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An Empirical Study on the International Competitiveness of China's Manufacturing Industry

Liu Lu[1,a]

[1]*School of Economics, Harbin University of Commerce, Harbin, China*
[a]*ll522714@126.com*

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Abstract: The manufacturing industry is the stabilizer of a country's national economy. The level of international competitiveness of the manufacturing industry determines the strength of a country's international competitiveness to a certain extent. Based on the relevant data from 30 China's provinces and cities from 2013-2021, this paper measures the international competitiveness of China's manufacturing industry by using factor analysis to form a comprehensive index of four single indexes measuring international competitiveness. The results show that the international competitiveness of China's manufacturing industry shows a geographical distribution pattern of "strong in the east and weak in the west." Based on the empirical findings, policy recommendations are proposed to improve the international competitiveness of China's manufacturing industry.

1. Introduction

The manufacturing industry stabilizes a country's economic development in an era of significant changes. 2010, China's manufacturing added value was 1.92 trillion U.S. dollars, accounting for about 18.5% of the total global manufacturing added value, and for the first time, China's manufacturing added value surpassed that of the United States and became the world's number one country. Since 2010, China's manufacturing industry began to break through the enormous scale of the manufacturing industry in human history, showing its robust development and coordination ability to the world. Despite COVID-19, China's manufacturing added value reached US$3.85 trillion in 2020, making it the world's largest manufacturing industry country for 11 consecutive years. However, despite such high achievement, China's manufacturing industry has always been labeled "a big manufacturing country" rather than "a manufacturing power." Firstly, "Made in China" is still at the middle level in the world, with a surplus of low-end products and a shortage of mid-and high-end products. Secondly, the rising prices of production factors have led to an increase in the production and operation costs of the manufacturing industry, posing a threat to the competitiveness of domestic enterprises in the global market. Finally, the weakness of global demand weakened the profitability of enterprises, and their development could not be sustained. China's cheap production base status and comparative advantage gradually lost. Therefore, measuring the international competitiveness of China's manufacturing industry is a meaningful way to help China's manufacturing industry to break away from the dilemma of "Low-end locking" and enhance its international competitiveness.

Kaveri et al. (2017) selected the Revealed Comparative Advantage Index (RCA) to evaluate the international competitiveness of industries [2]. Olczyk et al. (2017) analyzed the international competitiveness of the Czech manufacturing industry with the help of the ECM model, using data related to 13 manufacturing subsectors from 1995-2011[3]. Yu Mingyuan (2014) measured the international competitiveness of six Chinese manufacturing industries by using principal component analysis to form a composite index of export contribution rate (EC), international market share (IMS), RCA, trade competitive index (TC), and export growth advantage index [4]. Wu Chuanqing and Deng Mingliang (2017) measured the competitiveness of the electronics and communication equipment manufacturing industry from four perspectives: development environment, scale, input, and innovation [5]. Tang Hongxiang et al. (2019) used RCA and TC to measure export competitiveness, the intra-industry trade index (IIT) to measure intra-industry trade, and IMS to measure market share as a comprehensive evaluation of the international competitiveness of China's manufacturing industry[6]. Gao Honglei et al. (2020) constructed an evaluation index system including brand innovation, human resources, corporate culture, and institutional environment, and evaluated and analyzed the level of manufacturing soft competitiveness of 39 major countries around the world with the help of the longitudinal and horizontal pull-out grade method [7].

It is known from the existing literature that there are few measures of the international competitiveness of China's manufacturing industry from the perspective of provincial areas. Therefore, this paper uses factor analysis to calculate a comprehensive index to measure the international competitiveness of China's manufacturing industry from 2013 to 2021.

2. Evaluation of the International Competitiveness of China's Manufacturing Industry

2.1. Scope of Study on Manufacturing Industry

The manufacturing industry involves various links from raw materials and intermediate products to the production and circulation of final products, providing a steady stream of elements and products to circulate the entire industrial chain and supply chain. With regard to the research scope of manufacturing industry, this paper refers to the practice of Li Xueya (2021)[1], combines the selected indicators, measurement methods and availability of relevant data, and takes Chapters 16 to 96 of HS-Code binary code as the research scope of manufacturing industry, specifically including: Food manufacturing, beverage manufacturing, tobacco manufacturing, leather products, textiles and raw materials, shoes, boots, umbrellas and other light industrial products, wood products, furniture manufacturing, Wood pulp, paper, printed books, musical instruments, toys and sporting goods, mineral fuels, oils and their products, chemical products, plastics, rubber and their products, non-metallic minerals and their products, metals and their products, mechanical and electrical products, Pharmaceutical products, vehicles other than railways and trams, railway and tram equipment, aircraft, spacecraft and their parts, ships and other floating products, instrument products.

2.2. Measuring the International Competitiveness of China's Manufacturing Industry

In this paper, drawing on Yu Mingyuan (2014) [4], EC, RCA, IMS, and Michaely Volatility Index (MI) were selected to form comprehensive indicators using factor analysis. The single indexes evaluate the international competitiveness of the manufacturing industry from different perspectives, and their specific measures are shown in Table 1. The relevant data of each province and city are obtained from the "China Statistical Yearbook" released by the National Bureau of Statistics of China in previous years and the statistical yearbooks of the region released by each province and city in previous years. Among them, Tibet is excluded because of more missing data.

Table 1: Single Index of the International Competitiveness of the Manufacturing Industry

Index	Measurement method
EC	The ratio of manufacturing industry exports to total exports
RCA	The ratio of the EC of the manufacturing industry to the EC of the world manufacturing industry
IMS	The ratio of manufacturing industry exports to total world manufacturing industry exports
MI	Difference between the proportion of exports and imports of the manufacturing industry

Let there be p-dimensional variables $X_1, X_2, \ldots, X_p$, and by factor analysis, it is uncovered that there are q potential variables that jointly influence this p-dimensional X variable (where, q<p), there are q factors that jointly influence $X_1, X_2, \ldots, X_p$, which in turn reflect the p-dimensional data of the original variables with minimal information loss through the q-dimensional potential variable data. Factor analysis simplifies the number of variables and calculations with little information loss, thus achieving dimensionality reduction. The specific model equation is as follows:

$$X_1 = \alpha_1 F_1 + \alpha_2 F_2 + \cdots + \alpha_p F_p + \varepsilon_1 \quad (1)$$

$$X_2 = \beta_1 F_1 + \beta_2 F_2 + \cdots + \beta_p F_p + \varepsilon_2 \quad (2)$$

$$X_q = \gamma_1 F_1 + \gamma_2 F_2 + \cdots + \gamma_p F_p + \varepsilon_q \quad (3)$$

Among them, $F_1, F_2, \ldots, F_p$ is called the common factor, $\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_q$ is the special factor for the $X_1, X_2, \ldots, X_q$.

Factor analysis using SPSS software yielded a value of 0.66 for KMO and a p-value of 0, indicating that the data were suitable for information extraction. In order to provide a more accurate and comprehensive description of the problem and reduce information loss, two common factors with a cumulative contribution of 80% or more were selected for analysis. As shown in Table 2, after rotation by the Kaiser normalized maximum variance method, the variance percentage of the two common factors were obtained as 61.095% and 26.007%, cumulative contribution rate reached 87.066%.

Table 2: Total Variance Explanation

Component	Initial eigenvalues			Sum of squared rotating loads		
	Eigenvalue	Variance percentage	Cumulative contribution	Eigenvalue	Variance percentage	Cumulative contribution
1	2.634	65.838	65.838	2.442	61.059	61.059
2	0.849	21.228	97.066	1.040	26.007	87.066
3	0.514	12.855	99.921			
4	0.003	0.079	100.000			

After the above steps, the final index value of the international competitiveness of the manufacturing industry in 30 Chinese provinces and cities from 2013-2021 is obtained, as shown in Table 3. From the perspective of single provinces and cities, although the index value of Guangdong Province decreases year by year, it ranks first during 2013-2021, followed by Jiangsu Province and Zhejiang Province, indicating the high level of manufacturing international competitiveness of the three provinces; the index values of Inner Mongolia Autonomous Region, three northeastern provinces, Hainan Province, and Yunnan Province are all negative in all years, indicating that their manufacturing industry international competitiveness is at In addition to the above provinces, Tianjin in the eastern region, Jiangxi in the central region and Chongqing in the western region have higher index values, indicating that their manufacturing industry international competitiveness is higher.

Table 3: China's Manufacturing Industry International Competitiveness Comprehensive Index

Area	Year								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Beijing	0.34	0.57	0.70	0.69	0.25	0.25	0.23	0.30	0.37
Tianjin	0.53	0.53	0.57	0.64	0.40	0.43	0.51	0.72	0.69
Hebei	0.21	0.27	0.35	0.37	0.49	0.46	0.35	0.45	0.49
Shanxi	0.22	0.33	0.29	0.36	0.29	0.27	0.24	0.24	0.27
Neimenggu	-0.21	-0.09	-0.29	-0.48	-0.96	-0.87	-1.06	-0.98	-0.57
Liaoning	-0.08	-0.07	-0.08	-0.06	-0.23	-0.24	-0.32	-0.27	-0.12
Jilin	-1.24	-1.07	-1.13	-1.32	-1.31	-1.00	-1.30	-1.16	-0.72
Heilongjiang	-0.85	-0.65	-1.19	-1.50	-0.70	-1.03	-1.44	-0.48	-0.32
Shanghai	0.58	0.62	0.72	0.84	0.64	0.61	0.56	0.57	0.48
Jiangsu	0.80	0.85	0.93	0.96	0.88	0.90	0.88	0.95	0.95
Zhejiang	0.57	0.63	0.71	0.78	0.69	0.69	0.72	0.81	0.80
Anhui	0.02	0.09	0.16	0.26	0.31	0.35	0.38	0.50	0.48
Fujian	0.11	0.07	0.09	0.06	0.17	0.14	0.17	0.23	0.25
Jiangxi	0.21	0.20	0.32	0.36	0.26	0.28	0.27	0.31	0.35
Shandong	0.01	0.08	0.09	0.02	0.05	0.09	0.04	0.24	0.41
Henan	0.16	0.16	0.16	0.16	0.08	0.05	0.02	-0.23	-0.21
Hubei	-0.29	-0.22	-0.12	-0.06	-0.12	-0.09	-0.03	0.03	0.07
Hunan	0.15	-0.09	-0.09	0.00	0.14	0.21	0.30	0.18	0.19
Guangdong	1.71	1.62	1.76	1.68	1.18	1.12	1.01	1.04	0.98
Guangxi	-0.15	-0.01	0.25	0.20	0.76	0.96	0.67	0.46	0.36
Hainan	-1.34	-1.18	-0.74	-0.99	-0.79	-0.74	-0.55	-0.12	-0.02
Chongqing	0.59	0.53	0.41	0.45	0.41	0.41	0.42	0.45	0.49
Sichuan	-0.05	-0.10	-0.02	0.02	0.30	0.34	0.33	0.37	0.34
Guizhou	0.24	0.21	0.25	0.26	0.17	0.26	0.16	0.00	-0.13
Yunnan	-1.60	-1.88	-2.87	-3.97	-2.57	-2.11	-2.56	-2.15	-1.15
Shannxi	0.02	0.16	0.12	0.19	0.29	0.29	0.28	0.28	0.26
Gansu	-1.83	-1.38	-1.31	-1.26	-1.32	-0.82	-1.11	-1.73	-1.40
Qinghai	-0.42	-1.31	-0.55	-0.25	-0.40	0.01	-0.27	-0.87	-1.14
Ningxia	0.20	0.40	0.15	0.18	0.10	0.11	0.01	-0.44	-0.06
Xinjiang	0.12	0.15	0.07	0.21	0.32	0.33	0.22	0.31	0.37

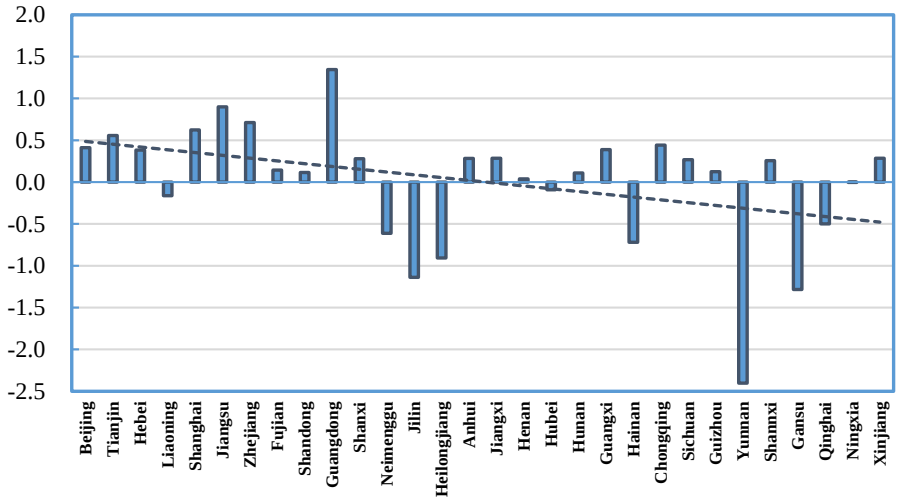

Figure 1: Average index chart by city and province 2013-2021

According to the China National Bureau of Statistics, 30 provinces and cities in China are

divided into eastern, central, and western regions according to their geographical locations. Figure 1 shows the average value of the international competitiveness comprehensive index of the manufacturing industry in 30 provinces and cities in China during 2013-2021. The figure shows that the international competitiveness of China's manufacturing industry shows a geographical distribution pattern of "strong in the east and weak in the west." With its muscular economic strength, high infrastructure construction, and openness to the outside world, the eastern region provides the first-mover advantage for its manufacturing industry.

3. Conclusion

This paper measures the international competitiveness of the manufacturing industry in 30 China's provinces and cities by using factor analysis to form a comprehensive index of the four indexes measuring the international competitiveness of the manufacturing industry and draws the following conclusions: the provinces and cities in the eastern region of China benefit from a high level of economic development, and their international competitiveness of manufacturing industry is high. The manufacturing industry is a low level of international competitiveness in some provinces in the central and western regions, and these provinces should take the right way to improve their manufacturing industry in future development. The overall geographical distribution of the east is strong, and the west is weak.

In the future development, governments at all levels should give their manufacturing industries a broader development space and richer development resources, continuously strengthen infrastructure construction, expand the level of opening to the outside world, improve their economic strength, continuously improve the ability of technological innovation, and accelerate the pace of industrial structure upgrading. The central and western regions should catch up with the development level of the manufacturing industry in the eastern region as soon as possible, improve the overall level of international competitiveness of China's manufacturing industry, and finally help China transform from “a big manufacturing country” to “a manufacturing power”, take its economy to a higher level, enhance its comprehensive national power, and further improve its voice in the international area.

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