Slicing up China's regional value chains-based on China interregional input-output model

Zhuoying Zhang:

Academy of Mathematics and Systems Science, Chinese Academy of Sciences
No.55, Zhongguancun East Road, Haidian District, 100190, Beijing, China
Email: zhangzy@amss.ac.cn

Minjun Shi (corresponding author):

University of Chinese Academy of Sciences
Research Centre on Fictitious Economy & Data Science, Chinese Academy of Sciences
No.80, Zhongguancun East Road, Haidian District, 100190, Beijing, China
Email: mjshi@ucas.ac.cn

Acknowledgement

This work is supported by National Natural Science Foundation of China under Grant No. 71303232 and Grant No. 71173212.

Abstract

This paper conducts a comprehensive investigation of the geographic distribution of the value added content of industrial sectors across the 30 provinces in China in the framework of China Interregional Input-Output model 2007. This analysis focuses on elaborating the geographic and sectorial discrepancies in gaining value added along the production chains through slicing up the regional value chains and tracing the sectors contributing to the value added. This decomposed provincial and sectorial analysis contributes to a deeper understanding on regional division of value chains in China and provides more pertinent enlightenment for relevant policy formulations.

Key words

Regional value chains, value added, production chains, interregional input-output, regional disparity, China

1. Introduction

The multiple stages of industrial production no longer take place in the same location in the trend of globalization and regional integration. Fostered by plummeting cost of cross-border/region communication and trade, the economic interaction and production fragmentation among different countries/regions have become unprecedentedly deepened, which is reshaping the economic patterns of the countries/regions. In this context, there is an acute awareness that the economic gains of different countries/regions are usually unevenly distributed along the production chains and this characteristic is usually captured by the concept of value chains. Value chains describes the full range of activities required to bring a product or service from conception, through the intermediary phases of production (involving a combination of physical transformation and the input of various producer services), delivery to final consumers and final disposal after use (Gereffi et al., 2001). Since these activities have increasingly spread over several countries/regions, each region actually contributes differently to the achievement of final products and generates unequal value added accordingly. According to Heckscher–Ohlin model Theory, which was built on David Ricardo's theory of comparative advantage (David Ricardo, 1817) by predicting patterns of commerce and production based on the factor endowments of a trading region, countries will export products that use their abundant and cheap factors of production and import products that use the countries' scarce factors. However, continu-

ous economic growth in country/region depends on the enhancement in productivity and competitiveness from economy of scale and regional specialization. Regional economic growth is accumulative, which means regions with initial advantage tends to gains more benefits in the production process and sustain the advantage (Myrdal, 1957; Kaldor, 1970; Dixon and Thirlwall, 1975). Therefore, investigating the regional and sectoral disparities in gaining value added via a decomposed value chain analysis is conducive to a better understanding on how each region participates in industrial production and how regional economic growth is stimulated from the process.

In recent years, there has been a growing body of studies analyzing the multinational production from the perspective of global value chains (GVCs). The concept of GVC was introduced in the early 2000s and has been successfully applied in capturing characteristics of world economy. Analyses are carried out on particular sectors, such as garments, electronics, automobiles, etc (Gereffi, 1999; Humphrey, J, 2000; Kaplinsky et al, 2002; Humphrey and Memodovic ,2003; Kaplinsky, 2006; Linden, 2007; Sturgeon, et al, 2008; Dedrick, 2010). One of the most classic and widely quoted examples is the study of the iPod's GVC distribution. It is estimated that a third of the output value of iPod is captured by the lead firm in the US. The remaining two-thirds of the value are added in the physical production, of which a major part goes as profits for manufacturing high-valued components. The value added in China by assembling components, testing and packaging the final product is estimated to be no more than three percent of the total profit (Linden, 2007; Dedrick, 2010). Except for the sectorial level analysis, there are also studies concerning about the issues relevant to the division of value added like company competitiveness, industrial upgrading, poverty alleviation, etc (Kaplinsky, 2000; Gereffi et al, 2001; Humphrey and Schmitz, 2002; Kaplinsky, 2005; Godberg et al, 2007; Gereffi and Fernandez-Stark, 2010; Timmer, 2013). In most of the previous studies, the value chain investigations are limited at the macro scope of "global" or "international". The analyses downscaling the value chains into different regions within one country are rare due mainly to the lack of relevant data measuring the economic interactions between different regions. The intra-country study is quite necessary when the study area is a large country like China where the substantial regional variations in natural conditions and economic development levels make different regions function and benefit distinctly along the production chains.

China's industries are unevenly distributed across different provinces and expe-

riencing transitions under the trend of industrial upgrading and transferring in recent years (Shi, et al., 2012). Knowing how the different regions participate in the benefit division inside China is of practical meaning to perceive the causes behind the formation of the distributive pattern as well as the corresponding competences and supporting measures required to upgrade certain region's insertion into the national economy. To this end, this paper conducts a systematic and comprehensive investigation of the geographic distribution of the value added of industrial sectors amongst the 30 provinces in China based on China Interregional Input-Output model 2007. In this study, the economic gains in each region means the value added "created" by the sectors located in each region from the production of final goods, in other words, the value added content embodied in each region's sectoral contribution to fulfil the production of the final goods. The production of final goods includes the production of the goods for domestic final demand and export. Through slicing up the regional value chains and tracing the sectors contributing to the value added, this study contributes to a deeper understanding on regional benefit division throughout the production chains and provides valuable enlightenment for relevant policy formulations in coping with the enlarging economic disparities across regions.

2. Data and Methodology

2.1 Data

The quantitative analysis in this study is based on China Interregional Input-output 2007 (China-IRIO 2007), which was built by the main authors of this paper (Shi and Zhang, 2012). China-IRIO 2007 is currently the latest interregional input-output table available in China. China-IRIO 2007 consists of 30 administrative entities including 22 provinces, 4 municipalities and 4 autonomous regions in mainland China. Hong Kong, Macao, Taiwan and Tibet are not included due to data unavailability. For simplicity, these 30 administrative entities are all called provinces in this study. The standard structure of China-IRIO 2007 is shown in Table 1. The sector classification in the model is shown in Table 3.

Table1. The standard format of China-IRIO 2007

Table1. The standard format of China-IRIO 2007

Output / Input		Intermediate consumption							Final consumption	Export	Import	Error	Total output
		R_1			…	R_{30}			R_1… R_{30}				
		s_1	…	s_{29}	…	s_1	…	s_{29}					
Intermediate input	R_1	s_1			x_{ij}^{RS}				f_{it}^{RS}	E_i^R	M_i^R	ERR_i^R	X_i^R
		…											
		s_{29}											
	…	…											
	R_{30}	s_1											
		…											
		s_{29}											
Value added		v_{hj}^S											
Total input		X_j^S											

2.2 Methodology

The interregional input-output table is a top-down economic model. It uses interregional and inter-sectorial monetary transaction data to account for the interconnections of different industries in different regions, which makes it a preferable tool for cross-region value chain accountings. In the interregional input-output system, the central link between income and consumption is the various stages of production, which can be geographically fragmented. Interregional trade and consumption in one region will lead to income for production factors in other regions, either through importing final products or through the use of intermediates in production process. Then the indirect linkage consumption in these regions will continue generate in other regions, and so on. These indirect effects are usually sizeable when interregional trade in intermediate goods is high. Interregional Input-Output model is a perfect tool in quantitatively capturing these processes.

Assuming the number of regions is *n*, and for each region there are *m* sectors, then the mathematical structure of an interregional input-output system consists of ($m \times n$) linear equations. They show the contribution of the production of one sector of one region to the intermediate and final consumption of all the sectors of all the regions in the form of monetary transactions of goods and services. The standard inter-

regional input-output model is represented by Eq.1

$$X = AX + F \qquad (1)$$

where X is the output matrix; A is the matrix of interregional input coefficients, representing the intermediate demand of industries in one region supplied by another; F is the matrix of final consumption.

China-IRIO 2007 is characterized as import-competitive, the underlying assumption of which is that the imports are competitive with domestic supplies and hence the imports can be incorporated with domestic supplies in each row. In order to separately account the domestically produced part, an import coefficient matrix $\widehat{M}$, the proportions of the imported goods in the total demand, is applied to eliminate the imported goods contained in intermediate demand AX and final demand F. Then Eq. 1 can be rewritten as:

$$X = \left[I - (I - \widehat{M})A\right]^{-1}\left[(I - \widehat{M})F\right] \qquad (2)$$

where $\left[I - (I - \widehat{M})A\right]^{-1}$ is known as the import-excluded Leontief inverse matrix denoting how much output is required to meet one monetary unit of the final consumption. X denotes the matrix of intermediate inputs which is numerically equals to outputs.

Let V be the matrix of value added rate, the value added per unit of production, which denotes the shares in the value of gross production of the value added gained by the region to produce a given product and it is province- industry- specific. Then the value chains can be decomposed as follows:

$$K = V\left[I - (I - \widehat{M})A\right]^{-1}\left[(I - \widehat{M})F\right] \qquad (3)$$

where K is the matrix of value added attributed to the final goods. A typical element in K indicates the value added in the production of final goods by certain sector located in certain region. Thus the decomposition of final goods into the value added by various sectors as well as various regions throughout the value chains is completed.

3. Results

3.1 The geographic decomposition of industrial sectors' value chain

The 17 industrial sectors in China-IRIO 2007 are discriminately analyzed in three subcategories according to sector features: raw material industries[1], manufactur-

[1] Raw material industries refer to the industries providing basic materials (e.g. coal, petroleum,

ing industries[2] and high-tech industries[3]. For clarity and better visualization, the 30 provinces are classified in to 4 main regions: Eastern China, Central China, Western China and Northeastern China (see Table 2 and Appendix A for regional divisions and Table 3 for sector categories).

In 2007, the total value added created in production of the final goods of industrial sectors (the value added content of industrial sectors) of China is 21.2 trillion Yuan, of which the dominant share of 78.5% can be attributed to the production of manufacturing goods. The value added content of raw material industries is less than 0.5 trillion Yuan, holding the least share of 2.3%. The distributional shares of industrial sectors' value added content amongst the four regions is shown in Figure 1. For the whole industrial sectors with no differentiation of subcategories, the value added content gained by Eastern China is 11.2 trillion, 53% of the total, far exceed the share of 26% in Central China. At the subcategory level of the industrial sectors, Eastern China still possesses the largest share of value added content (53%, 49% and 71% for raw material industries, manufacturing industries and high-tech industries, respectively). Northeastern China possesses the smallest share of value added content, with the proportion of no higher than 10% for the three subcategories. The high-tech industries show the most prominent discrepancy in the regional allocation of the value added content: its value added gained by Eastern China far exceeds the summation of the other three regions.

The specific results for provincial distribution of industrial sectors' value added content are provided in Table 2. The top five provinces in gaining value added from industrial production, Henan, Jiangsu, Shandong, Guangdong and Zhejiang, mostly pertain to Eastern China and possess around 50% of the total, in contrast to the five bottom provinces, Ningxia, Hainan, Qinghai, Chongqing and Guizhou, which mostly pertain to Western China with the possessed value added content no higher than 3%. For most provinces, manufacturing industries compose the major part of the total value added content of all the industrial sectors, with the proportion of over 60%. Raw material industries hold the least value added content, mostly no more than 10%. The

minerals, etc.) for other industries to produce products or services.

[2] Manufacturing industries refer to industries associated with formulas and manufacturing recipes, and can be contrasted with discrete manufacturing, which is concerned with bills of material and routing.

[3] High-tech industries refer to industries that incorporate advanced technologies (e.g. advanced telecommunication technologies, computer electronics, etc.).

proportions of value added content held by high-tech industries in certain eastern provinces, like Beijing, Tianjin, Shanghai, Jiangsu and Guangdong are all over 30%, notably higher than other provinces, accord with their comparatively high economic levels and favorable environment for the adoption of advanced technologies, making it capable of seizing high share of value added in high-tech industries. In most western and certain central provinces (like Gansu, Shanxi, Qinghai, Ningxia), the proportions of the value added content held by raw material industries are higher than the national average level. Raw material supply is the substantial way for these provinces to gain value added in industrial production process, reflecting their lower status in the value chain.

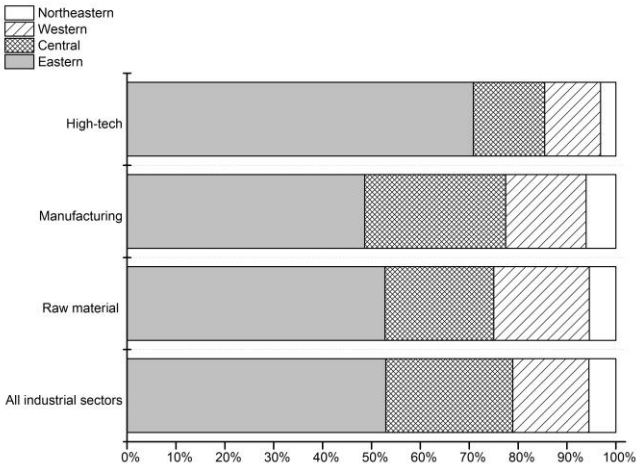

Figure 1 The distributional shares of industrial sectors' value added content amongst the four regions.

Table 2 The provincial distribution of industrial sectors' value added content (Unit: billion Yuan)

Region	Provinces	Industrial sectors	Raw material industries	Manufacturing industries	High-tech industries
Eastern	Beijing	309.3	11.7	181.5	116.1
	Tianjin	434.5	28.0	284.0	122.6
	Hebei	1065.6	16.6	931.0	118.1
	Shanghai	966.1	5.5	666.4	294.3
	Jiangsu	2219.8	52.9	1393.5	773.3
	Zhejiang	1221.8	13.2	996.6	211.9
	Fujian	1093.6	11.7	886.0	195.9
	Shandong	1938.0	102.8	1634.6	200.6
	Guangdong	1889.7	18.4	1032.2	839.1
	Hainan	92.4	0.9	85.3	6.2
Central	Shanxi	500.4	45.2	413.8	41.3
	Anhui	609.2	13.1	479.9	116.2
	Jiangxi	414.6	16.9	319.0	78.6

	Henan	3046.4	25.5	2761.3	259.5
	Hubei	492.9	4.0	438.6	50.3
	Hunan	445.5	5.8	391.8	47.8
Western	Inner Mongolia	388.5	14.3	336.3	37.8
	Guangxi	592.7	7.7	474.8	110.1
	Chongqing	198.8	2.2	170.4	26.3
	Sichuan	552.0	6.5	455.6	89.9
	Guizhou	202.3	5.7	167.4	29.1
	Yunnan	287.4	4.4	249.7	33.4
	Shaanxi	444.4	12.7	367.4	64.3
	Gansu	238.6	28.6	187.2	22.9
	Qinghai	114.3	4.4	97.6	12.3
	Ningxia	79.8	3.2	65.7	11.0
	Xinjiang	203.8	7.2	169.3	27.2
Northeast-ern	Liaoning	648.4	10.6	553.4	84.4
	Jilin	235.4	3.8	214.1	17.5
	Heilongjiang	285.6	12.5	248.4	24.6
Total		**21211.7**	**496.1**	**16652.9**	**4062.7**

3.2 The interregional decomposition of industrial sectors' value chain

The value added obtained by a region is composed of two parts: intra-regional value added (the value added created from local production processes using local intermediate inputs) and interregional value added (the value added created from the process of providing local intermediate inputs to other regions' production processes). In this section, the intra-regional value added and interregional value added are decomposed from each region's total gains in value added to investigate how the cross-region commodity exchange contributes to regional gains in value added.

In the 21.2 trillion Yuan of value added created in production of the final goods of industrial sectors in China, 9.7 trillion Yuan is attributed to interregional value added, accounting for 46% of the total. The share of interregional value added in Western China is 65.4%, the highest of the four regions, followed by Northeastern China of 51.9%. The share of interregional value added in Eastern China is the lowest of the four regions (Figure 2). At the provincial level, the provinces with high shares of interregional value include: Qinghai, Guangxi, Xinjiang, Anhui, and Shaanxi, the shares of interregional value added of which are over 70%. On the contrary, the provinces like Guangdong, Hainan, Zhejiang, etc. have their shares of interregional value added less than 30%. The results of the interregional decomposition of value added reveal that the share of interregional value added has roughly reversed relationship with the region's economic status. For the economically developed provinces in Eastern China, the essential contribution to their

regional value added formation comes from inside, while the economically underdeveloped provinces in Western China mainly depend on their interregional economic actions with outside. The results also verify the significance of interregional economic correlation based on cross-region commodity exchange to regional accumulation in value added from industrial production.

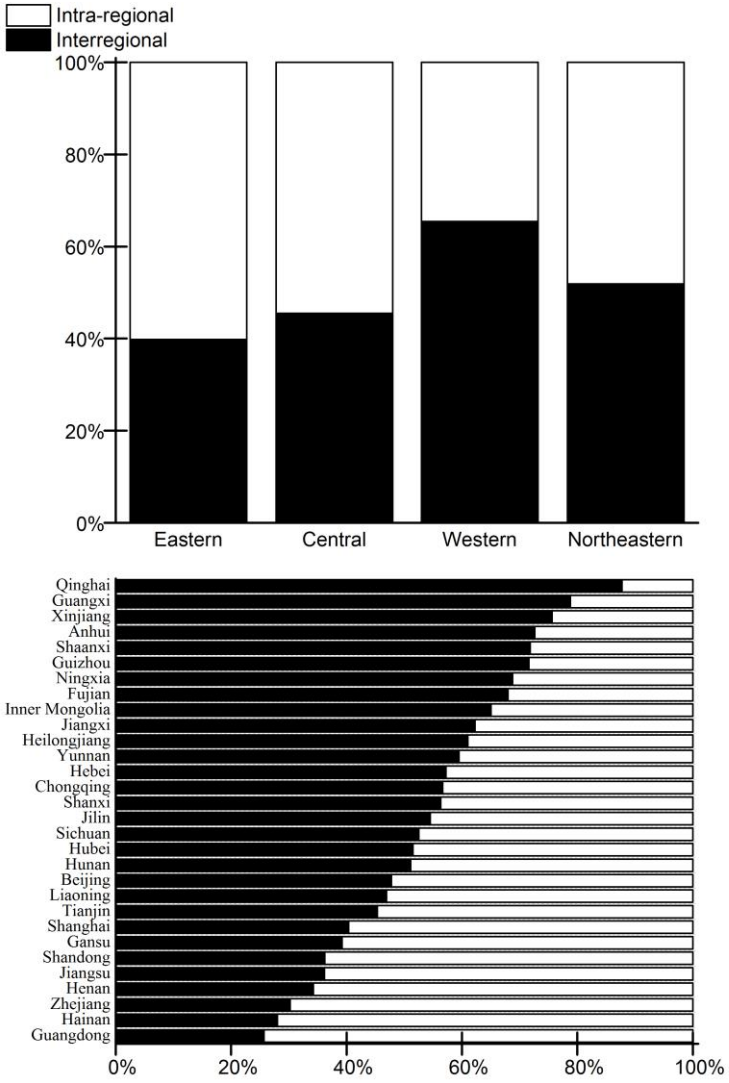

Figure2 The interregional shares of the value added content in each region

3.3 The sectoral decomposition of industrial sectors' value added chain

This section aims to make clear the sectoral variations in contributing to value added gaining by tracing the sectoral composition of the value added content at different scales of sector categories.

How the industrial sectors' value added content is distributed across different

sectors is demonstrated in Figure 3. In the 21.2 billion Yuan of the value added content of the whole industrial sectors, 53% is created in manufacturing industries, followed by service sectors of 18%, raw material industries of 10%, high-tech industries of 9% , agriculture of 5% and other industries of 5%. At the subcategory level, the value added content is predominantly concentrated in the intra-sectoral part: 51% of the value added content of raw material industries is created in raw material industries and that figure for manufacturing industries and high-tech industries are 61% and 41%, respectively. It is notable that the value added content created in high-tech industries is at a low amount, with its share of 1.8% in the total value added content of raw material industries and 2% in the total value added content of manufacturing industries.

The sectoral distribution of industrial sectors′ value added is remarkably unbalanced. The top five principle sectors in composition of the whole industrial sectors′ value added content includes 16-SPM, 14-CMP, 28-CTC, 21-CCE and 18-MSM, accounting for 42% of the total. Three sectors out of the five sectors pertain to manufacturing industries, one pertains to high-tech industries and one pertains to service sectors. The traditional manufacturing industries (like 16-SPM, 14-CMP, etc.) are the main forces in the value added composition. The same distributional feature can be observed in the three subcategories of industrial sectors. Nevertheless, it should be noted that some service sectors (like 27-FTS, 28-CTC) undertake important roles in the value added composition. The specific results on how the value added content of the whole industrial sectors as well as the subcategories are distributed among different sectors are shown in Table 3.

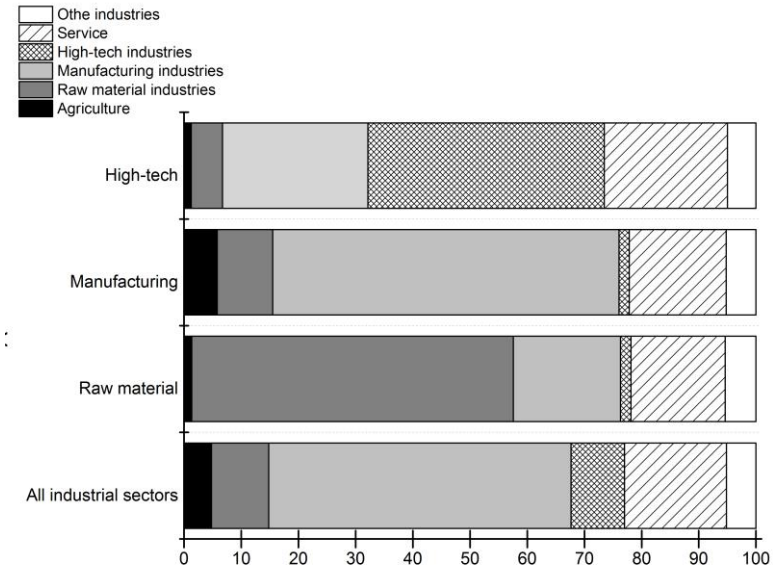

Figure 3 The distributional shares of industrial sectors' value added content amongst different sectors

Table 3 The sectoral distribution of industrial sectors' value added content (Unit: billion Yuan)

Sectors			Industrial sectors	Raw material industries	Manufacturing industries	High-tech industries
Agriculture	1-AGR	Agriculture	**622**	3	592	27
	2-FRT	Forestry	**82**	2	74	7
	3-AMH	Animal husbandry	**243**	1	232	10
	4-FSR	Fishery	**73**	0	66	6
Raw material industries	5-CMD	Coal mining and dressing	**617**	96	447	74
	6-PGE	Petroleum and natural gas extraction	**628**	103	465	60
	7-MMD	Metal minerals mining and dressing	**783**	58	647	78
	8-NMD	Nonmetal minerals mining and dressing	**88**	22	56	10
Manufacturing industries	9-FDP	Food processing	**1184**	3	1152	30
	10-TWL	Manufacture of textile wearing apparel and leather	**1087**	5	1049	33
	11-PTF	Processing of timber and manufacture of furniture	**291**	3	275	14
	12-PPP	Manufacture of paper and paper products	**329**	2	281	46
	13-PPC	Processing of petroleum and coking	**616**	11	541	63
	14-CMP	Manufacture of raw chemical materials and chemical products	**1581**	19	1292	270
	15-NMP	Manufacture of non-metallic mineral products	**400**	5	329	66
	16-SPM	Smelting, pressing of metals	**3248**	23	2885	340
	17-MPD	Metal products	**520**	5	420	95
	18-MSM	Manufacture of special purpose machinery	**1267**	12	1201	54
	19-TPE	Manufacture of transport equipment	**691**	4	665	22
High	20-EME	Manufacture of electrical machinery	**640**	4	153	483

-tech in-dustries		and equipment				
	21-CCE	Manufacture of communication equipment, computers and other electronic equipment	**1346**	5	145	1196
Other in-dustries	22-OMS	Other manufacturing sectors	**241**	3	191	47
	23-EHP	Production and supply of electric power and heat power	**780**	22	616	142
	24PSG	Production and supply of Gas	**23**	0	19	4
	25-PSW	Production and supply of water	**22**	1	17	5
	26-CTR	Construction	**30**	1	23	5
Ser-vice	27-FTS	Freight transport and storage	**1133**	31	878	225
	28-CTC	Commerce, tourism and catering services.	**1493**	23	1088	382
	29-OSV	Other services	**1152**	28	855	269
Total			**21212**	**496**	**16653**	**4063**

4. Discussion

4.1 Regional discrepancy in the capacity of gaining value added

The results in this study indicate that different regions in China benefit distinctively from industrial production. Eastern China, the most economically developed region in China, holds the substantial share of the value added content of the industrial sectors. By contrast, Western China and Northeastern China are at the unfavorable status in gaining value added from industrial production. This can be attributed to regional discrepancy in the capacity of gaining value added, which can be reflected by regional averaged value added rate, the proportion of regional value added in total production. Compared with other regions, Eastern China has higher capacity in gaining value added from industrial production: from 1000 Yuan of industrial production, Eastern China can obtain 676 Yuan of value added, more than the other regions (654 Yuan, 628 Yuan, and 534 Yuan in Central China, Western China and Northeastern China, respectively) to enhance its local regional economic growth (Table 4).

A region's capacity of gaining value added is relevant to the role the region plays along the industrial production chains. In current China, different regions are at disparate phases of industrial development and play distinctive roles in involving in the interregional industrial production chains. By looking at the value added compositional structures in each province, it can be observed that although the manufacturing industries hold the largest share of value added in nearly all the provinces, there is evident distinction between eastern provinces and western and northeastern provinces. For the former, the portions of raw material industries which generally attach less value added from industrial production are quite low (no more than 5%), while the portions of high-tech industries which attaches higher value added are remarkably

higher than other provinces all around the country. The opposite can be observed for the latter. As intelligence-oriented industries, high-tech industries' development requires sufficient "soft" supports like extensive scientific knowledge reserve, advanced operational technology, developed information network, sound atmosphere for innovation, etc., as well as sophisticated "hard" supports like favorable infrastructure, satisfactory production and living environment, etc. Compared with western and northeastern provinces, eastern provinces have higher capability in providing those prerequisite supports for high-tech industries, making the high-tech industries in those provinces able to create considerable share of value added. This somehow proves the broad Heckscher-Ohlin predictions still hold: regions carry out those tasks in regional value chains using factors they are relatively intensive in.

The ultimate goal for production is to trigger the engine of inner economic growth. The developing advantages of the region with high capacity of gaining value added will be continuously be maintained and strengthened under the cumulative effect of markets (Myrdal, 1957). In the meantime, the regions with low capacity of gaining value added will stay at the unfavorable status in getting benefits and achieving internal economic growth. The regional economic disparity between eastern provinces and western and northeastern provinces tends to enlarge if no effective measures are carried out. Since 2000 and 2003, Chinese central government has started "West Development Strategy" and "Northeast Revitalization Strategy" in succession to enhance industrial restructure and economic development in western and northeastern provinces. However, the results of this study reveal that the capacity of gaining value added of these provinces still has great room to improve to benefit more from industrial production.

China is now standing at a new historical changing point of a geographic transfer of manufacturing sectors from eastern provinces to central and western provinces. During the past 30 years after China economic reform, the eastern provinces have achieved great economic prosperity and made positive contribution for national economic growth. However, their economic development mainly depended on labor-intensive and environment-unfriendly industries, which are increasingly exposing their deficiencies in innovation and development mode. The excessively concentrated industries in the eastern provinces occupied massive amount of resources and resulted in the rise in the production factors (e.g., high labor cost, land over-demand, resources scarcity, etc.), which constrains the competitiveness of high-value added industries. In

this context, the space of gaining profit from the traditional industries will gradually shrink. In order to sustain the economic growth in the new era, the eastern provinces is motivated to upgrade the industrial structure through moving out the industries of less competence and lower value added and enhance the industries with independent innovation, core competitiveness and high value added. It is predictable that the capacity of gaining value added in the eastern countries will continuously grow in the future. However, on the other side, the regional policy of moving the sectors of low competence and value added to the underdeveloped areas might worsen the unfavorable status of these provinces in the benefit division and thus fade the policy effect of alleviating regional disparity. The fundamental way to alleviate regional disparity lies on western and northeastern provinces' industrial upgrading based on the transferred industries from eastern provinces. Besides, as mentioned in section 3.3, interregional economic interaction is the significant source for the underdeveloped regions to gain value added. The interregional cooperation in western and northeastern regions should be appropriately encouraged to realize their improvement in the capacity of gaining value added..

Table 4 The averaged value added rate in each province and region.

Region	Provinces	Value added	Gross production	Averaged value added rate)	Value added	Gross production	Averaged value added rate
		A	B	A/B	C	D	C/D
Eastern China	Beijing	309.3	457.6	0.68	11230.8	16602.0	0.676
	Tianjin	434.5	624.0	0.70			
	Hebei	1065.6	2401.8	0.44			
	Shanghai	966.1	1382.5	0.70			
	Jiangsu	2219.8	2992.7	0.74			
	Zhejiang	1221.8	1657.4	0.74			
	Fujian	1093.6	1639.2	0.67			
	Shandong	1938.0	2693.4	0.72			
	Guangdong	1889.7	2610.8	0.72			
	Hainan	92.4	142.6	0.65			
Central China	Shanxi	500.4	810.6	0.62	5508.9	8419.4	0.654
	Anhui	609.2	911.1	0.67			
	Jiangxi	414.6	729.5	0.57			
	Henan	3046.4	4512.5	0.68			
	Hubei	492.9	733.3	0.67			
	Hunan	445.5	722.4	0.62			
Western China	Inner Mongolia	388.5	635.3	0.61	3302.5	5257.7	0.628
	Guangxi	592.7	976.4	0.61			
	Chongqing	198.8	319.3	0.62			
	Sichuan	552.0	795.8	0.69			
	Guizhou	202.3	341.1	0.59			
	Yunnan	287.4	442.9	0.65			
	Shaanxi	444.4	638.2	0.70			
	Gansu	238.6	414.7	0.58			

	Qinghai	114.3	197.0	0.58			
	Ningxia	79.8	156.9	0.51			
	Xinjiang	203.8	340.3	0.60			
North-eastern China	Liaoning	648.4	1264.6	0.51	**1169.4**	**2188.7**	**0.534**
	Jilin	235.4	446.0	0.53			
	Heilongjiang	285.6	478.1	0.60			

4.2 The participation of service sectors in industrial sectors' value chain

The results of sectoral decomposition reveal that the share of the service sectors in composing the value added created from industrial production is at a relatively low level (Raw material industries: 16%; Manufacturing industries: 17%; High-tech industries: 22%), which reflects the service sectors in China have not fully participated in the benefit division along the industrial production chain. In nowadays, the service sectors are more and more closely fused in the industrial sectors than ever before. More and more industrial products are bundled with corresponding services to provide the consumers complete functional experience including not only the tangible products but also a serial of services covering the process of purchasing, using, maintaining and recycling. In other words, the connotation of the industrial products has extended from simplex entity to a set of comprehensive solutions. It is particularly typical in high-tech industries (e.g., the sale of computer is usually bound with system software operation and relevant technical services.). The practice of modern economy indicates that it is the general trend for the industrial enterprises to transfer their business to the services in the upstream or downstream of the production value chains to maintain the product advantage and economic benefit under fiercely commercial competition. In Many international industries, the value added created from the stage of pure manufacturing is decreasing, whereas the value added created from the accessory services has exceeded that of the products. For instance, in the General Electric Company, 85% of which are traditional industries, its revenue from "technology, management and services" accounts for 70% of the total. Another example is IBM, which used to be a hardware manufacturer, now 55% of its global total revenue attributes to IT service (21th Century Business Herald, 2009).

However, as shown in the results of this study, the industries of China are still at the primary stage of the transition from product oriented economy to the service oriented economy, reflected by the high share of the industrial sectors (especially manufacturing industries) in composing the industrial value added content. The reasons for the service sectors having not fully participated in the industrial sectors' value chains

in China includes: 1) The competition strategy of industrial sectors mostly depends on advantage in factor cost rather than technology advancement and service upgrading, making the production chains concentrated on entitative products but confines the participation of service sectors. 2) Insufficient interconnection between export-oriented manufacturing industry and local service sectors. As the "world manufacturing factory", China substantially holds the session of manufacturing and processing in the global production system of multinational corporations, most of which greatly depend on foreign technology services and marketing system. Its production session and service session are usually isolated, restricting the production chains extending to domestic service sessions. 3) Lack of appropriate policy in support of the establishment of the satisfactory environment for the integrated development of industries and services.

5 Concluding remarks

Regional value chains within a nation are a newly emerging conception in the context of regional integration. It provides a new perspective to investigate how a region participates in the production chains and achieves value accumulation throughout the process. Through slicing up China's regional value chains, this study contributes to a better understanding on regional and sectoral benefit division throughout the value chains. The main findings include:

- The distribution of industrial sectors' value added content is of significant regional discrepancy. The eastern provinces hold the substantial share of industrial sectors' value added from industrial production, whereas the western and northeastern provinces hold the least share of value added content. This reflects regional disparity in the capacity of gaining value added which is relevant to the roles the regions play along the industrial production chains. The eastern provinces have more favorable conditions for industries of high value added rate than western and northeastern provinces. In the trend of geographic transfer of manufacturing sectors, the fundamental way to alleviate regional disparity is to enhance the capacity of gaining value added for the provinces in the western and northeastern areas through industrial structure upgrading. The regional policy to make raw material sectors to transfer into the central and western areas might fade the policy effect of alleviating regional disparity.
- Interregional economic connection plays a significant role for regional accumu-

lation in value added from industrial production. The essential contribution to regional value added formation in eastern provinces comes from inside, whereas the economically underdeveloped provinces in western China mainly depend on their interregional economic interactions with the outside.

- The traditional industries are currently the major part in composition of the value added created from industrial production. High-tech industries have initially shown their significance in composition of the industrial sectors' value added creation in eastern provinces. Service sectors have not fully participated in the benefit division of the industrial sectors. In the future, the functions of those high-value-added sectors will be further strengthened with the advancement in industrial upgrading and establishment of relevant policy supports.

It should be noted that this study is a preliminary attempt to investigate the distributional patterns of the value chains of the industrial sectors. A further step to advance the study would be a quantitative analysis of how the current pattern in value added distribution are formed, which would provide more comprehensive information to deepen our understating of the determinants in behind and be conducive for more pertinent policy implications.

Appendix A. The division of the four regions and their geographic locations

References

21th Century Business Herald, November 13th, (2009). http://www.21cbh.com/.

DEDRICK, J., KRAEMER, K.L. and LINDEN, G. (2010), Who Profits From Innovation in Global Value Chains? A Study of the iPod And Notebook PCs", *Industrial and Corporate Change*, 19(1), 81-116.

Dixon, R.J, Thirlwall, A. P.1975. A model of regional growth rate differentials along kaldorian lines. Oxford Economic papers, 27:201-214.

GEREFFI, G. (1999), International Trade and Industrial Upgrading in the Apparel CommodityChain, *Journal of International Economics*, 48(1), 37-70.

GEREFFI, G. and FERNANDEZ, S. K. (2010). The Offshore Services Value Chain: Developing Countries and the Crisis. In CATTANEO, O., GEREFFI, G. and STARITZ, C. (Eds), *Global Value Chains in a Postcrisis World. A Development Perspective.* Washington, D.C., The World Bank.

GEREFFI, G., HUMPHREY, J., KAPLINSKY, R. and STURGEON, T.J. (2001). Introduction: Globalisation, Value Chains and Development. IDS Bulletin, 32 (3), 1-8.

GOLDBERG, P. K. and PAVCNIK, N. (2007). Distributional Effects of Globalization in Developing Countries, Journal of Economic Literature, 45(1), 39-82.

Heckscher, Eli, "The Effects of Foreign Trade on the Distribution of Income," in Heckscher-Ohlin Trade Theory,, Harry Flam, and June Flanders, eds. (Cambridge, MA: MIT Press, 1991).

HUMPHREY, J. (2000). Assembler-Supplier Relations in the Auto Industry: Globalization and National Development, Competition and Change, 4(3), 245-271.

HUMPHREY, J. and MEMODOVIC, O. (2003) The global automotive industry value chain: whatprospects for upgrading by developing countries? *Sectoral Studies Series*, Vienna: United Nations Industrial Development Organization.

HUMPHREY, J. and SCHMITZ, H. (2002). How does insertion in global value chains affect upgrading in industrial clusters. *Regional Studies*, 36(9), 1017-1027.

Kaldor, N. 1970. The case for regional policies. Scottish Journal of Political Economy, 18: 337-348.

KAPLINSKY, R. (2000). Globalisation and Unequalisation: What Can Be Learned from ValueChain Analysis? *Journal of Development Studies*, 37(2), 117-146.

KAPLINSKY, R. (2005). Globalization, Poverty and Inequality. Cambridge: Polity Press.

KAPLINSKY, R. (2006). How can agricultural commodity producers appropriate a greater share of value chain incomes? In SARRIS, A. and HALLAM, D. (Eds) Agricultural Commodity Markets and Trade: New Approaches to Analyzing Market Structure and Instability. Cheltenham, Edward Elgar and FAO.

KAPLINSKY, R., MORRIS, M. and READMAN, J. (2002). The globalization of product markets and immiserizing growth: lessons from the South African furniture industry. *World Development*, 30(7), 1159-1177.

LINDEN, G., KRAEMER, K. L., DEDRICK, J. (2007) Who Captures Value in a Global Innovation System? The case of Apple's iPod., Personal Computing Industry Center (PCIC) Working paper, June, Irvine: University of California.

Myrdal, G. 1957. Economic theory and underdeveloped regions. London: Duckworth.

Ohlin, Bertil Gotthard, Interregional and international trade (Cambridge,: Harvard University Press, 1933).

Ricardo, D, 1817, Principles of Political Economy and Taxation, reprinted by J.M. Dent, London, in Everyman's Library, 1911

SHI, M. J., YANG, J., LONG, W., WEI, Y. H.（2013）. Changes in geographical distribution of Chinese manufacturing sectors and its driving forces. *Geographical research*. 32(9), 1708-1720.

SHI, M.J., ZHANG, Z. Y. (2012). The construction of China Interregional Input Output model 2007. *Report of Research Centre on Fictitious Economy & Data Science,* Chinese Academy of Sciences, Beijing.

STURGEON, T., BIESEBROECK, J. V., and GEREFFI, G. (2008). Value chains, networks and clusters: reframing the global automotive industry, *Journal of Economic Geography*, 8(3), 297-321.

TIMMER, M., LOS, B., STEHRER, R. and VRIES, G. (2013). Fragmentation, incomes and jobs: an analysis of European competitiveness. *Economic Policy*. 28(76), 613–661.