	-0.653877943
20092	-47.51986555	1.710732443	-3.105849419	-0.034235955	0.538253696	1.069271934
20093	-24.38452902	5.285580869	-7.576310908	2.887254819	3.471267903	0.476134731
20094	27.02828612	6.399772783	-9.212019958	4.092788146	9.349974554	-0.30736465
20101	141.5730743	9.438032237	-3.907359364	-2.70151177	-5.0053079	0.014193761
20102	62.81275429	4.244024719	0.852404146	0.488695327	2.338468593	-0.005779772
20103	21.66351466	0.265307451	-3.381487917	-2.695844874	-2.048718928	-0.158011738
20104	13.75728676	-1.569187478	-1.177239441	-3.581770035	-4.017623457	0.093770663

Appendix D: Continued

(b) Firms with Capital over 100 Million Yen

(%)

	Growth of Labor Productivity	Growth of Capital Labor Ratio	Growth of Intangible Fixed Assets	Growth of Outsourcing	Growth of 1st VIIT	Growth of 2nd VIIT
19911	0.393117049	2.399276455	47.41376859	0.012263035	0.544075233	0.044737463
19912	-3.342246258	0.349376954	27.12785037	0.066264723	1.144599901	-0.083729241
19913	-6.405717371	-2.188676701	30.41565814	0.268727684	1.166955068	0.047369255
19914	-10.21192295	-0.54372373	30.22159749	0.505167337	0.653700079	-0.095277126
19921	-14.26901014	-2.170540589	7.957022434	0.553126738	0.43568147	0.060829995
19922	-18.7220586	1.275023784	21.46902334	0.686366018	2.067844199	0.102576259
19923	-11.77160338	1.996070644	15.32540699	-0.083630101	-1.000927248	0.039846091
19924	-17.58401695	0.473559253	12.94685377	-0.27923148	-0.658900019	0.253074597
19931	-2.808898922	2.597327535	15.51567023	-0.109293894	0.140401014	0.21645431
19932	-5.756264367	2.269801183	12.38748642	-0.550257645	-1.838758529	0.020359334
19933	-6.06557512	1.798256083	9.774448375	0.287058343	2.850442424	0.020406272
19934	3.61613079	3.119621803	3.146583572	0.5907942	2.420699862	-0.026978453
19941	1.892499446	2.227628607	3.47489153	0.367144198	1.865440127	-0.062747401
19942	14.94553263	4.231135917	0.459132078	0.787050112	3.317739916	0.155468252
19943	11.08458536	4.685871253	2.948443174	0.527543232	1.885691309	0.179003281
19944	16.78779208	4.673787644	7.491007054	0.418628458	2.592466698	0.360123952
19951	11.05029713	5.254915306	11.93195408	0.253633979	2.257264087	0.115230081
19952	7.979785919	3.882560091	7.01495279	0.182188183	0.997617786	0.005233871
19953	7.531641402	3.01306722	1.9228267	0.480018096	1.538338282	0.033613975
19954	12.97802553	2.59926447	0.924269313	-0.084053532	-2.143825072	0.114807772
19961	7.289530811	4.212230261	-4.027217607	-0.035986374	-3.360067846	0.216992817
19962	6.701627383	7.425838399	-0.174400242	0.250997001	-1.374106505	0.060568233
19963	7.564409576	7.454063636	4.555383764	-0.0094615	-2.143194045	0.009554273
19964	2.669110448	7.552828998	5.901055759	0.476853536	2.518308262	-0.068435472
19971	13.02185693	3.038856996	1.12089059	0.763401758	3.854300223	-0.147219251
19972	11.88875443	2.466836561	0.69881971	0.560697112	2.424014327	0.091391456
19973	7.344321684	3.575729193	2.53084703	0.19539307	0.379955765	-0.097109301
19974	-3.468674333	2.585073873	2.051466253	-0.010940975	-1.597708673	-0.165968208
19981	-7.461780305	4.392128708	6.564099741	0.232011808	-1.243516358	-0.32951406
19982	-19.46073596	2.568120189	9.659572143	-0.321640149	-1.950599367	-0.119494362
19983	-8.666373412	1.227854113	10.21885255	-0.064516376	1.398489373	-0.021129768
19984	-18.91517167	1.253617209	12.69956169	-0.407530191	-1.89758975	0.149077579
19991	-9.952665405	1.929684228	18.0124745	-0.947969914	-1.684009721	0.158775426
19992	-1.119414216	6.488905125	30.85657693	-0.462007384	-0.936776391	0.266466457
19993	-0.52970684	5.844614676	247.830106	-0.303224488	-2.854850747	0.002422772
19994	20.028955	7.216461398	237.4695792	-0.42347791	1.011488668	-0.264124725
20001	15.76099576	8.165872179	239.7618904	0.034717761	1.931150754	-0.131453677
20002	23.28034321	7.560168903	202.8607468	0.289803995	1.860087874	-0.305283247
20003	22.6453488	7.01397957	17.18425894	0.178250118	2.976469715	-0.110173199
20004	21.15099841	6.223395577	19.25908335	0.583065653	1.620960356	0.008950647
20011	5.178692694	5.844630456	18.43257492	0.833271588	0.834810351	0.377500181
20012	-13.84609402	2.276965538	17.12949793	0.683356009	-0.191107094	0.38941047
20013	-31.55824248	4.314412748	20.55055761	1.040724363	-0.043132364	0.326411939
20014	-39.1740741	7.664663757	18.43564786	1.5231552	1.859240584	0.027673371
20021	-22.66409106	9.428972287	17.97519369	0.957478422	3.180571945	0.139840153
20022	5.43099958	17.16848746	7.803782335	0.529558865	3.247140229	0.068070148
20023	18.6052393	17.39823855	2.547254055	0.108202647	4.558482793	0.208300028
20024	44.57714592	15.44129942	1.642465256	1.308912911	7.191995367	0.526330275
20031	24.54897038	10.95041934	4.801430979	1.675932262	4.827244826	-0.184624289
20032	1.525042269	2.462115479	1.032844916	1.693459191	1.857507738	0.142165936
20033	4.719917746	5.801617268	-2.292786187	1.904525214	-0.558125762	0.366774874
20034	6.040362961	6.015987698	0.126612762	1.204117015	2.567918595	0.382580727
20041	6.937464477	5.968704212	-5.322340479	0.007624272	-2.167875371	0.45150478
20042	27.35832524	12.64526982	8.439467297	1.418929126	6.150161431	0.278667604
20043	16.38930377	3.03260898	15.64217544	-0.294158175	-0.05184521	-0.48095352

20044	7.520749675	1.153665241	12.89209738	-0.392432879	-4.752352926	-0.146088093
20051	0.487001462	3.852123839	24.41002136	1.085225089	-0.541713188	0.142652158
20052	-7.309169998	0.731866911	17.70546708	-0.001499172	-3.844052794	-0.097673054
20053	0.33733244	5.37249575	11.8623822	1.650500404	2.856222902	0.383943756
20054	8.836784991	4.04010701	13.3727868	1.583992241	2.144585953	0.420011223
20061	11.838408	4.541212251	-1.499619073	1.387998459	2.178352902	0.057414168
20062	17.0819852	0.878605835	0.052603131	0.904521533	1.867290607	0.885431495
20063	11.90517809	4.257157255	-0.675571875	0.852565203	2.463075718	1.136172755
20064	10.35271476	2.578845815	-2.832352771	0.386794012	-0.125627701	0.112562833
20071	2.35340542	0.145289187	1.608989488	-0.661301143	6.603455647	1.659790652
20072	2.611474412	2.054984806	3.848235345	-1.46652332	-2.96965321	2.143306583
20073	3.38527318	-3.203023122	11.95937977	-1.674784928	-2.88963394	1.549211886
20074	1.026595213	2.986725751	9.186914683	-1.234600993	-3.0562735	2.606120887
20081	-5.236323289	0.855038746	5.540002892	-0.350720572	-10.20083283	1.063710493
20082	-5.090674071	1.897364069	9.191952409	1.967734595	1.303288986	-0.732287054
20083	-15.23864499	2.942404384	-0.279431881	1.996043472	1.066683633	0.333083752
20084	-44.03327797	0.144065082	4.866083409	2.247284863	1.776633211	-0.226454644
20091	-66.73705423	0.875505525	-2.184337084	4.317786108	7.616805523	-0.653877943
20092	-47.57704211	2.374580929	-4.050118806	-0.034235955	0.538253696	1.069271934
20093	-24.56056806	5.380838755	-8.309897102	2.887254819	3.471267903	0.476134731
20094	24.12817777	4.727956447	-9.17478776	4.092788146	9.349974554	-0.30736465
20101	149.8502306	8.249768098	-4.335116477	-2.70151177	-5.0053079	0.014193761
20102	65.38721033	3.017030439	1.324212654	0.488695327	2.338468593	-0.005779772
20103	23.89023689	-0.6358017	-2.315022946	-2.695844874	-2.048718928	-0.158011738
20104	13.70923987	-1.70518837	-0.757863218	-3.581770035	-4.017623457	0.093770663

Appendix D: Continued

(c) Firms with Capital over 1 Billion Yen

(%)

	Growth of Labor Productivity	Growth of Capital Labor Ratio	Growth of Intangible Fixed Assets	Growth of Outsourcing	Growth of 1st VIIT	Growth of 2nd VIIT
19911	3.07504032	4.359925687	55.47796013	0.012263035	0.544075233	0.044737463
19912	-4.545867385	2.155260454	28.47796605	0.066264723	1.144599901	-0.083729241
19913	-6.097676607	-0.158082258	28.14209581	0.268727684	1.166955068	0.047369255
19914	-11.26577057	0.30416643	31.71676938	0.505167337	0.653700079	-0.095277126
19921	-13.70265229	-0.222117268	6.663743503	0.553126738	0.43568147	0.060829995
19922	-18.26263177	-1.159296685	20.04523837	0.686366018	2.067844199	0.102576259
19923	-12.84642173	-1.22250632	17.00846121	-0.083630101	-1.000927248	0.039846091
19924	-18.06275221	-1.044574256	9.008622451	-0.27923148	-0.658900019	0.253074597
19931	-4.828277849	-0.155516087	12.27428136	-0.109293894	0.140401014	0.21645431
19932	-7.657565491	2.629587443	11.22706322	-0.550257645	-1.838758529	0.020359334
19933	-6.286952018	2.113430363	8.3334119	0.287058343	2.850442424	0.020406272
19934	4.060237991	3.185104494	6.812430882	0.5907942	2.420699862	-0.026978453
19941	2.268891319	3.18642236	4.400825155	0.367144198	1.865440127	-0.062747401
19942	15.5115079	4.258671189	1.162366432	0.787050112	3.317739916	0.155468252
19943	10.81491254	5.176251642	2.761387569	0.527543232	1.885691309	0.179003281
19944	14.95278591	4.167297435	3.823779733	0.418628458	2.592466698	0.360123952
19951	10.00041923	4.682396223	10.43821157	0.253633979	2.257264087	0.115230081
19952	9.938981375	5.143447021	11.8739695	0.182188183	0.997617786	0.005233871
19953	9.64863606	4.635809709	6.978378882	0.480018096	1.538338282	0.033613975
19954	16.40435222	4.735684808	5.445833228	-0.084053532	-2.143825072	0.114807772
19961	9.558758546	5.655652723	-0.274184804	-0.035986374	-3.360067846	0.216992817
19962	4.345306339	4.351503345	1.315678373	0.250997001	-1.374106505	0.060568233
19963	4.709686128	4.493169282	5.300073623	-0.0094615	-2.143194045	0.009554273
19964	1.904268069	5.156348392	6.250551001	0.476853536	2.518308262	-0.068435472
19971	11.15766468	0.894141035	2.226692348	0.763401758	3.854300223	-0.147219251
19972	12.12055389	4.025214563	-1.028115979	0.560697112	2.424014327	0.091391456
19973	7.944071607	5.128043745	1.415640459	0.19539307	0.379955765	-0.097109301
19974	-4.290034203	3.26692494	2.479407416	-0.010940975	-1.597708673	-0.165968208
19981	-6.56248446	6.187318312	5.36000547	0.232011808	-1.243516358	-0.32951406
19982	-18.21368796	4.886273935	5.191683508	-0.321640149	-1.950599367	-0.119494362
19983	-6.311055811	3.890617338	6.534615299	-0.064516376	1.398489373	-0.021129768
19984	-18.85246338	3.627087947	8.232064125	-0.407530191	-1.89758975	0.149077579
19991	-9.373488947	2.740848603	16.11070249	-0.947969914	-1.684009721	0.158775426
19992	-2.079491676	4.521545888	42.27807938	-0.462007384	-0.936776391	0.266466457
19993	-2.296603759	3.092643026	288.4957415	-0.303224488	-2.854850747	0.002422772
19994	20.11546306	5.404015515	273.522031	-0.42347791	1.011488668	-0.264124725
20001	14.00983532	7.39932734	268.4573345	0.034717761	1.931150754	-0.131453677
20002	20.55694135	7.955342994	209.5780267	0.289803995	1.860087874	-0.305283247
20003	20.87693852	7.654484306	14.98168597	0.178250118	2.976469715	-0.110173199
20004	19.76217758	7.014040572	17.14284154	0.583065653	1.620960356	0.008950647
20011	6.149128391	6.378873053	16.90539197	0.833271588	0.834810351	0.377500181
20012	-11.59122303	1.801846797	16.47633398	0.683356009	-0.191107094	0.38941047
20013	-30.68042422	4.355083993	20.42977756	1.040724363	-0.043132364	0.326411939
20014	-38.70528074	6.547387814	19.04559111	1.5231552	1.859240584	0.027673371
20021	-25.04383923	6.6490688	18.95130827	0.957478422	3.180571945	0.139840153
20022	2.797720341	16.08573243	8.103492298	0.529558865	3.247140229	0.068070148
20023	15.7010078	15.5982077	2.986893215	0.108202647	4.558482793	0.208300028
20024	42.88673747	14.19849068	2.163641372	1.308912911	7.191995367	0.526330275
20031	27.17708999	12.89962425	5.32900542	1.675932262	4.827244826	-0.184624289
20032	1.857272982	3.121452215	-0.291297296	1.693459191	1.857507738	0.142165936
20033	5.37973748	7.281100185	-3.191648361	1.904525214	-0.558125762	0.366774874
20034	7.028148669	8.966739882	-1.446000846	1.204117015	2.567918595	0.382580727
20041	5.472952845	6.900623974	-6.892881226	0.007624272	-2.167875371	0.45150478
20042	27.45666591	12.60664155	10.5491862	1.418929126	6.150161431	0.278667604

20043	16.93621605	2.774004882	17.63811461	-0.294158175	-0.05184521	-0.48095352
20044	7.572418935	-0.073222866	14.91633687	-0.392432879	-4.752352926	-0.146088093
20051	1.981531961	4.02771147	26.77570977	1.085225089	-0.541713188	0.142652158
20052	-5.279729594	3.1215509	17.36337123	-0.001499172	-3.844052794	-0.097673054
20053	1.786723684	7.059275978	11.65091801	1.650500404	2.856222902	0.383943756
20054	9.604526753	5.733490952	13.58656588	1.583992241	2.144585953	0.420011223
20061	11.47694044	5.738371568	-1.731333738	1.387998459	2.178352902	0.057414168
20062	15.44930859	2.627326173	-1.446885165	0.904521533	1.867290607	0.885431495
20063	13.03834649	8.583152819	-2.438788291	0.852565203	2.463075718	1.136172755
20064	10.00421283	4.936519309	-4.372320261	0.386794012	-0.125627701	0.112562833
20071	3.787644038	2.256820757	0.667472237	-0.661301143	6.603455647	1.659790652
20072	1.070306365	-0.244478553	5.420698485	-1.46652332	-2.96965321	2.143306583
20073	-0.414055069	-7.956652469	13.33788263	-1.674784928	-2.88963394	1.549211886
20074	-0.761325745	0.412222513	9.681232892	-1.234600993	-3.0562735	2.606120887
20081	-6.471397058	-2.05670673	6.094549182	-0.350720572	-10.20083283	1.063710493
20082	-3.568165525	3.458120858	8.248919279	1.967734595	1.303288986	-0.732287054
20083	-14.32134278	4.949242624	-0.933773793	1.996043472	1.066683633	0.333083752
20084	-44.72694868	0.67980383	4.87939095	2.247284863	1.776633211	-0.226454644
20091	-65.79789144	1.945244165	-3.184983168	4.317786108	7.616805523	-0.653877943
20092	-47.51986555	1.710732443	-3.105849419	-0.034235955	0.538253696	1.069271934
20093	-24.38452902	5.285580869	-7.576310908	2.887254819	3.471267903	0.476134731
20094	27.02828612	6.399772783	-9.212019958	4.092788146	9.349974554	-0.30736465
20101	141.5730743	9.438032237	-3.907359364	-2.70151177	-5.0053079	0.014193761
20102	62.81275429	4.244024719	0.852404146	0.488695327	2.338468593	-0.005779772
20103	21.66351466	0.265307451	-3.381487917	-2.695844874	-2.048718928	-0.158011738
20104	13.75728676	-1.569187478	-1.177239441	-3.581770035	-4.017623457	0.093770663

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