

Research on the competitiveness of high-tech industries in northeast China

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Abstract: Based on characteristics of high-tech industry in Northeast China, high-tech industry competitiveness index system was developed, and the competitiveness of high-tech industry was evaluated through principal component analysis and location quotient method. The results showed that the scale of high-tech industry in Northeast China as a whole was small, and presented a decreasing trend for the proportion in the country. The competitiveness of high-tech industry in Northeast China lagged far behind that of the eastern and central regions. The high-tech industry competitiveness of Liaoning, Jilin and Heilongjiang provinces in China ranked 15, 19 and 21, respectively. The manufacture of medicine in Jilin province, and the manufacture of aircraft and spacecraft and the related equipment in Liaoning and Heilongjiang provinces had high competitive advantage, but the manufacture of electronic equipment and communication equipment and the manufacture of computers and office equipment was lack of competitiveness. The development suggestions were put forward to improve the competitiveness of high-tech industries in Northeast China.

Introduction

High-tech industry is relatively high intensive in research and development among the national economy industries, with high product output and innovation ability. High-tech industry is an important force to promote economic growth at a certain economic development stage [1]. Since 2003, the strategy implement of rejuvenating northeast old industrial base, the economy development in the region become better, but the condition of heavy industrial structure remains unchanged, the shortage in new industry nurturing is still very prominent [2]. With regional good industrial base in Northeast China, how to accelerate the development of high-tech industry for the industrial structure adjustment and to select the strategy is very important under giving play to comparative advantage. In this paper, the high-tech industry competitiveness in northeast China and its development were analyzed, in order to provide suggestions for the development of regional high-tech industry.

1 Characteristics of high-tech industry development in Northeast China

1.1 High-tech industry development overview

Since 2003, as shown in Figure 1 main business income of high-tech industry in Northeast China took a sustainable growth trend with the average annual growth rate of 17.6%, below the national average rate of 18.9%. But the proportion of main business income decreased from 4.24% to 3.80% of 2013. The proportion of main business income for Jilin province to that of the whole nation increased from



0.52% to 1.23% of 2013, whereas those of Liaoning and Heilongjiang provinces decreased from 2.49% and 1.23% to 2.04% and 0.53%, respectively. The main business income of high-tech industry in Northeast China in 2013 is 440.4 billion Yuan, only accounting for 3.8% of that of the whole country. Among them, the main business income of Liaoning province is 236.24 billion Yuan, significantly higher than those of Jilin and Heilongjiang provinces, and ranking 14, 17 and 22 in the country for the three provinces.

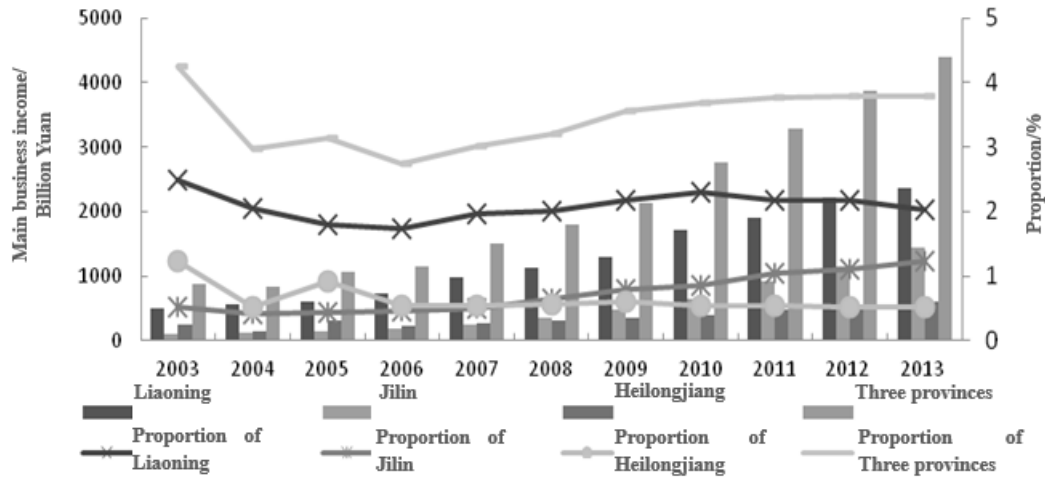


Figure 1 High-tech industry development in northeast China

1.2 Internal structure difference of high-tech industry

Northeast pharmaceutical manufacturing, aircraft and spacecraft and their equipment manufacturing, and medical apparatus and instrument manufacturing industry accounted for a higher proportion, but electronic communication equipment and computer and office equipment manufacturing industry accounted for a lower proportion in the country (Figure 2). Pharmaceutical manufacturing industry accounted for more than 50%, with 87% for Jilin province, 68% for Heilongjiang province, which were far more than the national average of 18.5%. Aircraft and spacecraft and their equipment manufacturing industry accounted for 8.6%, which were higher than the national average of 2.5%. Electronic communication equipment manufacturing industry accounted for only 22.8%, which were far below the national average of 51.4%, and mainly distributed in Liaoning province.

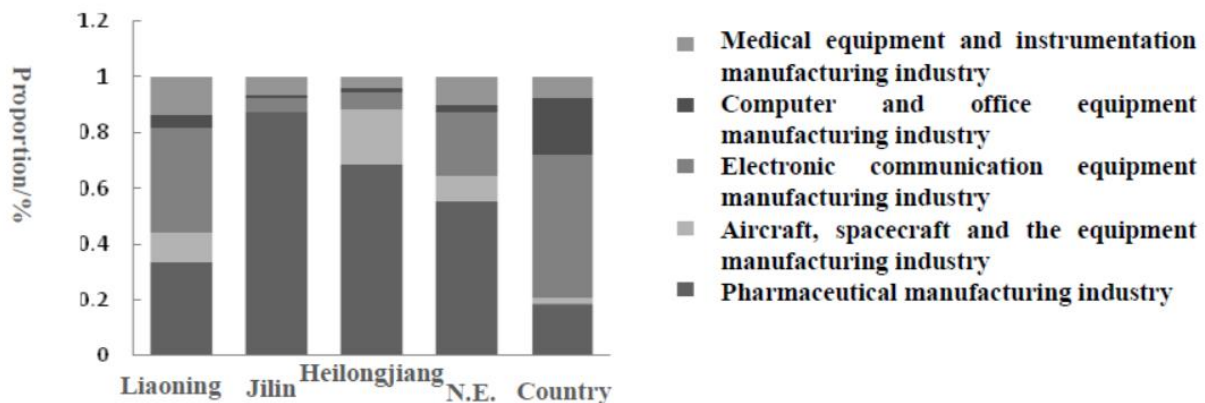


Figure 2 High-tech industry structure characteristics in Northeast China

2 High-tech industry competitiveness analysis of northeast China

2.1 Index selection and research methods

Twelve indicators from three aspects of industry input, industry output and innovation ability were selected (Table 1). Four indicators of full-time equivalent of personnel, research and development

funds, fixed assets and labor were selected from industry input; Four indicators of main business income, overall profit, profit tax and export value were selected from industry output; Four indicators of new product sales income, effective number of invention patents, number of companies with research and development institution, and spending on import technology were selected from industry innovation ability. Centralization and dimensionless method was used to process the index data. High-tech industry competitiveness evaluation function was constructed with principal component analysis, simplifying the multidimensional vector to number less comprehensive vector. The proportion of variance contribution rates of each principal component was taken as Weight Value to construct the evaluation function as follow:

$$f(x) = \frac{\lambda_1}{\sum_{i=1}^n \lambda_i} F_1 + \frac{\lambda_2}{\sum_{i=1}^n \lambda_i} F_2 + \dots + \frac{\lambda_n}{\sum_{i=1}^n \lambda_i} F_n$$

Here, $f(x)$ is high-tech industry competitiveness evaluation function; $F_1 \dots F_n$ are principal component scores; $\lambda_1 \dots \lambda_n$ are variance contribution rate of each main component. The $f(x)$ of comprehensive evaluation value represents the relative level of the certain region among the whole evaluation. When $f(x)$ is positive, indicating that the regional development level is higher than that of the national average.

Table 1 High-tech industry competitiveness assessment indicator system

Objective level	Criterion layer	Index level	Action direction
High-tech industry competitiveness	Industry input	full-time equivalent of personnel	+
		research and development funds	+
		fixed assets	+
		labors	+
	Industry output	main business income	+
		overall profit	+
		profit tax	+
		export value	+
	Industry innovation ability	new product sales income	+
		effective number of invention patents	+
		number of companies with research and development institution	+
		spending on import technology	+

2.2 Results of high technology industry competitiveness evaluation

High-tech industrial competitiveness of 31 provinces and cities nationwide (not including Taiwan province, Hong Kong and Macao special administrative region) in 2013 were evaluated. SPSS software was used to standardize the original data, and test the data with KMO value of 0.768, which showed a strong correlation between original variables, and were suitable for principal component analysis. Principal components of characteristic root above 1 were selected and the high-tech industry competitiveness evaluation function was: $f(x) = 0.889 F_1 + 0.111 F_2$.

High-tech industry competitiveness distributions of 31 provinces and cities in China were shown in Figure 3, showing that the high-tech industry competitiveness of Northeast China was low relatively. The comprehensive scores of high-tech industry competitiveness of Liaoning, Jilin and Heilongjiang provinces were 0.687, -1.138 and -1.413 in 2013, which were below the national average level, ranking 15, 19, and 21 in the country, respectively. The average comprehensive score of high-tech industry competitiveness of Northeast China was -1.079, only higher than that of western region of -1.322, and far less than that of eastern region of 2.205 and central region of -0.490. High-tech industry competitiveness of Northeast China as a whole was very low, owing to small scale industry, relatively small industry investment, and lack of innovation.

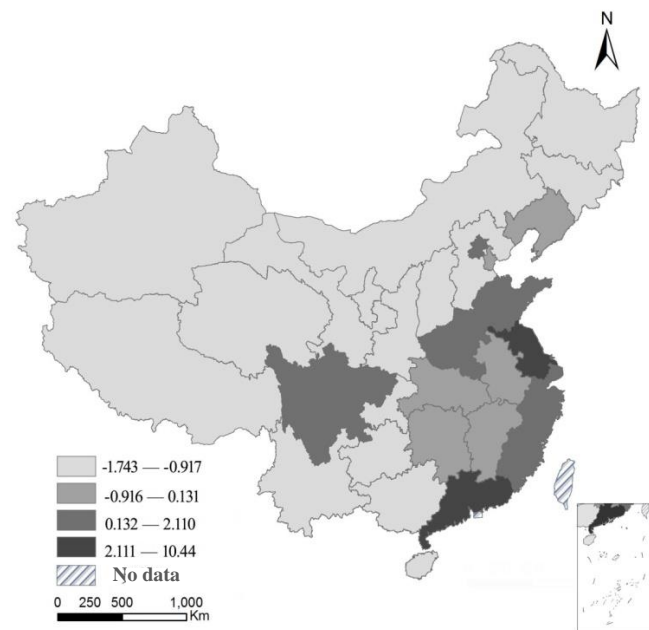
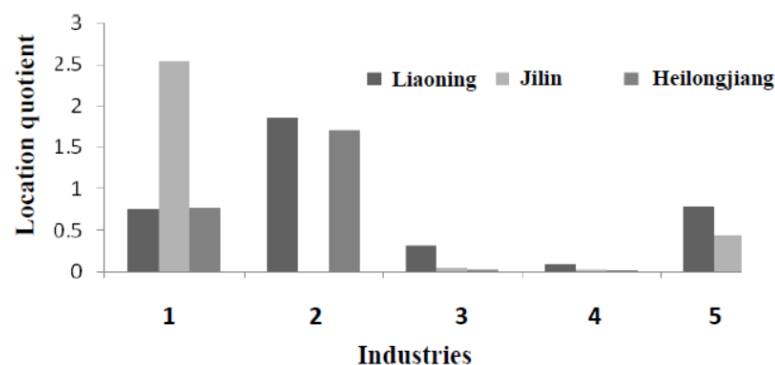


Figure 3 High-tech industry competitiveness distributions of 31 provinces and cities in China



1 Pharmaceutical manufacturing industry; 2 Aircraft, spacecraft and the equipment manufacturing industry; 3 Electronic communication equipment manufacturing industry; 4 Computer and office equipment manufacturing industry; 5 Medical equipment and instrumentation manufacturing industry

Figure 4 The location quotient of high-tech industry in northeast China

2.3 High-tech industry competitive analysis

The advantage industries among Northeast China high-tech industry were clearly put forward through location quotient method, as shown in Figure 4. The location quotient of pharmaceutical manufacturing in Jilin was 2.54, and the location quotient of aircraft, spacecraft and the equipment manufacturing industry in Liaoning and Heilongjiang provinces were 1.855 and 1.711, respectively, which were greater than 1, with strong competitive advantage in the whole country. While the location quotients of electronic communication equipment manufacturing and computer and office equipment manufacturing industries were very low, smaller share in the country, and less competitive. Northeast China is rich in medicinal material resources and good enterprise foundation, competitive advantage of pharmaceutical manufacturing in the whole country is stronger, especially for Jilin province the pharmaceutical manufacturing production proportion is very high. The aircraft, spacecraft and equipment manufacturing industry are mainly distributed in Liaoning and Heilongjiang provinces (Shenyang and Harbin city), with a higher proportion in the whole country, higher investment in

research and development, and strong innovation output ability.

3 Conclusions

The scale of high-tech industry in Northeast China as a whole was small except for pharmaceutical manufacturing, and presented a decreasing trend for the proportion in the country. The competitiveness of high-tech industry in Northeast China lagged far behind that of the eastern and central regions. The high-tech industry competitiveness of Liaoning, Jilin and Heilongjiang province in China ranked 15, 19 and 21, respectively. The manufacture of medicine in Jilin province, and the manufacture of aircraft and spacecraft and the related equipment in Liaoning and Heilongjiang provinces had high competitive advantage. For the high-tech industry development characteristics and industry competitiveness, the introduction of human sources and industry innovation ability should be strengthened to improve the advantage industries, and actively cultivate electronic communication equipment manufacturing and other industries.

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