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COMPARATIVE ANALYSIS ON THE COMPETITIVENESS OF INDUSTRIAL MANUFACTURING INDUSTRY IN NORTHEAST CHINA

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Abstract. *Northeast China is an important industrial manufacturing base in China. Many industrial enterprises have been set up in the early days of the founding of the People's Republic of China. However, in recent years, due to the backward technology, the competitiveness is insufficient and its status has fallen sharply, and it is at the end of the three major manufacturing bases in the country now. This paper uses factor analysis method, using spss20.0 software to comprehensively compare the industrial manufacturing level of 31 provinces across the country, analyze the advantages and disadvantages of manufacturing industry in Northeast China, and propose countermeasures and suggestions to improve the competitiveness of industrial manufacturing in the region.*
Keywords: Northeast China, Manufacturing industry, Competitiveness, Factor analysis

1. **Introduction.** Manufacturing is a cornerstone of national security and a concrete manifestation of the country's core competitiveness. At the beginning of the founding of New China, due to its geographical proximity to the Soviet Union, China has placed a large number of industrial enterprises in the three northeastern provinces, making it become the cradle of Chinese industry and one of the three bases of China's manufacturing industry. After the reform and opening up in the Northeast, the manufacturing industry has developed slowly. The coastal areas have relied on policy advantages and transportation advantages, and they are gradually in the lead. At the same time, the problems of serious industrial homogeneity and short industrial chain also seriously restrict the economic development of the Northeast. The state timely proposed the revitalization strategy of the old industrial bases, aiming at revitalizing the northeast economy and the pillar industries. Accurately assessing the regional competitiveness of each province is the basis to formulate a revitalization policy.

The key to competitiveness evaluation lies in the selection of evaluation indicators and the establishment of evaluation models. The model of China's competitiveness evaluation of manufacturing also changes from single indicator evaluation to comprehensive index evaluation. The methods currently used by scholars are mainly Analytic Hierarchy Process (AHP), Shift-Share Method (SSM), Principal Component Analysis (PCA) and Data Envelopment Analysis (DEA). Zhou [1] presented the global principal component analysis method was used to compare the manufacturing competitiveness of the Yangtze River Delta cities; Li and Wang [11] used the genetic algorithm-based projection pursuit model for 31 provinces and cities in China; Jiang and Wang [2] used the SBM super-efficient DAE model to measure the competitiveness of the manufacturing industry in the middle region of the Yangtze River; Ma and Huang [3] applied the shift-share method to doing

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the comparative study of the competitiveness of the manufacturing industry in the Pearl River Delta region and Yangtze River Delta region.

The theoretical methods used in these documents have their own advantages and disadvantages. For example, the AHP method is simple and easy, but there are some shortcomings of subjective weighting. The DEA method can achieve objective weighting, and can effectively combine static analysis with dynamic analysis, but the application of the method is premised on the similarity of production Decision-Making Unit (DMU). Principal Component Analysis (PCA) reduces the dimension of multiple single indicators into a few comprehensive indicators, which can avoid the information overlap of related indicators and the lack of subjective empowerment. The Shift-Share Method (SSM) is suitable for studying the inter-regional competitiveness comparison. Therefore, the researcher should make method selection and model establishment, and correctly evaluate the core of regional competitiveness according to the specific situation. Through combining the literature, the existing research mainly studies the Pearl River Delta region and the Yangtze River Delta region, mainly using the AHP and DEA. So, this paper uses factor analysis as the analysis method, and chooses a reasonable analysis index to establish a model. The paper analyzes the industrial manufacturing level of each province, analyzes the development status and problems of the manufacturing industry in Northeast China, and provides reference for the transformation and development of manufacturing industry in China.

2. **Evaluation Indicators, Data and Research Methods.** There is no clear and unified definition of manufacturing competitiveness evaluation indicators. According to the principles of science, comparability and operability, this paper selects six main evaluation indicators and constructs an evaluation index system (Table 1) to compare and evaluate the manufacturing level of the province. At the same time, this paper selects the first year of China's 13th Five-Year Plan and selects the data for 2016, which is a signal for the development of manufacturing industry in the next five years. The specific evaluation indexes are as follows: X1: the total industrial output value, which refers to the total industrial output value of the region in 2016; X2: full time equivalent of R&D personnel, which is used for international comparison, R&D refers to the full time personnel (annual accumulated working time in the R&D activity of total working time of 90% and above) and non full time staff work according to the actual workload and work time conversion; X3: the cost of management: the cost of industrial enterprises in the area for the management of the enterprise in 2016; X4: main business income: the main business income of industrial enterprises in this area in 2016; X5: the value of export: the sum of the value of products produced by the industrial enterprises to the foreign trade department or (commissioned) export, self operated export, and the volume sold abroad or exported on the frontier in the area in 2016; X6: profitability: the operating profit of industrial enterprises in this area in 2016.

Table 1. Evaluation index system for competitiveness of manufacturing industry

Evaluation goal	Evaluation content	Specific indicators
Manufacturing level	Production capacity	Total industrial output value (100 million yuan)
	R&D capability	Full time equivalent of R&D personnel (ten thousand people)
	Management capability	Management cost (100 million yuan)
	Market capability	Main business income (100 million yuan)
	Foreign trade capacity	Export delivery value (100 million yuan)
	Profitability capacity	Operating profit (100 million yuan)

The research method used in this paper is factor analysis, which uses the idea of dimensionality reduction. First, the data is standardized, and then the KMO statistic of the calculated variables and Bartlett's spherical test are performed to determine whether it is suitable for factor analysis, and the eigenvalue is calculated. The indicators are converted into a few variables that can summarize the main information. Finally, the factor scores are calculated for the comprehensive evaluation, and the ranking status of the subjects to be studied is obtained.

The data sources of this paper are China Statistical Yearbook in 2016, China's industrial economic statistics yearbook and the official network of the China Statistics Bureau. According to the index system of Table 1 and using SPSS20.0 software as a tool, the factor analysis method is used to evaluate the competitiveness of the equipment manufacturing industry in three provinces. Table 2 shows the original data of manufacturing industry in three provinces of Northeast China selected according to the index system.

Table 2. Original data for evaluating the competitiveness of the manufacturing industry

Province	Total industrial output value (billion yuan)	Full time equivalent of R&D personnel (ten thousand people)	Management cost ($100 million)	Main business income ($100 million)	Export delivery value ($100 million)	Operating profit ($100 million)
Liaoning	6818.32	49254	1157.77	22038.95	2102.26	575.39
Jilin	6070.07	23469	1069.02	23431.37	402.09	1268.49
Heilongjiang	3647.14	32219	566.18	11347.77	126.55	295.54

3. **Empirical Analysis.** First, the data is normalized, and then KMO and Bartlett's Test of Sphericity are used to test the correlation degree between variables to see if it is appropriate to use factor analysis. KMO statistics is 0.862, Bartlett's sphericity test value is 414.24, the significant level is 0, so factor analysis can be done.

SPSS is for the use of principal component analysis, and the analysis results are as follows. According to the selection principle of the characteristic root greater than 1, the 5 factors were extracted from the public factors according to the high load, and the number of common factors was determined (Table 3), the only characteristic roots of a common factor greater than 1, and the first common factors have explained 93.904% of the total variance while the rest of the common factor explain only 6.096% of the total variance. From gravel map (Figure 1), we can further verify this point: the first common factor has great difference from other common factors, and the curve from the second

Table 3. Factors explaining the variance of the original variable

Total variance explained						
Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	5.634	93.904	93.904	5.634	93.904	93.904
2	.264	4.398	98.303			
3	.043	.714	99.016			
4	.037	.613	99.629			
5	.016	.263	99.892			
6	.006	.108	100.000			

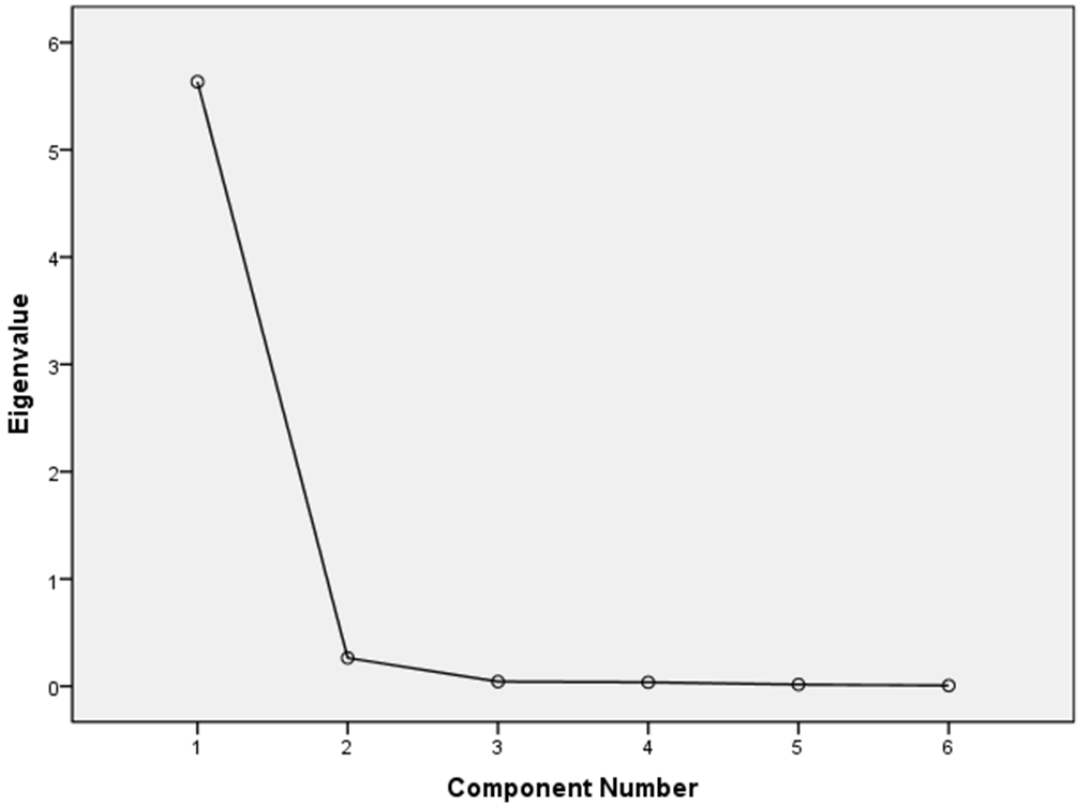

FIGURE 1. Lithotripsy

TABLE 4. Factor load matrix

Communalities		
	Initial	Extraction
Total industrial output value	1.000	.960
Full time equivalent of R&D personnel	1.000	.953
Management cost	1.000	.974
Main business income	1.000	.936
Export delivery value	1.000	.861
Operating profit	1.000	.950
Extraction method: principal component analysis		

common factors is quite gentle. Therefore, we select the first public factor for analysis and evaluation. The factor load matrix (Table 4) is calculated to determine the score of the common factor. The competitiveness ranking is calculated according to the public factor score (Table 5).

According to the data and the factor score rankings in the table, Liaoning province manufacturing industry ranked seventeenth in the country, Jilin province ranked twentieth in the country, Heilongjiang province ranked twenty-fourth in the country, and the top five are Guangdong, Jiangsu, Shandong, Zhejiang, Henan. The top ranked provinces and cities are mainly concentrated in the eastern coastal areas, which are significantly different from those in the northeast. Manufacturing industry in eastern coastal areas of the Yangtze River Delta and Pearl River Delta was significantly higher, and the northeast manufacturing industry has ranked last in the country's three largest manufacturing base.

At the same time, the rankings of production capacity, R&D capacity, management capacity, market capacity, foreign trade capacity and profitability capacity of the three northeastern provinces in 2016 are as Table 6.

Table 5. Factor score

Province	Factor score	Ranking	Province	Factor score	Ranking
Beijing	−0.39573	18	Hubei	0.15287	8
Tianjin	−0.22493	13	Hunan	0.01353	11
Hebei	0.08826	9	Guangdong	3.00619	1
Shanxi	−0.56427	22	Guangxi	−0.41019	19
Inner Mongolia	−0.43171	21	Hainan	−0.84427	30
Liaoning	−0.35876	17	Chongqing	−0.29993	15
Jilin	−0.41127	20	Sichuan	0.00404	12
Heilongjiang	−0.62621	24	Guizhou	−0.6187	23
Shanghai	0.18582	7	Yunnan	−0.65468	25
Jiangsu	2.97241	2	Tibet	−0.87869	31
Zhejiang	1.19747	4	Shaanxi	−0.33909	16
Anhui	0.01742	10	Gansu	−0.75773	27
Fujian	0.21844	6	Qinghai	−0.83764	29
Jiangxi	−0.22747	14	Ningxia	−0.81035	28
Shandong	1.90247	3	Xinjiang	−0.70538	26
Henan	0.6381	5			

Table 6. Production, R&D, management, market, foreign trade and profitability of the three northeastern provinces

Province	Production capacity	R&D capability	Management capability	Market capability	Foreign trade capacity	Profitability capacity
Liaoning	16	15	13	18	13	22
Jilin	20	22	14	16	21	20
Heilongjiang	25	19	23	23	26	25

It can be seen from the above table that Liaoning province is the best in the overall competitiveness of the three northeastern provinces, Jilin province is in the middle, and Heilongjiang province is the worst, but from a national perspective, the competitiveness of the three provinces is not optimistic, and all rankings are in the middle and lower level, and this situation is urgently needed to be changed.

4. **Countermeasures and Suggestions.** The manufacturing industry in Northeast China is the pillar industry. However, problems such as backward development concept, weak export trade and financing difficulties are also in front of the industry. With the help of "The Belt and Road" policy and "support strategy to revitalize the northeast old industrial base", they should actively develop the original advantages, enhance the comprehensive strength, and break through the predicament.

4.1. **Cooperating with colleges and universities, training talents, and improving the production capacity of enterprises.** Technicians are the core resources of industrial enterprises. There are a large number of science and engineering colleges in the northeast, which can provide intellectual support for enterprises and solve problems encountered by enterprises in the process of technological upgrading. Enterprises cooperate with universities and research institutes to jointly train senior management talents, and order-based training of senior technicians, which can greatly enhance the production capacity of enterprises.

4.2. **Increasing investment in research and development to improve innovation capabilities.** Technology is the core competitiveness, and the government should have a strategic vision, increase the income of R&D personnel, improve research incentives, and stimulate scientific research staff enthusiasm. Enterprises should pay attention to technological innovation, invest in funds, eliminate backward technologies, and master core competitiveness.

4.3. **Improving corporate management capabilities and improving business efficiency.** Enterprises should pay attention to the position and role of managers in the enterprise, improve the personnel management ability, reduce the inefficient resource investment, and also enhance the interpersonal relationship of the enterprise; therefore, the enterprises' production efficiencies are also promoted.

4.4. **With the help of national policies, they will expand the development space and enhance our foreign trade capabilities.** In the global economic downturn, in addition to the original channels of exports to Europe, the United States, Japan and South Korea, they should actively integrate into the national The Belt and Road strategy, and expand the markets in Southeast Asia, Central Asia, the Middle East, Africa and other regions. Otherwise, Emerging e-commerce platforms will also increase foreign trade channels.

4.5. **Promoting advantages, attracting foreign investment, and improving profitability.** The northeast region is close to Japan, and South Korea, due to the bad relationship with them in the near stage, the foreign investment and export have fallen sharply, and even a large number of enterprises move away from China. The enterprises in the northeast region should actively establish contacts with European and American enterprises to attract investment, increase exports, and enhance the profitability of the enterprises.

5. **Conclusions.** This paper compares the development status and existing problems of industrial manufacturing between northeast region's provinces and other provinces in China. On the one hand, it describes the status of industrial manufacturing of the northeast region, and now it is at the end of the three largest manufacturing base in China. On the other hand, the advantages and disadvantages of manufacturing industry in Northeast China are analyzed and solutions are put forward. Of course, there are some limitations in this study, and the authors are limited by the object of study and the availability of data. This paper only analyzes the overall situation of various provinces and regions, and the differences in competitiveness of different regions and industries within the manufacturing industry are still deserved to be studied.

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