Guangdong's Role in the Global Value Chain and Its Evolution
An Empirical Analysis Based on China's Interregional Input-Output Table

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Abstract. Guangdong is one of the earliest regions in China to be embedded in the global value chain (GVC). However, due to the large proportion of processing trade, Guangdong has a severe problem of "value chain capture". Based on the perspective of the value chain, this paper uses the value-added decomposition framework in non-competitive interregional input-output tables, to explore the role of Guangdong in the national value chain and the embedding condition of Guangdong into the global value chain. The significance lies principally in revealing Guangdong's evolution in the value chain, which sheds light on Guangdong's construction of strategic propellers for the New Development Paradigm.

Keywords: Guangdong · Global Value Chain · National Value Chain · Value-added Decomposition Framework

1 Introduction

Guangdong, as a "frontier position" in China for opening to the outside world, adheres to the belief of "crossing the river by feeling the stones", and develops the foreign processing trade modes of "processing with supplied materials", "assembly with supplied materials", "processing with supplied samples" and "compensation trade", that is, the "three-plus-one" trading-mix, and which marks that Guangdong became one of the earliest Chinese regions embedded in the global value chain (GVC).

Although Guangdong is deeply embedded in GVC, the proportion of processing trade in the region's foreign trade is relatively large and Guangdong has a severe problem of "value chain capture". At present, most enterprises in the Pearl River Delta are still in the middle and low end of the international division of labour. With the rise of "trade protectionism", as the most apparent export-oriented characteristic, Guangdong urgently needs to improve the regional division of labour and cooperation under the national value chain (NVC) to promote coordinated innovation regional development. However, few literatures study the international specialization and regional cooperation

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in Guangdong under the dual background of economic globalization and regional economic integration. This paper is based on Koopman et al. (2014, hereinafter referred to as KWW), Wang et al. (2014, hereinafter referred to as WWZ) and Li and Pan (2016) input-output decomposition framework, which can accurately identify the circulation process of added value at home and abroad, conduct in-depth research on the development degree, development trajectory, and development characteristics of Guangdong's NVC and GVC. Thus, to clarify the development context of Guangdong in NVC and GVC is of great significance for Guangdong to optimize the layout of the value chain and improve production efficiency.

2 Methodology

2.1 Data

The database of this paper is the 2002 China Inter-regional Input-Output Table (China IRIO 2002) developed by Shi Minjun and the 2007, 2010 and 2012 China Inter-regional Input-Output Table (China IRIO 2007, 2010, 2012) developed by Chinese Academy of Sciences. Subject to data availability, this paper has data for 30 provinces (cities), including Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia, Liaoning, Jilin, Heilongjiang, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai and Ningxia.

2.2 Vertical Specialization Index

This paper follows the definition of vertical specialization by HIY (2001): the added value from other domestic regions or foreign countries included in the outflow of a specific region. According to the decomposition model of KWW (2014), Li and Pan (2016), it can be obtained that the region flows out of other regions in China (OVA) and foreign components (FC), representing the added value of other regions in China or abroad, and OF represents the total outflow of a region, therefore:

$$VSI = \frac{VS}{OF} = \frac{OVA}{OF} + \frac{FC}{OF} \tag{1}$$

2.3 NVC Cooperation Index

The degree of inter-regional value chain cooperation mainly measures the proportion of the added value of the importing countries or regions included in the added value flow between the two regions. According to the input-output analysis, IVA^{ij} can be seen that the added value from area i to area j that is finally absorbed in other regions and the added value from area i to area j that is finally absorbed in the original region can be seen as RIV^{ij}, which is expressed as:

$$V_i^j = (IVA^{ij} + RIV^{ij}),\ V_j^i = (IVA^{ji} + RIV^{ji}) \tag{2}$$

Thus, the degree of cooperation between region i and region j can be expressed as:

$$C^{ij} = C^{ji} = \frac{IVA^{ij} + RIV^{ij} + IVA^{ji} + RIV^{ji}}{OF^i + OF^j} \tag{3}$$

2.4 Value Chain Benefits

The value-added benefits from production activities in the China and the rest of the country are:

$$VR^i = \sum_{j=1}^{G} V^i B^{ij} (Y^j + E^j) \tag{4}$$

Therefore, the benefits brought by the value chain can be decomposed into domestic and foreign benefits as follows:

$$R_V = \frac{\sum_{j=1}^{G} V^i B^{ij} Y^j}{(Vu^{\mathrm{T}})^i} + \frac{\sum_{j=1}^{G} V^i B^{ij} E^j}{(Vu^{\mathrm{T}})^i} \tag{5}$$

3 Empirical Results

This part analyzes the status quo of Guangdong's evolution in the national value chain and global value chain, including the perspective of participation in the value chain, the perspective of regional cooperation in the national value chain and the perspective of value chain benefits.

3.1 Comparative Analysis of Guangdong's Participation in Global Value Chain and National Value Chain

Based on the vertical specialization index, this paper uses the KWW and WWZ input-output decomposition framework to eliminate double counting problems to measure the value chain participation, and longitudinally analyzes the changes of embeddedness in the time dimension, in order to investigate the role of Guangdong over time in the NVC and GVC. DVSI represents the domestic vertical specialization index. The higher the index, the deeper the global value chain embedding degree. FVSI represents the foreign vertical specialization index. The higher the index, the deeper the domestic value chain embedding degree. Through detailed analysis, Guangdong has the following two characteristics:

First, Guangdong presents a remarkable characteristic of export-oriented specialization. In general, the eastern coastal areas of the country are more deeply embedded in the GVC, such as the three major domestic economic regions, the Beijing-Tianjin-Hebei Region, Yangtze River Delta, and Pearl River Delta regions. Among them, Guangdong's

Table 1. Value chain embedding of major urban agglomerations in China.

		Beijing-Tianjin-Hebei	Yangtze River Delta	Guang-dong	Average
DVSI	*2002*	16.8%	15.3%	9.9%	13.8%
	2007	17.4%	16.4%	14.9%	13.2%
	2010	16.7%	18.2%	17.1%	12.5%
	2012	13.2%	17.1%	10.2%	13.7%
FVSI	*2002*	15.4%	21.2%	34.0%	11.3%
	2007	17.2%	22.8%	31.9%	13.1%
	2010	14.2%	18.0%	19.3%	12.8%
	2012	13.9%	16.9%	28.2%	9.6%
VSI	*2002*	32.2%	36.5%	43.9%	25.1%
	2007	34.5%	39.1%	46.8%	26.3%
	2010	30.9%	36.2%	36.4%	25.3%
	2012	27.1%	33.9%	38.4%	23.4%

export-oriented characteristics are particularly significant. During the four years of 2002, 2007, 2010 and 2012, the foreign vertical specialization index was 34.0%, 31.9%, 19.3%, and 28.29%, respectively. Although affected by the aftermath of the subprime mortgage crisis, the level of vertical specialization dropped sharply, but it gradually recovered to the high level in 2012. The above statement shows that Guangdong is deeply embedded in the GVC. The upstream and downstream links of the superimposed production value chain are all overseas, and the dependence is substantial. Therefore, Guangdong's foreign vertical specialization index is always higher than the domestic average (Table 1).

Second, Guangdong has a low degree of cooperation in the NVC. Guangdong's domestic vertical specialization index was 9.9%, 14.9%, 17.1%, and 10.2% in 2002, 2007, 2010, and 2012, respectively, which were generally lower than the levels of the Beijing-Tianjin-Hebei Region and Yangtze River Delta. In other words, Industrial production in Guangdong is more dependent on the transmission of foreign added value. The regional cooperation between Guangdong and other domestic regions is relatively low, so domestic vertical specialization is lower than that of eastern coastal provinces and cities. On the one hand, due to geographical and historical factors, the Beijing-Tianjin-Hebei Region and the Yangtze River Delta region are located on open and flat plains and have been the hub of inland water transportation since ancient times. Although the Pearl River Delta region in China has a good foundation for connecting the global value chain, it lacks good domestic cooperation conditions, so it is difficult to radiate beyond the Pearl River Delta region. On the other hand, Guangdong's processing trade is developing, and it has been embedded in the middle and low end of the GVC for a long time. It has a large "value chain capture" effect, lacks the enthusiasm to cooperate with other parts of the country, and therefore has a low degree of NVC embedding.

Third, Guangdong has a relatively high level of embeddedness in the value chain. In the four years of 2002, 2007, 2010 and 2020, Guangdong's vertical specialization

index was 43.9%, 46.8%, 36.4% and 38.4%, respectively, much higher than the domestic averages of 25.1%, 26.3%, 25.3% and 23.4%. This shows that, thanks to the "three-plus-one" trading-mix in the 1980s, factors such as equipment, technology and talents quickly flowed into Guangdong and gathered, and laid a good industrial foundation to build a value chain network that radiates across the country and faces the world. In addition, in horizontal comparison, Guangdong's value chain embedded level is higher than that of Beijing-Tianjin-Hebei, Yangtze River Delta and other places in these four years, and the fluctuation is also smaller, which further indicates that Guangdong's economy has excellent development quality, and its industrial system is strongly competitive in China.

3.2 The Status and Changes of NVC Cooperation Between Guangdong and Other Domestic Provinces and Cities

Figure 1 and Fig. 2 shows the value chain cooperation between Guangdong and other regions in China. According to the definition of the domestic value chain cooperation degree, the higher the degree of inter-regional cooperation, the higher the level of cooperation between the two places. In general, Guangdong's NVC cooperation shows a tendency of network decentralization from near to far.

First, Guangdong has been expanding the scope of cooperation with other provinces and cities in China. In 2002, the scope of Guangdong's cooperation in NVC showed that multiple extremes were close to each other, and the cooperation regions were relatively concentrated. In 2012, Guangdong established a relatively extensive national production cooperation network. The cooperation pole shifted from the Yangtze River Delta to the northern coastal area, and the degree of cooperation with the Northeast region was considerably deepened.

Second, Guangdong's NVC cooperation index range has narrowed, showing a trend to decentralize the NVC cooperation network. In 2002, Guangdong's regional production cooperation was concentrated in Guangxi, Hunan and Zhejiang in the Yangtze River Delta, which are adjacent to Guangdong, and the regional differences are enormous. In fact, NVC Cooperation index between Guangdong and Hunan reached the highest level of 10.07%, while the lowest index degree is only 0.01%. It is worth noting that after 2012, Guangdong has actively promoted the development of "Internet+" technology, which has better resolved the problem of information asymmetry in cross-regional cooperation between enterprises in China and promoted Guangdong enterprises to decentralize cooperation better. Therefore, the degree of NVC cooperation shrinks to the range of 0.17% to 2.08%.

Third, the regional cooperation of Guangdong is gradually developing from near to far. In 2002, the cooperation degree of value chain production between Guangdong and Guangxi, Hunan and Zhejiang were relatively prominent. The degree of cooperation showed a decreasing trend from south to north, which shows that Guangdong's production network in NVC still exists integrated to a relatively low extent in 2002. The tendency of "nearest cooperation" is more pronounced. Since then, in 2012, Guangdong's cooperation centre gradually moved northward to the Beijing-Tianjin-Hebei Region and Yangtze River Delta, and deepened the NVC cooperation with Inner Mongolia and the three northeastern provinces to a greater extent. The situation of "nearest cooperation" basically ended. It is speculated that with the rapid development of China's high-speed

Fig. 1. Value chain cooperation between Guangdong and other provinces and cities in 2002.

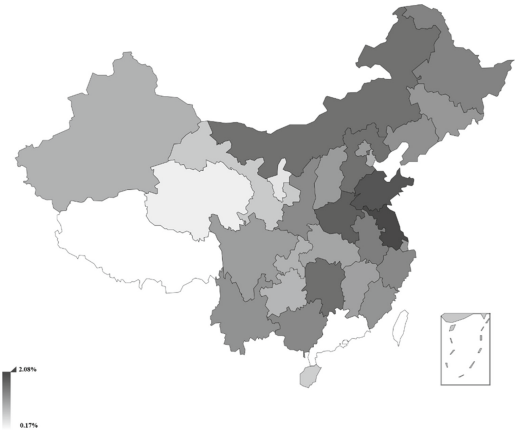

Fig. 2. Value chain cooperation between Guangdong and other provinces and cities in 2012.

railway network and the development of heavy-haul freight technology from 2002 to 2012, the geographical barriers between Guangdong and the northern regions were gradually broken, and the Guangdong production network was able to extend from southwest to northwest, from east China to north and northeast China. Extend, the geographical limitation of "nearest cooperation" was broken, promoting the extension of Guangdong's NVC network.

3.3 Value Chain Revenue Sources in Guangdong

Figure 3 reflects the value chain benefit of the three major economic circles. From the perspective of foreign benefit, the proportion of foreign revenue in the three major domestic economic circles in 2012 was relatively high. The proportion of foreign revenue in all provinces and cities is above 19%, of which Guangdong has the highest proportion

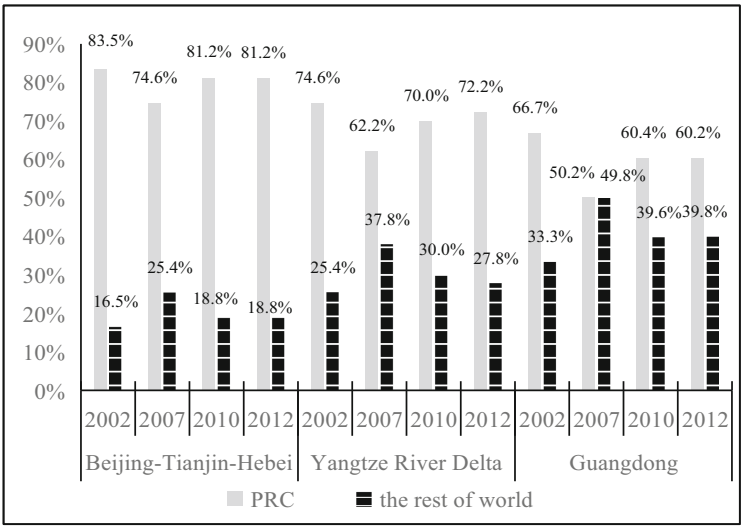

Fig. 3. Value chain benefits of major urban agglomerations in China.

of foreign revenue, reaching 39.8%. In a vertical perspective, affected by the impact of China's entry into the WTO and the exogenous impact of the economic crisis in 2008, the proportion of foreign benefit in three regions fluctuated "high and low and high", but since then, the value chain embedding strategies of three regions have changed respectively, such as the Yangtze River Delta region. In 2012, the proportion of foreign benefit showed a downward trend, from 30% in 2010 to 27.8% in 2012, while domestic income increased from 70% to 72.2%, indicating that the Yangtze River Delta Region is actively adjusting their structure of production and selling network after the economic crisis, and the level of embeddedness in the NVC has been significantly improved. However, Guangdong is still affected by economic inertia. Compared with 2010, the proportion of foreign benefit in 2012 increased by 0.2%, and the export-oriented characteristics are still relatively prominent.

4 Policy Implications

Guangdong is located at the intersection of internal and external circulation, and has the unique advantage of linking the world and radiating the inland. After more than 40 years of development, Guangdong has accumulated a relatively solid material and technological foundation and formed a huge market space. It is fully qualified to play a more important role in building the new development paradigm. At present, COVID-19 is forcing the reconstruction and upgrading of the domestic industrial chain. Guangdong should repeatedly tap the potential of the domestic market and promote technological innovation on the market side, thereby driving the reconstruction of the regional value chain and helping to solve the "low-end lock-in" dilemma.

On the one hand, Guangdong should strengthen its cooperation in the domestic value chain and improve its economic stability. The export-oriented economy is highly

dependent on the global value chain. Once the global market suffers from severe crisis, Guangdong's economy is vulnerable to meet economic shocks. Taking the subprime mortgage crisis as an example, Guangdong's foreign income dropped from 49.67% in 2007 to 39.67% in 2010, and the foreign vertical specialization index dropped from 31.9% to 19.3%, which greatly affected Guangdong's economic stability. Especially under the influence of the new crown epidemic, the uncertainty of the global industrial chain and supply chain has increased sharply, and as the COVID-19 in Vietnam and other places tends to ease, trade transfer into Guangdong is unsustainable.

On the other hand, Guangdong should activate its resource allocation potential in the national value chain. In 2007, Guangdong's domestic vertical specialization index was 14.9%. However, under the impact of the subprime mortgage crisis in 2008, Guangdong immediately exerted its strong resource allocation ability and actively promoted national value chain cooperation. However, as the economic crisis gradually subsided, the domestic vertical specialization index rose to 17.1% in 2010, and economic inertia made Guangdong's national value chain participation and the domestic vertical specialization index return to a new low level. Therefore, Guangdong should rely on its flexible resource allocation capabilities to step out of its comfort zone, and strengthen value-chain cooperation with other regions in China, to improve Guangdong's ability to resist external risks. In addition, Guangdong should take the lead in exploring effective paths to construct the strategic pivot of the new development paradigm.

5 Conclusion

Based on Li and Pan (2016) domestic inter-regional input-output table decomposition model, this paper further expands the WOID decomposition model of Koopman et al. (2014) and Wang et al. (2014). Under the unified decomposition system, we discussed Guangdong's participation in GVC and regional collaboration in NVC in the new millennium. It is found that: First, Guangdong is deeply embedded in the GVC and it has a deepening trendcy, but the regional embeddedness of the NVC is relatively low. Secondly, Guangdong's NVC cooperation has gradually become multi-dimensional and networked. Finally, the foreign benefit is a leading source of revenue in Guangdong's value chain, and there is an upward trend. In contrast, foreign benefit in other regions is gradually flattened and occupies a secondary position.

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