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Empirical Study on Effect of Industrial Structure Change on Regional Economic Growth of Beijing-Tianjin-Hebei Metropolitan Region

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Abstract: Based on the data of gross domestic product (GDP), industrial added value and the proportion of industrial employees from 2000 to 2008, this paper studies the effect of industrial structure change on the regional economic growth of Beijing-Tianjin-Hebei Metropolitan Region in China using the shift-share method. The results show that: 1) In the 21st century, the industrial output of three industries, namely, primary, secondary, and tertiary, and the GDP grew rapidly in the study period. The tertiary industry grew the fastest; it had the largest contribution to the GDP and meanwhile had become the most competitive industry in the metropolitan region. 2) The development of cities within the region was not balanced. Firstly, compared with Tianjin, Beijing, as one of the two core cities, was more rational in the industrial structure. Secondly, the surrounding eight cities, which are Shijiazhuang, Qinhuangdao, Tangshan, Langfang, Baoding, Cangzhou, Zhangjiakou, and Chengde, were all uncompetitive than the two core cities. 3) There was a great industrial gradient in the region (especially between the two core cities and the cities of Tangshan, Baoding, Zhangjiakou, Chengde, Cangzhou, and Langfang). As a result, it is foreseeable that the industry transfer in the Beijing-Tianjin-Hebei Metropolitan Region will be one of the trends in regional development, and the industry transfer is inevitably to promote the regional integration.

Keywords: Beijing-Tianjin-Hebei Metropolitan Region; economic growth; shift-share analysis; industrial structure

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1 Introduction

Since the onset of the 21st century, regional economic development in China has been characterized by the emergence of urban agglomeration. Under the ″Eleventh Five-year Plan″ issued by the National Development and Reform Commission of the People″s Republic of China, the Beijing-Tianjin-Hebei (Jing-Jin-Ji) Region, one of the typical megalopolises or global city regions in the East Coastal of China, is given more attention (Yu, 2006). Over the past few years, inter-city cooperation within the Beijing-Tianjin-Hebei Metropolitan Region has been promoted, and all three regions have issued a series of policies concerning regional integration. For example, to achieve rapid and sound development of urban economy, Beijing proposed a policy to speed up the significant adjustment of its economic structure and transform its growth mode. Tianjin and Hebei adopted the same policy.

Regional economic development is reflected by not only the growth of the overall economy but also the adjustment and optimization of the industry structure. Regional division of labor and rational spatial distribution of regional industrial structure are very significant to regional development. Many economists found that with economic growth, the economic contribution of the primary industry would decline gradually, but those of the secondary and tertiary industries would increase gradu-

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ally (Kuznets, 1985; Chenery, 1991). In China, interests in the regional economic development of the Beijing-Tianjin-Hebei Metropolitan Region have increased rapidly in the past decade (Li *et al*., 2004). Recently, more scholars have studied the regional economic growth in China from the perspective of technology spillovers (Tian *et al.*, 2010), exports, and foreign direct investments (Gao, 2004). These scholars put forward recommendations from different perspectives to achieve the balanced development of Beijing-Tianjin-Hebei Region. For example, Li *et al.* (2004) took the Beijing-Tianjin-Hebei Megalopolis as a case to study the economic relationship within the region, focusing on the industrial structure, spatial structure, and division of labor, and analyzed the economic, social, ecological, and spatial development statuses and trends from three spatial scales. Sun and Deng (2006) agreed that the regional difference enlarged much in Beijing-Tianjin-Hebei region since 1990, and the cooperative development of regional economy can be realized possibly through reducing regional disparities, strengthening the development of tertiary industry and improving the traffic conditions in Hebei Province. Quan and Yang (1999) and Dai (2000) emphasized the promotion of regional integration to accelerate regional cooperation within the Beijing-Tianjin-Hebei Metropolitan Region. Shi and Luo (2007) suggested developing industrial clusters to achieve regional cooperation. In addition, using census data on the first economic analysis, Liu and He (2007) analyzed the convergence of industrial structure in Beijing-Tianjin- Hebei. The results showed that there was similarity among the industrial structures of the 13 cities in Beijing-Tianjin-Hebei Metropolitan Region; however, the degree of similarity decreased significantly with further industrial subdivision.

The literature above-mentioned showed that the industrial structure had an important influence on regional economic development. However, the metropolitan region is a complex region involving economic, social, spatial, and the other characteristics. There are still many theoretical issues to be resolved, such as how to measure the regional cooperation from the changes in industrial structure, and how to measure the influence industrial structure change on regional economic growth.

This paper analyzed the effect of industrial structure change on regional economic growth in Beijing-Tianjin-Hebei Metropolitan Region using shift-share analysis. Furthermore, applying the data of the proportion of industrial employees, this paper studied the internal structure of industry and cities′ functions.

2 Materials and Methods

2.1 Study Area

The Beijing-Tianjin-Hebei Metropolitan Region covers two municipal cities, Beijing and Tianjin, and eight cities in Hebei Province, namely, Shijiazhuang, Qinhuangdao, Tangshan, Langfang, Baoding, Cangzhou, Zhangjiakou and Chengde (Fig. 1). Considering the non-agricultural characteristics of an urban economy, this paper mainly confines its subject to city area only. Entering the 21st century, the inter-city cooperation within the Beijing-Tianjin-Hebei Metropolitan Region is significantly accelerating. In 2009, the GDP of Beijing exceeded 1.2×10^{12} yuan, and that of Tianjin exceeded 7.5×10^{11} yuan, while the GDP of the eight cities in Hebei Province above-mentioned were relatively lower.

Although the Beijing-Tianjin-Hebei Metropolitan Region has been regarded as an integral geographical unit since the 1980s, the regional division of labor among the cities has been unsatisfactory. In fact, the functional polycentric structure with reasonable labor and market divisions is far from forming. Competition among cities in the metropolitan area was becoming fiercer (Tang and Xu, 2008). Some studies showed that the Beijing-Tianjin-Hebei Metropolitan Region experienced a period of rapid development in the beginning of the 21st century (Chen and Li, 2010). From 2000 to 2008, the amount of GDP and industrial output showed a tendency of rapid growth. The average annual growth rates of the primary, secondary, and tertiary industries in the Beijing-Tianjin-Hebei Metropolitan region stood at 13.7%, 20.1% and 24%, respectively. The average annual growth rate of GDP stood at 22% (Table 1).

Based on the GDP data (Table 1), the contributions of the three industries to regional economic grow are shown in Fig. 2.

From 2000 to 2008, the contribution of the industry to the economic growth in Beijing-Tianjin-Hebei Metropolitan Region showed the following characteristics: the contribution of the primary industry to the regional economic growth was gradually reduced; the contribution of the tertiary industry to the regional economic

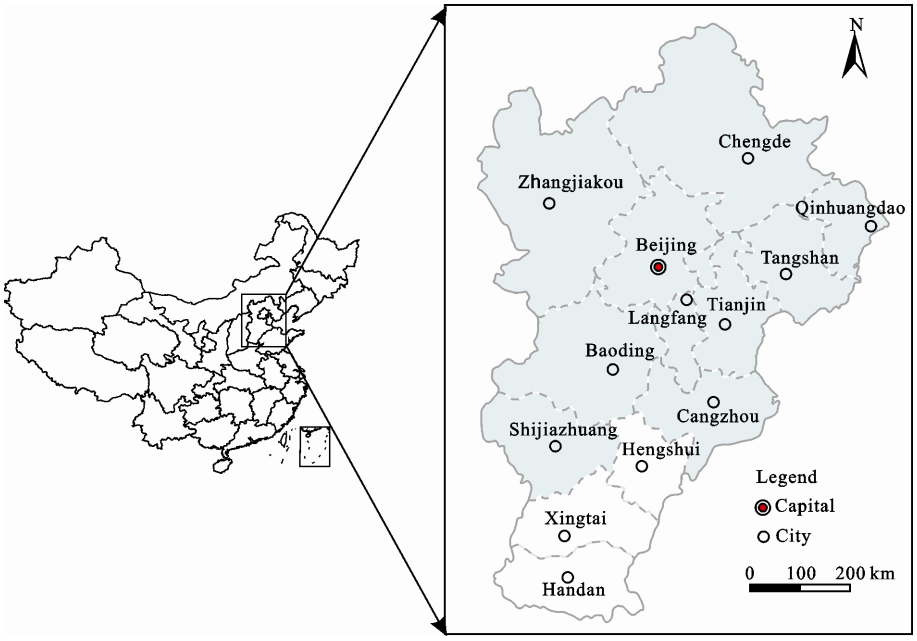


Fig. 1 Beijing-Tianjin-Hebei Metropolitan Region

Table 1 Basic data in Beijing-Tianjin-Hebei Metropolitan Region in 2000 and 2008 ($\times 10^9$ yuan)

City	GDP		Primary industry		Secondary industry		Tertiary industry	
	2000	2008	2000	2008	2000	2008	2000	2008
Beijing	233.231	1032.515	6.297	9.086	87.928	263.601	139.005	759.931
Tianjin	139.288	590.957	3.621	8.037	69.783	357.470	65.883	225.450
Shijiazhuang	41.773	113.901	0.501	0.718	19.592	41.278	21.680	71.906
Tangshan	29.574	180.773	1.006	8.659	19.075	106.132	9.493	65.982
Qinhuangdao	15.870	47.233	0.524	0.581	5.888	17.911	9.458	28.736
Baoding	13.641	39.108	0.396	0.641	6.643	21.822	6.602	16.644
Zhangjiakou	11.668	28.673	0.210	0.571	5.659	16.883	5.799	11.220
Chengde	5.327	18.049	0.112	0.375	3.596	11.727	1.619	5.947
Cangzhou	6.019	24.385	0.102	0.429	3.292	13.321	2.624	10.634
Langfang	7.331	23.503	0.946	1.744	3.057	10.682	3.335	11.077

Source: National Bureau of Statistics of China (2002, 2010)

growth increased rapidly. So far, the tertiary industry had become the main pillar of economic development of the Beijing-Tianjin-Hebei Metropolitan Region.

2.2 Data sources

Considering the background of the Beijing-Tianjin-Hebei regional cooperation, the period covered by this study is between 2000 and 2008. Using data on Beijing-Tianjin-Hebei Metropolitan Region from the China Statistical Yearbook of 2001–2009 (National Bureau of Statistics of China, 2001–2009) and the Regional Eco-

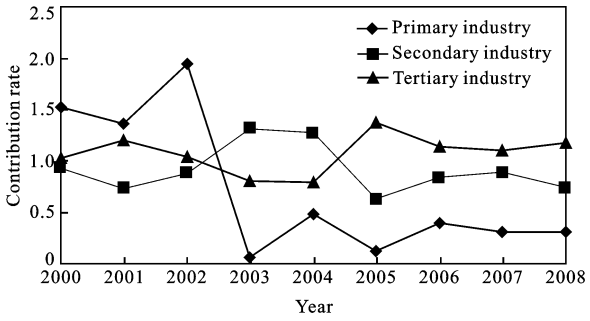


Fig. 2 Contribution rate of three industries to economic growth of Beijing-Tianjin-Hebei Metropolitan Region

nomic Statistical Yearbook of 2001–2009 (National Bureau of Statistics of China, 2003–2010).The data applied in this study are calculated at current prices.

2.3 Analysis methods

The relationship between regional growth and industrial structure is often analyzed and decomposed into various effects using the method called shift-share analysis. The shift-share method (SSM) is a useful technique to analyze the regional economy in economic geography and regional science. This study uses the SSM to analyze the effect of industrial structure on the regional economic growth and decompose the economic growth of Beijing-Tianjin-Hebei Metropolitan Region into regional share component, the industrial mix component and competitive component.

According to shift-share analysis (Cui *et al*., 2006), the total regional economic growth (G) is the sum of regional share component (N), industrial mix component (P) and competitive component (D). The specific content of the three components is described as follows:

(1) Regional share component:

$$N = \sum B_i^0 R \tag{1}$$

where N denotes the regional economic growth of a certain region at the GDP growth rate of the entire study area; B_i^0 denotes the output of industry i at the base period; R denotes the GDP growth rate of the entire region. The equation means that compared with the actual growth, if the assumed growth is higher, the total deviation from the entire region studied is positive and otherwise negative.

(2) Industrial mix component:

$$P = \sum B_i^0 R_i^0 - \sum B_i^0 R = \sum B_i^0 (R_i - R) \tag{2}$$

where P denotes the differences between the growth of industry i at the actual growth rate and the growth of industry i at the regional GDP growth rate; R_i denotes the growth rate of industry i. This means that if $P > 0$, the region is dominated by a fast-growing industry; if $P < 0$, the region is dominated by a backward or declining industry.

(3) Competitive component:

$$D = \sum B_i^0 r_i - \sum B_i^0 R = \sum B_i^0 (r_i - R_i) \tag{3}$$

where D denotes the differences between the growth of industry i at the actual growth rate and the growth of industry i at the regional industry growth rate; r_i denotes the growth rate of industry i in the study area.

The relationship of the three components can be described by the following equation:

$$G = N + P + D = \sum B_i^0 R + \sum B_i^0 (R_i - R) + \sum B_i^0 (r_i - R_i) \tag{4}$$

where G denotes the amount of regional economic growth.

Similarly, regional economic growth rate (G_r) can also be divided into GDP growth rate of the entire region R, industrial mix component (R^* — R) and competitive component ($G_r - R^*$):

$$G_r = R + (R^* - R) + (G_r - R^*) \tag{5}$$

Where R^* denotes the regional economic growth achieved through the growth of the three industries at the regional growth rate:

$$R^* = \frac{\sum B_i^0 (R_i + 1)}{\sum B_i^0 - 1} \tag{6}$$

This means that if a region is dominated by a fast-growing industry, (R^*—R) > 0; otherwise, (R^*—R) < 0. If the competitiveness of a region is higher than that of the entire study area, (G_r—R^*) > 0; otherwise, (G_r—R^*) < 0.

3 Results

The following results are obtained based on the SSM (Table 2).

Firstly, tertiary industry led the development of Beijing-Tianjin-Hebei Metropolitan Region, the following two industries were secondary and primary industry. Development within the region is not balanced: the tertiary industry of Beijing was well developed. In 2007, the proportion of three industrial output in Beijing was 1.1∶26.8∶72.1. In 2008, this proportion changed to 0.9∶25.5∶73.6. As a well-established industrial city in China with a long history of industrial development, Tianjin has a good foundation of industry, and its secondary industry has maintained a strong growth in the past 10 years, accounting for the largest share of GDP. However, the tertiary industry lags behind the secondary industry.

In 2008, the proportion of three industrial output value in Tianjin was 1.4∶60.5∶38.2. In the eight cities of

Table 2 Results obtained through shift-share method in 2000–2008

	Total economic growth		Regional share component		Industrial mix component		Competitive component		Total deviation	
	Increment ($\times 10^6$ yuan)	Growth rate (%)	Increment ($\times 10^6$ yuan)	Growth rate (%)	Increment ($\times 10^6$ yuan)	Growth rate (%)	Increment ($\times 10^6$ yuan)	Growth rate (%)	Increment ($\times 10^6$ yuan)	Growth rate (%)
Beijing	79938726	342.75	73871477	316.73	1156072	4.96	4911177	21.06	6067249	26.01
Tianjin	45166900	324.27	44116916	316.73	–510606	–3.67	1560590	11.20	1049984	7.54
Shijiazhuang	7212766	172.67	13230859	316.73	76769	1.84	–6094862	–145.90	–6018093	–144.07
Tangshan	15119908	511.26	9366996	316.73	–466844	–15.79	6219756	210.31	5752912	194.53
Qinhuangdao	3135800	197.59	5026499	316.73	63567	4.01	–1954267	–123.14	–1890700	–119.14
Baoding	2546639	186.69	4320644	316.73	–45782	–3.36	–1728223	–126.69	–1774005	–130.05
Zhangjiakou	1700554	145.75	3695561	316.73	–7982	–0.68	–1987025	–170.30	–1995007	–170.98
Chengde	1272219	238.82	1687248	316.73	–79577	–14.94	–335452	–62.97	–415029	–77.91
Cangzhou	1836627	305.16	1906256	316.73	–29373	–4.88	–40256	–6.69	–69629	–11.57
Langfang	1616463	220.29	2324145	316.73	–156244	–21.29	–551438	–75.15	–707682	–96.44

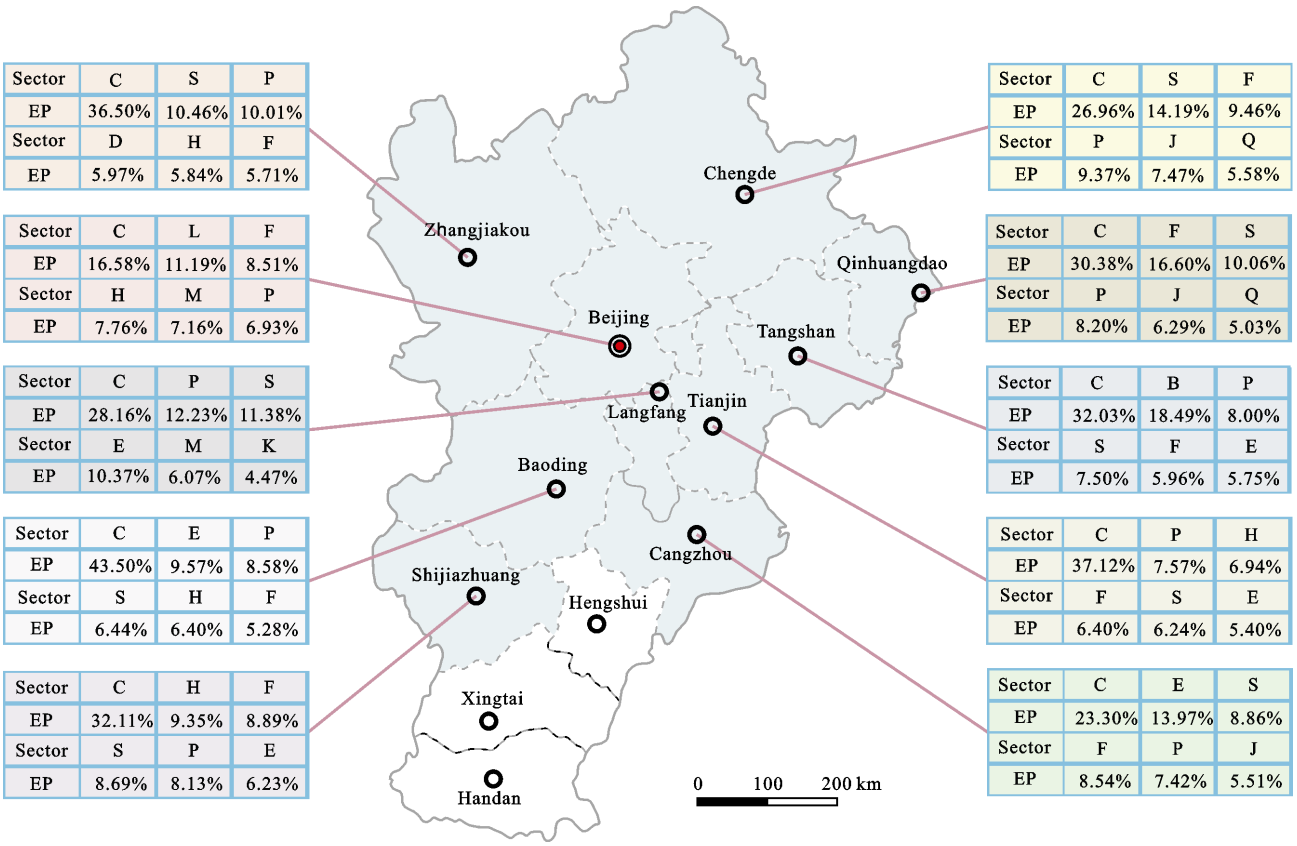
Hebei Province, primary industry is the most developed, followed by the secondary industry. The tertiary industry is considered backward.

Secondly, among the 10 cities covered by the study, only Beijing and Tianjin show positive deviation. Furthermore, Beijing was the only city with positive values for *P* and *D*, indicating that its urban economic development was dominated by the tertiary industry. The results were consistent with the overall trend of regional development. In addition, in the growth rate of the total deviation, competitiveness had the largest contribution at 21.06%. The growth rate of the industrial mix component was 4.96%, indicating that Beijing had the absolute advantage in industrial structure and competitiveness. The industrial mix component in Tianjin was –3.67%, but the competitive component was positive at 11.20%, indicating that although the overall economic competitiveness of Tianjin (measured by the industry structure) was stronger, its tertiary industry lagged behind compared with that of Beijing.

Thirdly, among the eight secondary cities in the region, only Tangshan had a positive total deviation (194.53%). The indexes of the other seven cities are all negative. The industrial mix component for Tangshan was negative at –15.79%, but the competitive component was positive at 210.31%, indicating that the city's economy was the strongest among the eight secondary cities. In contrast, Shijiazhuang and Qinhuangdao were different, as the contributions of their industrial mix components were positive and those of their competitive component were negative. This indicates that the tertiary industry was the most competitive industry in those cities, but their overall economic competitiveness (measured by the industry structure) remained weaker. In the cities of Baoding, Zhangjiakou, Chengde, Cangzhou, and Langfang, both their industrial mix components and competitive components had negative contributions, indicating that their industrial structure and competitiveness were at a disadvantage. Consequently, the total urban economic growth of these cities was less than the economic growth of the entire region.

Industrial structure plays an important role in regional economic development. It reflects a different stage of economic development in different countries or regions. The internal structure of the industry in a region reflects its economic potentials (Tu, 2010). Furthermore, using the data of industrial employees′ proportions in 2008, this paper analyzed the internal structure of industry and studies the cities′ functions in the region. The classification of employees in the 10 cities of the Beijing-Tianjin-Hebei Metropolitan Region was shown in Fig. 3.

As shown in Fig. 3, most employees in the 10 cities of Beijing-Tianjin-Hebei Metropolitan Region were in the manufacturing sector. However, the specific proportions of employees between cities were different. Beijing and Tianjin were different in education and health, social security, and so on, forming a complementary function. Industrial structure was the ratio of industry production and the association mode of mutual interdependence and mutual restraint. Industrial structure was in the dominant position in the economic structure. It had a decisive influence on economic growth. The re-



EP. employees′ proportions; B. Mining industry; C. Manufacturing; D. Electric, gas and water production and supply; E. Building industry; F. Transport, storage and post and telecommunications; H.Wholesale and retail trade; I. Accommodation, catering industry; J. Finance; K. Real estate; L. Leasing and business services; M. Scientific research, technical services and geological prospecting; P. Education; Q. Health, social security and social welfare; S. Public Management and Social Organization

Source: National Bureau of Statistics of China (2010)

Fig. 3 Proportion of industrial employees in Beijing-Tianjin-Hebei Metropolitan Region in 2008

sults showed that, on the one hand, Tianjin's tertiary industry need to be further enhanced. Moreover, the secondary cities were generally not strong enough to promote the development of the metropolitan region. On the other hand, the numerical component of the industrial structure showed that the cities of Tangshan, Baoding, Zhangjiakou, Chengde, Cangzhou, and Langfang took absolute advantage of the secondary industry. Moreover, there was a great industrial gradient in the region (industry transfer is in the advanced stage of regional cooperation), and this will help promote industry transfer within the economic development of the Beijing-Tianjin-Hebei Metropolitan Region.

As the third economic development polar of China, the Beijing-Tianjin-Hebei Metropolitan Region is a ′polycentric′ urban area. On the one hand, in a recent study, the estimation of the polycentric density function showed the concentration of population into the core urban centers during the 1980s, the coexistence of the concentration of population into multi-urban centers, and the decentralization of population from the core urban centers during the 1990s (Sun *et al*., 2009). On the other hand, using the SSM, this paper explained the ′polycentric′ urban area based on the regional division of labor. As shown in Fig. 3 and Table 2, but until 2009, Hebei Province certainly can not be the center of the metropolitan region, and the core cities were still Beijing and Tianjin.

4 Conclusions

From the perspective of regional integration, based on an analysis on the current status of Beijing-Tianjin-Hebei regional economic development as well as the change in the industry structure, this paper pointed out that the core issue about the regional economy was to

upgrade the industry structure of the 10 cities by not only upgrading industrial capacity but also promoting the linkage between optimization of the regional industrial structure and the regional division of labor. In addition, some conclusions can be drawn: the tertiary industry had the largest contribution to the regional GDP and became the most competitive industry in the metropolitan region; up to now, the development of cities in the region was not balanced, Beijing and Tianjin were the two core cities, and Beijing had the absolute advantage in industrial structure and competitiveness. Besides these, there was a great industrial gradient in those regions (especially between the two core cities and the cities of Tangshan, Baoding, Zhangjiakou, Chengde, Cangzhou, and Langfang). Therefore, it can be expected, with deepening of regional cooperation, the pace of the industry transfer and regional division of labor will accelerate, and by then, each of the ten cities in the metropolitan region will develop different dominant industries and regional competitiveness will enhance significantly.

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