Analysis of the Status Quo of China's Peripheral Cooperation and China's Influence under the Perspective of Value Added

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Keywords: value added; regional cooperation; neighboring countries and regions; influence

Abstract: This paper analyses the regional cooperation around China by setting model to decompose export according to the value added using non-competitive input-output data covered 2000-2014 from WIOD database. Also, this paper analyzes the regional influence of China compared with the United States and Japan. The result shows that the global financial crisis has increased the level of regional cooperation and Chinese regional position. However, China gains the regional rise mainly as intermediate product market while US as the final product market has also been strengthened. And the certain imitation and follow signs exist among Japan and other Asian countries and regions.

1. Introduction

Asian Competitiveness Annual Report 2018 indicates the regional cooperation in Asia has been strengthened against the adverse environment of anti-globalization and trade protectionism around the world in 2017, and the "Belt and Road Initiative" has played an important role in promoting it [1]. Before the "Belt and Road Initiative", there were already many regional economic integration arrangements in Asia, but they all had objective exclusivity due to higher thresholds. On the contrary, the "Belt and Road" has stronger openness, diversity and inclusiveness. The relevant economies are based on, but not limited to, the scope of the ancient Silk Road, and the threshold of trade and investment is lower, adapting to the diverse economic development level of Asian economies. This paper analyzes the trade structure and evolution path of economies in the region from the perspective of value added, discusses the advantages and difficulties of strengthening regional cooperation from the perspective of demand market, and the role that China can play in this process compared with the United States and Japan [2].

2. Literature Review

Most of the literature on regional cooperation in Asia recognizes the importance of strengthening regional cooperation and believes that the level of regional cooperation in Asia still needs to be improved [3]. Access to external markets through participation in global production networks is an important reason for East Asia's success, but as Asia's production capacity increases and developed countries enter the post-industrialization stage, external market constraints faced by Asian countries and regions are becoming more and more important. In the short term, it is difficult for Asian countries and regions to rely on domestic demand to make up the decline in external demand, so the concept of the region becomes more important(Zhao & Zhang, 2012; Kiyota, Oikawa et al., 2017) [4]. However, the lack of a unified free trade zone agreement in the Asian region has led to the failure of companies to fully utilize the FTA agreement and results in "spaghetti bowl effect" (Li, 2015). The "Belt and Road Initiative" provides an opportunity to create a new closed-loop system and cooperation platform through the integration of regional product market, raw material market and investment market, reflecting the new functional complementarity and development cooperation between developing countries and regions (Lu, 2016). The construction of the "Belt and Road" will inevitably affect the development trend of Eurasia and even the whole world. Therefore, it has received widespread

attention around world. The key foreign powers also have an important influence on regional cooperation [5].

The rise of value-added accounting in recent years has provided a new perspective for the analysis of regional cooperation (Alfaro, Antràs et al., 2017; Johnson, 2018). The globalization of production and trade has led to multiple cross-border transactions of intermediate products. To avoid duplication of statistics, major international organizations have strengthened their research on value-added trade statistics (Wang, Wei et al., 2015) [6]. Specifically, the calculation of the value added is mainly based on the macro-estimation method of the input-output table, including: the HIY method of measuring the import content contained in the export (Hummels, Ishii et al., 2001), the DRS method measuring the percentage of intermediates one country export used by other countries for the production of final products imported by the country (Daudin, Rifflart et al., 2011), and value added ratio measuring the proportion of domestic export directly used abroad (Johnson & Noguera, 2012) [7]. However, above methods ignore the difference between intermediate products and final products and only estimates the scale of intermediate products; or can eliminate the value of intermediate products to calculate the value added of trade, but can not fully reveal the composition of export. Thus, based on existing research, Koopman, Wang et al. (2014) builds a world input-output table, accounts for intermediate products and final product scale in major countries, and tracks utilize of products, introduces a method of completely decomposing a country's export with information from customs [8].

Based on the above methods, some literatures have studied regional cooperation in Asia. Yin et al. (2016) pointed out that the influence of the United States and Japan is an important part of the maritime Silk Road construction, used the Asian international input-output data to establish an inter-regional industrial network model between China-ASEAN, the US-ASEAN and Japan-ASEAN, calculated the inter-regional correlation effects and industrial ripple effects and analyzed the interactions between countries as well as their status. Zheng et al. (2017) analyzed the evolution of the structural characteristics of the maritime Silk Road trade network, showing that China played an extremely important role in the process of ASEAN integration and South Asia integration into the region and the rise of China's status company with the decline of Japan's status [9]. In general, the literature on regional cooperation based on the value-added perspective is still relatively limited, especially the analysis from the perspective of demand [10].

3. Theory and Hypothesis

3.1 Input-Output Model

The input-output table is divided into two types: competitive and non-competitive. The competitive input-output table assumes that the imported and domestic intermediate inputs are completely replaced, and therefore do not provide foreign input-output data. The World Input-Output Database (WIOD) data, also known as inter-country input-output tables, is a non-competitive input-output table. The imported in a country is divided into two categories: intermediate product and final product (see Table 1).

Table 1 inter-country input-output table

input	output	Intermediate use				Final use				total output
		Country 1	Country 2	…	Country G	Country 1	Country 2	…	Country G	
intermediate input	country 1	X_{11}	X_{12}	…	X_{1G}	Y_{11}	Y_{12}	…	Y_{1G}	X_1
	country 2	X_{21}	X_{22}	…	X_{2G}	Y_{21}	Y_{22}	…	Y_{2G}	X_2
	…	…	…	…	…	…	…	…	…	…
	country G	X_{G1}	X_{G2}	…	X_{GG}	Y_{G1}	Y_{G2}	…	Y_{GG}	X_G
Value added		V_1	V_2	…	V_G					
Total input		X_1	X_2	…	X_G					

From the rows in the table, all products produced by the country i will be used for intermediate consumption and final consumption in G countries, namely:

$$X_i = \sum (A_{ij} X_j + Y_{ij}) \tag{1}$$

where X_i is an N-order column vector, representing the total output of country i; Y_{ij} is an N-order column vector, representing the final products produced by country i and consumed by country j; A_{ij} is N×N direct consumption coefficient matrix, representing intermediate products produced by country i and consumed by country j. With G countries and N departments, the following identity exists:

$$\begin{bmatrix} X_1 \\ X_2 \\ \cdots \\ X_G \end{bmatrix} = \begin{bmatrix} A_{11} & A_{12} & \ldots & A_{1G} \\ A_{21} & A_{22} & \ldots & A_{2G} \\ \ldots & \ldots & \ldots & \ldots \\ A_{G1} & A_{G2} & \ldots & A_{GG} \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ \cdots \\ X_G \end{bmatrix} + \begin{bmatrix} Y_{11}+Y_{12}+\cdots+Y_{1G} \\ Y_{21}+Y_{22}+\cdots+Y_{2G} \\ \cdots\cdots \\ Y_{G1}+Y_{G2}+\cdots+Y_{GG} \end{bmatrix} \tag{2}$$

that is:

$$\begin{bmatrix} X_1 \\ X_2 \\ \cdots \\ X_G \end{bmatrix} = \begin{bmatrix} I-A_{11} & -A_{12}\ldots-A_{1G} \\ -A_{21} & I-A_{22}\ldots-A_{2G} \\ \ldots & \ldots \ldots \ldots \\ -A_{G1} & -A_{G2}\ldots I-A_{GG} \end{bmatrix}^{-1} \begin{bmatrix} Y_{11}+Y_{12}+\ldots+Y_{1G} \\ Y_{21}+Y_{22}+\ldots+Y_{2G} \\ \ldots \\ Y_{G1}+Y_{G2}+\ldots+Y_{GG} \end{bmatrix} = \begin{bmatrix} B_{11} & B_{12}\ldots B_{1G} \\ B_{21} & B_{22}\ldots B_{2G} \\ \ldots & \ldots \ldots \ldots \\ B_{G1} & B_{G2}\ldots B_{GG} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ \ldots \\ Y_G \end{bmatrix} \tag{3}$$

where B_{ij} is N×N Leontief inverse matrix, representing the total demand for the product produced in country i. when country j increase one unit of final use; Y is an N-order column vector, representing the final consumption to product produced in country i from G countries. Equation (3) can be abbreviated as X=BY.

From the columns in the table, assume V_i is an N-order row vector, representing the value added share in country i, and meeting the following constraints:

$$V_i = u(I - \sum A_{ji}) \tag{4}$$

where u represents the row vector whose element is 1, and equation (4) indicates that the value added is the total value of the product minus the value of the intermediate product. Therefore, the value-added rate matrix in G countries is:

$$V = \begin{bmatrix} V_1 & 0 & \ldots & 0 \\ 0 & V_2 & \ldots & 0 \\ \ldots & \ldots & \ldots & \ldots \\ 0 & 0 & \ldots & V_G \end{bmatrix} \tag{5}$$

V is the matrix of G×GN. Thus, the value added contained in a country's total output can be expressed as VX:

$$VX = VBY = \begin{bmatrix} V_1 \sum B_{1j} Y_{j1} & V_1 \sum B_{1j} Y_{j2} & \ldots & V_1 \sum B_{1j} Y_{jG} \\ V_2 \sum B_{2j} Y_{j1} & V_2 \sum B_{2j} Y_{j2} & \ldots & V_1 \sum B_{2j} Y_{jG} \\ \ldots & \ldots & \ldots & \ldots \\ V_G \sum B_{Gj} Y_{j1} & V_G \sum B_{Gj} Y_{j2} & \ldots & V_G \sum B_{Gj} Y_{jG} \end{bmatrix} \tag{6}$$

The part on the diagonal line is consumed in one country, and the rest is exported abroad. Thus, VT_{ij} is value-added export from country i to country j, and

$$VT_{ij} = V_i \sum_{t}^{G} B_{it} Y_{tj} \tag{7}$$

The total value added export of country i is:

$$VT_{i*} = V_i \sum_{i \neq j}^{G} \sum_{t}^{G} B_{it} Y_{tj} = V_i \sum_{i \neq j}^{G} B_{ii} Y_{ij} + V_i \sum_{i \neq j}^{G} B_{ij} Y_{jj} + V_i \sum_{i \neq j}^{G} \sum_{t \neq i,j}^{G} B_{ij} Y_{jt} \tag{8}$$

where $V_i \sum_{i \neq j}^{G} B_{ii} Y_{ij}$ represents the value added of the final product of country i directly absorbed by importing country j; $V_i \sum_{i \neq j}^{G} B_{ij} Y_{jj}$ represents the value added of the intermediate product of country i directly absorbed by importing country j; $V_i \sum_{i \neq j}^{G} \sum_{t \neq i,j}^{G} B_{ij} Y_{jt}$ represents the value-added export of intermediate products of country i exported from the importing country j to the third country t.

Assuming E_{ij} is the export from country i to country j, then:

$$E_{ij} \equiv A_{ij} X_j + Y_{ij} \tag{9}$$

The total export of a country can be expressed as:

$$E_{i*} = \sum_{i \neq j}^{G} E_{ij} \tag{10}$$

A country's exports consist of three parts of value added: domestic products consumed by foreign countries (domestic value added in export, VT); domestic export that have been repatriated back to the country after foreign processing (return value added); the value added of foreign products included in the export (foreign value added). Equation (8) lists three composition of VT. According to equation (3) and (5), Koopman, Wang et al.(2014) also lists the composition of return value added and foreign value added. Return value added includes: $V_i \sum_{i \neq j}^{G} B_{ij} Y_{ji}$, the value added of intermediate products returned to the country as final products after export; $V_i \sum_{i \neq j}^{G} B_{ij} A_{ji} (I - A_{ii})^{-1} Y_{ii}$, the value added of intermediate products returned to the country as intermediate products after export; $V_i \sum_{i \neq j}^{G} B_{ij} A_{ji} (I - A_{ii})^{-1} E_{i*}$, double-counted value added export of domestic intermediate products. Foreign value added includes: $\sum_{t \neq i}^{G} \sum_{i \neq j}^{G} V_t B_{ti} Y_{ij}$, the value added of foreign products contained in the country's final product exports; $\sum_{t \neq i}^{G} \sum_{j \neq i}^{G} V_t B_{ti} A_{ij} (I - A_{jj})^{-1} Y_{jj}$, the value added of foreign countries contained in the country's intermediate product exports; $\sum_{t \neq i}^{G} V_t B_{ti} A_{ij} \sum_{j \neq i}^{G} (I - A_{jj})^{-1} E_{j*}$, double-counted value added exports of foreign intermediate products.

3.2 Indicator Construction

First, degree of globalization participation and degree of regionalization participation. Based on the method in Los, Timmer et al. (2015), assuming FVA to be the ratio of foreign-used value added in the total value added, presenting the degree of the country participating in globalization. It can be known from (6):

$$FVA_i = V_i \sum_{i \neq j}^{G} \sum_{t}^{G} B_{it} Y_{tj} / V_i \sum_{j}^{G} \sum_{t}^{G} B_{it} Y_{tj} \tag{11}$$

Similarly, assuming GFVA to be the indicator representing the degree of extra-regional participation and RFVA to be the indicator representing the degree of regional participation [11]. GFVA is the ratio of value added used by extra-regional countries (like non-Asian countries) in total value added; RFVA is the ratio of value added used by regional countries (like Asian countries) in total values added. The values of FVA, GFVA and RFVA are all between 0 and 1, and FVA is the sum of GFVA and RFVA. By comparing RFVA and GFVA, it shows whether one country participates in more regional activities or extra-regional ones [12].

Also, it shows the region's trade dependence by calculating the ratio of value added used by regional countries in total value added produced in the region. And it further shows different level of development by comparing trade dependence in different regions [13].

Second, the position in global value chain. Based on Antràs, Chor et al.(2012) and Fally (2011), set up UGVC (Upstream Global Value Chain) and DGVC (Downstream Global Value Chain) to carve country's position in global value chain [14]. Fan & Huang (2014) and He & Gao (2014) also used these indicators. UGVC represents the degree of one country participating in global value chain as an upstream producer, showing this country's capacity to provide intermediate products for foreign export production. DGVC represents the degree of one country participating in global value chain as an downstream producer, showing this country's capacity to utilize foreign products for domestic export production [15].

$$UGVC_i = (V_i \sum_{i \neq j}^{G} B_{ij} Y_{jj} / E_{i*}) \times 100 \tag{12}$$

$$\begin{aligned} DGVC_i &= (\sum_{i \neq j} V_j B_{ji} / E_{i*}) \times 100 \\ &= [(\sum_{t \neq i}^{G} \sum_{i \neq j}^{G} V_t B_{ti} Y_{ij} + \sum_{t \neq i}^{G} \sum_{j \neq i}^{G} V_t B_{ti} A_{ij} (I - A_{jj})^{-1} Y_{jj} + \sum_{t \neq i}^{G} V_t B_{ti} A_{ij} \sum_{j \neq i}^{G} (I - A_{jj})^{-1} E_{j*}) / E_{i*}] \times 100 \end{aligned} \tag{13}$$

DCR (Double Counting Ratio) shows the similar information, although its value counts into none country's GDP. For example, assuming certain industries in both country A and B create the same value added export, A has higher position in global value chain than B if double counting rises from the use of more foreign intermediate products in the final product in country A while it rises from the use of more import intermediate products that once exported to the foreign countries in country B. Thus, define:

$$DCR = V_i \sum_{i \neq j}^{G} B_{ij} A_{ji} (I - A_{ii})^{-1} E_{i*} / \sum_{t \neq i}^{G} V_t B_{ti} A_{ij} \sum_{j \neq i}^{G} (I - A_{jj})^{-1} E_{j*} \tag{14}$$

The larger the DCR is, the more domestic intermediate products are used in the double counting of a country's exports, which means a stronger link between the export sector and the domestic economy and a higher position of one country in the global value chain.

Third, the role of market provider. Define PI, the ratio between Asian value added exported to the US and exported to China, to measure the influence of China and the US as the market provider on Asian economies. PI can be easily calculated though equation (7). If PI is greater than 1, the US provides more markets, otherwise, China provides more markets [16].

Similarly, define PIF to be the ratio between Asian value added of final products exported to the US and exported to China and PII the ratio between Asian value added of intermediate product exported to the US and exported to China [17].

Forth, trade similarity. With the index of trade similarity (TS) raised by Finger & Kreinin (1979), this paper investigates the pattern of other Asian economies that are more like Japan or China in terms

of production structure. Xu & Song (2002) have done the similar analysis in 2002. Both traditional and value added data are used to calculate TS respectively. The calculation of TS is as below:

$$TS = \left\{ \sum_{l} \min\left(\frac{E_{ik}^{l}}{E_{ik}}, \frac{E_{jk}^{l}}{E_{jk}}\right) \right\} \times 100 \tag{15}$$

where, j represents China and Japan, i represents other Asian economies except China and Japan, k represents countries in the world except country i and country j, l represents commodities. Thus, $\frac{E_{ik}^{l}}{E_{ik}}$ represents the share of the lth commodity in country i's exports to country k, $\frac{E_{jk}^{l}}{E_{jk}}$ represents the share of the lth commodity in country j's exports to country k. The larger TS is, the more similar the exports of country i and country j are. In the extreme case that country i and country j have exactly the same kind of exports, the index is 100.

3.3 Data Resources

This paper uses the 2006-2014 world input-output data table (WIOT) in WIOD database. The data combines bilateral trade data to build input and output data at the global industry level. It includes the exchange of intermediate and final products in different sectors within and between economies, direct value added in different sectors of all economies, and output in all sectors of all economies. The data covers 44 economies including 30 EU member states[①], 13 other major countries[②] and "other regions of the world", and also covers 56 sectors under the International Standard of Industrial Classification Rev4 (ISIC Rev4) [18].

During the comparison of regional participation, Asian countries and regions includes China, Japan, Korea, Taiwan (China), India and Indonesia, accounting for 60% of Asia's global trade, while NAFTA includes the US, Canada and Mexico and EU includes Germany, France, UK, Italy and Netherlands, accounting for 60% of the EU's global trade. When analyzing the impact of China on Asia, the control group is Japan and the US. Except the sample countries in the certain comparison, the rest of countries are summed into "the other countries in the world".

4. Research Findings

4.1 Regional Cooperation

Asian economies mainly participate in global cooperation compared with regional cooperation, and anti-globalization moves can be seen in part of Asian economies. The FVA curve in Figure1 shows Indonesia is the most typical economy in reverse globalization. During the sample period, its participation in globalization slowly declined. China's openness is at the forefront of sample countries and regions, but it declined between 2010 and 2014. Korea and Taiwan (China) showed clear trend of opening up. Asian countries and regions were affected by global economic crisis and reduced the level to participate in globalization except for Korea. So, the peaks were mostly around 2007. GFVA's trend is almost identical to FVA, although its position is higher than FVA. It means the participation in extra-regional production activities is the main driving force of globalization for sample areas. The global crisis affected economies' connection with extra-regional economies, but it had little effect on economic development in regional areas. However, the degree of regional cooperation is low for most economies, most of which is less than 10%.

① Austria, Belgium, Bulgaria, Cyprus, Czech, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and UK.

② Canada, USA, Brazil, Mexico, China, India, Japan, South Korea, Australia, Taiwan (China), Turkey, Indonesia, and Russia.

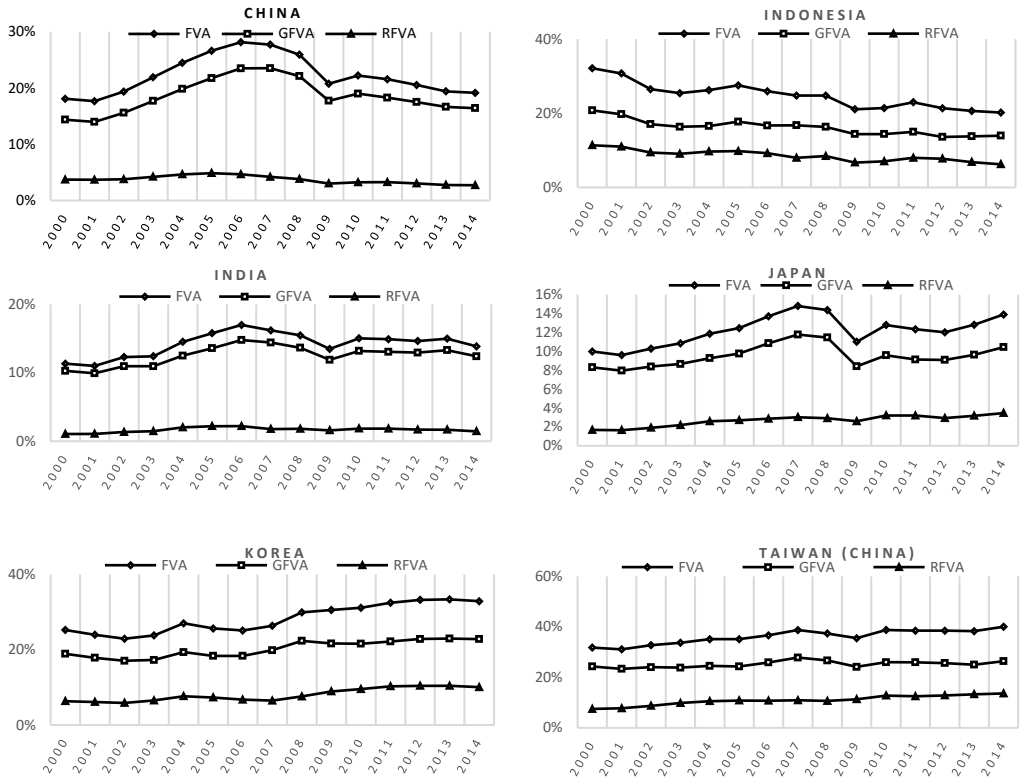

Figure 1 FVA, GFVA, RFVA in major Asian countries and regions

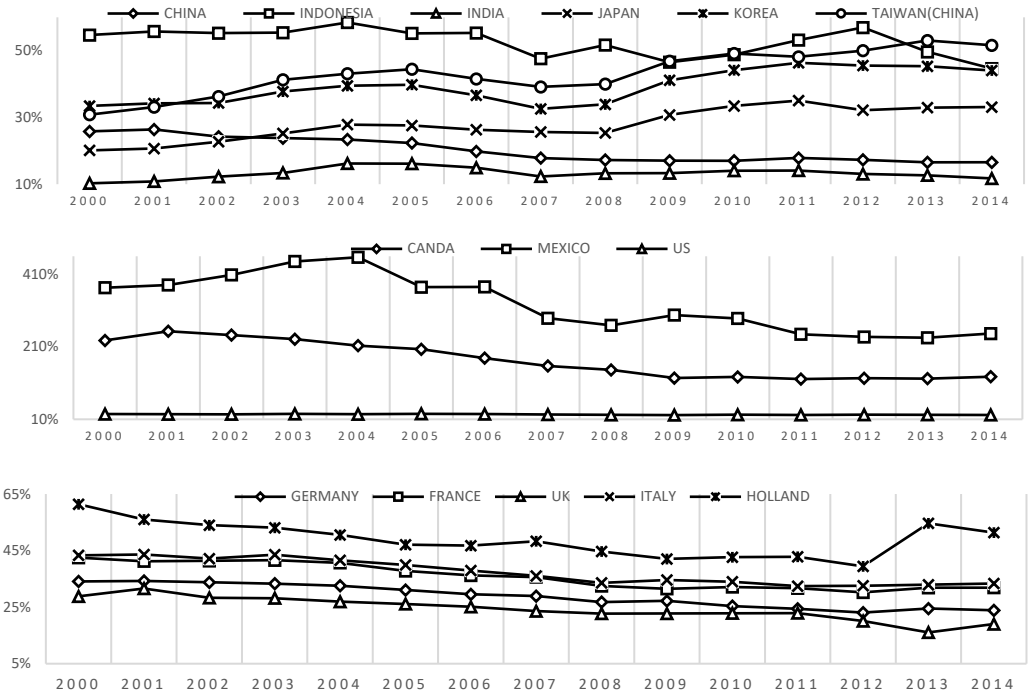

Figure 2 The ratio of RFVA to GFVA of major countries and regions in Asia, NAFTA and EU

Second, the degree of production cooperation is high in Asia. Figure 2 shows the ratio of RFVA to GFVA in both Asian and NAFTA countries and regions. Only Canada and Mexico have the value over 1, which means that these two countries add their value mainly from regional countries. The proportion of internal trade in Asia is similar to that in Europe and America, which indicates similar production integration level in all areas.

Third, Asian economies are mainly located in the downstream of global value chain although upstream activities are increasing. Figure 3 and Figure 4 respectively show the UGVC and DGVC in

the US and major Asian economies. The US has high position in value chain, whose products are widely used in export of other economies. Asian economies have clear division of work and stable position in value chain while Japan takes the higher position in the value chain.

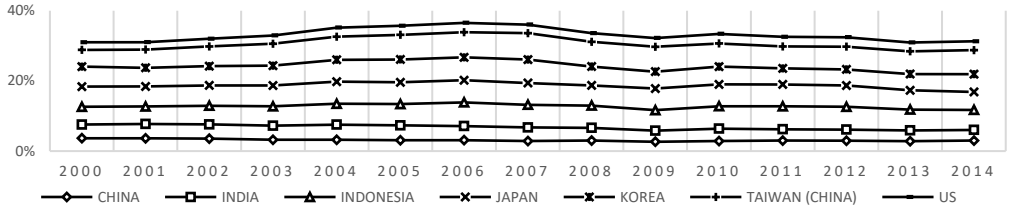

Figure 3 UGVC in the US and Asian countries and regions

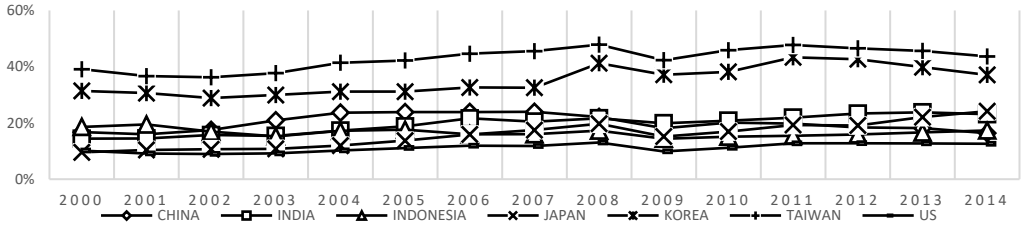

Figure 4 DGVC in the US and Asian countries and regions

Double counting data gives the same picture. Figure 5 clearly shows that during the observation period, the export of the US contains more intermediates that were exported firstly and then imported, and thus export sectors in the US have closer connection with domestic economy. The US takes the highest position of the value chain and the peak appears at the end of 1990s.

The positions of China and Japan are higher in Asia. Although the position of Japan has declined in recent years, it is still one of the highest in Asia. Figure 5 shows that China's position continued to increase and has surpassed Japan in 2005. But Figure 3 also shows that China's high-end industry still lagged behind major Asian countries and regions. Figure 4 indicates that China still mainly exported low-end products. The reason lies in processing industry in China which causes less intermediates export and more intermediates import in China. Thus, this paper concludes that China 's industrial structure has been significantly improved.

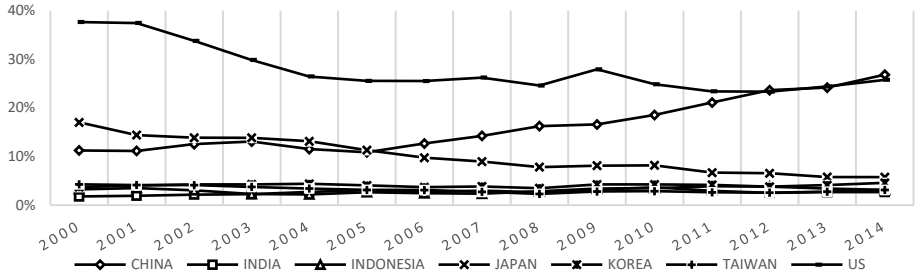

Figure 5 DCR in the US and Asian countries and regions

4.2 China's Regional Influence

The US remains the largest consumer of final products in Asian countries and regions. China mainly provides intermediate products market rather than final products market for neighboring countries and regions. PI in Figure 6 indicates that after 2009, more value added flowed to China instead of the US, which means China started to provide more markets for major Asian countries and regions. Figure 7 and Figure 8 respectively shows the final and intermediate markets provided by China and the US. As we can see, although China's market size is gradually surpassing that of the US, the US still consumes more final product until 2011.

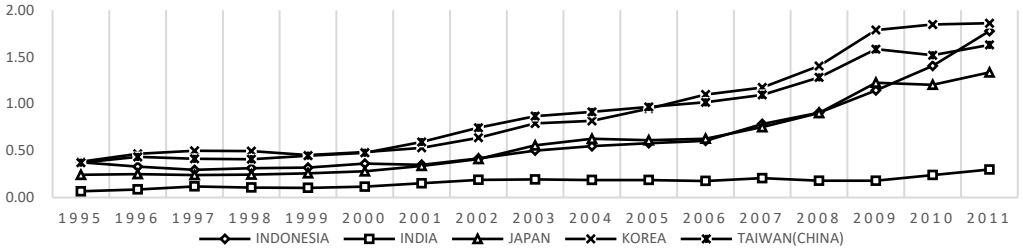

Figure 6 PI in Asian countries and regions

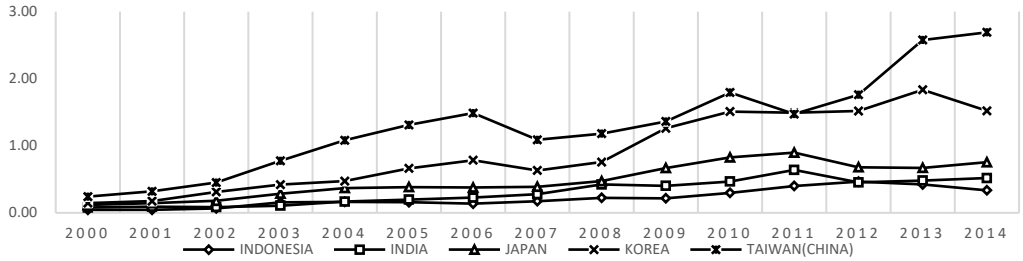

Figure 7 PIF in Asian countries and regions

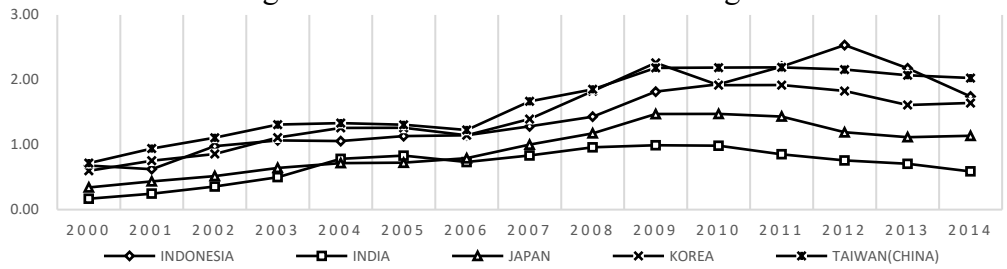

Figure 8 PII in Asian countries and regions

Chinese products have higher similarity with neighboring countries and regions than Japanese products. Figure 9 shows the trade similarity between them. Export products from Asian countries and regions were highly similar, and thus raise fierce competition. China competed especially fiercely with Indonesia and India while Japan competed especially fiercely with Korea and Taiwan (China).

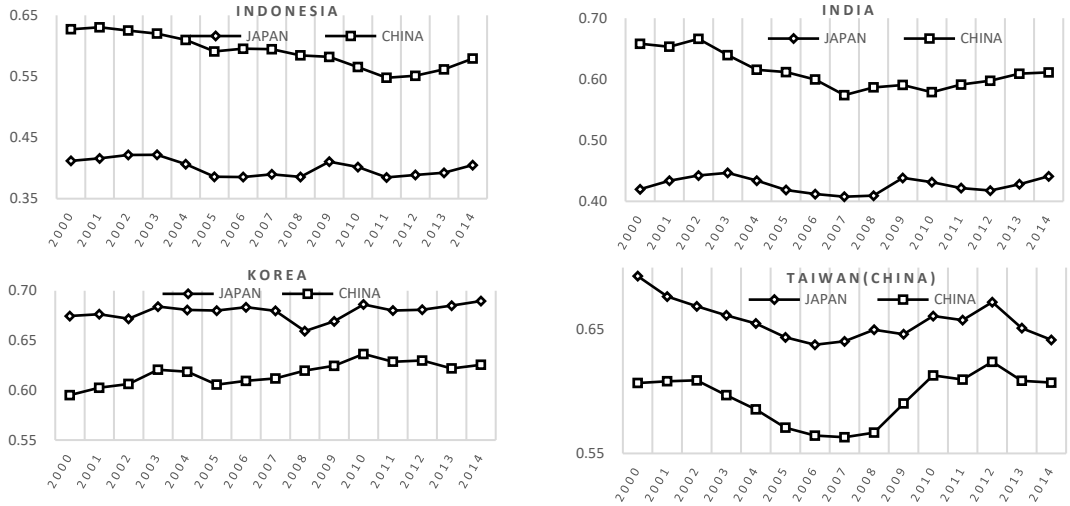

Figure 9 TS between Asian countries and regions and China/Japan

5. Conclusion

In terms of globalization and regionalization, major Asian countries and regions are increasingly involved into the globalization mainly due to the closer connection with extra-region economies. Although the inter-regional connection was weaker than the extra-regional connection, the inter-

regional connection has already strengthened after the crisis. The regional cooperation is still low especially the final market cooperation with the sign of rising after the global crisis.

The degree of production integration is relatively high in the region, not inferior to that in Europe and America. However, the degree of production integration varies among economies, and value added of products mainly comes from extra-regional economies. The region mainly located in the downstream of global value chain, and the level of participation in the upstream value chain is constantly improving.

China, Japan and the US played different role in the region. China's position in the value chain has improved significantly, but in the sample period, its position is far away behind Japan. China has much more similar export product structure with other regional countries and regions than Japan. The US is still the major consumer for final products and the market role rise after global crisis. Also, China plays an increasing important role as the final market provider.

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