Comparison and Measurement of Economic Growth in Coastal Areas and Inland Provinces of China

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This study aims to measure the regional difference in economic growth and the driving effect of export of coastal areas for inland provinces in China from the perspective of labor division. Embedded input and output data are adopted on the basis of the input-output theory for economic growth and trade accounting. Since China's accession to WTO, vertical specialization across areas has been improved in general, but the areas differ widely in their participation in labor division in the global value chain (GVC) and national value chain (NVC). Different areas in China mainly rely on local production for economic growth, but engagement in GVC and NVC labor division is the major driver for the country's rapid economic growth. Under the external impact, local economic growth has relied less on the outside, but more on local production since 2008. The driving effect of export of coastal areas for inland provinces is mainly reflected in agriculture, indicating that inland provinces and cities indirectly participate in international division of labor mainly by providing raw materials for production for eastern areas. This study, based on GVC and NVC integration and interaction, conducts in-depth research on the driving effect of export of coastal areas for the economic development of inland provinces, and offers a new perspective for studying the regional difference in economic growth in China.

Keywords: regional difference in economic growth, driven by export, specialization

1. Introduction

Since the 1980s, the international pattern of labor division had gone through profound changes, presenting major opportunities for China that just started from scratch. In the process, China made remarkable achievements in foreign trade, with its total volume of foreign trade surging from 20.64 billion dollars in 1978 to 4622.42 billion in 2018, and took over the United States as the world's largest trader. Foreign trade thus became a major engine for China's economic growth. During the opening up, however, local areas in China differed in resource endowment, industrial structure

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and economic development, and therefore had a wide gap in foreign development. In the face of the significant regional difference, people naturally bring up the following questions. Will the difference among areas in participation in international division of labor affect their economic growth? Or furthermore, while participating in labor division in the global value chain (GVC), how will eastern coastal areas drive the development of inland provinces through the national value chain (NVC)? What provinces and industries have benefited from the export of eastern coastal areas and to what extent? Research on these questions is of great significance both theoretically and realistically.

In recent years, as the system of GVC labor division was shaped, the value added in export commodities was mainly from multiple countries and regions. Therefore, research on regional economic development from the perspective of GVC labor division has become the focus of attention of economists in international trade (Hummels *et al*., 2001; Timmer *et al*., 2014). Koopman *et al*. (2014) proposed a framework of trade accounting in value added (KWW model), while Wang *et al*. (2013) and Wang *et al*. (2014) further expanded trade accounting in value added to multiple levels (including domestic/sector, bilateral and bilateral/sector levels), which was widely applied at home and abroad. As the multi-regional input-output table for China was released, NVC and its integration and interaction with GVC were gradually included into the research of scholars. Su (2016), on the basis of the KWW model (2014), took the lead to construct an accounting framework of export value added and based on this, decomposed the value added of provincial-level export in China, leading to a series of valuable conclusions. With a different perspective from Su (2016), Li and Pan (2016) started from value added transfer and used the multi-regional input-output data in China to study the model of different regions getting embedded into GVC in multiple dimensions. Since these researches were mostly based on the multi-regional input-output table for China, it was difficult to get detailed information on the integration of GVC and NVC. Also, the provincial-level export accounting and decomposition could not be expanded to bilateral and bilateral/sector levels.

In order to address the insufficient export information for trade accounting with the multi-regional input-output table for China, domestic and overseas scholars started to combine China's multi-regional input-output tables and the world's input-output tables. Meng *et al*. (2013) was the first to embed China's multi-regional input-output table in 2007 into the world's input-output table of the same year, providing an analysis framework on the integration of GVC and NVC. Afterwards, many scholars referred to this, embedding China's regional input-output tables into the global input-output table of the same year and conducting empirical study on the positions of different regions in China along GVC and NVC as well as their level of involvement (Ni and Xia, 2016; Li *et al*., 2018). Unlike these researches, Pan and Li

(2018) used the 2005 multi-regional input-output tables for countries compiled by Chinese, Japanese and South Korean research institutes and took the perspective of value added supply and demand to study the interactive relationship among different regions of China in their participation in GVC and NVC as well as their interactive relationship with other countries.

The literature review indicates that the interaction and integration of GVC and NVC have become the research frontier in trade accounting. However, the current literature focuses more on the interaction of areas in China and their value-added income, with less attention paid to the difference among each region of China in economic growth. Besides, against the background of GVC and NVC integration, can the export of eastern coastal areas drive the economic development in inland provinces? No literature has centered on this topic for in-depth study yet. In terms of data timeliness, the existing literature mostly adopts the data before 2007 and gives little consideration to the impact of the 2008 financial crisis on the evolvement and integration of GVC and NVC. Compared with the existing literature, this paper is innovative in the following aspects. First, regarding the research perspective, the paper analyzes and measures the difference among each region of China areas in economic growth from the perspective of labor division of value chain. Second, with respect to the object of study, the paper researches the driving effect of export of coastal areas on the economic development of inland provinces based on the integration and interaction of GVC and NVC, which is the first in this field. Third, as for data, the paper embeds the multi-regional input-output tables for China into the corresponding world input-output tables and updates the data to 2012, enabling the analysis of the influence of 2008 financial crisis on different regions of China participating in the GVC and NVC labor division.

The paper is structured as follows. The first part is introduction; the second part introduces the theoretical model and the data source; the third part analyzes in details the level of different areas of China participating in the GVC and NVC labor division and their economic growth; the fourth part discusses in depth the influence of export of eastern coastal areas on inland provinces; and the last part concludes and provides policy suggestions.

2. Theoretical Model and Data Source

2.1. Embedded Input-Output Modeling and Economic Growth Accounting

To analyze the influence of participation in the GVC and NVC labor division on the economic development of different areas in China, the paper embeds the multi-regional input-output tables into the world's input-output tables. Table 1 is a simplified embedded input-output model.

Table 1. Simplified Embedded Multi-Regional Input-Output Model for Countries

			Intermediate use				End use				
	Country (region)		Country 1		Country 2	Country 3	Country 1		Country 2	Country 3	Total output
			Region *a*	Region *b*			Region *a*	Region *b*			
Intermediate input	Country 1	Region a	z_{aa}	z_{ab}	z_{a2}	z_{a3}	y_{aa}	y_{ab}	y_{a2}	y_{a3}	x_a
		Region b	z_{ba}	z_{bb}	z_{b2}	z_{b3}	y_{ba}	y_{bb}	y_{b2}	y_{b3}	x_b
	Country 2		z_{2a}	z_{2b}	z_{22}	z_{23}	y_{2a}	y_{2b}	y_{22}	y_{23}	x_2
	Country 3		z_{3a}	z_{3b}	z_{32}	z_{33}	y_{3a}	y_{3b}	y_{31}	y_{33}	x_3
	Value added		va_a	va_b	va_2	va_3					
	Total input		x_a	x_b	x_2	x_3					

In the table, the embedded input-output model includes three countries, among which country 1 includes region *a* and region *b*. *Z* refers to the input and use matrix of intermediate products and z_{ij} refers to quantity of intermediate products provided by country (region) *i* to country (region) *j*. Value added *VA* is a row vector and va_i is value added vector of country (region) *i*. Total output *X* is a column vector, and output vector of country (region) *i* is expressed in x_i. *Y* is the use matrix of end products and y_{ij} represents quantity of end products provided by country (region) *i* to country (region) *j*.

Similar to models for a single country or countries, in the embedded input-output model, total output in the horizontal direction equals the sum of intermediate use and end use, and reflects the use structure after products are manufactured. It is expressed in the following matrix:

$$\begin{bmatrix} X_a \\ X_b \\ X_2 \\ X_3 \end{bmatrix} = \begin{bmatrix} A_{aa}, A_{ab}, A_{a2}, A_{a3} \\ A_{ba}, A_{bb}, A_{b2}, A_{b3} \\ A_{2a}, A_{2b}, A_{22}, A_{23} \\ A_{3a}, A_{3b}, A_{32}, A_{33} \end{bmatrix} \begin{bmatrix} X_a \\ X_b \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} Y_{aa} + Y_{ab} + Y_{a2} + Y_{a3} \\ Y_{ba} + Y_{bb} + Y_{b2} + Y_{b3} \\ Y_{2a} + Y_{2b} + Y_{22} + Y_{23} \\ Y_{3a} + Y_{3b} + Y_{32} + Y_{33} \end{bmatrix} \tag{1}$$

A is the inter mediate input coefficient matrix, and $A_{ij}=Z_{ij}/X_j$ refers to the part derived from economy *i* in the intermediate input of unit products in economy *j*. The formula is further varied into:

$$\begin{bmatrix} X_a \\ X_b \\ X_2 \\ X_3 \end{bmatrix} = BY = \begin{bmatrix} B_{aa}, B_{ab}, B_{a2}, B_{a3} \\ B_{ba}, B_{bb}, B_{b2}, B_{b3} \\ B_{2a}, B_{2b}, B_{22}, B_{23} \\ B_{3a}, B_{3b}, B_{32}, B_{33} \end{bmatrix} \begin{bmatrix} Y_a \\ Y_b \\ Y_2 \\ Y_3 \end{bmatrix} = \begin{bmatrix} B_{aa}, B_{ab}, B_{a2}, B_{a3} \\ B_{ba}, B_{bb}, B_{b2}, B_{b3} \\ B_{2a}, B_{2b}, B_{22}, B_{23} \\ B_{3a}, B_{3b}, B_{32}, B_{33} \end{bmatrix} \begin{bmatrix} Y_a, 0, 0, 0 \\ 0, Y_b, 0, 0 \\ 0, 0, Y_2, 0 \\ 0, 0, 0, Y_3 \end{bmatrix} u \tag{2}$$

In formula (2), u=[1,1,1,1]', B=$(I–A)^{-1}$ is a Leontief inverse matrix, among which B_{ij} is the corresponding partitioned sub-matrix. $\widehat{V}$ is taken as value-added coefficient matrix and its diagonal element is recorded as V_{ii}=va_i/x_i. Then, $\widehat{V}B\widehat{Y}$ can be expressed as:

$$\widehat{V}B\widehat{Y}=\begin{bmatrix} V_aB_{aa}Y_a, V_aB_{ab}Y_b, V_aB_{a2}Y_2, V_aB_{a3}Y_3 \\ V_bB_{ba}Y_a, V_bB_{bb}Y_b, V_bB_{b2}Y_2, V_bB_{b3}Y_3 \\ V_2B_{2a}Y_a, V_2B_{2b}Y_b, V_2B_{22}Y_2, V_2B_{23}Y_3 \\ V_3B_{3a}Y_a, V_3B_{3b}Y_b, V_3B_{32}Y_2, V_3B_{33}Y_3 \end{bmatrix} \tag{3}$$

In the matrix, $V_iB_{ij}Y_j$ refers to value added in country (region) i induced through economic connections by end product Y_j manufactured by country (region) j. Therefore, value added of region a in formula (3) can be further expressed as:

$$Va_a=V_aB_{aa}Y_a+V_aB_{ab}Y_b+V_aB_{a2}Y_2+V_aB_{a3}Y_3 \tag{4}$$

With formula (4), we can get the structure of source for value added of region a, i.e. the part $V_aB_{aa}Y_a$ driven by end product Y_a manufactured in the local region, the part $V_aB_{ab}Y_b$ driven by end product Y_b manufactured in other regions of the country, and the part ($V_aB_{a2}Y_2$+$V_aB_{a3}Y_3$) driven by end products manufactured in other countries.

Since there is $\sum V_iB_{ij}$=1 in the multi-country (region) model, we vertically add the matrix elements related to region a in formula (3) to get:

$$Y_a=V_aB_{aa}Y_a+V_bB_{ba}Y_a+V_2B_{2a}Y_a+V_3B_{3a}Y_a \tag{5}$$

Through formula (5), value added of end products manufactured in region a covers three parts: value added $V_aB_{aa}Y_a$ provided by the local region, value added $V_bB_{ba}Y_a$ provided by other regions in the country, and value added ($V_2B_{2a}Y_a$+$V_3B_{3a}Y_a$) provided by other countries.

As this paper focuses on the impact of participation in the value chain labor division on regional economic growth, under the input-output framework of a single country, output X can be expressed as:

$$X=LY+(B—L)Y=LY^d+LY^f+LA^fBY \tag{6}$$

In formula (6), L=$(I–A^d)^{-1}$. In another word, in a single-country (region) framework, output X of a country (region) can be divided into three parts: output LY^d to meet local end demand Y^d, output LY^f driven by export of end product Y^f, and output LA^fBY driven by export of intermediate product A^fBY. Value added VA can be further expressed in matrix as:

$$VA = V \times X = V \times \{LY + (B—L)Y\} = VLY^d + VLY^f + VLA^f BY = VLY^d + VLY^f + VLA^f X \tag{7}$$

In formula (7), V is the value-added rate matrix and its diagonal element $v_{ii}=va_i/x_i$ is value-added rate. Make $VLY^f=VLY^{f\_reg}+VLY^{f\_int}$ and $VLA^fX=VLA^fX^{reg}+VLA^fX^{int}$. Among this, Y^{f_reg} and Y^{f_int} respectively refer to end product vector flowing to other regions in the same country and to other countries, and A^fX^{reg} and A^fX^{int} respectively refer to intermediate product vector flowing to other regions in the same country and to other countries. In this sense, formula (7) can be expressed as:

$$VA = \underbrace{VLY^d + \underbrace{VLY^{f\_reg} + VLY^{f\_int}}_{\text{End product trade}}}_{\text{LVC}} + \underbrace{\underbrace{VLX^{reg} + VLX^{\text{int}}}_{\text{Intermediate product trade}}}_{NVC\ and\ GVC} \tag{8}$$

For region *a* or *b*, the first three items are value-added income from assembling and production of local value chain (LVC), and the fourth and fifth items respectively refer to value-added income from participation in NVC and GVC labor division. Value added of period *t* and that of period *t*+1 are marked as VA^t and VA^{t+1}, and then economic growth during the two periods can be expressed as:

$$\triangle VA = VA_{t+1} - VA_t = \triangle VLY^d + \underbrace{\triangle VLY^{f\_reg} + \triangle VLY^{f\_int}}_{\substack{\text{Growth driven by}\\ \text{end product trade}}} + \underbrace{\triangle VLX^{reg} + \triangle VLX^{int}}_{\substack{\text{Growth driven by}\\ \text{intermediate product trade}}} \tag{9}$$

With formula (9), we can calculate the economic growth driven by trade, but we are more interested in the following question. In their participation in international division of labor, have China's coastal areas driven the economic growth of inland areas through NVC? In another word, how much is the value added of inland areas included in the export commodities of coastal areas? In order to answer this question, value-added trade accounting for export commodities of coastal areas becomes necessary. First, commodities in outbound flow can be expressed as:

$$E = Y^f + A^f X \tag{10}$$

It should be pointed out that some of the commodities in outbound flow are accounted more than once, so VBE cannot be used to directly calculate domestic value added implied in export commodities.[1] For eliminating the impact of repeated

[1] A large part of literature in China adopts VBE to directly calculate the domestic value added driven by export and thus over-estimates the driving effect of export.

accounting of some export commodities, formula (6) can be substituted into formula (10) to get:

$$E = Y^f + A^f LY^d + A^f (BY - LY^d) \tag{11}$$

As observed in formula (11), export commodities can be divided into three parts: export of end products Y^f, export of intermediate products that are directly used by importing countries $A^f LY^d$, and export of intermediate products that further flow outbound after entering importing countries $A^f(BY-LY^d)$. Therefore, for export commodities, the first two parts are accounted once with customs, but the last part is in repeated accounting.

After removing the part of repeated accounting in export commodities in formula (11), we get:

$$E^Y = Y^f + A^f LY^d \tag{12}$$

Referring to formula (3), we can mark this part of value added driven by export of commodities in matrix $\widehat{V}B\widehat{E}^y$ as follows:[1]

$$\widehat{V}B\widehat{E}^y = \begin{bmatrix} V_a B_{aa} E_a^y, V_a B_{ab} E_b^y, V_a B_{a2} E_2^y, V_a B_{a3} E_3^y \\ V_b B_{ba} E_a^y, V_b B_{bb} E_b^y, V_b B_{b2} E_2^y, V_b B_{b3} E_3^y \\ V_2 B_{2a} E_a^y, V_2 B_{2b} E_b^y, V_2 B_{22} E_2^y, V_2 B_{23} E_3^y \\ V_3 B_{3a} E_a^y, V_3 B_{3b} E_b^y, V_3 B_{32} E_2^y, V_3 B_{33} E_3^y \end{bmatrix} \tag{13}$$

Similarly, $V_i B_{ij} E_j^y$ in this matrix represents the value added of country (region) i driven through economic connections by export E_j^y of country (region) j with repeated accounting being removed. Since we already get the local value-added income driven by export commodities through formula (9), here we only need to get the value added of other countries (regions) included in the export commodities.

For example, value added included in commodities in outbound flow of region a covers three parts: value added $V_a B_{aa} E_a^y$ provided by the local area, value added $V_b B_{ba} E_a^y$ provided by region b of the country, and value added $(V_2 B_{2a} E_a^y + V_3 B_{3a} E_a^y)$ provided by country 2 and country 3. Therefore, value added of other countries (regions) included in commodities in outbound flow of region a is as follows:

$$Va_a^{else} = V_b B_{ba} E_a^y + V_2 B_{2a} E_a^y + V_3 B_{3a} E_a^y \tag{14}$$

[1] The author makes calculations with both the accounting method in this paper and the KWW (2014) method, which, after validation, come to completely consistent conclusions.

Referring to Hummels *et al*. (2001), we can define value added of other countries (regions) included in commodities in outbound flow of a country (region) as its level of vertical specialization. For region *a*, its general vertical specialization level is:

$$VS_a = (V_b B_{ba} E_a^y + V_2 B_{2a} E_a^y + V_3 B_{3a} E_a^y) / E_a \tag{15}$$

Furthermore, according to the source of external value added included in commodities in outbound flow, we can decompose the vertical specialization level of region *a* into:

$$FVS_a = (V_2 B_{2a} E_a^y + V_3 B_{3a} E_a^y) / E_a;\ DVS_a = V_b B_{ba} E_a^y / E_a \tag{16}$$

In formula (16), FVS_a is international specialization index and expressed as the ratio of value added of other countries in the products in outbound flow. Correspondingly, DVS_a is domestic specialization index and expressed as the ratio of value added of other regions in a country in the products in outbound flow. The two reflect the level of participation by region *a* in international and domestic vertical specialization respectively.

Commodities in outbound flow are further divided into domestic trade and international trade. Then for region *a*, external value added included in export commodities (y_{a2}+y_{a3}+y_{a2}+y_{a3}) in international trade is:

$$Va_a^{else\_for} = \left(V_b B_{ba} + V_2 B_{2a} + V_3 B_{3a}\right)\left(y_{a2} + y_{a3} + A_{a2} L_{22} y_{22} + A_{a3} L_{33} y_{33}\right) \tag{17}$$

Among this, value added of region *b* driven by export of commodities in region *a* is:

$$Va_a^{else\_forb} = V_b B_{ba}\left(y_{a2} + y_{a3} + A_{a2} L_{22} y_{22} + A_{a3} L_{33} y_{33}\right) \tag{18}$$

With the above analysis, we finally get the value added of different regions in China and outside China included in export commodities of eastern coastal areas, and thus make it possible to calculate the driving effect of export of eastern coastal areas on the economic development of inland provinces.

2.2. Data Source

There are mainly two sources for multi-regional input-output tables currently used in China. The first is the 1997, 2002 and 2007 China Multi-Regional Input-Output Tables compiled by State Information Center, providing the input-output information

of eight regions in China; the second is the 2007 and 2012 China Multi-Regional Input-Output Table of 30 (31) Provincial Units compiled by Key Laboratory of Regional Sustainable Development Modeling, CAS. In order to analyze the driving effect of export of eastern areas on inland provinces since China's accession to WTO, the paper adopts the 2002 multi-regional input-output table of eight regions in China and the 2007 and 2012 multi-regional input-output tables of 30 (31) provincial units, and embeds them into the global input-output tables of corresponding years. The specific process is as follows. (1) Through currency conversion and dimension unification, the multi-regional input-output tables in China are converted into China multi-regional input-output tables aligned with World Input-Output Database (WIOD). (2) For the input-output data among countries in the world excluding different regions of China, the previous WIOD data is continuously used. (3) With WIOD data as the target variable, the multi-regional input-output data in China, export data, import data, output value and value added are subject to adjustment. (4) Balance adjustment is conducted horizontally and vertically, and error terms after the balance adjustment are included into "Rest of the World" (ROW).

3. Measurement and Comparison of Regional Economic Growth in China from the Perspective of Labor Division

3.1. Measurement of Vertical Specialization Level of Different Regions in China in 2002–2012

Before comparing and measuring the economic growth of China's coastal areas and inland provinces, we first refer to Hummels *et al*. (2001) and Li *et al*. (2018) and measure the vertical specialization level of different regions with the ratio of external value added included in commodities in outbound flow. As shown in Table 2, the average vertical specialization level of different regions in China rose from 18.92% in 2002 to 25.39% in 2007, and then dropped to 20% in 2012, with an increase of 1.08 percentage points during the analysis period, indicating that the vertical specialization level of different regions in China during this period was generally improved, despite of some fluctuations. Except northeast, the vertical specialization level of other three regions all displayed an inverted U-shaped trend of "rising first and then declining". To be specific, the level of the east remained the highest, and the middle had a level slightly lower than the west at the first period, but then surpassed the west at the end of the period. Different from these regions, the northeast saw its level increase from 14.37% in 2002 to 17.53% in 2007 and then, instead of dropping, further rose to 19.42% in 2012. Its trend of continuous increase during the analysis period indicated that the ratio of external value added included in the commodities in outbound flow in the northeast was continuously climbing.

Table 2. GVC and NVC-Based Vertical Specialization Level of Different Regions in China in 2002–2012 (%)

	2002			2007			2012		
	NVC	GVC	Total	NVC	GVC	Total	NVC	GVC	Total
East	5.92	15.45	21.37	13.38	15.98	29.35	7.39	14.70	22.09
Middle	8.29	3.19	11.48	9.71	6.91	16.63	11.56	4.26	15.82
West	9.59	3.81	13.4	10.95	6.36	17.31	9.52	5.69	15.21
Northeast	7.51	6.86	14.37	8.87	8.66	17.53	11.11	8.31	19.42
Mean	6.68	12.24	18.92	12.29	13.11	25.39	8.56	11.44	20.00

After decomposing the external value added included in the commodities in outbound flow of different regions into domestic and foreign part, we further get their NVC and GVC-based vertical specialization level, as shown in Table 2. According to the table, the average level of NVC-based vertical specialization of these regions climbed from 6.68% in 2002 to 12.29% in 2007, and then dropped to 8.56% in 2012, with an increase of 1.88 percentage points throughout the analysis period, signaling that the domestic vertical specialization level was rising on average. To our surprise, the average level of GVC-based vertical specialization of different regions in China increased from 12.24% in 2002 to 13.11% in 2007, and then decreased to 11.44% in 2012 under the impact of the 2008 financial crisis. It did not rise, but declined by 0.8 percentage point during the analysis period. It is further found that the vertical specialization level of these regions in China was different. For the east, its international specialization level was far higher than its domestic specialization level, which was clearly related to its long-term participation in international division of labor through processing trade. Compared with the east, the middle and the west showed an inverse trend, with the domestic specialization level being far higher than the international level. Different from those regions, the northeast saw little difference between its domestic and international vertical specialization levels.

Table 3 shows the ratio of external value added included in the commodities in outbound flow in international (domestic) trade of different regions in China in 2002–2012. As revealed, in the east, ratios of both foreign value added (FV) and domestic value added (DV) in export commodities grew slowly during the analysis period; different from the east, the two ratios in export commodities in the middle, west and northeast all showed a trend of noticeable growth. Besides, during the period, ratios of external value added included in the commodities in outbound flow of these regions in domestic trade were all lower than the ratios in international trade in terms of both absolute level and increase, indicating that the export was more helpful for improving the vertical specialization level. For the east, the ratios of domestic value added in

commodities for export and domestic trade were not apparently different, and the difference in the ratio of external value added was mainly reflected in foreign value added, which was clearly related to the east's participation in international division of labor through processing trade. For the middle, west and northeast, in both export and domestic trade, the ratio of value added of other regions in China was all far higher than foreign value added, meaning that these regions participated in the international division of labor more through normal trade.

Table 3. Ratio of External Value Added in Commodities in Outbound Flow in International (Domestic) Trade of Different Regions in China in 2002–2012 (%)

Trade	Region	2002			2007			2012		
		DV	FV	Total	DV	FV	Total	DV	FV	Total
International	East	5.90	17.64	23.54	15.14	19.70	34.84	7.82	17.77	25.59
	Middle	7.91	3.33	11.24	14.49	11.13	25.62	15.35	5.69	21.04
	West	12.61	5.16	17.77	15.87	10.48	26.35	15.11	8.53	23.64
	Northeast	6.96	7.44	14.40	12.02	13.13	25.15	15.82	11.03	26.85
Domestic	East	5.95	12.80	18.75	11.28	11.56	22.85	6.97	11.70	18.68
	Middle	8.36	3.16	11.52	8.92	6.21	15.14	10.78	3.97	14.75
	West	8.94	3.52	12.46	10.24	5.76	16.00	8.23	5.03	13.27
	Northeast	7.79	6.56	14.35	8.00	7.43	15.44	10.00	7.67	17.67

3.2. Value Added Accounting and Comparison of Different Regions in China from the Perspective of Labor Division

With the value added accounting framework constructed as above, we can measure the composition of value added of different regions in China in 2002–2012 from participation in labor division in different value chains since China's accession to WTO, with the results listed in Table 4. According to the table, for China as a whole, value added was mostly derived from local production, but the ratio declined from 78.25% in 2002 to 72.12% in 2012, indicating that during the analysis period, dependence of all regions on LVC was reduced. On the contrary, the ratio of value added generated by different regions' participation in NVC and GVC showed an inverse U-shaped trend and increased slightly. Based on further observation, we find that in NVC and GVC, these regions were more dependent on the former, and during the analysis period, the ratio of value added generated by the former outgrew that by the latter. This signaled that NVC, rather than GVC, played a more important role in the economic development of these regions in China.

Table 4. Ratio of Value Added from Participation in Labor Division in Different Value Chains of Different Regions in China in 2002–2012 (%)

	2002			2007			2012		
	LVC	NVC	GVC	LVC	NVC	GVC	LVC	NVC	GVC
East	76.29	13.39	10.32	66.42	19.38	14.14	70.73	17.51	11.75
Middle	79.76	17.30	2.94	71.87	24.97	2.98	74.90	21.76	3.18
West	83.12	14.50	2.38	67.97	28.76	3.21	72.62	23.80	3.58
Northeast	77.75	14.88	7.37	62.97	30.71	6.25	72.89	23.15	3.96
Mean	78.25	14.48	7.27	67.45	22.96	9.60	72.12	20.08	7.80

Table 4 also lists the proportion of value added generated by these regions' participation in labor division of different value chains in 2002–2012. As displayed, the four economic regions of China had both similarities and differences in their composition of value added. They were similar in the following aspects. First, they depended most on local production, which was followed by NVC, and their dependence on GVC was the lowest. Second, their dependence on local production showed a downward trend, but that on NVC an upward trend. As for the differences, the east depended on GVC most among the four regions, with the dependence rate increasing from 10.32% in 2002 to 11.75% in 2012. Similar to the east, the middle had a dependence rate on GVC that rose from 2.94% in 2002 to 3.18% in 2012, but the dependence was mainly reflected in 2007–2012. For the west, its dependence on GVC increased in an insignificant way, but its dependence on NVC surged from 14.50% in 2002 to 23.8% in 2012 by 9.3 percentage points. Unlike other regions, the northeast had a dependence rate on GVC that dropped from 7.37% in 2002 to 3.96% in 2012, marking the only decrease among the four regions. It meant that the northeast's participation in GVC labor division during the period declined noticeably.

Figure 1 introduces the contribution of participation in labor division of different value chains to economic growth in different regions of China. It is found that during 2002–2012, local production activities contributed to 68.53% of economic growth of these regions on average, participation in NVC labor division contributed to 23.39%, and participation in GVC labor division 8.08%, indicating that local production contributed most to regional economic growth, followed by NVC labor division and then GVC labor division. Regionally speaking, these regions differed in their composition of economic growth. During the analysis period, GVC labor division contributed to 12.67% of economic growth in the east, the highest among the four regions; for the middle, more than three quarters of GDP was driven by local production; and NVC labor division contributed to 28.13% of economic growth in the west, the most significant among all the regions. However, GVC labor division

contributed to only 1.66% of economic growth in the northeast, the lowest among these regions.

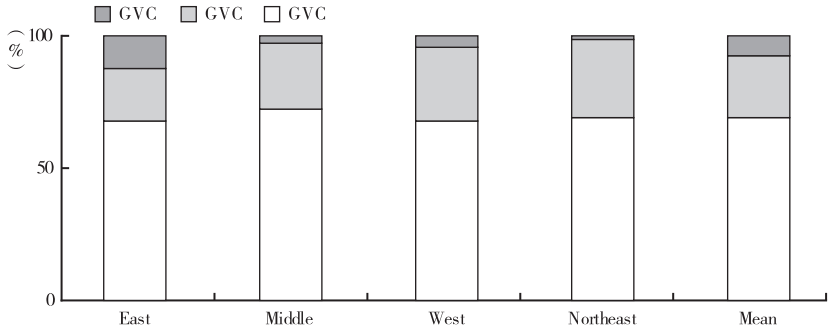

Figure 1. Contribution of Participation in Labor Division of Different Value Chains to Economic Growth of Different Regions in China in 2002–2012 (%)

On such basis, Table 5 further lists the growth rate related to labor division of different value chains in different regions of China in 2002–2012. During the analysis period, growth rate of the four regions driven by participation in NVC, GVC and LVC labor division was 14.11%, 11.19% and 9.54% respectively. It indicated that though these regions mainly relied on local production activities to drive economic growth, related growth rate was lower than the overall economic growth; on the contrary, participation in NVC and GVC labor division was an important driver of China's rapid economic growth. By stage, the four regions experienced a decrease of average growth from 11.64% in 2002–2007 to 9.25% in 2007–2012 by roughly 2.39 percentage points. After further analysis, it is found that while the overall economic growth in China slowed down, the economic growth driven by local production climbed from 8.37% in 2002–2007 to 10.72% in 2007–2012. On the contrary, the economic growth rates related to NVC and GVC participation declined from 22.39% and 18.1% in 2002–2007 to 6.39% and 4.69% in 2007–2012 respectively. This meant that the 2008 financial crisis posed a major impact on China's economy, driving the economic growth model in China to gradually change from being export-oriented to internal-oriented.

Table 5. Growth of Value Added in Participation in Labor Division of Different Value Chains in Different Regions of China in 2002–2012 (%)

	2002–2007				2007–2012				2002–2012			
	LVC	NVC	GVC	Overall	LVC	NVC	GVC	Overall	LVC	NVC	GVC	Overall
East	9.07	20.74	19.41	12.12	8.99	5.47	3.72	7.64	9.03	12.85	11.29	9.85
Middle	8.73	19.47	11.34	10.98	11.61	7.69	12.14	10.70	10.16	13.42	11.74	10.84
West	7.78	28.68	19.09	12.19	13.60	7.94	14.56	12.12	10.65	17.86	16.81	12.16
Northeast	4.65	26.19	5.63	9.15	13.20	3.89	0.31	9.94	8.84	14.50	2.93	9.55
Mean	8.37	22.39	18.10	11.64	10.72	6.39	4.69	9.25	9.54	14.11	11.19	10.44

Regionally speaking, in 2002–2012, economic growth rate in the west was 12.16%, the highest among the four regions, and this was clearly related to the West Development campaign initiated by Chinese central government since 2000. Among that, the growth driven by NVC reached 17.86%, which was apparently related to the fact that the west provided the country with a large quantity of intermediate products, including raw materials. Economic growth in the middle region was 10.84%, ranking second among the four regions. Out of the three drivers of local economic growth, the growth driven by NVC and GVC was higher than that by LVC, but the difference among the three was not distinct. The economic growth of the east and the northeast was 9.85% and 9.55% respectively, the lowest two among the four regions. As a common reason for the two regions, the economic growth driven by GVC labor division declined dramatically. To be specific, the growth driven by GVC in the east dropped from 19.41% in 2002–2007 to 3.72% in 2007–2012, and that in the northeast decreased from 5.63% to 0.31%.

Table 6. Economic Growth Driven by Different Types of Commodity Trade in Different Regions of China in 2002–2012 (%)

	2002–2007			2007–2012			2002–2012		
	End product	Intermediate product	Mean	End product	Intermediate product	Mean	End product	Intermediate product	Mean
East	15.01	20.17	17.92	5.41	4.74	5.01	10.10	12.19	11.28
Middle	19.86	18.42	18.81	10.05	8.20	8.72	14.85	13.19	13.65
West	22.47	27.49	25.93	7.40	8.69	8.33	14.69	17.71	16.80
Northeast	20.19	20.83	20.65	9.18	3.32	5.08	14.55	11.73	12.60
Mean	16.83	21.03	19.42	6.38	5.90	6.07	11.48	13.21	12.55

As LVC-related economic growth is driven by two forces, namely local demand and outbound flow of end products, for analyzing the influence of commodity circulation on regional economic growth, the paper extracts the related part and lists it in Table 6 in parallel with outbound flow of intermediate products. As shown in the table, during the analysis period, the growth related to commodity trade in regional economic growth was around 12.55%. To be specific, the growth driven by end product trade was 11.48% and that driven by intermediate product trade was 13.21%, indicating that intermediate product trade grew faster during the period. By stage, the growth driven by end product trade and intermediate product trade dropped from 16.83% and 21.03% in 2002–2007 to 6.38% and 5.9% in 2007–2012 respectively, both showing a noticeable trend of decrease. Regionally speaking, in the east, the economic growth driven by both end product trade and intermediate product trade was low among the four regions. The

reason was partially that the east's participation in domestic and international division of labor was relatively high, causing its marginal growth to decrease progressively. Contrary to the east, the west participated in domestic and international labor division at a low level at the beginning of the analysis period. When it was integrated into the two labor division systems, commodity trade, especially intermediate product trade, exerted a rather apparent driving effect on local economic growth.

Table 7. Economic Growth Driven by Domestic and International Trade in Different Regions of China in 2002–2012 (%)

	2002–2007		2007–2012		2002–2012	
	Domestic trade	International trade	Domestic trade	International trade	Domestic trade	International trade
East	18.85	17.11	7.39	2.63	12.97	9.63
Middle	19.41	15.36	7.99	12.92	13.56	14.13
West	27.44	17.42	6.77	17.54	16.65	17.48
Northeast	25.16	9.60	5.95	1.62	15.15	5.53
Mean	21.10	16.98	7.30	3.95	13.99	10.28

Table 7 further introduces the economic growth driven by domestic trade and international trade in different regions of China. In 2002–2012, the growth of the four regions driven by domestic and international trade was 13.99% and 10.28% respectively. In combination with the analysis above, we know that compared with international trade, not only domestic trade had a larger proportion in China's economic growth, but the economic growth driven by domestic trade was faster as well. By stage, regional economic growth driven by domestic and international trade was 21.1% and 16.98% respectively in 2002–2007, but displayed a downward trend in 2007–2012, decreased to 7.3% and 3.95% respectively. This signaled that before the 2008 financial crisis, domestic trade and international trade had a significant driving effect on China's regional economic growth, but after the crisis, the effect of both showed a distinct trend of decline. Comparatively speaking, the effect of international trade declined further.

Regionally speaking, the driving effect of domestic and international trade during the analysis period differed widely in different regions. In the east, the economic growth driven by international trade dropped from 17.11% in 2002–2007 to 2.63% in 2007–2012, while that driven by domestic trade declined from 18.85% to 7.39%. The decline of growth driven by international trade was significantly greater than that driven by domestic trade, showing that eastern provinces located in coastal open areas were subject to fiercer external impact. In the middle and west, as their export-oriented economy was generally at the initial stage of development, the economic

growth driven by international trade was higher than that driven by domestic trade, but the contribution of international trade to regional economic growth was relatively low. Different from these regions, in the northeast, the economic growth driven by domestic trade was 5.95% in 2007–2012, not much different from other regions, but the growth driven by international trade dropped from 9.6% in 2002–2007 to 1.62% in 2007–2012. It suggested that the slowed growth of international trade, especially in intermediate products, after 2007 in the northeast was the direct cause of this region lagging behind in economic development in China over recent years.

4. Driving Effect of Export in Coastal Areas on Economic Growth of Inland Provinces

It is found in the above analysis that in the context of economic globalization and regional integration, vertical specialization of different regions in China has been improved to some extent. However, under the external impact such as the financial crisis, domestic and international labor division starts to differ, which will inevitably exert influence on economic development of these regions. On such basis, the paper hopes to further answer the following question in this part: in their active participation in GVC labor division, have eastern coastal areas driven the economic development of inland areas through NVC?

Table 8. Export Volume and Proportion of Different Types of Commodities in Different Regions of China in 2002–2012 (100 Million Dollars, %)

	2002			2007			2012		
	Intermediate product	End product	Total	Intermediate product	End product	Total	Intermediate product	End product	Total
East	1283.47 (81.69)	1707.87 (91.32)	2991.34 (86.92)	5389.6 (85.64)	6102.13 (90.34)	11491.73 (88.07)	8915.06 (81.8)	8899.16 (83.75)	17814.21 (82.77)
Middle	98.42 (6.26)	47.03 (2.51)	145.45 (4.23)	297.23 (4.72)	217.26 (3.22)	514.49 (3.94)	721.22 (6.62)	595.56 (5.61)	1317.78 (6.12)
West	74.29 (4.73)	59.4 (3.18)	133.69 (3.88)	301.99 (4.8)	209.82 (3.11)	511.82 (3.92)	835.78 (7.67)	760.84 (7.16)	1596.62 (7.42)
Northeast	115.04 (7.32)	55.93 (2.99)	170.97 (4.97)	304.27 (4.83)	225.71 (3.34)	529.98 (4.06)	426.01 (3.91)	369.74 (3.48)	795.75 (3.7)

Table 8 first displays the export volume and structure of different types of commodities in different regions of China in 2002–2012. According to the data, the volume of export commodities in the east was far higher than other regions, and its proportion was decreased from 86.92% in 2002 to 82.77% in 2012 by a decline of 4.15 percentage points. Unlike the east, in the middle and the west, though the proportion

of export commodities was not high, it was increased from 4.23% and 3.88% in 2002 to 6.12% and 7.42% in 2012 by 1.89 and 3.54 percentage points respectively. In the northeast, the proportion of export commodities was 4.97% in 2002, ranking second among the four regions, but dropped to 3.7% in 2012, the last among the regions. This indicated that the east far surpassed other regions in volume of export commodities, but was outgrown by the middle and the west during the analysis period, resulting in the decline of its proportion in national total volume. Besides, the northeast ranked the last among the four regions in terms of growth of volume of export commodities, causing its proportion to slump. This further verified the previous opinion in the paper that the trade-related economic growth effect in the northeast had slowed down.

After further categorizing export commodities into intermediate products and end products, we find that export volume of intermediate products and end products in China was increased from 157.1 billion dollars and 187 billion in 2002 to 1089.8 billion dollars and 1,062.5 billion in 2012, by 5.94 and 4.68 times respectively. For China as a whole, export of intermediate products outgrew that of end products. Regionally speaking, in the east, the ratio of its intermediate product export remained almost unchanged, but that of end product export decreased by 7.57 percentage points, reflecting that the east's growth of end product export was lower than the national average. Contrary to the east, in the northeast, the ratio of its end product export climbed slightly, but that of intermediate product export slumped from 7.32% in the beginning of the analysis period to 3.91% at the end, signaling that the slowdown of export in the northeast was related to its intermediate products. Unlike the east and the northeast, the middle and the west showed a noticeable upward trend in both ratio of intermediate product export and ratio of end product export, indicating that the export-oriented economy in the middle and the west experienced fast development during the analysis period.

Table 9. Value Added Driven by Export of Eastern Region and Its Ratio in Inland Provinces in 2002–2012
(100 Million Yuan, %)

Industry	2002			2007			2012		
	Intermediate product	End product	Total	Intermediate product	End product	Total	Intermediate product	End product	Total
Primary	30.87 (0.31)	83.13 (0.84)	114.01 (1.15)	315.77 (1.74)	759.11 (4.19)	1074.84 (5.93)	374.41 (1.11)	699.65 (2.07)	1074.06 (3.17)
Secondary	348.96 (1.48)	626.14 (2.65)	975.09 (4.12)	1800.68 (3.29)	2925.94 (5.35)	4726.66 (8.64)	2062.57 (1.72)	3072.05 (2.56)	5134.62 (4.28)
Tertiary	128.46 (0.60)	242.21 (1.12)	370.69 (1.72)	609.79 (1.31)	1049.35 (2.25)	1659.13 (3.56)	958.31 (0.96)	1554.83 (1.56)	2513.14 (2.52)
Total	508.29 (0.92)	951.49 (1.73)	1459.79 (2.65)	2726.24 (2.28)	4734.4 (3.97)	7460.63 (6.25)	3395.28 (1.34)	5326.54 (2.10)	8721.82 (3.44)

Table 9 demonstrates the value added driven by export of the eastern region and its ratio in inland provinces in 2002–2012. As shown in the table, value added in inland provinces driven by export of the eastern region had a ratio of 2.65% in regional GDP in 2002, which increased to 6.25% in 2007 and then declined to 3.44% in 2012, increased by 0.79 percentage point across the analysis period. By product, value added in inland provinces driven by export of end products of the eastern region was larger than that of intermediate products, which grew from 50829 million yuan and 95149 million in 2002 to 339528 million yuan and 532654 million in 2012 respectively. By industry, the driving effect of export in the eastern region on agriculture of inland provinces was marginal at the beginning of the analysis period, but it showed a trend of fast growing over the period, with related value added increased from 11,401 million yuan in 2002 to 107,406 million in 2012, the fastest growth among the three industries. Compared with the driving effect on the agricultural industry, the influence of export of the eastern region on the service industry in inland provinces was weaker, with the value added driven by the export in 2012 only accounting for 2.52%, the lowest among the three industries. The ratio of value added of the secondary industry in inland provinces driven by export of the eastern region climbed from 4.12% in 2002 to the peak of 8.64% in 2007 and then dropped to 4.28% in 2012, always being the highest among the three industries. It indicated that the driving effect of export of the eastern region on inland provinces was mainly reflected in the secondary industry.

Table 10. Ratio of Value Added of Inland Provinces Driven by Export of Eastern Region in China in 2002–2012 (%)

Region	Industry	2002			2007			2012		
		Intermediate product	End product	Total	Intermediate product	End product	Total	Intermediate product	End product	Total
Middle	Agriculture	0.45	1.32	1.77	1.81	4.20	6.01	1.17	2.29	3.47
	Industry	1.58	3.08	4.66	3.09	5.29	8.38	1.64	2.76	4.41
	Service	0.66	1.36	2.02	1.25	2.19	3.45	1.17	1.96	3.13
	Total	1.03	2.11	3.13	2.19	3.94	6.14	1.40	2.39	3.80
West	Agriculture	0.21	0.49	0.70	1.59	3.90	5.49	1.08	1.98	3.06
	Industry	1.49	2.60	4.09	3.74	6.02	9.76	1.75	2.39	4.15
	Service	0.54	1.00	1.55	1.52	2.61	4.13	0.71	1.08	1.78
	Total	0.85	1.52	2.36	2.50	4.31	6.81	1.24	1.81	3.05
Northeast	Agriculture	0.19	0.38	0.56	1.97	4.91	6.88	1.01	1.73	2.74
	Industry	1.26	1.92	3.18	2.90	4.23	7.13	1.82	2.45	4.26
	Service	0.56	0.89	1.45	0.99	1.63	2.62	1.07	1.76	2.83
	Total	0.85	1.32	2.17	2.04	3.31	5.34	1.41	2.08	3.49

Table 10 shows the ratio of value added in inland areas driven by export of the eastern region in 2002–2012. According to the table, the ratio of value added in middle provinces driven by the export of the eastern region rose from 3.13% in 2002 to 3.80% in 2012, which was always the highest among inland areas. This indicated that the export of eastern coastal areas exerted a rather noticeable impact on the economic growth of middle provinces. By industry, the ratio of value added of agriculture in the middle region driven by the export of eastern coastal areas was only 1.77% in 2002, the lowest among all the three industries, but it climbed to 3.47% at the end of the analysis period with the most significant growth among all the industries. The driving effect of the export on value added of industry in the middle region was the most significant, with the ratio increasing from 4.66% in 2002 to the peak 8.38% in 2007 and then dropping to 4.41% in 2012, presenting a general decrease of 0.25 percentage points over the analysis period. Comparatively speaking, the driving effect of the export on value added of the service industry in middle provinces was not noticeable, but the ratio of the value added grew from 2.02% in 2002 to 3.13% in 2012. The detailed analysis demonstrates the significant driving effect of eastern export on value added of middle provinces, which gradually transferred from the industrial sector to the agricultural and service sectors over recent years.

For the western region, 2.36% of its value added in 2002 was driven by export of the eastern region. It was a ratio between that of the middle and the northeast, which grew to the peak 6.81% in 2007 and then declined to 3.05% in 2012, registering the most significant changes among inland provinces. In terms of the industry, the ratio of value added driven by eastern export on agriculture of the western region climbed from 0.70% in 2002 to 3.06% in 2012, with an increase of 2.36 percentage points over the analysis period; that on industry increased from 4.09% in 2002 to 4.15% in 2012, with no significant change during the period; and that on the service industry grew from 1.55% in 2002 to 1.78% in 2012, which was relatively low in both value itself and growth margin. The above analysis demonstrates that prior to the 2008 financial crisis, export of eastern coastal areas drove the economic development, especially in the industrial sector, in western provinces, but under the external impact, the driving effect on the west apparently declined after 2008.

As for the northeastern region, around 2.17% of its value added was driven by export of eastern coastal areas in 2002, the lowest among inland regions, which indicated that the driving effect of eastern export on the northeastern region's economic growth was insignificant. The ratio, however, grew to 3.49% in 2012, displaying the most significant growth in inland regions during the analysis period. By industry, the ratio of value added driven by eastern export on agriculture in the northeastern region was only 0.56% at the beginning of the period, but it climbed to 6.88% in 2007 and then dropped to 2.74% in 2012, showing an apparent inverse U-shaped trend. For the industrial sector, the ratio increased from 3.18% in 2002 to 7.13% in 2007 and then

declined to 4.26% in 2012, with an increase of 1.08 percentage points over the period, always being the most significant among the three industries. Unlike the industrial and agricultural sectors, the service industry was subject to a continuously increased driving effect, with the ratio of related value added increasing from 1.45% in 2002 to 2.83% in 2012. The analysis shows that during the analysis period, though the northeastern region's direct participation level in international labor division slightly declined, its indirect participation in export of eastern coastal areas through NVC labor division climbed to some extent.

5. Conclusions and Policy Suggestions

The paper uses the 2002, 2007 and 2012 embedded input-output data, measures and analyzes the difference between eastern coastal areas and inland provinces in China in economic growth from the perspective of labor division, and comes to the conclusions as follows. (1) The general vertical specialization in different regions in China was improved in 2002–2012, while there were differences in domestic and overseas specialization. (2) The ratio of value added generated by the four regions' participation in NVC and GVC during the analysis period showed an inverse U-shaped trend and increased slightly, and NVC, rather than GVC, played a more important role in the economic development of these regions. (3) The four regions of China mainly relied on local production to drive their local economic growth, but related growth was lower than the overall economic growth. On the contrary, participation in NVC and GVC labor division was an important driver of China's rapid economic growth. (4) As enterprises in the eastern region mostly participated in international labor division by processing trade, the driving effect of export of eastern coastal areas on inland provinces was insignificant and mainly reflected in industries such as agriculture, mining, and production and supply of power, heat, water and gas. It showed that inland provinces mainly participated in international labor division indirectly by providing the eastern region with energy and raw materials.

Based on the conclusions, the paper proposes the following policy suggestions.

First, while opening up to the outside, the eastern region should further open up to the inside of China. China's eastern coastal areas have been long participating in international division of labor through processing trade, resulting in a much higher proportion of foreign value added than that of inland value added in its export commodities and thus an insignificant driving effect on economic development of inland provinces. Therefore, while opening up to the outside, the eastern region should further open up to inland provinces.

Second, it is important to promote regional integration, break administrative barriers among different regions in China and accelerate the circulation of commodities, especially intermediate products, in the domestic market. The study in this paper shows

that circulation of intermediate products in the domestic market is the prerequisite of constructing the NVC. In China, local protectionism has long been prevailing, making it difficult to form a unified domestic market and increasing the circulation cost of commodities. Therefore, currently, it is important to enhance the building of coordination mechanisms among different regions and promote regional integration.

Third, the eastern region, along with its own industrial transformation and upgrade, should drive the upgrade of inland provinces in the GVC. The study in the paper points out that China's inland provinces indirectly participate in international labor division mainly by providing the eastern region with energy and raw materials. Therefore, in addition to its own industrial transformation and upgrade, the eastern region should drive the upgrade of inland provinces in the GVC through industrial transfer, technological diffusion, etc.

Fourth, against the background of de-globalization, it is imperative to construct a complete NVC to resist the risk of external impact. This study indicates that under the impact of the 2008 financial crisis, vertical specialization of different regions in China gradually changed from being external-oriented to internal-oriented. But in general, the current NVC construction in China is immature, and labor division and cooperation among different regions remain at a low level. Consequently, in order to resist the risk of external impact, it is essential to enhance and refine the NVC construction.

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