

# **Comparing Japan, the US, and China's Roles in Trade Relationships with Emerging East Asian Countries during the Last Three Decades**

**Nahid Pourrostami and Toru Yanagihara**

The expansion of trade relationships among East Asian economies along with the high economic growth rate in these countries within the last three decades has demonstrated their accomplishment in transferring the benefits of trade into their economies and increasing their production capacities. The 1985 Plaza Accord and the revaluation of Japan's yen, China's transition over the last three decades, and the banking crisis in 1997 to 1998 are among the main events affecting the influence of Japan, the US, and China in East Asia. This study analyzes the pattern of trade relationships in the Emerging East Asian (EEA) economic network in the past three decades and the role of Japan, the US, and China in the region over the mentioned period. The analysis is based on the real data of Asian input-output tables from 1985 to 2005 while estimating those of 2012. The trend of the Leontief coefficients from 1985 to 2012 illustrates that the concentration of suppliers has changed gradually due to the emergence of China, South Korea, and Taiwan as new regional suppliers in addition to Japan and the US since 2005. However, China, to some extent, has managed to outperform Japan and the US in the region. Determinants, such as Export-Platform Foreign Direct Investment (FDI) and the resulting knowledge and technology transfers, are analyzed as the drivers of the evolution of China's role in the region. The Contribution Ratios

Nahid Pourrostami, Faculty of World Studies, University of Tehran, Tehran, Iran. (E-mail): [prostami@ut.ac.ir](mailto:prostami@ut.ac.ir), (Tel): +98-21-8801-1304, (Fax): +98-21-8801-1304; Toru Yanagihara, Faculty of International Studies, University of Takushoku, Tokyo, Japan. (E-mail): [yt\\_tic@yahoo.co.jp](mailto:yt_tic@yahoo.co.jp), (Tel): +81-3-3334-8613, (Fax): +81-3-3334-8613, respectively.

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(CR) of final demand of Japan and the US to EEA countries' value added, have decreased during 1985 to 2012, whereas the CR of China has drastically increased during the same period.

The results corroborate that the share of export to the GDP index overestimates the share of external demands to the value added in EEA countries. This finding supports the notion that the total export is prone to double counting in East Asian economies.

*Keywords:* Trade relationship, Contribution ratio, Leontief coefficient, Emerging East Asia, Export-platform FDI, Asian International Input-Output table

*JEL Classification:* F14, C67, R12, D57

## I. Introduction

The development of production possibilities and social welfare through trade under government control and not exclusively through open markets is the strategy that East Asian countries have adopted in the past three decades, following Japan's approach to its economic development. Several models have been developed on the basis of the doctrine of the catch-up development strategy, such as the "flying geese" model (Akamatsu 1962), "big-push" theory, and the "import substitution" approach (Ozawa 2013). The models, which appear to be fairly simple at first glance but are complicated and detailed in reality, have been implemented by these countries and have resulted in considerable outcomes. Several of these countries experienced high rapid growth rates during the 1950s to the 1970s, and from 1985 to 2014. The growth rates of the emerging economies of East Asia (EEA)<sup>1</sup> surpassed the economic growth of developed countries (2.37%) almost by twice with the rate of 5.09%. The high growth rates have been accompanied by considerable export shares in GDP (49%) in 2012.

Figure 1 shows the trend of the total exports of EEA countries to the groups mentioned in the table. Table 1 depicts the EEA exports to the US, Japan, China, EEA countries themselves and the rest of the

<sup>1</sup> In this analysis, Emerging East Asia (EEA) consists of Indonesia, South Korea, Malaysia, the Philippines, Singapore, and Thailand. Other countries of emerging Asia are excluded due to data limitation.

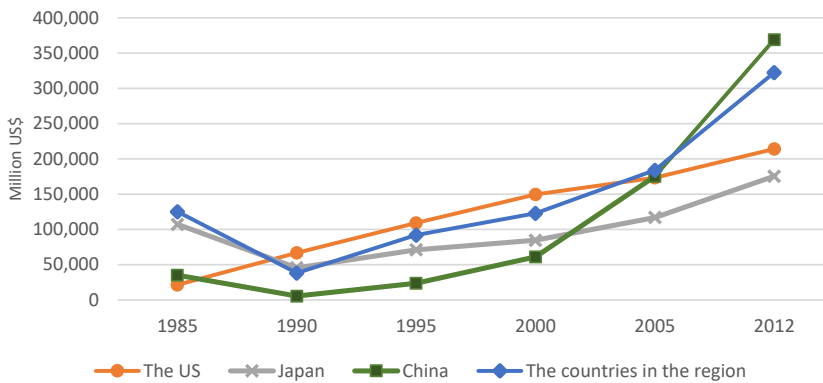
world (RoW) to the total EEA exports, as well as EEA exports to their GDP. The EEA's exports constituted 49.19% of GDP in 2012. This rate implies that approximately 50% of these countries' value added in 2012 originated from the countries out of the region. Thus, could we conclude that the contribution of external demands in value added is close to 50% in these countries? Does this rate mean that the role of the global economy is decreasing in these countries over the last three decades? Table 1 indicates the increasing share of EEA countries' export to the US, China, and the RoW from 6.12% to 11.19%, from 10.01% to 19.31%, and from 17.70% to 43.47%, respectively, during the period under study. By contrast, data confirm the decreasing shares of export to Japan and the countries in the region from 30.56% to 9.17% and from 35.62% to 16.86%, respectively. Could we then conclude that the share of the US and China in value added of the EEA countries increased during the period under review, while the share of domestic demand decreased? Does the increase in RoW's share and the decrease in the share of domestic demand in EEA countries' exports indicate an increase in EEA countries' dependency to the RoW (*i.e.*, increase of integration in the global economy) and a decrease in their dependency on themselves (*i.e.*, decrease of regionalism)? Therefore, the present study is assumed to address the following questions:

- a) What has been the role of the US, Japan, and China in creating the value added in the EEA countries over the past three decades?
- b) What were the main drivers of the changing process? When did the changing process start and under the influence of which policies have they occurred?
- c) Has the pattern of change been the same for all the emerging countries in the region?
- d) What changes have occurred in the structure of the trade among the countries in the region?
- e) What has been the role of foreign direct investment (FDI) in the structure of trade relationships among the countries under study?

To provide answers to the above questions, we must investigate the trend of trade relationship among the EEA countries over the last three decades. The Asian International Input–Output (IO) Tables would provide the necessary data needed to examine the various aspects of trade in the East Asian region. Given that the IO table is published

**TABLE 1**  
EXPORT SHARES OF EEA TO JAPAN, THE US, AND CHINA

Export shares of EEA to:	1985	1990	1995	2000	2005	2012
US	6.12	22.54	18.10	14.06	15.19	11.19
Japan	30.56	15.34	11.78	7.97	10.24	9.17
China	10.01	1.87	3.92	5.73	15.36	19.31
Inside EEA	35.62	12.87	15.22	11.55	16.12	16.86
R.O.W	17.70	47.38	50.97	60.69	43.09	43.47
GDP	93.70	38.25	41.31	73.10	53.74	49.19



**FIGURE 1**

COMPARISON OF THE TOTAL EXPORT OF EEA TO JAPAN, THE US, CHINA, AND INSIDE EEA

periodically once every five years and usually with a delay of several years, one of our concerns would be to find a solution to estimate those data together with the Leontief coefficients between the two releases of the IO tables. In this regard, many suggestions have been made using national account data and various methods (Mori and Sasaki 2007; Pula and Peltonen 2009, 2011).

Pula and Peltonen (2009, 2011) estimated the 2006 IO table based on the 2000 IO table. The validity of their method is checked by the present study and subsequently approved on the basis of the actual data released in 2005. This method is used to estimate the 2012 IO table, which was chosen by the authors to keep a reasonable distance from the authentic data of 2005 with coverage of the 2008 crisis in the

region and the 2011 Tsunami event in Japan, until these events' effects were stabilized.

As mentioned before, the present study focuses on the role of the three countries, namely, the US, Japan, and China, in the region over the past three decades (1985 to 2012). Given the huge volume of China's exports to all countries, we would not need to prove the importance of this country as an influential supplier in the world. However, the objective of the present research will be on the trajectories of trade development in the EEA region over the past three decades and the role of the most influential actors during these international trade evolutions while examining the effects of Japan and China's economic policies.

This paper is organized in six sections. Following the Introduction section, the major events affecting Japan, the US, and China's roles among EEA countries will be analyzed in Section II. Subsequently, in Section III, related works will be reviewed, and the differences between the present study and the existing literature will be discussed. Section IV presents the research method. Section V constitutes the findings of the research. Finally, Section VI concludes this paper.

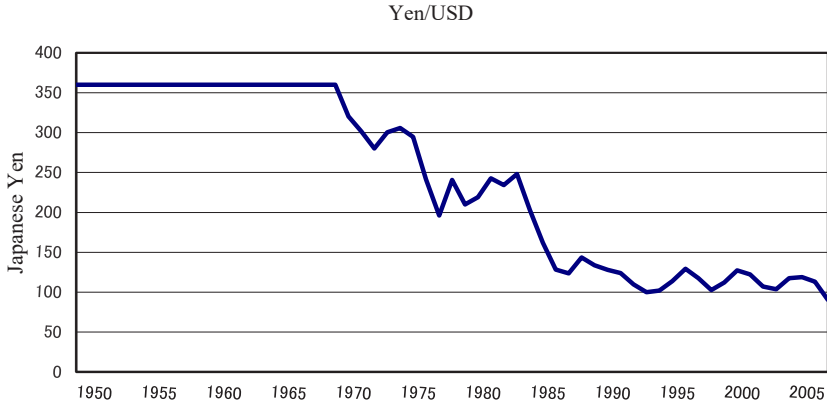
## **II. Major Events affecting the Roles of Japan, the US, and China in EEA Countries**

During the past three decades, EEA countries have experienced great changes in their trade relationships. This change has been caused by various regional and international events, as follows:

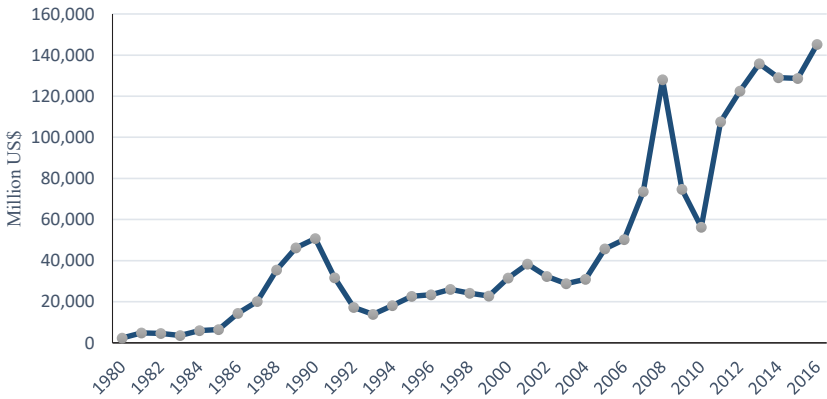
### *A. Plaza Accord and the Revaluation of Japan's Yen*

In 1973, after the collapse of the Bretton Woods fixed exchange rate system, the pressure was on Japan and major European economies to increase their currencies' exchange rate against the US dollar. Several of these countries, especially Japan, resisted this pressure by adding to their dollar reserves. Finally, in 1985, delegates from G5 member states gathered in Plaza Hotel in New York and made the decision to end the policy of privileging the dollar. In 1987, G5 members along with Italy and Germany gathered in Paris and decided to devalue the dollar against their currencies. The value of the Yen increased in several phases during this period of up to three times its initial rate.

Tripling the exchange rate of the Yen caused the collapse of its bub-



**FIGURE 2**  
US DOLLAR TO JAPANESE YEN EXCHANGE RATE



Data source: UNCTAD database

**FIGURE 3**  
JAPAN OUTWARD FDI (FLOW)

ble economy in the 1980s, which marked Japan’s greatest economic crisis after World War II (Naghizade 1998). Given this new situation and other factors, Japanese companies were forced to relocate to other countries mainly within the region (Soderberg 2000). Figure 3 illustrates that Japan’s outward FDI increased sharply from 1985 to 1990.

**TABLE 2**  
CHANGES IN CAPITAL-LABOR RATIOS OF SELECTED COUNTRIES IN  
1979, 1997, AND 2006 (IN 1990 INTERNATIONAL DOLLAR PRICES)

Country	1979	1997	2006	2006/1979
Japan	64, 218	77, 429	111, 615	1.74
Korea	13, 002	26, 635	45, 235	3.48
The US	40, 366	50, 233	73, 282	1.82
Thailand	3, 144	8, 106	11, 688	3.72
China	1, 114	3, 219	7,485	6.72

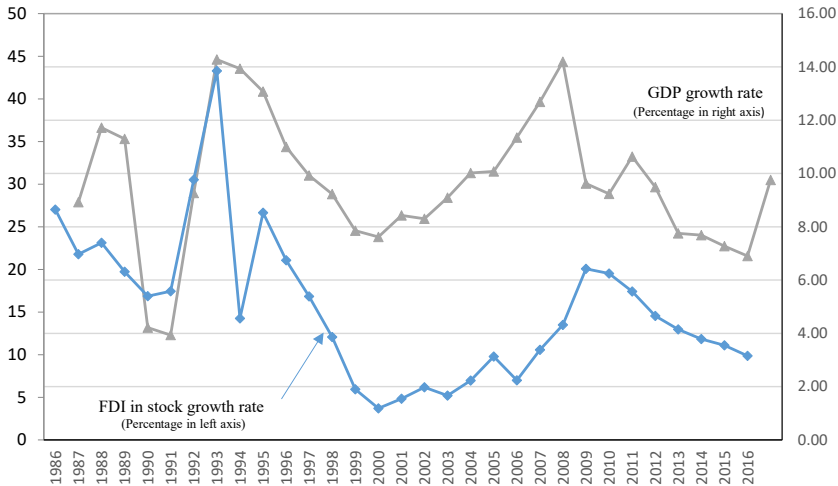
Source: Salvatore (2010, p. 196).

### *B. China's Transition*

In 1978, China's post-Maoian changes began under Deng Xiaoping, particularly during the Third Plenary Session of the Party's 11th Central Committee that initiated a new phase in China's economic relations with foreign countries in 1978 (Sun and Heshmati 2010). Xiaoping pursued China's economic reforms successfully by introducing "*Open Door Policy*" that prescribed the import of science and technology. As a result of reforms, China's economic growth rate increased from 5.3% from 1971 to 78 to 9.7% from 1979 to 1999 (Kouhkan 2008). After Xiaoping's death in 1997, China's National Congress decided to continue his reform policies within the Communist regime with the goal of economic, political, and cultural development. In addition, as part of the *Open Door Policy*, China became a member of the WTO in 2001. These changes improved China's trade relationships with the world and increased its regional trade with other EEA countries.

Literature identifies three major mediums for transferring knowledge capital, namely, trade, FDI, and human resources (Kang 2016, p. 69). China during this period embraced FDI from advanced economies, especially Japan and the US. With increasing FDI, China has been able to stimulate domestic investments and gain from provisions of technology and communication with transnational corporations for Chinese investors (Gabriele 2001). Table 2 shows that the ratio of capital to labor in China, being \$1114 in 1979, increased to \$7485 in 2006 (*i.e.*, 672% growth rate). China experienced the high economic growth era in the 1990s and the 2000s, which were concurrent with its high FDI inflow.

Figure 4 compares China's GDP growth rate with the FDI growth rate from 1986 to 2016. The synchronic fluctuations of these two indicators from 1980 to 2016 are noteworthy. This behavior would signify the



**FIGURE 4**

COMPARISON OF CHINA'S FDI IN STOCK GROWTH RATES WITH THAT OF GDP GROWTH RATES FROM 1986 TO 2016

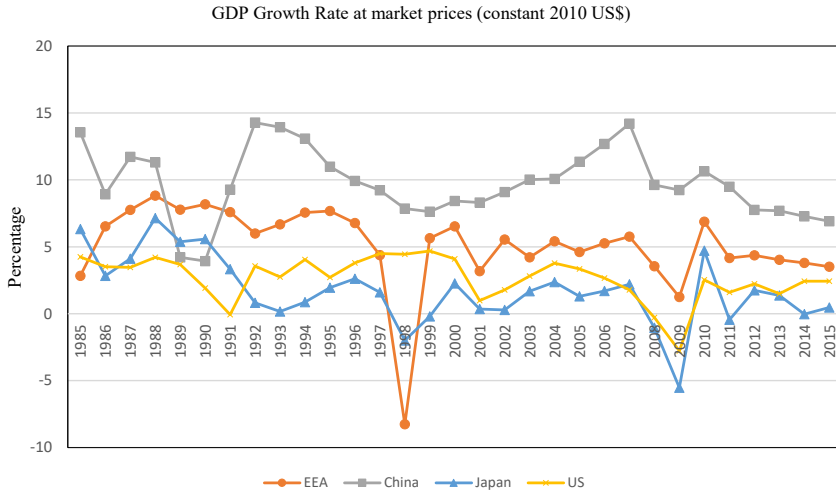
high contribution of FDI in stock in the Chinese economic growth rate. However, to understand the relationship between the growth rate of FDI and the economic growth rate, we examine the other determinants of economic growth (Ameer and Xu 2017).

### C. Banking and Monetary Crises

From 1997 to 1998, EEA countries confronted a great banking crisis that brought heavy financial burdens. Several causes are mentioned for the crisis. Stiglitz (2002, p. 89) argued that “excessively rapid financial and capital market liberalization was probably the single most important cause of the crisis, though mistaken policies on the part of the countries themselves played a role as well.”

Although the crisis resulted in the reduction of the export growth rates of these countries, the effects were varied. China was less affected by the crisis compared with other countries due to the absence of a considerable financial market and the controlled capital market (Figure 5). Moreover, the economic growth rate of China in 1998 (approximately 7.4%) was close to the government's prescribed rate of 8%. This performance helped China increase its influence and broaden its trade in the region.





**FIGURE 5**  
COMPARISON OF EEA COUNTRIES' GDP GROWTH RATE WITH THAT OF JAPAN, CHINA, AND THE US

In 2008, the next crisis happened. The crisis started in the US and soon spread to Europe and East Asia (Okubo *et al.* 2014). Figure 5 depicts that the crisis left a negative impact on China (Schmidt 2009, p. 1), and Japan, which are the two main trade partners of the US. Consequently, China's growth rate decreased from 14.2% in 2007 to 9.6% in 2008, which was still higher than the government's prescribed rate of 8%.

Hence, the Chinese government, putting in place appropriate monetary policies and setting the priorities on economic growth, instead of inflation, was able to stabilize the rate of economic growth above the projected rate in their national plan, thereby avoiding falling below 8% (Xu 2010).

*D. Japan's Shift into Regionalism in Asia*

Japan entered a turning point in its policy toward East Asian regionalism and its relations with neighboring countries. Japan did not have positive attitude toward East Asian regionalism until the 1990s. Japan pursued mutual trade with Australia, an idea severely sponsored by economists of the two countries, such as Okita, Kojima, Drysdale, and Crawford, with the ambition of creating a new economic dialogue

between the nations of Asia and those of the Pacific, which was later realized in 1989 with the establishment of APEC (Yoshida 2004).

Most nations in East Asia were developing countries at the time, and Japan intended reliance on Pacific countries for solving its problems. However, several countries in the region experienced rapid economic growth in the 1980s (Huang 2005; Hiratsuka and Kimura 2008). This fact together with other events happened during those years, which made Japan change its approach (Yoshida 2004). The prelude to this political change in Japan includes the following:

- 1) APEC stagnation partly due to Japan's refusal to join "Early Voluntary Sectorial Liberalization" program;
- 2) Expansion of Japan's economic relations with the EEA countries; and
- 3) Increase in China's regional influence.

Another major factor in the regionalism shift of Japan in EEA was the region's 1997 financial crisis. To provide financial help to affected countries, the Japanese Finance Minister proposed the establishment of the Asian Monetary Fund, consisting of Japan, China, Hong Kong, South Korea, Indonesia, Malaysia, Singapore, Thailand, the Philippines, and Australia. The proposition failed to be realized due to the opposition of the United States, but the result could be understood as part of the reason for Japan's changing approach (Yoshida 2004; Kikuchi 2002).

Therefore, 1985 to 2014 was determinant in terms of the changes that happened to EEA countries and their trade relationships, which has evolved into today's complex production network. Thanks to the developed regional trade relations, the network has brought considerable economic growth for these countries while improving trade relations with the rest of the world.

### **III. Review of Literature**

A wide range of studies addresses the trade relations among EEA economies from different aspects. In this section, relevant studies and their findings are mentioned below (ordered on the basis of their relevancy to the current work).

Pula and Peltonen (2009, 2011) studied the trade relations among Asian countries including China, Hong Kong, Indonesia, Malaysia, the

Philippines, Singapore, South Korea, Taiwan, and Thailand, as emerging economies. The authors investigated whether these countries have decoupled from the rest of the world due to their emerging regionalism and figured out the shares of other countries in these countries' economies. This study uses Asian input–output tables from 1985 to 2000, while the data related to 2006 are estimated on the basis of the IO table 2000. Their findings affirm that the production structure in EEA has changed in a way that China increasingly takes over the role of Japan and the US by supplying inputs to the countries in the region. They defined the CR coefficient to calculate the impact of final demand in country  $j$  on the value added in country  $i$ . The computation shows that the shares of external demand on the value added of the 9 above mentioned countries has been 35.7% in 2006. The shares, firstly, are lower than the 50% shares of their total exports on their value added and, secondly, have an upward trend from 1995 to 2006. The authors corroborated that the reason behind this difference (between 35.7% and 50%) lies on production segmentation and trade in intermediate goods among these countries, which result in double counting of the total trade statistics. The authors count the upward trend of non-EEA countries' shares on the value added within the region to be the cause for the improving global integration of the region. Comparing the shares in 2006 with those in 1995 and 2000 shows that the shares of EU15 in EEA countries grew, while the shares of the US and Japan declined. In addition, Pula and Peltonen interpreted the increase in the dependence of the value added to exports since 1995 as a symptom of increasing trade integration regionally and globally.

In their 2009 article, Meng and Inomata discussed that the rapid economic growth of EEA is partially due to the expansion of production network and other changes caused by spatial economic interdependence in the region.

Inomata (2008) used Eric Dietzebacher's model (2005) of average propagation lengths to construct a new measurement for analyzing the level and model of decomposing production processes. Inomata defined the fragmentation index (F index) and used the input–output tables for 1990, 1995, and 2000 in the manufacturing section for this purpose. The fragmentation of the production process means dividing the production of goods into different parts for producing in different countries. The fragmentation of the production among different countries entails the expansion of trade on intermediate

goods. This step would reduce production costs, while leading to considerable dependence of internal production to intermediate goods' import. From 1985 onward, EEA countries began the production of parts and components of manufacturing industries. Hence, the shares of component trade in EEA increased from 1984 to 1996 with 15% annually, reaching 20% of the entire trade in 1996 (Inomata 2008). The result of the study validates that, in 1990, 1995, and 2000, the highest rate of F index, *i.e.*, the highest rate of fragmentation with an upward trend, has taken place in the industrial machinery section, textile and leather, rubber products, and computer and electronics. The author asserted that the ratio of capital to labor in the mentioned sections is lower than the average amount of the same ratio in the industry section in general. On the basis of this measure, Inomata argued that the fragmentation of the production process has taken place in labor-intensive sections. This idea is in accordance with Heckscher-Ohlin International Fragmentation Theory, which states that labor-intensive industries are highly prone to fragmentation. Therefore, such industries play a significantly vital role in leading the international value chain in the region. His findings are in line with Helble and Ngiang's research on East Asia's changing trade composition and orientation (2016).

Yamada *et al.* (2015) formulated a model by using Asian International Input-Output tables. In their research, they proposed to define production segmentation given the procurement costs minimization and the greenhouse gas emission reduction from EEA economies.

Kang (2016) studied the means for knowledge transfer among East Asian countries from 1996 to 2010 and compared three means, namely, knowledge transfer through trade, FDI, and human resources. The author verified that FDI and human resource relocation have positive impact on the knowledge transfer among East Asian countries, but the impact is less important when the two countries have nearly the same technological level. This study proves that trade acts as a medium of knowledge transfer, too. However, due to the inconsistent effect of trade on knowledge flow in different regression models, this study failed to derive a consistent interpretation. Comparing the most influential knowledge transfer from the above three mediums shows that human resource relocation has the greatest impact on knowledge transfer in a situation where the technology levels of the two countries are completely different. However, when the technology level of the two countries is the same, trades have the greatest impact on knowledge transfer.

The findings of the above study are consistent with Gabriele (2001), who elucidated that technology transfer in China has taken place through strategic negotiations with large transnational corporations from industrialized countries. Thus, when Chinese companies negotiate with transnational companies from advanced industrial countries (with different technological levels), they manage to transfer the necessary technology knowledge. However, this study, as well as the study by Tolentino (1993), argues that a threshold level of domestic technological competency is required for the absorption of new technology. Hence, the large amount of FDI in China is not the only source of technological advancement in this country, as the existence of the minimum necessary capacity to attract technology is required.

In their 2007 article, Baltagi *et al.*, extending the effects of bilateral and conventional determinants on FDIs, suggested a model with three countries. The model aims to integrate the influential determinants associated with the third country (the market) along with the weightings proportional to spatial factors. On the basis of US data from 1989 to 1999, they contended that the third country effect has a significant impact on the American transnational corporations' trades. In fact, their conclusions suggest that the export platform outward FDI is common in American transnational corporations. In such a case, direct foreign investment is a combination of horizontal and vertical forms of FDI, *i.e.*, complex FDI.

Ekholm *et al.* (2007) differentiated three types of Export-Platforms (EP) for FDIs, namely, home-country EP, third-country EP and global EP. They proved that multinational firms in large countries (such as the US) build their affiliates in a low cost country inside a free-trade area (such as NAFTA) mostly to export back to the home-country, or to export to the third and home countries, and build their affiliates outside a free-trade area (like Europe) to export to third countries.

Anand and Delios (1996) confirmed that Japanese FDIs in China have been able to better transfer the management skills and organizational knowledge compared with Japanese FDIs in India. On the basis of a few samples of Japanese investments in these two countries, they affirmed the differences between the strategies of host countries. Consequently, Japanese subsidiaries in China joined the international subsidiaries network as part of the international strategy of transnational corporations and exported their products to other countries in addition to the Chinese market. Meanwhile, Japanese investment in India was

motivated to meet the needs of domestic markets in India.

Using a gravity model, Thorbecke (2015) investigated China–US trade as a global outlier. Dungey and Tugrul (2015) compared the influences of international output shocks from the US and China on ASEAN economies.

### **Discussion**

Although numerous research has been conducted on economic relationships among EEA countries from different aspects, some of which reviewed in this section, many questions should be investigated, such as questions presented in the Introduction section. Several major events have happened over the last three decades, which were briefly discussed earlier in section II, and these events have led to questions regarding the following issues, which have not been answered so far:

- Position and the roles of the main actors in this region, especially Japan, the US, and China among the EEA countries;
- Trend of the entrance of main actors over the past three decades;
- Degree of dependence of these countries on their domestic economy, on the other countries in the region, and on the major actors, over the last three decades; and
- Relationship between trade network and FDI flows as a medium of capital knowledge transfer among EEA.

## **IV. Research Method**

### *A. Asian Input–Output Table*

The international Asian input–output tables (IO)<sup>2</sup> are designed to illustrate industrial networks among 10 countries, namely, China, Indonesia, Korea, Malaysia, Taiwan, the Philippines, Singapore, Thailand, the US, and Japan. These tables include data for export and import to four countries, namely, Hong Kong, India, Europe, and RoW.

This table consists of three major parts. Part A shows the data related to the demands for intermediate goods by industries. The number of sections has been varying for each year. In this study, the 24-section

<sup>2</sup> Additional information about the background of IO tables can be found in Kuwamri *et al.* (2013).

	Intermediate Demand (A)										Final Demand (F)										Export (L)				Total Outputs		
	Indonesia (AI)	Malaysia (AM)	Philippines (AP)	Singapore (AS)	Thailand (AT)	China (AC)	Taiwan (AN)	Korea (AK)	Japan (AJ)	U.S.A. (AU)	Indonesia (FI)	Malaysia (FM)	Philippines (FP)	Singapore (FS)	Thailand (FT)	China (FC)	Taiwan (FN)	Korea (FK)	Japan (FJ)	U.S.A. (FU)	Export to India (LI)	Export to Hong Kong (LH)	Export to EU (LO)	Export to R.O.W. (LW)		Statistical Discrepancy (LX)	
code	A										F										L						
Indonesia (AI)																											
Malaysia (AM)																											
Philippines (AP)																											
Singapore (AS)																											
Thailand (AT)																											
China (AC)																											
Taiwan (AN)																											
Korea (AK)																											
Japan (AJ)																											
U.S.A. (AU)																											
Freight and Insurance (BF)																											
Import from India (CI)																											
Import from Hong Kong (CH)																											
Import from EU (CO)																											
Import from the R.O.W. (CW)																											
Duties and Import Commodity Taxes (DI)																											
Value Added (VV)																											
Total Inputs (IX)																											

**FIGURE 6**  
THE GENERAL FORMAT OF INTERNATIONAL IO TABLES

table for 1985, 1990, 1995, 2000, and 2005 is used. Part F shows the data related to the demands for final goods by industries, including private sector expenditures, government expenditures, gross fixed capital formation, changes in stocks, and statistical discrepancies. Part L provides data related to the countries' exports outside the region, namely, India, Hong-Kong, European Union, and RoW, in addition to statistical discrepancies and the total production. Similar to the typical IO table, the demand countries are listed in columns, and the supplier countries are listed in rows.

*B. Analytical Framework*

For determining the interlinkages among different economic sectors in EEA countries with other parts of the world, the IO table is used to calculate the intermediate input ratio  $a^{ij}$  as follows:

$$a^{ij} = \frac{A^{ij}}{X^j} \tag{1}$$

In this relationship,  $A^{ij}$  is the value of intermediate goods that country  $i$  as the supplier country in the row exports to country  $j$  as the demand country in the column. The coefficient could be calculated for every country and based on each section. As this study aims to analyze the

trade relations between countries, the country coefficient is considered here.

$$AX + Y = X \quad (2)$$

Equation (2) describes the IO table, in which  $A$  is the matrix of coefficients with the elements of  $a^{ij}$  and  $X$  is the matrix of total output, with the elements of  $X^i$  and  $Y$  is the matrix of final demand. The above equation should be solved to  $X$  to find out the production needed to meet one unit of demand:

$$X = (I - A)^{-1}Y = BY \quad (3)$$

In Equation (3),  $B$  is called Leontief coefficient matrix. Each part of this matrix displays the amount of production needed in country  $i$  (supplier country) to produce one unit of value added in country  $j$  (demand country).

The present study intends to determine the role of Japan, China, and the US in emerging Asian economies from 1985 until now. As the latest published IO table is for 2005, the authors decided to estimate the IO table for 2012 at country level. Accordingly, the method used by Mori and Sasaki (2007) and Pula and Peltonen (2009, 2011) was applied in this study. The reason why 2012 was chosen is that the authors did not intend to go too far away from the authentic data of 2005 and at the same time meant to cover the 2008 crisis in the region and the 2011 Tsunami event in Japan. The reason why the procedure used by Mori and Sasaki (2007) and Pula and Peltonen (2009, 2011) was applied in this study is that their approach turned out efficient enough to produce comparatively accurate data. The Leontief coefficient, extracted for 2006 by this approach based on the real values of 2000 IO table, turned out significantly accurate compared to the Leontief coefficient for 2005.

Therefore, two sets of experiments were carried out to test the validity of the procedure introduced by Mori and Sasaki (2007) and Pula and Peltonen (2009, 2011). First, the Leontief coefficients and the CRs for 2005 based on the real values for 2005 were calculated and compared to the Leontief coefficients and CRs estimated for 2006. The results were significantly similar and, therefore, confirmed the validity of the method of estimation.

Second, the estimated sums of the value added for 2012 were



compared with the real data of each country for the same year. The discrepancies were less than 3% for all countries with the exception of Malaysia (8%), Singapore (14%), and Taiwan (12%). The residual for Malaysia may have occurred because we had to use GDP at market prices owing to lack of data, instead of the sum of the value added for 2012. In the case of Taiwan, the discrepancy may have happened because of the fact that we had to use the data from Taiwanese National Account reports. In this account, the data are in Taiwanese currency. We had to convert the data by using the average exchange rate in 2012. In the case of Singapore, the discrepancy may have happened because of trade re-export. Pula and Peltonen (2009, 2011) report a significant residual for these countries.

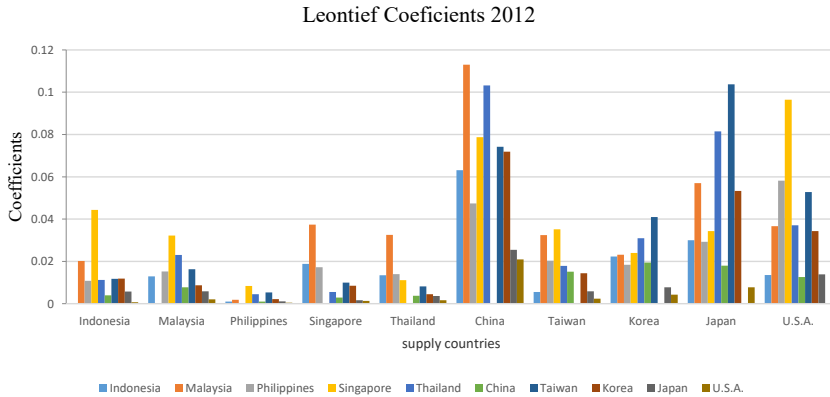
For the analysis of the role of the countries in the region, Leontief coefficients were calculated using the IO tables for 1985 to 2012. Figures 5–10 depict the results.

Moreover, to study the influence of Japan, China, and the US on value added created in the mentioned countries, Pula and Peltonen (2009, 2011) method is used to calculate the CR of final demand to value added index for each year. The CR index shows the shares of final demand in the demand countries in creating the value added for the corresponding supplier countries.

To calculate CR index, we must evaluate the impact of each country's final demand on the value added of the other countries ( $IF_j$ ). Let us suppose that we intend to calculate the impact of country  $j$ 's final demand on the value added of other countries. Subsequently, for each unit increase in country  $j$ 's final demand, one of the following situations could happen:

- 1) Final goods and the intermediate goods for producing these goods are produced in country  $j$ ;
- 2) Final goods are produced in country  $j$ , but the intermediate goods are produced in other countries;
- 3) Final goods are produced in other countries, but the intermediate goods are produced in country  $j$ ;
- 4) Final goods and the intermediate goods for producing these goods are produced in other countries.

The ( $IF_j$ ) index is calculated on the basis of the following formula and applies to all the above situations:



**FIGURE 7**  
LEONTIEF COEFFICIENTS IN 2012

$$IF_v^j = v^{\wedge} * B * f^j \tag{4}$$

In this equation,  $v^{\wedge}$  is a diagonal matrix consisting of the elements  $v = V^j / X^j$ , which is the share of the value added to total output in the demand country. Matrix  $B$  is the Leontief coefficient matrix and  $f^j$  is the column vector of country  $j$ 's final demand. The shares of each country in producing the value added comes from the following equation:

$$CR_i^j = \frac{IF_v^j}{\sum_j^n IF_v^j} \tag{5}$$

**V. Findings**

Figure 7 shows the values of the Leontief coefficients for 2012 that are in fact the backward linkages of the production in the demand countries towards the industries in the supplier countries. As already mentioned, these coefficients are calculated using the estimated values for IO table 2012. The horizontal axis here represents the supplier countries and the vertical one represents the amount of production needed in the supplier countries to produce one unit of value added in the demand countries. Regarding seven EEA counties, Malaysia, Indonesia, and South Korea have strong backward linkages with China, while Singapore and the Philippines have strong backward linkages

with the US, and finally Thailand has a strong backward linkage with Japan.

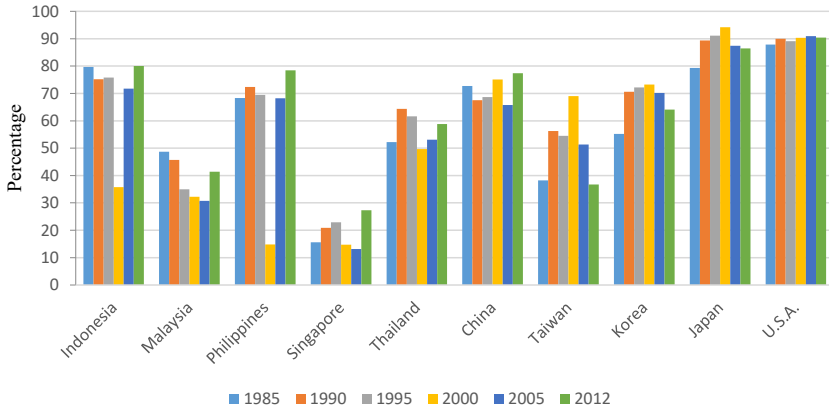
The Leontief coefficients for 1985, 1990, 1995, 2000, and 2005 are calculated and shown in Appendix Figures 1–6, along with the estimated data for 2012 to reveal the trends of trade patterns among these countries over the past three decades. Appendix Figure 1 indicates that Japan and the US are dominant supplier countries, which illustrates high concentration of suppliers in 1985. Appendix Figure 4 shows that in 2000, China emerges in the region as an important supplier country along with South Korea and Taiwan, but as shown in Appendix Figure 5, only China catches up with Japan and the US in 2005.

Therefore, the trend of the Leontief coefficients from 1985 to 2012, as depicted in Appendix Figures 1–6, illustrates that the concentration of suppliers has changed gradually due to the emergence of China, Korea, and Taiwan as regional suppliers besides Japan and the US. IO-2012 estimations show that China bypasses Japan and the US in the region. As in the introduction section of this article argues, China's economy has been comparatively less affected by the 1997 crisis compared with Japan and other countries in the region. Moreover, the WTO membership of China in 2001 contributes significantly to this success. Figure 4 illustrates that China experiences a sharp increase in FDI inflow in 1993 and high economic growth rates over 14% in 1993 and in 2008.

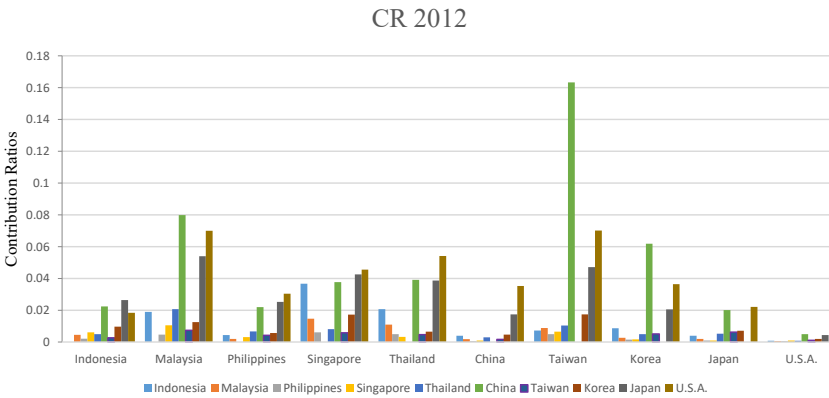
Another important observation is the dominant position of Singapore as a demand country in the region. This finding confirms the conclusions made by Sally (2007) regarding the success of this country in developing (a) a comprehensive Free Trade Agreements especially with the US, (b) an efficient administration and excellent regulatory standards to provide a good platform for different services, and (c) a hub in the region.

Noticeably, in EEA countries, internal demand always plays an important role in these countries' value added. Figure 8 depicts the shares of each country's domestic input needed to meet the output or total production in that country. The shares are above 50% in almost all countries except for Singapore and Malaysia. In large economies, such as Japan and the US, the shares are more than 80%.

Figure 9 shows the final demand CR of the demand countries in creating value added in the supplier countries (horizontal axis) in 2012. As illustrated in this figure, China's final demand CR is higher than the



**FIGURE 8**  
DOMESTIC INPUT SHARES IN EACH COUNTRY'S OUTPUT



**FIGURE 9**  
CR OF FINAL DEMAND TO VALUE ADDED 2012

US and Japan in South Korea, Taiwan, and Malaysia, while Japan's highest final demand CR is in Indonesia. The highest CR of the US final demand is in the Philippines, Singapore, Thailand, China, and Japan. Another important point to notice in 2012 is the low CR of the abovementioned countries in the US.

The final demand CR in creating value added in the countries of the region for 1985, 1990, 1995, 2000, and 2005 are illustrated in Appendix Figures 7–12, along with the estimated data for 2012 to observe the

pattern of trade among these countries over the past three decades. The figures imply that the demands of Japan and the US have the highest impact on the region's value added from 1985 to 2000. However, since 2005, China's CR has increased, and, as for 2012, China's demand (compared with the US and Japan) has more value added in certain countries in the region, such as Malaysia, Taiwan, and South Korea (Appendix Figures 7–11). This finding confirms that China has served as a supplier country in the region and as an important demand country since 2005.

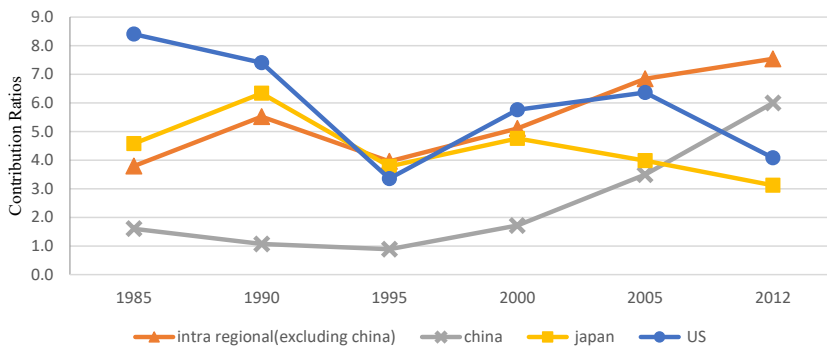
Given that we aim to compare the roles of Japan, the US, and China as the three main actors in the region, the CRs of these countries are shown in Table 3. This table includes the CR of domestic and the intra-regional demands of EEA countries in producing value added in the EEA countries. This table shows that the CR of external demand in producing value added in EEA countries is 42.74%, which is less than the export share in their GDP (49.19%). This finding, which is consistent with Pula and Peltonen's results, corroborates that, due to the production fragmentation, trade on parts and components (*i.e.*, trade on intermediate goods and merchandise) is huge in the region. Therefore, the total export statistics of these countries are prone to double counting, and its share in GDP is overestimated.

Table 3 illustrates the CR of domestic demand in these countries' value added has increased sharply until 1995 and then decreased sharply by 2000 before increasing again at a modest pace until 2012. These fluctuations can be explained by the changes in economic growth of EEA countries during this period (Figure 4). The gradual increase in the domestic final demand CR to EEA countries' value added and the gradual decrease in the RoW's final demand CR to its value added during the period under review reflect the high role of the domestic economy, rise of regionalism, and reduction of integration in the global economy from 1985 to 2012. This finding is in accordance with Baldwin's (2008) regionalization processes in East Asia over the past three decades.

Regarding the position of the US, Japan, and China among EEA countries, the CR of these countries' final demand to EEA value added is compared in Figure 10. As shown in this figure, during the period under study, the CR of the US and Japan's final demand is fluctuating, while their trend is declining from 8.4% and 4.6% in 1985 to 4.1% and 3.1% in 2012, respectively. Meanwhile, the share of China has increased

**TABLE 3**  
COMPARISON OF THE CR OF JAPAN, THE US, CHINA, AND EEA COUNTRIES' FINAL DEMAND TO EEA COUNTRIES' VALUE ADDED

	1985	1990	1995	2000	2005	2012
Domestic demand of EEA countries	52.6	61.1	73.6	45.1	55.8	57.3
Intra-regional demand of EEA countries	3.8	5.5	4.0	5.1	6.8	7.5
China	1.6	1.1	0.9	1.7	3.5	6.0
Japan	4.6	6.3	3.8	4.8	4.0	3.1
The US	8.4	7.4	3.4	5.8	6.4	4.1
RoW	29.0	18.6	14.4	37.5	23.5	22.0

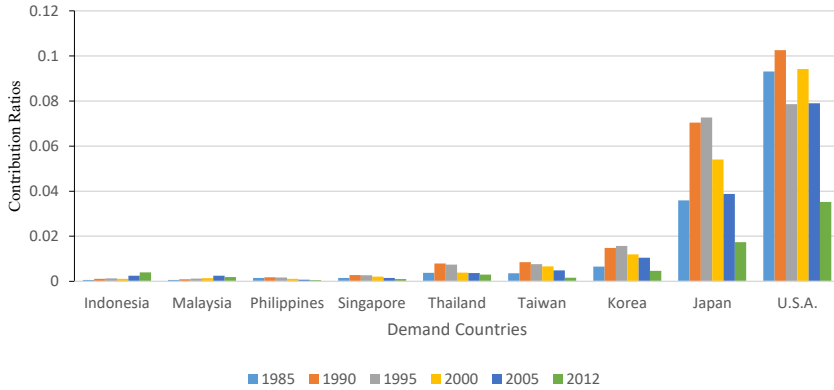


**FIGURE 10**  
CR OF INTRA-REGIONAL COUNTRIES, CHINA, JAPAN AND THE US FINAL DEMAND TO VALUE ADDED 1985 TO 2012

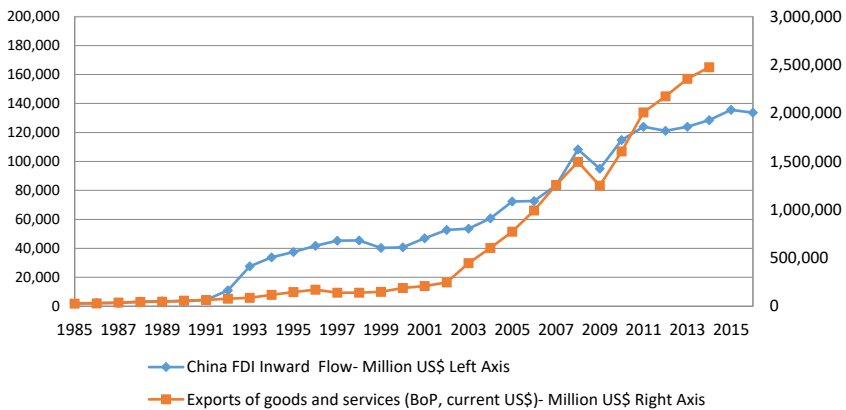
from 1.6% in 1985 to 6% in 2012.

Figure 11 exhibits the final demand CR of the studied countries in China's value added over the period under study. As illustrated, the final demands of the US and Japan have the highest shares in China's value added. Although the trend of their shares has been decreasing, by the end of the period, their shares are still significant compared with other countries.

Given the high contribution of FDI to China's economic growth (Figure 4) and its close relationship with the exports (Figure 12), we investigate the cause of the high share of Japan and the US in China and FDI in stock from the countries of the region. Figure 13 shows that

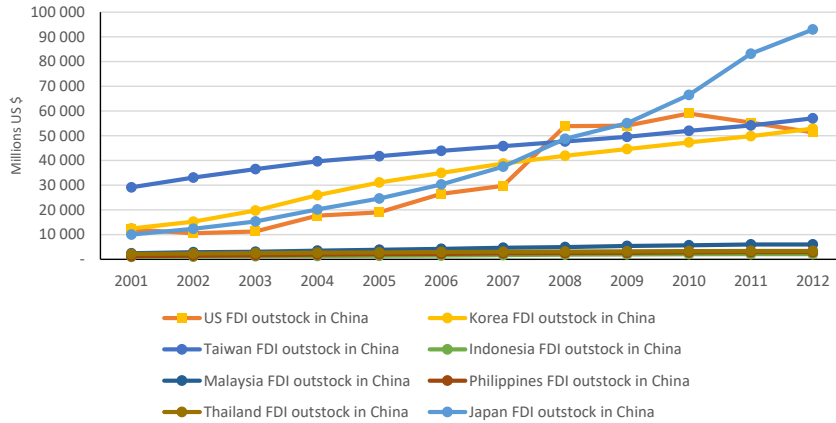


**FIGURE 11**  
FINAL DEMAND CR OF THE STUDIED COUNTRIES IN CHINA'S VALUE ADDED 1985 TO 2012



**FIGURE 12**  
COMPARISON OF CHINA'S INFLOW OF FDI WITH ITS EXPORT OF GOODS AND SERVICES FROM 1985 TO 2016

Japan, Taiwan, the US, and Korea have the highest FDI in stock in China. Figures 11 and 13 show that the FDI in stock patterns of these countries in China are remarkably similar to their CR patterns. Hence, we argue that these countries' FDIs in China are combinations of horizontal FDI (market-seeking production) and vertical FDI (resource-seeking investment or offshoring) (Baldwin and Okubo 2014; Ekholm *et al.* 2007). Therefore, China's intermediate goods exports to these



**FIGURE 13**

COMPARISON OF EEA COUNTRIES' FDI OUT STOCK IN CHINA FROM 2001 TO 2012

countries are the basis of their high demands due to vertical FDI, which contributes to their high CR in China. This result explains the simultaneous patterns of CR and vertical FDI of these countries in China. Among EEA countries, Singapore is an exception. Given its low population, Singapore has low share in CR, in spite of its high share in FDI.

Historically, since the second half of the 1980s, Japan has moved its factories to East Asian countries, especially in China. Japanese investors began to establish new subsidiaries in China. Figure 13 shows that, after 2008, US FDI stock in China stopped to increase and that Japanese FDI in this country continued to grow at the same pace.

## VI. Conclusion

1. As mentioned before, the 2012 IO table was calculated by using the 2005 IO table and based on the method used by Mori and Sasaki (2007) and Pula and Peltonen (2009, 2011). The sums of the value added of the estimated versions are compared with the real data of each country for the same year. The discrepancies are less than 3% for all countries except for three.

2. The trend of the Leontief coefficients shows that between 1985 and 2000, the US and Japan had the highest coefficients in relation to the eight countries of the region. During this time, the two countries



play a pivotal role in supplying intermediate goods among the eight countries studied. Since 2005, with the increase of the Leontief coefficients of China, Taiwan, and Korea, a decrease in the supplier countries' concentration is noticed. The trend for China's Leontief coefficients has been increasing until 2012. Therefore, among the seven EEA countries, Malaysia, Indonesia, and South Korea have the highest backward linkage with China. Singapore and the Philippines have the most backward linkage with the US, while Thailand has the most backward linkage with Japan. This observation signifies that the industries in China are the main suppliers of intermediate goods to the above-mentioned countries. This phenomenon reflects the change in the production pattern from integrated production to modular production (decomposition of the production process) in large countries, such as the US and Japan.

3. Given the fragmentation of productions to various parts and components in the East Asian countries and as the consequence of the expansion of trades in intermediate goods in the region, the total exports of these countries are prone to double counting. Therefore, the share of total export to GDP overestimates the CR of external final demand to GDP or created value added in EEA countries. To obtain the share of the different countries' final demand to value added in the studied countries, we calculate the CR index by using the Pula and Peltonen (2011) method. The value of this index in 2012 shows that the share of the external demand in producing value added in the EEA countries is 42.74%, which is less than the share of total exports of these countries in their GDP (49.19%).

4. The trend of the final demand CR to EEA value added shows that the final demands of the US and Japan have the highest share in created value added in the studied countries until 2000. However, China's CR has increased since 2005 while its demand (compared to the US and Japan) has more value added in 2012 in some countries in the region, such as Malaysia, Taiwan, and South Korea. This finding shows that China plays its role as a supplier country and gradually emerges as an influential demand country in the region since 2005.

In fact, the final demands of the US and Japan have significant contributions to the created value added in China, but the trend of their contributions has been decreasing over the period of study. Finally, the CR trend of seven EEA countries shows that during the studied period, their dependencies have increased toward each other and to China but

decreased to the US, Japan, and RoW.

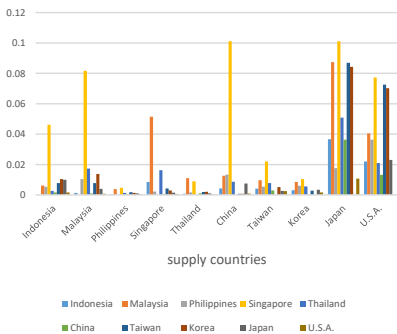
5. The high contribution of FDI to China's economic growth and its close relationship with its export show the important role of FDI in Chinese economy. Therefore, FDI in stock from the countries of the region in China has been examined and Japan, Taiwan, the US, and Korea have the highest FDI in stock in China. In addition, the FDI in stock patterns of these countries in China are remarkably similar to their CR patterns. These countries' FDI in China are export-platform FDI and therefore, China's exports to these countries are the basis for their high demands, which contribute to their high CR in China.

6. Finally, as a limitation of the present study, we have to mention that since the last released IO table for this region corresponds to 2005, we estimate the IO table for 2012 at country level. The reason why 2012 was chosen is that the authors did not intend to go too far away from the authentic data of 2005 and at the same time mean to cover the 2008 crisis in the region and the 2011 Tsunami event in Japan.

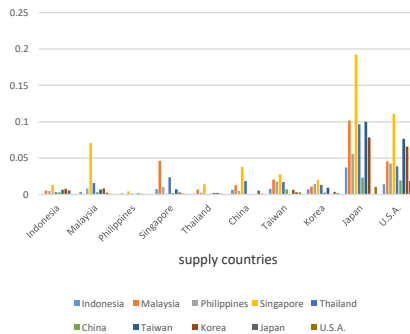
*(Received 12 November 2017; Revised 30 April 2018; Accepted 10 May 2018)*

**Appendix**

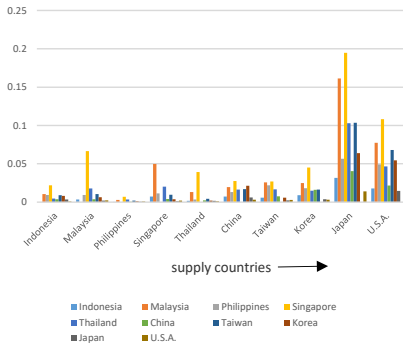
The trend of the Leontief coefficients from 1985 to 2012, pictured in Appendix Figures 1–6, illustrates that the concentration of suppliers has changed gradually due to the emergence of China, Korea, and Taiwan as regional suppliers in addition to Japan and the US. The IO-2012 estimations show that China has bypassed Japan and the US in the region. Significant discussions are given in Section V.



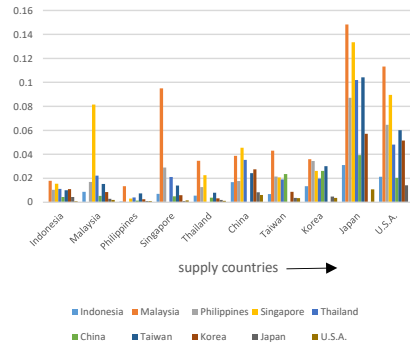
**APPENDIX FIGURE 1**  
LEONTIEF COEFFICIENTS FOR 1985



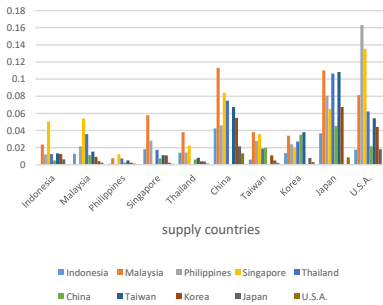
**APPENDIX FIGURE 2**  
LEONTIEF COEFFICIENTS FOR 1990



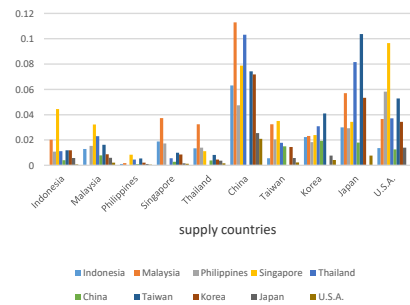
**APPENDIX FIGURE 3**  
LEONTIEF COEFFICIENTS FOR 1995



**APPENDIX FIGURE 4**  
LEONTIEF COEFFICIENTS FOR 2000

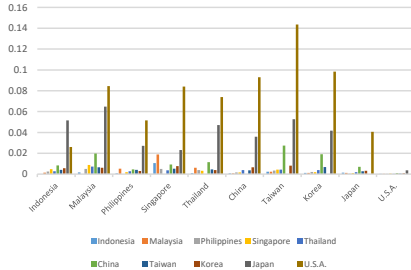


**APPENDIX FIGURE 5**  
LEONTIEF COEFFICIENTS FOR 2005



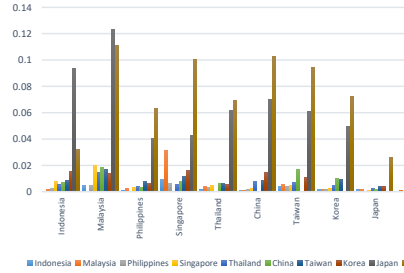
**APPENDIX FIGURE 6**  
LEONTIEF COEFFICIENTS FOR 2012

Final demand CRs in creating value added in the countries of the region for 1985, 1990, 1995, 2000, and 2005 are illustrated in Appendix Figures 7–12, along with the estimated data for 2012. The figures imply that Japan and the US’s demand have the highest impact on the region’s value added from 1985 to 2000. However, since 2005, China’s CR has increased. As for 2012, China’s demand (compared with the US and Japan) has more value added in countries in the region, such as Malaysia, Taiwan, and South Korea (Appendix Figures 7–11). This finding corroborates that China appears as a supplier country in the region and as an important demand country since 2005.



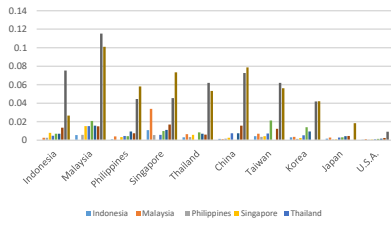
**APPENDIX FIGURE 7**

CR OF FINAL DEMAND TO VALUE ADDED  
1985



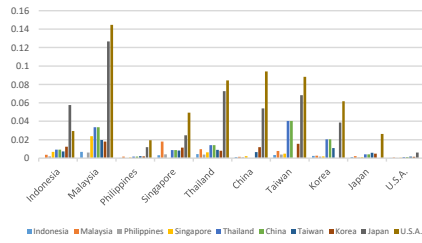
**APPENDIX FIGURE 8**

CR OF FINAL DEMAND TO VALUE ADDED  
1990



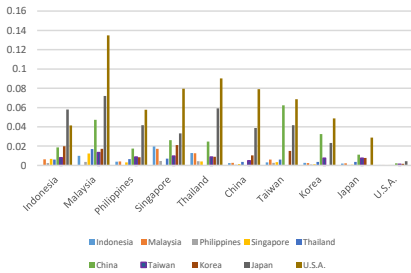
**APPENDIX FIGURE 9**

CR OF FINAL DEMAND TO VALUE ADDED  
1995



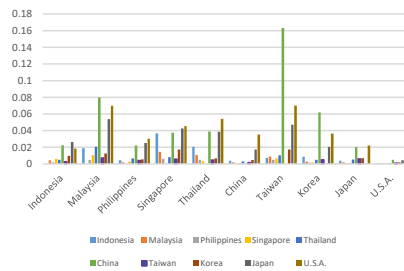
**APPENDIX FIGURE 10**

CR OF FINAL DEMAND TO VALUE ADDED  
2000



**APPENDIX FIGURE 11**

CR OF FINAL DEMAND TO VALUE ADDED  
2005



**APPENDIX FIGURE 12**

CR OF FINAL DEMAND TO VALUE ADDED  
2012

**APPENDIX TABLE 1**  
CONTRIBUTION RATIOS 1985–2012

CR 1985	Indonesia	Malaysia	Philippines	Singapore	Thailand	China	Taiwan	Korea	Japan	U.S.A.
Indonesia		0.001	0.003	0.005	0.003	0.008	0.004	0.006	0.052	0.026
Malaysia	0.002		0.005	0.009	0.007	0.020	0.007	0.006	0.065	0.084
Philippines	0.001	0.005		0.002	0.003	0.005	0.004	0.003	0.027	0.052
Singapore	0.010	0.019	0.005		0.004	0.009	0.005	0.008	0.023	0.084
Thailand	0.001	0.006	0.004	0.003		0.011	0.005	0.004	0.047	0.074
China	0.001	0.001	0.002	0.002	0.004		0.004	0.007	0.036	0.093
Taiwan	0.002	0.002	0.003	0.004	0.004	0.027		0.008	0.053	0.144
Korea	0.001	0.001	0.002	0.002	0.004	0.019	0.007		0.042	0.098
Japan	0.001	0.001	0.000	0.001	0.002	0.007	0.003	0.003		0.041
U.S.A.	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.004	
CR 1990										
Indonesia		0.002	0.003	0.008	0.005	0.007	0.009	0.015	0.094	0.032
Malaysia	0.005		0.005	0.020	0.015	0.018	0.017	0.014	0.123	0.111
Philippines	0.001	0.003		0.003	0.004	0.003	0.008	0.006	0.041	0.063
Singapore	0.009	0.031	0.006		0.005	0.008	0.012	0.016	0.042	0.100
Thailand	0.001	0.004	0.003	0.005		0.006	0.007	0.006	0.062	0.069
China	0.001	0.001	0.002	0.003	0.008		0.009	0.015	0.070	0.103
Taiwan	0.004	0.006	0.004	0.005	0.007	0.017		0.011	0.061	0.094
Korea	0.002	0.002	0.001	0.002	0.005	0.010	0.010		0.049	0.072
Japan	0.002	0.002	0.000	0.001	0.003	0.002	0.004	0.004		0.026
U.S.A.	0.000	0.001	0.000	0.001	0.001	0.001	0.001	0.002	0.007	
CR 1995										
Indonesia		0.003	0.003	0.008	0.005	0.007	0.007	0.014	0.075	0.027
Malaysia	0.006		0.006	0.015	0.015	0.021	0.016	0.015	0.115	0.101
Philippines	0.001	0.004		0.003	0.005	0.004	0.010	0.007	0.045	0.058
Singapore	0.011	0.034	0.006		0.006	0.010	0.011	0.017	0.045	0.073
Thailand	0.003	0.007	0.003	0.006		0.008	0.007	0.006	0.062	0.053
China	0.001	0.001	0.002	0.003	0.007		0.008	0.016	0.073	0.079
Taiwan	0.004	0.007	0.004	0.004	0.007	0.021		0.012	0.062	0.056
Korea	0.003	0.004	0.001	0.002	0.005	0.014	0.009		0.042	0.042
Japan	0.002	0.003	0.001	0.001	0.003	0.003	0.004	0.005		0.018
U.S.A.	0.001	0.001	0.000	0.001	0.001	0.001	0.002	0.002	0.009	

**APPENDIX TABLE 1**  
(CONTINUED)

CR 2000	Indonesia	Malaysia	Philippines	Singapore	Thailand	China	Taiwan	Korea	Japan	U.S.A.
Indonesia		0.004	0.002	0.007	0.003	0.009	0.007	0.012	0.058	0.030
Malaysia	0.007		0.006	0.024	0.013	0.034	0.020	0.018	0.127	0.145
Philippines	0.000	0.002		0.001	0.001	0.002	0.002	0.002	0.012	0.020
Singapore	0.003	0.018	0.004		0.003	0.009	0.008	0.011	0.025	0.049
Thailand	0.004	0.010	0.004	0.006		0.014	0.009	0.008	0.073	0.084
China	0.001	0.001	0.001	0.002	0.004		0.007	0.012	0.054	0.094
Taiwan	0.003	0.008	0.004	0.005	0.006	0.040		0.016	0.068	0.088
Korea	0.002	0.003	0.002	0.002	0.003	0.020	0.011		0.039	0.062
Japan	0.001	0.002	0.001	0.001	0.002	0.004	0.006	0.005		0.026
U.S.A.	0.000	0.001	0.000	0.001	0.000	0.001	0.002	0.002	0.006	
CR 2005										
Indonesia		0.006	0.002	0.007	0.006	0.019	0.008	0.020	0.058	0.041
Malaysia	0.010		0.004	0.012	0.017	0.047	0.013	0.017	0.072	0.135
Philippines	0.004	0.004		0.003	0.007	0.017	0.009	0.008	0.042	0.058
Singapore	0.020	0.017	0.005		0.007	0.026	0.010	0.021	0.033	0.080
Thailand	0.013	0.013	0.004	0.004		0.025	0.009	0.009	0.059	0.090
China	0.002	0.003	0.001	0.002	0.004		0.005	0.010	0.039	0.079
Taiwan	0.003	0.006	0.003	0.003	0.006	0.062		0.015	0.042	0.069
Korea	0.003	0.002	0.001	0.001	0.004	0.033	0.008		0.023	0.049
Japan	0.002	0.002	0.001	0.001	0.004	0.011	0.007	0.008		0.029
U.S.A.	0.000	0.001	0.000	0.001	0.001	0.002	0.001	0.002	0.004	
CR 2012										
Indonesia		0.004	0.002	0.006	0.005	0.022	0.003	0.010	0.026	0.018
Malaysia	0.019		0.005	0.011	0.021	0.080	0.007	0.013	0.054	0.070
Philippines	0.004	0.002		0.003	0.007	0.022	0.004	0.006	0.025	0.030
Singapore	0.037	0.015	0.006		0.008	0.038	0.006	0.017	0.043	0.045
Thailand	0.021	0.011	0.005	0.003		0.039	0.005	0.007	0.039	0.054
China	0.004	0.002	0.001	0.001	0.003		0.002	0.005	0.017	0.035
Taiwan	0.007	0.009	0.005	0.007	0.010	0.163		0.017	0.047	0.070
Korea	0.009	0.003	0.002	0.002	0.005	0.062	0.005		0.021	0.036
Japan	0.004	0.002	0.001	0.001	0.005	0.020	0.006	0.007		0.022
U.S.A.	0.001	0.001	0.001	0.001	0.001	0.005	0.001	0.002	0.004	

A. *Methods of Estimation for IO Table 2012*

As mentioned earlier, the IO table consists of three major sections comprising intermediate demand, final demand, and export to other countries. The estimation method of the three parts A, F and L of the IO table are as follows:

**Part A: Demand for Intermediate Goods**

As suggested by Pula and Peltonen (2009, 2011), the compound annual growth rate is calculated using Formula (6). This rate is multiplied by the values of the 2005 IO table to estimate the 2012 IO table for part A for all countries with the exception of the main diagonal, which represents the domestic demand for each country.

$$(\text{int } M_{t+1}^{ij} / \text{int } M_t^{ij}) = (M_{t+1}^{NA} / M_t^{NA}) * \left( \frac{\text{int } M_{t+1}^{comij} / \text{int } M_t^{comij}}{M_{t+1}^{com} / M_t^{com}} \right) \quad (6)$$

In this formula, NA stands for *National Accounts*, COM for COMTRADE, intM for *import of intermediate goods*, and M for *total import*. COMTRADE data show import of goods, and thus, in this formula, we assume that the changes in the import of goods are similar to the changes in import of goods and services.

The classification of goods extracted from COMTRADE are based on the Pula and Peltonen's article (2009, 2011).

To estimate domestic input (the main diagonal values), we calculate X (total output), V (value added), DA (duties and import commodity taxes), and BA (freight and insurance) for 2012, as follows:

A) Knowing that the statistics for X (total output) is not declared for any country except the US, we assume that the growth rate of X is equal to the growth rate of the value added in the industrial sector. This value is calculated by using data for the value added in this sector from the National Accounts for 2005 and 2012.

B) To calculate V, the growth rate of the total value added is obtained by using data for the value added from the National Accounts for 2005 and 2012.

C) BF and DT for 2012 are calculated using compound annual growth rate estimated from Formula (6).

Please note that in this part the total import of intermediate goods is used for each country, while in part (A), the import of intermediate

goods from each country is used.

### Part B: Demand for Final Goods

This part consists of five subsections for which the estimation method is as follows:

(a) The import of goods and services among 10 countries: The growth rates of final goods are calculated by using Formulas (7) and (8) in which  $(cM^{com})$  stands for the final goods and  $(capM^{com})$  stands for the capital goods. The data were extracted from the COMTRADE database. These rates were multiplied by the values of the 2005 IO table to estimate the 2012 IO table part F for all countries with the exception of the main diagonal, which represents the domestic demand for the final goods and services for each country.

$$(c M_{t+1}^{ij} / c M_t^{ij}) = (M_{t+1}^{NA} / M_t^{NA}) * \left( \frac{cM_{t+1}^{comij} / c M_t^{comij}}{M_{t+1}^{com} / M_t^{com}} \right) \quad (7)$$

$$(cap M_{t+1}^{ij} / cap M_t^{ij}) = (M_{t+1}^{NA} / M_t^{NA}) * \left( \frac{capM_{t+1}^{comij} / cap M_t^{comij}}{M_{t+1}^{com} / M_t^{com}} \right) \quad (8)$$

(b) Freight and Insurance (BF): The values for 2012 were calculated according to those of 2005 IO table and using the ratios between “the total imported consumption goods in 2012” and those of 2005 with the real data from the COMTRADE database.

(c) Import of final goods from Hong Kong, EU, and RoW: The calculation was similar to (b) but the growth rate of capital goods is used to predict the imported capital goods.

(d) Duties and import commodity taxes (DT): The same calculation method as (c) was applied.

(e) Total consumption and investments  $C^j$  and  $I^j$ : These values are computed by using the growth rates of consumption and investments extracted from the National Accounts data.

Finally, to calculate the domestic demand for final goods (main diagonal in part F), we extract total consumption  $C^j$  and total investments  $I^j$  estimated in part 5 from the sum of parts 1, 2, 3, and 4 of the 2012 IO table.



**Part C: Export to Hong Kong, EU, and RoW**

The compound annual growth rate is calculated by using Formula (9). This rate is multiplied by the values of the 2005 IO table to estimate the 2012 IO table part L for all countries.

$$(EX_{t+1}^{ij}/EX_t^{ij}) = (EX_{t+1}^{NA}/EX_t^{NA}) * \left( \frac{EX_{t+1}^{comij}/EX_t^{comij}}{EX_{t+1}^{com}/EX_t^{com}} \right) \quad (9)$$

In this equation, EX stands for the total export of country  $i$  to country  $j$ . The required data are extracted from the National Accounts and COMTRADE databases.

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