

# RESEARCH ON DIVISION OF LABOR OF CHINA'S DOMESTIC VALUE CHAIN FROM THE GLOBAL VALUE CHAIN PERSPECTIVE

---

SHANTONG LI, JIANWU HE

Development Research Center, the State Council, China

## Introduction

With the development of infrastructure and information and communication technology, the global division of labor has deepened. It developed gradually from the separation of production and consumption to inter-industry and intra-industry, and further to the current intra-product division of labor or the division of production. From the early division within a smaller region to the present division among different countries, more and more enterprises have been engaged in investment, production, and trade activities on a global scale. At present, about 80 % of global trade is transnational trade (UNCTAD, 2013).

At the same time, with the development of regional integration and the continuation of all-around “opening up”, the economic ties between different regions within a country and between domestic regions and foreign countries are becoming closer and closer. From 1987 to 2007, the average inter-provincial trade dependence in the domestic provinces increased by nearly 20 percentage points, and the economic and trade links between the provinces were continuously strengthened (Zhang, 2013). What's more, the export proportion of the central and western regions in total in the country rose from 6.7 % in 2002 to more than 13 % in 2016 from January to August. The economic development of any region within a country depends not only on its own domestic environment, but even more so on its role and status in the entire global production network. So, we need to understand regional economic development from the perspective of the global value chain. There is a high degree of heterogeneity between regions in China, so research in

the regional level has a stronger practical significance to promote the transformation of China's economy.

In recent years, the gradual emergence of trade in value-added measurement and decomposition methods based on the input-output model is providing a new set of theoretical systems for the study of the global value chain. It is also changing people's understanding of economic ties between countries based on traditional balance of payments and trade statistics. Based on this theoretical background, this paper attempts to construct the fusion analysis framework of the domestic value chain and the global value chain by embedding the domestic regional input-output table in the global input-output table. This is based on the value-added trade calculation and decomposition framework proposed by Wang, Wei, & Zhu (2015) in order to solve the current problem of fracture analysis for the domestic value chain and the global value chain. The specific research arrangements in this paper are as follows: in the second section, we will comb the current literature on the domestic value chain based on the input-output model and find out the shortcomings of the current research; in the third section we introduce the methods and analysis framework adopted in this study; the fourth section will analyze the trade pattern, value chain participation, and industry competitiveness; and finally, we end with the corresponding research conclusions.

## 1. Literature

At present, there have been many studies about research methods for the value chain division of labor and global value chain, such as (Yi, 2003), KWW method (Koopman, Wang, & Wei, 2010; 2014), WWZ method (Wang, Wei, & Zhu, 2015); the related literature has also been reviewed quite a lot, such as (Pan & Li, 2014). For the purposes of this paper, we will focus on combing the literature about domestic value chain based on input-output model.

For a long time, due to the lack of data on economic ties inside each province and between provinces, the study of the domestic value chain division of labor relied mainly on national or single region input-output tables. For example Chai & Yang (2011) proposed a new framework for analyzing the interrelationship between the domestic value chain and the global value chain of high-tech industries based on the non-competitive input-output model. Using the input-output tables and industry-level data of Guangdong Province and Jiangsu Province in 1997, 2002 and 2007, Zhang & Li (2013) established a simultaneous equation model and found that there is a negative correlation between the

domestic value chain and the global value chain, and that the domestic value chain has not successfully joined the global value chain.

As Wang, Wei, & Zhu (2015) proposed the global value chain research method based on input-output tables, some scholars began to apply this approach to the study of the domestic value chain. Meng, Wang, & Koopman (2013) embedded the domestic input and output table of eight districts into the global input-output table, studied the global division of labor and the links among different domestic regions on the basis of the KWW method, and analyzed how value added is distributed between domestic and international. Su (2016) considered the domestic value chain on the basis of the global value chain and decomposed the export value added of domestic regions. He had three major findings: 1) the level of economic development and the local share of the value added and the international vertical and professional share have respectively strong negative correlation and positive correlation; 2) the low local value-added ratio of China's exports is mainly due to the low ratio of value added export in gross value export of the manufacturing sector in the coastal provinces; and 3) the degree of export specialization measured by the value added export is lower than that measured by the gross value export. Based on China's interregional input-output tables, Li & Pan (2016) carried out the value-added decomposition of domestic interregional trade from the perspective of value added flow, and explored patterns of the Chinese regions embedded in the global value chain from three dimensions – vertical professional production, value added supply preferences, and the regional re-outflow. The study shows that the production of domestic regions is gradually turning from internal vertical specialization to external vertical specialization in 1997 to 2007. There is an obvious preference adjacent to the “polarity” value added supply in the inland area, and the pure repetition ratio of value added in China's regions expectedly rose after joining the WTO.

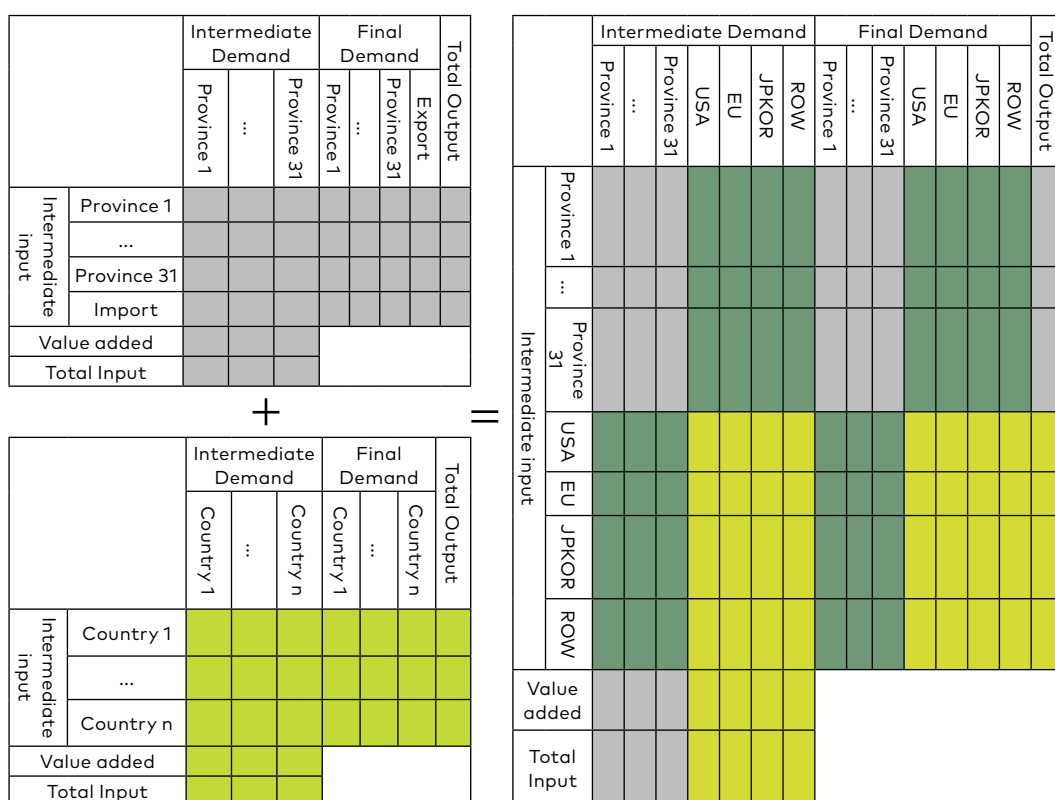
Although there are current studies on provincial value added and inter-provincial value added trade, the existing research is either the decomposition of the value added export in each province (Su, 2016), or the decomposition of inter-provincial trade value added and domestic vertical division of labor (Li & Pan, 2016). There is not any study combining these two aspects. This paper attempts to embed China's regional (provincial) input-output tables into the global input-output table and build a global input-output model containing China's inter-provincial input-output modules, which makes it convenient for us to analyze the domestic value chain from the global value chain perspective. Using this model, we start the analysis of different regions involved in the global division of labor and domestic division of labor from the perspective of the global value chain and the domestic value chain.

## 2. Methodology, data source and decomposition examples

This paper will follow the WWZ approach (Wang, Wei, & Zhu, 2015). In order to analyze the domestic value chain, this study expands it in two aspects, which is also the biggest difference between this study and the current decomposition methods of domestic provincial export value and domestic interregional trade value.

### 2.1. Constructing a global input-output table embedded with China's domestic input-output tables

Figure 1 shows the way to build and form a global input-output table embedded with China's domestic inter-provincial input-output tables. Specifically, a multiregional input-output table containing 30 provinces (cities, districts) in China is grafted together with a global input-output table containing China and other countries and regions. Domestic



**Fig. 1.** The Global input-output table embedded with China's domestic inter-provincial input-output tables.

provinces and international countries and regions are all seen as a separate area. The resulting global input-output table contains both economic ties among provinces and economic ties among countries, as well as economic links between different provinces and different countries and regions.

This method of grafting is based on the initial global input-output table as a control to adjust the domestic multiregional input-output table, making the industry output and import and export in the domestic multiregional input-output table consistent with China-related data in the global input-output table. See Meng, Wang, & Koopman (2013) for specific practices.

We will mainly use three types of data – the 2007 multiregional input-output table constructed by the State Council Development Research Center and the National Bureau of Statistics, the 2007 global input-output table from WIOD, and the import and export data of each province of China with different trade objects.

For the sake of analysis, this paper merges the 43 regions of WIOD's global input-output table into five countries and regions, namely, China, the United States, the European Union, Japan-South Korea (including Japan and Korea) and other countries and regions. At the same time, in order to make China's input-output table correspond to the WIOD industry, this article will merge their respective industries into 14 departments, including agriculture, extractive industries, food, textile and garment, petrochemical, building materials, metal smelting and products industry, equipment manufacturing, electrical and electronic and instrumentation, other manufacturing, electrical water, construction, production and distribution services and other services.

## 2.2. Constructing a unified framework of value added decomposition of foreign trade of the domestic provinces from global perspective

WWZ approach (Wang, Wei, & Zhu, 2015) divides exports into four parts (the domestic value added absorbed abroad, the domestic value added first exported then returned home, the foreign value added, and the purely double-counting term) and 16 items, as follows :

$$E^{sr} = A^{sr} X^r + Y^{sr} =$$

$$= (V^s B^{ss})' \# Y^{sr} + \quad (1.1)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rr} Y^{rr}) + \quad (1.2)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rt} Y^{tt}) + \quad (1.3)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rr} Y^{rt}) + \quad (1.4)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rt} Y^{tr}) + \quad (1.5)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rr} Y^{rs}) + \quad (1.6)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rt} Y^{ts}) + \quad (1.7)$$

$$+ (V^s L^{ss})' \# (A^{sr} B^{rs} Y^{ss}) + \quad (1.8)$$

$$+ (V^s L^{ss})' \# [A^{sr} B^{rs} (Y^{sr} + Y^{st})] + \quad (1.9)$$

$$+ (V^s B^{ss} - V^s L^{ss})' \# (A^{sr} X^r) + \quad (1.10)$$

$$+ (V^{rr} B^{rs})' \# Y^{sr} + \quad (1.11)$$

$$+ (V^{rr} B^{rs})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (1.12)$$

$$+ (V^{rr} B^{rs})' \# (A^{sr} L^{rr} E^r) + \quad (1.13)$$

$$+ (V^t B^{ts})' \# Y^{sr} + \quad (1.14)$$

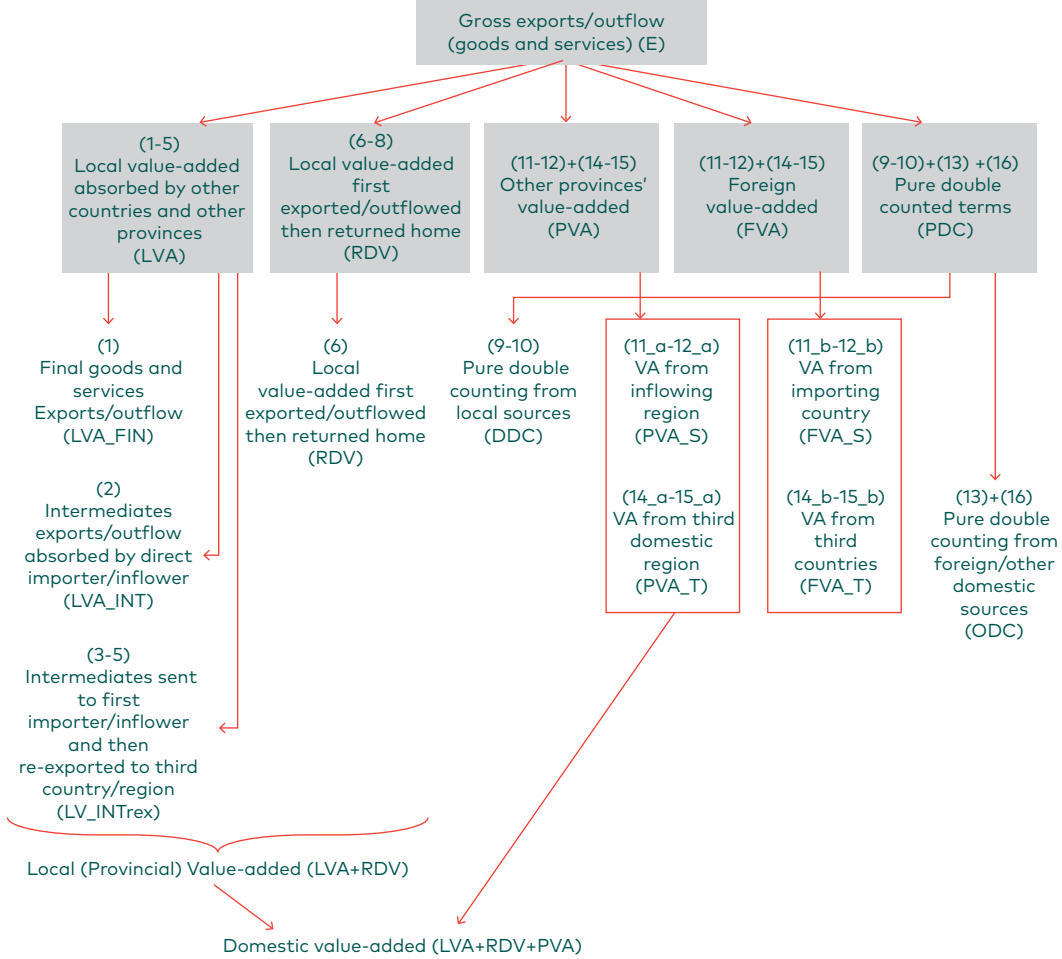
$$+ (V^t B^{ts})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (1.15)$$

$$+ (V^t B^{ts})' \# (A^{sr} L^{rr} E^r) \quad (1.16)$$

where  $E^{sr}$  is the vector of Country  $s'$  gross exports to country  $r$ ;  $V^s$  is the vector of direct value-added coefficients of Country  $s$ ;  $A$  is the input-output coefficient matrix; and  $B$  denotes the Leontief (global) inverse matrix;  $X$  is the gross output vector;  $Y^{sr}$  is the vector of final goods produced in  $s$  and consumed in  $r$ ;  $L$  is the local Leontief inverse matrix, and  $E^s$  is the vector of total gross exports by Country  $s$ .

Based on the previously constructed global input-output table, this study expands the WWZ approach (see Fig. 2). When we treat China as a whole, the trade objects can only be foreign countries and regions, and at the same time third parties can also be only foreign countries and regions. However, when we treat provinces as research objects, the trade objects can either be foreign countries and regions (international export) or other domestic provinces (inter-provincial export). Additionally, the relevant third parties include not only other countries and regions abroad, but also other domestic provinces.

Therefore, this study will decompose the foreign trade of each province (including international export and inter-provincial export) into four parts, namely, the value added of one province, the value added in other provinces, the foreign value added, and the repeated calculation part. Specifically, the third party in the WWZ method is divided into the domestic third party and the foreign third party. Based on this division, the 16 items of decomposition in the WWZ method can be further extended to 20 items. According to the trade object, we divide the eleventh item and the twelfth item into the value added in other provinces and the foreign value added; according to the third party, we



**Fig. 2.** Decomposition of international export / inter-provincial outflow of domestic provinces. (Source: Adjusted based on Wang, Wei, & Zhu (2015))

divide the fourteenth item and the fifteenth item into other provinces in the country value added and foreign value added:

$$E^{SP} = (V^S B^{SS})' \# Y^{SP} = \quad (2.1)$$

$$+ (V^S L^{SS})' \# (A^{SP} B^{rr} Y^{rr}) + \quad (2.2)$$

$$+ (V^S L^{SS})' \# (A^{SP} B^{rt} Y^{rt}) + \quad (2.3)$$

$$+ (V^S L^{SS})' \# (A^{SP} B^{rr} Y^{rt}) + \quad (2.4)$$

$$+ (V^S L^{SS})' \# (A^{SP} B^{rt} Y^{tr}) + \quad (2.5)$$

$$+ (V^S L^{SS})' \# (A^{SP} B^{rr} Y^{rs}) + \quad (2.6)$$

$$+ (V^S L^{SS})' \# (A^{sr} B^{rr} Y^{ts}) + \quad (2.7)$$

$$+ (V^S L^{SS})' \# (A^{sr} B^{rs} Y^{ss}) + \quad (2.8)$$

$$+ (V^S L^{SS})' \# [A^{sr} B^{rs} (Y^{sr} + Y^{st})] + \quad (2.9)$$

$$+ (V^S B^{SS} - V^S L^{SS})' \# (A^{sr} X^r) + \quad (2.10)$$

$$+ (V^r B^{rs})' \# Y^{sr} + \quad (2.11\_a) \text{ if } r \text{ is other domestic province}$$

$$+ (V^r B^{rs})' \# Y^{sr} + \quad (2.11\_b) \text{ if } r \text{ is other country}$$

$$+ (V^r B^{rs})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (2.12\_a) \text{ if } r \text{ is other domestic province}$$

$$+ (V^r B^{rs})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (2.12\_b) \text{ if } r \text{ is other country}$$

$$+ (V^r B^{rs})' \# (A^{sr} L^r E^r) + \quad (2.13)$$

$$+ (\sum_{t \in D} V^t B^{ts})' \# Y^{sr} + \quad (2.14\_a) \text{ D includes all other domestic provinces}$$

$$+ (\sum_{t \in F} V^t B^{ts})' \# Y^{sr} + \quad (2.14\_b) \text{ F includes all other countries}$$

$$+ (\sum_{t \in D} V^t B^{ts})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (2.15\_a) \text{ D includes all other domestic provinces}$$

$$+ (\sum_{t \in F} V^t B^{ts})' \# (A^{sr} L^{rr} Y^{rr}) + \quad (2.15\_b) \text{ F includes all other countries}$$

$$+ (V^t B^{ts})' \# (A^{sr} L^{rr} E^r) \quad (2.16)$$

What needs to be pointed out here is that  $E^{sr}$  can not only indicate the international export of one province to other countries, but also indicate the inter-provincial outflow between provinces within China. In addition, (2.11\_a), (2.11\_b), (2.12\_a) and (2.12\_b) do not appear in the decomposition of the four terms simultaneously. When  $r$  refers to other countries, only (2.11\_b) and (2.12\_b) will appear in the decomposition formula; when  $r$  refers to other province in China, only (2.11\_a) and (2.12\_a) will appear in the above formula.

On the basis of the previous decomposition, we follow the method of vertical specialization index proposed by Hummels et al. (1998; 2001). To reflect the degree of each domestic region participating in the global value chain and the domestic value chain, we respectively design  $VS\_GVC$  index and  $VS\_DVC$  index. The  $VS\_GVC$  measures the import value implied in exports of each province; the  $VS\_DVC$  measures the inter-provincial import value implied in inter-provincial exports of each province. The specific formulas are as follows:

$$VS\_GVC = \frac{FVA + PDC}{E}; \quad (3)$$

$$VS\_DVC = \frac{PVA + PDC}{DE}. \quad (4)$$

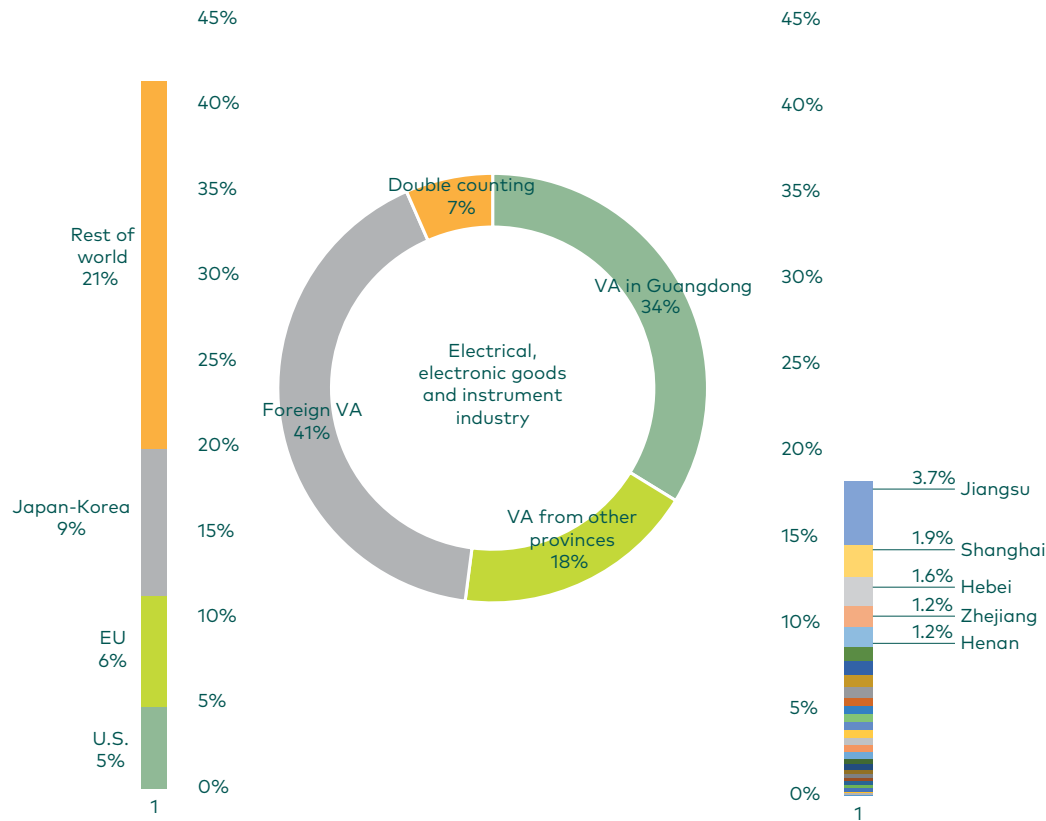
Hereinto,  $FVA$  and  $PDC$ , respectively, mean the foreign value added contained in exports of one province and the repeated calculation part

due to the intermediate trade. *PVA* represents the value added of other domestic provinces included in inter-provincial exports.

2.3. A decomposition example based on the new decomposition framework

In order to better demonstrate this new method of decomposition, we first take the decomposition for Guangdong's export of electrical, electronic, and instrumental goods to the US as an example of the method of value chain decomposition and the calculation of the vertical specialization index.

Figure 3 shows the decomposition for Guangdong's exports of the electric, electronics, and instrument industry to the United States. There are three parts in this figure. First, the middle portion shows the main content of decomposition. The export of Guangdong's electrical &



**Fig. 3.** GVC decomposition for Guangdong electrical & electronic goods exported to the U.S., %.

electronic goods is divided into four components: local value added (in Guangdong), foreign value added (international value added), value added from other provinces (domestic value added, excl. Guangdong), and double counting. Looking at the decomposition results, the largest component in Guangdong's export is foreign value added, accounting for 41 % of total exports; the second largest component is value added of Guangdong itself, accounting for 34 % of total exports; other domestic provinces get 18 % of value added from Guangdong's export; the remaining 7 % is double counting. According to the calculation, Guangdong's vertical specialization index in the electrical & electronic industry (export to the U.S.) reaches 48 %.

Secondly, the left portion shows the detail of the international value added in Guangdong's export. The EU, Japan-South Korea, and the United States account for half of the total Guangdong's export value added, and other countries and regions get the remaining half. Japan and South Korea account for 9 % of value added in the total of Guangdong's exports, which is related to a large number of Sino-Japanese and Sino-Korean intermediate trade. The EU and USA get 6 % and 5 % of value added in the total Guangdong's exports, respectively.

Finally, the right portion shows the value added of other provinces of the country. This shows that the proportion of the Yangtze River Delta region is the highest. More than 1/3 of the domestic value added is obtained by the Yangtze River Delta region. As for each province, the largest beneficiary is Jiangsu, which accounts for 1/5 of all domestic value added of other provinces.

### 3. Main results

#### 3.1. The participation degree of each province in the global value chain

Figure 4 shows the vertical specialization indices of each province participating in the global value chain. From the space point of view, the main features are as follows.

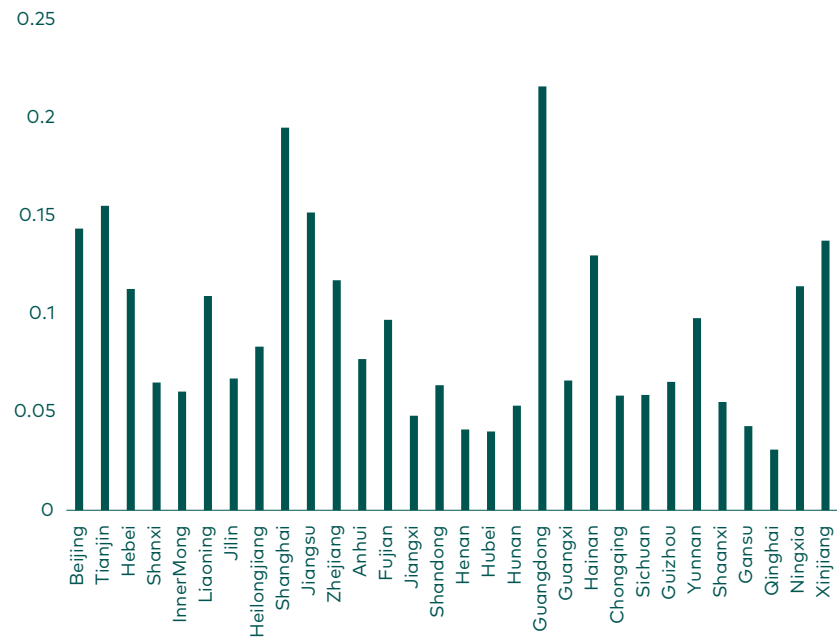
- (1) The degree of coastal and border provinces participating in the global value chain is significantly higher than that of the inland provinces.

From Fig. 4, both the developed southeastern coastal areas, and the northeast and northwest regions have higher vertical specialization indices of export than inland provinces. On average, the vertical specialization indices of the coastal and border areas are about 10 percentage points higher than those of the inland provinces in international trade. To a certain extent, this proves the importance of

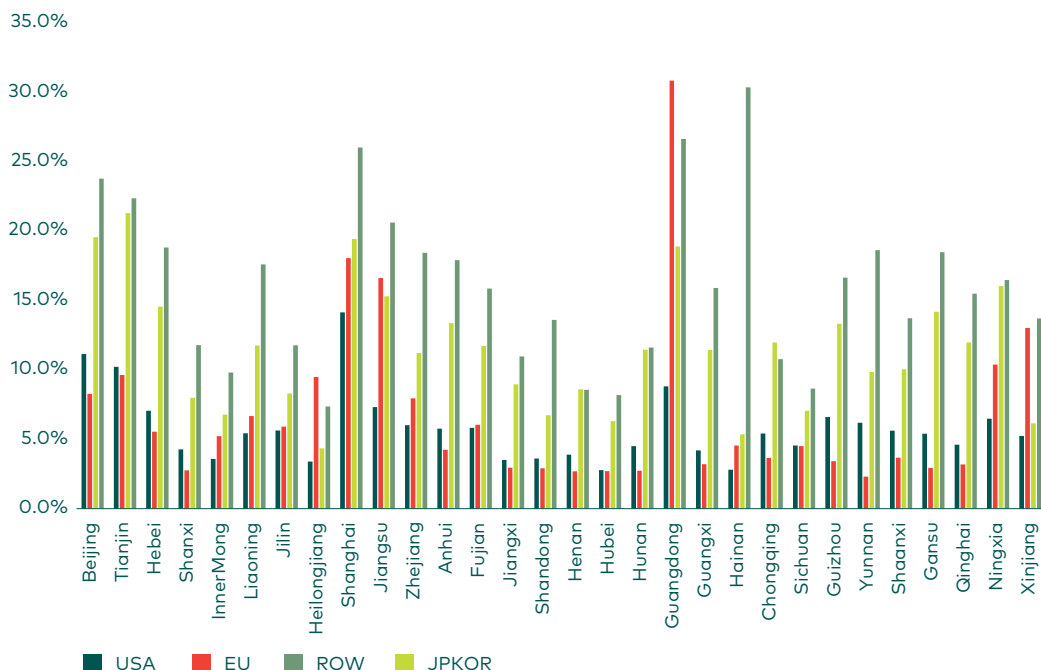
location advantages in international trade. This also explains why the world economy has concentrated in coastal port areas for a long time. However, there are significant differences within the coastal provinces, for example Shandong's vertical specialization index is lower than of other coastal provinces.

(2) The vertical specialization index of three growth poles of the global value chain in the national leading level.

From the results of the calculation, the vertical specialization indices of the three growth poles – the Pearl River Delta, the Yangtze River Delta and Beijing-Tianjin-Hebei are significantly higher than those in other regions in the global value chain. The vertical specialization index of the Pearl River Delta is the most prominent. Further, Guangdong Province owns the highest vertical professional index, reaching 21.6 %. The second is the Yangtze River Delta region that has an average index of about 15 % and in which Shanghai has the highest index, close to 20 %. Zhejiang has the lowest index, which has something to do with its industrial structure. The third is the Beijing-Tianjin-Hebei region that has an average index of about 14 % in which Hebei has the lowest index.



**Fig. 4.** Vertical specialization indices of each provinces in the global value chain.



**Fig. 5.** VS indices of each province with different export objects, %.

- (3) The vertical specialization index of areas close to coastal provinces is higher than the one of areas far away from the coastal areas in the global value chain.

In terms of calculation results, the participation degree of inland provinces bordering the coastal provinces in the global value chain is significantly lower than that of coastal provinces, but slightly higher than of other provinces that are closer to the interior. For example vertical specialization indices of Anhui, Jiangxi's are higher than Hubei. This, to some extent, is relevant to the fact that the change in comparative advantage of the factor cost leads to the transfer of part of industries from the coastal area to the inland provinces.

- (4) For most provinces, the vertical specialization index of trade with Japan-South Korea is significantly higher than it is with Europe and the United States.

Figure 5 shows the vertical specialization (VS) indices of trade between each province and different trade objects (including EU, JPKOR, USA, and ROW). From the comparison of different trade objects, the VS value of each province is generally shown as  $USA < EU < JPKOR < ROW$ , that is, the more developed the country, the lower is the participation

degree of China in its value chain. This is related to the trade structure between China and these trade objects, as well as the division of labor network. The fact that the VS index of trade between China and Japan-South Korea is significantly higher than Europe and the U.S., reflects that the division of labor network of the intermediate input product value chain in East Asia is very developed.

3.2. Analysis of the participation degree of each province in the domestic value chain

Figure 6 shows the vertical specialization indices of each province participating in the domestic value chain. From the calculation results, the main features are as follows.

- (1) The vast majority of eastern coastal provinces are more involved in the domestic value chain.

Similar to the global value chain, the vast majority of the eastern coastal provinces are more involved in the domestic value chain. On average, the vertical specialization index of the eastern coastal areas in the domestic value chain is about 8 to 10 percentage points higher than of other regions.

- (2) The participation degree of three growth poles and their surrounding areas in the domestic value chain is relatively high.

From the calculation results, another significant feature of the space is that the three major growth poles – the Pearl River Delta, the Yangtze

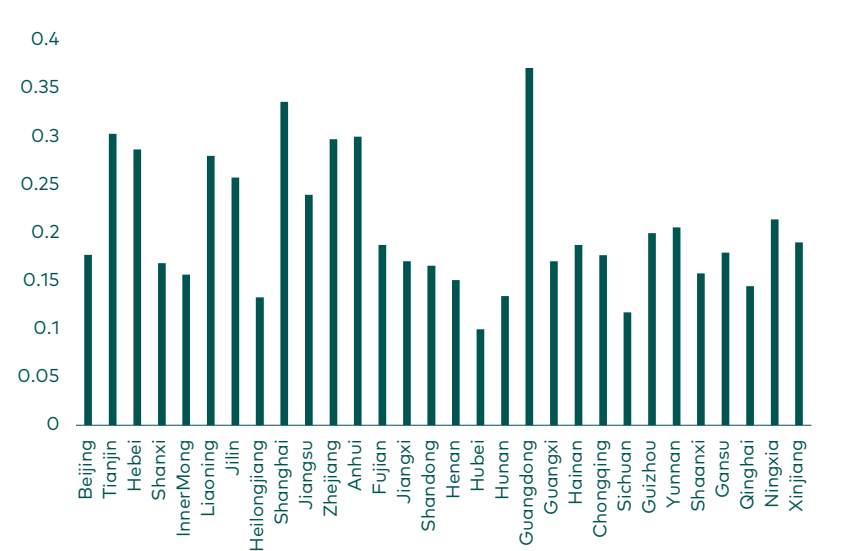


Fig. 6. Participation degree of each province in the domestic value chain.

River Delta and Beijing-Tianjin-Hebei and their surrounding areas in the domestic value chain have relatively high vertical specialization indices. The vertical specialization indices of Shanghai, Jiangsu, Zhejiang in Yangtze River Delta and its surrounding Anhui are relatively high. In particular, the vertical specialization index of Anhui has been basically the same with the Yangtze River Delta; the vertical specialization indices of the Pearl River Delta and its surrounding provinces, Guangxi, Jiangxi and other places are also relatively high. At the same time, the vertical specialization indices of Beijing-Tianjin-Hebei and its surrounding provinces in northern China are also relatively high, especially Tianjin and Hebei, reaching about 30 %. This phenomenon shows that the radiation and driving function of the three growth poles in the domestic economy has been revealed.

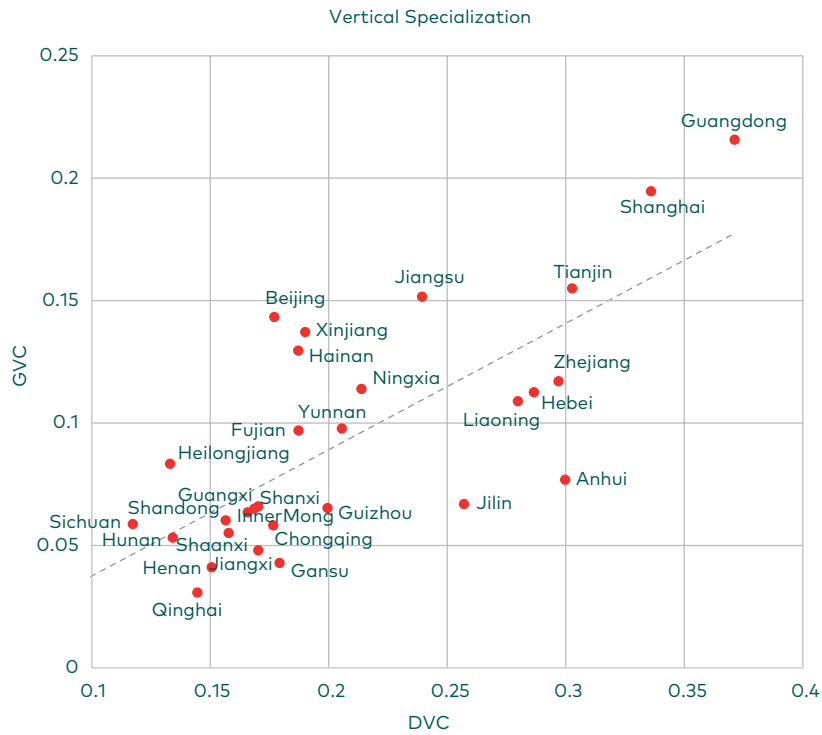
(3) The participation degree of the Northeast in the domestic value chain is also very high.

On the map, there is a more prominent area – Northeast China. Except Heilongjiang in Northeast China, the vertical specialization indices of Jilin and Liaoning in the domestic value chain are very high, reaching about 30 %.

This has a lot to do with its industrial structure. Northeast China is the old industrial base. Its equipment manufacturing industry has a higher proportion in the manufacturing industry, and the VS indices of these downstream industries are higher than the upstream industries. So, the overall VS of Northeast China is relatively high. This also explains why the vertical specialization index in Heilongjiang is not high, mainly because agriculture-related industries and oil-related industries own a higher proportion in Heilongjiang.

### 3.3 Comparison between GVC vertical specialization index and DVC vertical specialization index

By comparing *GVC* and *DVC*, it can be seen that the *DVC* value of each province is higher than that of the *GVC*, which indicates that the participation degree of each province in the domestic value chain is higher than in the global value chain. In order to more intuitively reflect the relationship between the global value chain and the domestic value chain, Fig. 7 shows the scatter plot and the fitting curve. It can be seen from the figure that China's domestic value chain and global value chain have a strong positive correlation, and the fitting degree is relatively high. However, different provinces also show different characteristics. Specifically, Guangdong, Shanghai and Tianjin have a relatively high participation degree both in the domestic value chain and the global value chain; Sichuan, Hunan, Inner Mongolia, Shanxi and other central and western regions have

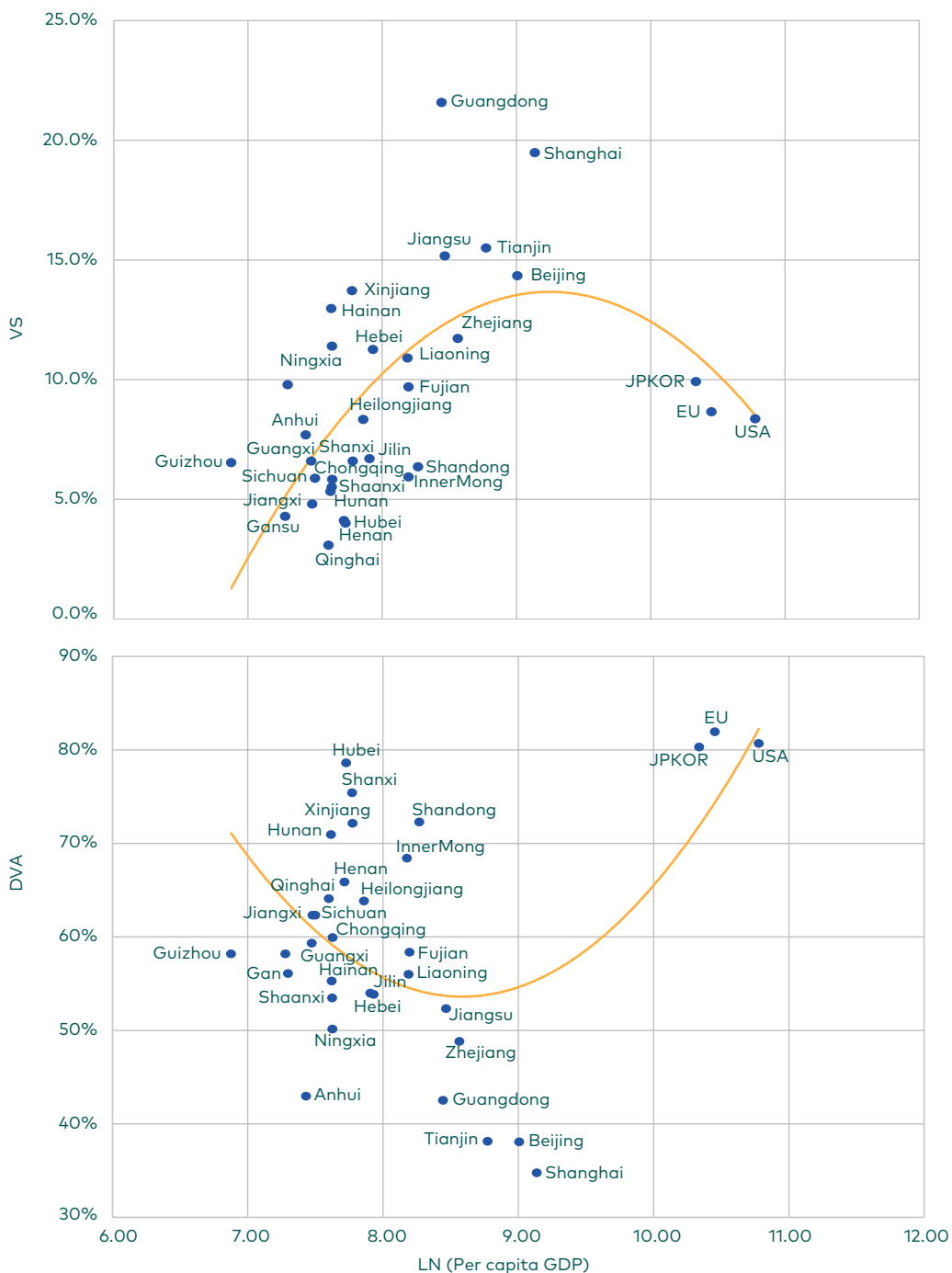


**Fig. 7.** Relationship between GVC and DVC.

relatively high participation both in the global value chain and the domestic value chain; and Beijing, Xinjiang, Hainan and Jiangsu have a relatively high participation degree in the global value chain but a low participation degree in the domestic value chain. Otherwise, Gansu, Anhui and Jilin have a relatively high participation degree in the domestic value chain but low participation degree in the global value chain.

**3.4. The domestic and international comparison of vertical specialization index**

In order to explore the possible law of value chain division of labor, we compare the vertical specialization index of domestic regions participating in the value chain and that of other countries and regions. Because there are no vertical specialization indices of different regions within a foreign country, we can only compare vertical specialization indices of domestic provinces participating in the global value chain and those of other countries or economies. Figure 8 shows the scatter plot of vertical



**Fig. 8.** Relationship between per capita GDP and VS/LVA index.

specialization indices of domestic provinces and the EU, Japan-South Korea and the United States participating in the global value chain and the level of development. By contrast, the following stylized facts can be observed.

- (1) There is an “inverted U” type relationship between the vertical specialization index and the level of development.

The explanation for this phenomenon is that countries with low levels of economic development usually export agricultural products, minerals, and primary products that do not require too much processing and therefore do not require imports of intermediate inputs. Thus, its vertical specialization index is relatively low, but its exports own a high proportion of its value added. With the advancement of the industrialization process, the industry needs to be upgraded, and the economy needs to participate more and more in the global division of labor to better organize their own production activities and better play the role of economies of scale. Thus, with continuous improvement at the developmental level, the vertical specialization index in the global value chain is also rising. With the increasing capacity of division of labor in the industrial chain, it will gradually upgrade to the high-end value chain and high-end links of the value chain. Because these parts have strong monopoly characteristics and share more value in the value chain, the share of intermediate input in the cost shows a significant decline. Its industry value-added rate continues to increase, and thus the vertical specialization index begins to decline again.

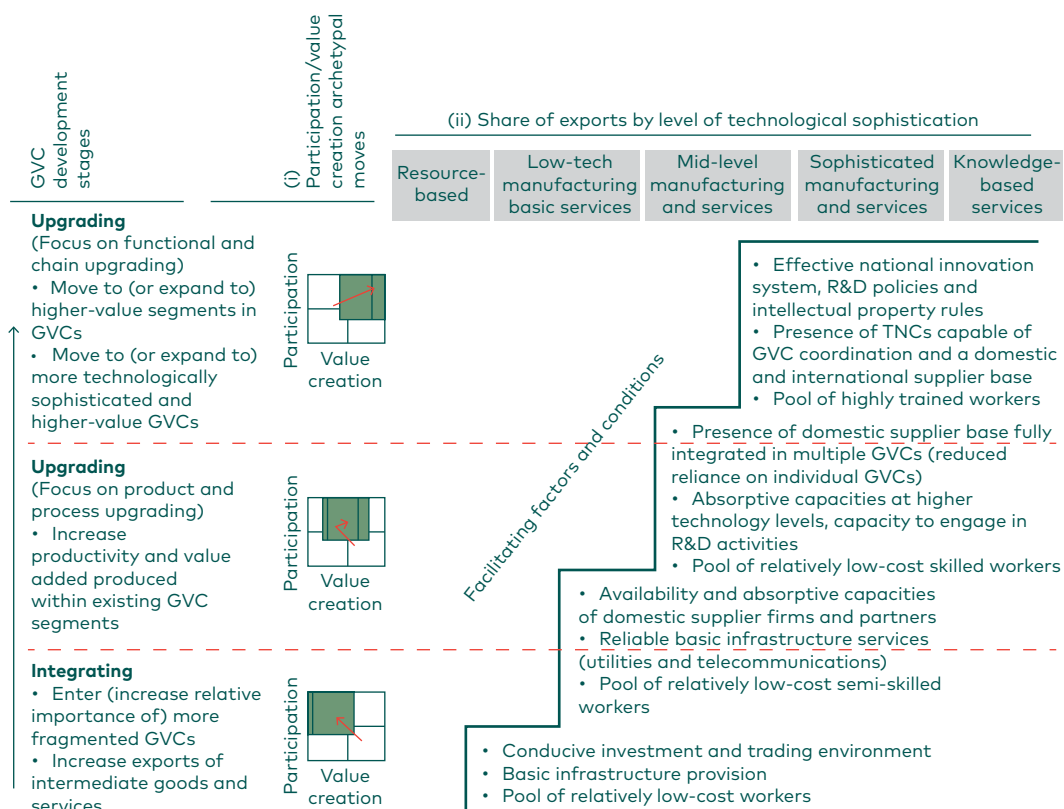
- (2) There is a positive correlation between the level of economic development of different regions in China and the vertical specialization index in the global value chain.

Comparing the vertical specialization indices of different provinces in the country participating in the global value chain, we find that the higher the participation degree in the global value chain, the higher is the level of economic development; and the lower the level of economic development, the lower is the vertical specialization index.

- (3) The vertical specialization indices of many central and western provinces participating in the global value chain are significantly lower than the current level of developed countries.

As can be seen from the figure, the vertical specialization indices of many current central and western provinces to participate in the global value chain are significantly lower than the current level of developed countries. For these regions, there is significant room for improvement of the participation degree in the global division of labor, both compared to the developed countries and domestic developed regions.

- (4) The vertical specialization indices of part of the eastern provinces participating in the global value chain have been far higher than those of the developed countries.



**Fig. 9.** Channels of value chain upgrading. (Source: UNCTAD analysis)

From the data shown in the figure, the vertical specialization indices of part of the eastern provinces have been much higher than of the EU, the United States, and Japan-South Korea. This, to some extent, indicates that these areas are different from the central and western provinces, and should transit towards the developed countries and increase the proportion of value added in the global value chain exports.

These stylized facts are consistent with the direction of the industry chain that the United Nations Conference on Trade and Development (UNCTAD) has raised for different levels of development (see Fig. 9). According to the study of UNCTAD (UNCTAD, 2013), for backward areas, its main task is to increase the participation degree in the value chain but not the proportion of value added. However, for areas with a relatively high participation degree, the main task is to upgrade the production process and work towards a more complex value chain.

## Conclusions and implications

By constructing an international input-output model, which includes the domestic inter-provincial input-output model, and using methods of value-added trade calculation, this paper analyzes the status of different regions participating in the global value chain and domestic value chain. It summarizes the relevant stylized facts by comparing the domestic and international vertical specialization indices. According to these analyses, we get the following conclusions and inspirations.

- (1) Since the reform and opening up, China's regional division of labor has formed a pattern similar to "dumbbell-shaped". In the process of participating in the global value chain, regional factor endowments and location conditions have led to a "dumbbell-shaped" docking model in which both the East and the West have a higher degree of participation. On the one hand, the eastern coastal areas develop foreign trade (especially processing trade) and import a large number of foreign intermediate inputs, and directly connect the domestic value chain to the global value chain. The vertical specialization indices of the eastern coastal areas participating in the global value chain are significantly higher than of the inland areas. On the other hand, the inland western regions own abundant energy and raw materials and provide these at low cost for the processing trade of the eastern regions.
- (2) The radiation and driving function of three growth poles on the surrounding areas is very obvious. The spatial characteristics of the domestic value chain participation show that the degree of neighboring provinces of the Yangtze River Delta, the Pearl River Delta and the Beijing-Tianjin-Hebei participating in the domestic value chain is significantly higher than of other provinces. In the future, it is necessary to further enhance the inter-provincial connectivity, radiation, and driving function of the three growth poles.
- (3) The relationship between vertical specialization index and the level of development is the "inverted U" type. Regions with relatively backward economic development are also less involved in *GVC*. With the vertical specialization index continually rising, its level of development is also continually rising. However, with the increasing level of development, the vertical specialization index shows a downward trend. The enlightenment of the evolution mechanism to China's regional economic development is that the less developed areas need to enhance participation

of the value chain. Additionally, those areas with a higher participation degree need to pay more attention to production technology and process upgrading, in hopes of upgrading to more complex value chain, rather than continuing to focus on the participation degree.

## REFERENCES

- Chai B. & Yang G. (2011). The interaction between global value chain and national value chain of advanced technology industry: analysis basing on non-competitive input-output model. *Studies in Science of Science*, 4, 533–540
- Cheng, D. (2015). China's Integration into the Global Value Chains: A Transnational Input-output Analysis. *Economic Research Journal*, 9, 4–16.
- Hummels, D. & Rappaport, D. (1998). Vertical Specialization and Changing Nature of World Trade. *Federal Reserve Bank of New York Economic Policy Review*, 4(2), 189–205.
- Hummels, D., Ishii, J., & Yi, K. M. (2001). The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*, 54, 75–96.
- Humphrey, J. & Schmitz, H. (2002), Governance and Upgrading: Linking Industrial Cluster and Global Value Chains Research. *IDS Working Paper*, No. 12, Institute of Development Studies University of Sussex.
- Humphrey, J. & Schmitz, H. (2002), How Does Insertion in Global Value Chains Affect Upgrading in Industrial Clusters. *Regional Studies*, 36(9), 1017–1027.
- Kaplinsky, R. & Readman, J. (2001). *Integrating SMEs in Global Value Chains: Towards Partnership for Development*. UNIDO.
- Koopman, R., Wang, Z. & Wei, S. J. (2012). Estimating domestic content in exports when processing trade is pervasive. *Journal of Development Economics*, 99(1), 178–189.
- Koopman, R., Wang, Z. & Wei, S. J. (2014). Tracing Value-added and Double Counting in Gross Exports. *American Economic Review*, 104(2), 459–494.
- Krugman, P. (1994). A Technology Gap Model of International Trade. In Krugman P. (ed.), *Rethinking International Trade*, MIT Press.
- Li, G. & Pan, W. (2016). How do Domestic Value Chains Embed into Global Value Chains? Perspective from Value Added. *Management World*, 7, 10–22.
- Liu, Z. & Zhao, Y. (2014). The Dependence of East Asia in Global Value Chains Network An Empirical Analysis Based on TiVA Database. *Nankai Economic Studies*, 5, 115–129.
- Meng, B., Wang, Z. & Koopman R. (2013). How are Global Value Chains Fragmented and Extended in China's Domestic Production Networks?. *IDE Discussion Papers*, No. 424.
- Pan, W. & Li, G. (2014). Vertical Specialization, Value-added in Trade and Trade in Value-added Accounting: A Review on the Inter-Region Input-output

- Model under the Background of Global Value Chains. *China Journal of Economics*, 4, 188–207.
- Su, Q. (2016). Tracing Value Added in China's Exports at the Provincial Level. *Economic Research Journal*, 1, 84–98.
- UNCTAD (2013). *Global Investment Report 2013*. <http://unctad.org/en/>
- Wang, Z., Wei, S., & Zhu, K. (2015). Total Trade Accounting: Official Trade Statistics and Global Value Chain Measurement. *Social Sciences in China*, 9, 108–127.
- WTO & IDE-JETRO (2011). *Trade Patterns and Global Value Chains in East Asia From Trade in Goods to Trade in Tasks*. World Trade Organization Geneva.
- Yi, K. M. (2003). Can Vertical Specialization Explain the Growth of World Trade?. *Journal of Political Economy*, University of Chicago Press, 111(1), 52–102.
- Zhang, S. & Li, S. (2013). Evolution Trend, Characteristics and Outlook of the Inter-provincial Trade in China: From 1987 to 2007. *Finance & Trade Economics*, 10, 100–107
- Zhang, S. & Liu, Z. (2013). Does the National Value Chain Associate with the Global Value Chain – Empirical Analysis Based on the Simultaneous Equation Model. *Journal of International Trade*, 2, 14–27.
- Zhang, S. (2009). Global Value Chain and National Value Chain-New Method Based on Input-output Table. *Journal of International Trade*, 4, 108–113
- Zhu W., Wei, S. J., & Zhu, K. (2013). Quantifying International Production Sharing at the Bilateral and Sector Levels. *NBER Working Paper* 19677, November.