

Research on High Quality Development Level of Regional Manufacturing Industry Based on Factor Analysis

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Abstract

Manufacturing industry is the foundation of "enriching the people and strengthening the province". The high-quality development of manufacturing industry is one of the key factors to determine the regional economic growth. This paper reviews the research results at home and abroad in recent years, constructs the evaluation index system of high-quality development of regional manufacturing industry, uses factor analysis method to study the high-quality development level of regional manufacturing industry, obtains the ranking of high-quality development of regional manufacturing industry, and obtains the relevant factors affecting the high-quality development of regional manufacturing industry. Finally, it puts forward relevant policy suggestions for the high-quality development of regional manufacturing industry.

Keywords: *Advanced manufacturing industry, high quality, regional economies, factor analysis method, policy suggestion*

I. Introduction

In recent years, the high-quality development of the manufacturing industry has been steadily improved, but there are still many problems in the manufacturing industry, such as the insufficient coordinated development of industries, the insufficient innovation of industrial mechanism, the disconnection between the real industry and the policy, and so on. Therefore, based on the evaluation system of high-quality development of manufacturing industry in various regions of Fujian Province, this paper uses factor analysis method to comprehensively compare and analyze the problems it faces, and puts forward some suggestions, hoping to provide some reference for policy-making.

II. A review of the Research on Fujian Manufacturing Industry

In 2019, Fujian Province issued the "action plan of accelerating the high quality development of leading enterprises and small giant enterprises in manufacturing industry in Fujian Province (2020-2022)", which aims to promote the manufacturing industry in Fujian to become stronger, bigger and better, give better play to the role of radiation and demonstration, and accelerate the high quality development of industry in Fujian Province.

Based on the existing literature, the research on Fujian manufacturing industry mainly focuses on competitiveness, talent, technology upgrading, transformation, collaboration and the correlation analysis with other industries. Zhang Junxiu (2014) studied the industrial competitiveness of Fujian high-end equipment manufacturing industry, pointed out its advantages and disadvantages, put forward corresponding development countermeasures, and constructed the "rudder model" [1]. Based on the agglomeration theory, Chen Jiahui (2018) calculated the impact of manufacturing agglomeration on Fujian's regional economic competitiveness by using the grey correlation model, and put forward countermeasures and suggestions to improve Fujian's economic competitiveness [2]. Song Ziting (2018) used DEA method to build an evaluation model of manufacturing quality competitiveness, and made an empirical analysis on the level of manufacturing quality competitiveness in Quanzhou [3]. Xu Wenfei et al. (2018) analyzed the current situation and existing problems of advanced manufacturing industry in Fujian Province,

and gave the path to improve the skilled talent team [4]. Ye Qi et al. (2018) analyzed the mechanism role of innovation system driving green transformation in Fujian Province, and put forward countermeasures and suggestions for green transformation of Fujian manufacturing industry [5]. Shi Jiajing (2019) analyzed the path of transformation and upgrading of Fujian's manufacturing cluster based on Internet plus [6]. Lin Hairong (2014) analyzed the mechanism of coordinated development between service outsourcing industry and manufacturing industry, found out the problems and reasons of service outsourcing industry and manufacturing industry in Fujian, and put forward policy suggestions [7]. Wang Bo (2020) analyzed the development of Fujian's manufacturing industry and studied the path of high-quality development of manufacturing industry driven by innovation [8].

In recent years, the research on Fujian manufacturing industry has been increasing, but it mainly focuses on the status quo, existing problems, industrial upgrading and Countermeasures Analysis of manufacturing industry, and few empirical studies on the high-quality development of manufacturing industry “The development of high quality was proposed by the Party Central Committee in the 19th National Congress. The high-quality development of manufacturing industry has become an inevitable trend of Fujian Province Economic Reform and breakthrough in the development dilemma. This paper compares the high-quality development level of manufacturing industry in Fujian Province by factor analysis, using the data of Fujian Statistical Yearbook in 2017-2020, and the research results have some innovation.

III. Evaluation Index System of High Quality Development of Manufacturing Industry in Fujian Province

3.1 Construction of evaluation index system

From the connotation of high-quality development of manufacturing industry in the 19th National Congress of the Communist Party of China, high-quality development of manufacturing industry must have the characteristics of structure optimization, integration and innovation ability enhancement, quality brand promotion, efficient change, green development and so on. Considering the reality of the development of manufacturing industry in Fujian Province and the availability of relevant data, according to the construction principle of evaluation index, combined with previous research results, this paper constructs the evaluation index system of high quality development level of manufacturing industry in Fujian Province. The index system includes six first level indicators, including structure optimization, innovation ability, brand quality, efficiency and benefit, industrial integration and green development, and 22 related second level indicators (as shown in Table 1).

Table 1 Evaluation index system of high quality development of Fujian manufacturing industry

Evaluation index system of high quality development of	First level indicators	Second level indicators
	C₁ Structural optimization	X₁ Proportion of owner business income of high end manufacturing
		X₂ Proportion of main business income of large and medium sized manufacturing enterprises
		X₃ Proportion of sales revenue of new industrial products
		X₄ Proportion of export transaction value of high end manufacturing industry
	C₂ Innovation ability	X₅ Proportion of science and technology expenditure
		X₆ R & D personnel investment in high end manufacturing industry
		X₇ R & D investment in high end manufacturing industry
		X₈ Number of invention patents per unit R & D expenditure
		X₉ Technology market turnover per 10000 scientific and technological personnel
		X₁₀ Qualified rate of product quality

Fujian manufacturing industry	C₃ Brand quality	X₁₁ Premium rate
		X₁₂ Number of top 500 manufacturing enterprises in China
	C₄ Efficiency benefit	X₁₃ Profit margin of main business income of manufacturing enterprises
		X₁₄ Total labor productivity of secondary industry
		X₁₅ Return on manufacturing assets
		X₁₆ Output rate of unit industrial energy consumption
	C₅ Industrial convergence	X₁₇ Informatization level of industrial application
		X₁₈ Internet penetration
		X₁₉ Proportion of industrial medium and long term loan balance
	C₆ Green development	X₂₀ Comprehensive utilization rate of general industrial solid waste
		X₂₁ Proportion of energy conservation and environmental protection expenditure in public budget
		X₂₂ Emission intensity of major industrial pollutants

3.2 Evaluation data sources

The data of this study are mainly from the statistical yearbook of Fujian Province from 2017 to 2020 and the statistical yearbook of nine cities in Fujian Province. In addition, we also refer to the direct or indirect data of Fujian economic and social statistical yearbook and Fujian science and technology development report.

3.3 Model construction

Because there are many index factors to evaluate the high-quality development of the manufacturing industry, and there is a certain correlation between these factors, so using factor analysis method to build the model can effectively solve such complex problems [9]. Factor analysis is actually a multivariate statistical analysis method, which studies the relationship between the correlation matrix, and then sums up the index variables with multiple complex relationships into a few comprehensive index factors. The weight of evaluation index coefficient is relatively objective. Because there are dimensional differences between the original data, we need to use SPSS software to standardize them and extract the main factors [10]. From the original data in Table 2, the eigenvalues and method contribution rate of each factor can be calculated (see Table 3). According to the principle of factor eigenvalue greater than 1, four main factors are selected. The cumulative method contribution rate is 96.88%, which shows that the first four factors can replace the original 22 indicators to describe the development level of advanced manufacturing industry. The characteristic values of other components are less than 1, which can not be considered.

Table 2 Original data of high quality development evaluation index of Fujian manufacturing industry

	C₁ Structural optimization				C₂ Innovation ability					X₁₀
	X₁	X₂	X₃	X₄	X₅	X₆	X₇	X₈	X₉	
Unit region	%	%	%	%	%	10000 people	100 million yuan	Units	10000 yuan	%
Fuzhou	36.7	65.6	23.9	24.1	63.2	12.58	41.36	978	27180	97.03
Xiamen	37.1	67.9	26.8	28.6	68.8	18.56	53.71	1523	34960	97.49
Putian	22.2	36.7	21.2	22.4	56.3	8.62	36.33	537	23108	97.52
Zhangzhou	17.8	33.4	16.5	21.2	52.4	6.12	32.42	429	22016	97.78
Quanzhou	34.9	56.8	22.3	23.8	62.7	11.32	40.52	1024	28954	95.20
Nanping	15.6	30.1	15.7	19.6	50.6	5.21	27.68	369	21230	97.98
Longyan	28.8	36.2	17.2	22.4	52.5	9.68	35.26	622	26938	98.59

Sanming	16.7	32.3	15.3	21.2	51.3	6.23	28.36	498	24873	95.87
Ningde	16.3	29.6	15.6	21.6	51.6	5.68	31.48	336	23875	95.36

Unit region	Brand quality		C ₄ Efficiency benefit				C ₅ Industrial convergence			C ₆ Green development		
	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	X ₁₉	X ₂₀	X ₂₁	X ₂₂
	%	Units	%	%	%	%	%	%	%	%	%	%
Fuzhou	98.31	10	6.7	45.32	8.9	13.4	7.6	73.7	9.4	93.3	77.3	6.3
Xiamen	99.12	5	8.6	46.34	9.2	15.3	8.3	74.2	9.2	94.2	78.2	5.8
Putian	97.43	0	5.4	41.22	8.6	12.6	6.7	69.8	9.6	87.1	76.4	7.7
Zhangzhou	97.54	0	5.6	39.96	8.3	12.7	6.8	68.9	9.7	88.3	75.3	7.3
Quanzhou	97.62	0	7.2	45.23	8.8	13.8	7.5	72.6	9.9	90.6	78.3	7.2
Nanping	97.23	0	4.3	37.64	8.1	11.6	6.4	66.3	9.8	86.2	76.3	7.8
Longyan	98.23	1	6.3	40.33	8.6	13.2	6.8	69.7	9.5	89.4	77.4	6.8
Sanming	97.13	1	5.2	38.23	8.3	12.5	6.6	67.2	9.6	83.3	73.2	7.4
Ningde	97.73	0	4.8	37.21	8.2	11.7	6.3	66.1	9.8	82.3	72.6	7.9

Table 3 Preliminary results of main factor extraction

Factor	Initial analysis results			Analysis results after rotation		
	Characteristic value	Variance contribution rate (%)	Cumulative contribution rate(%)	Characteristic value	Variance contribution rate (%)	Cumulative contribution rate(%)
1	17.012	77.327	77.327	12.465	56.660	56.660
2	2.141	9.730	87.058	5.290	24.046	80.706
3	1.085	4.932	91.990	1.822	8.284	88.990
4	1.076	4.893	96.883	1.736	7.893	96.883

The higher the factor load value is, the more information the factor contains. The factor load matrix can be obtained by maximizing variance orthogonal rotation (see Table 4).

Table 4 Factor load matrix after rotation

Index	Principal factor			
	1	2	3	4
X14 Total labor productivity of secondary industry	.962	.237	.084	.061
X18 Internet penetration	.924	.336	.129	.101
X5 Proportion of science and technology expenditure	.923	.348	.040	-.041
X2 Proportion of main business income of large and medium sized manufacturing enterprises	.917	.326	.189	-.018
X1 Proportion of owner business income of high end manufacturing	.903	.303	.135	.141
X3 Proportion of sales revenue of new industrial products	.902	.315	.057	.084
X17 Informatization level of industrial application	.869	.463	.002	.057
X15 Return on manufacturing assets	.861	.461	.066	.111
X13 Profit margin of main business income of manufacturing enterprises	.825	.514	-.123	.080
X20 Comprehensive utilization rate of general industrial solid waste	.817	.306	.160	.431
X7 R & D investment in high end manufacturing industry	.811	.540	-.072	.089
X6 R & D personnel investment in high end manufacturing industry	.809	.571	-.027	.115
X21 Proportion of energy conservation and environmental protection expenditure in public budget	.786	.042	-.073	.589
X9 Technology market turnover per 10000 scientific and technological personnel	.744	.634	-.138	-.038

X4 Proportion of export transaction value of high end manufacturing industry	.733	.666	-.022	-.021
X16 Output rate of unit industrial energy consumption	.722	.634	-.082	.182
X19 Proportion of industrial medium and long term loan balance	-.278	-.843	-.338	-.240
X11 Premium rate	.456	.812	.121	.280
X22 Emission intensity of major industrial pollutants	-.637	-.675	-.217	-.206
X8 Number of invention patents per unit R & D expenditure	-.137	-.017	.945	.216
X12 Number of top 500 manufacturing enterprises in China	.518	.399	.727	-.010
X10 Qualified rate of product quality	-.001	.253	.244	.926

From the rotated factor load matrix, the variance contribution rate of the first and second main factors is larger, and they are the main influencing factors. The first main factor has a large load factor in the secondary industry's total labor productivity, Internet penetration rate, science and technology expenditure proportion, main business income proportion of large and medium-sized manufacturing enterprises, high-end manufacturing owners' business income proportion, sales income proportion of new industrial products, industrial application informatization level and other indicators, which mainly reflects the high-tech degree of the manufacturing industry Personnel quality and operating income level. The second main factor has a large load factor in the high-grade product rate, technology market turnover per 10000 scientific and technological personnel, the proportion of export transaction value of high-end manufacturing industry, output rate of unit industrial energy consumption, R & D investment in high-end manufacturing industry, R & D personnel investment in high-end manufacturing industry and other indicators, which mainly reflects the input level of personnel and funds in manufacturing industry. The third main factor has a large load factor in the number of invention patents per unit R & D expenditure and the number of China's top 500 manufacturing enterprises, which mainly reflects the achievements and strength of the manufacturing industry. The fourth main factor has a large load factor in the product quality qualification rate, the proportion of sales revenue of new industrial products and the profit margin of main business income of manufacturing enterprises, which mainly reflects the profitability of manufacturing industry.

Using SPSS software to fill in the calculation formula of each factor, we can calculate the comprehensive score of high-quality development level of manufacturing industry in Fujian Province and sort it (see Table 5).

Table 5 Comprehensive score table of high quality development level of manufacturing industry in Fujian Province

City	Principal factor 1	Principal factor 2	Principal factor 3	Principal factor 4	Comprehensive score	sort
Xiamen	1.06894	2.10292	-.84961	.10965	1.07233	1
Fuzhou	1.03851	-.05254	2.40273	-.09867	.78100	2
Quanzhou	1.66198	-1.36341	-1.13533	-.58793	.47145	3
Longyan	-.52530	.56872	.00201	1.50775	-.03763	4
Putian	-.00662	-.58499	.03055	.48692	-.10671	5
Zhangzhou	-.53851	-.29531	-.21973	.56344	-.35556	6
Sanming	-.94039	.43055	.23679	-1.33527	-.52193	7
Ningde	-.77920	-.87893	-.26158	.86306	-.61786	8
Nanping	-.97941	.07299	-.20583	-1.50894	-.68509	9

IV. Analysis on the Evaluation Model of High Quality Development Level of manufacturing industry in Fujian Province

It can be seen from table 4 that Xiamen ranks the first in the high-quality comprehensive development level of manufacturing industry in Fujian Province. From the influencing factors, it can be seen that Xiamen has more high-tech level in manufacturing industry, more investment in personnel and funds, so the quality of manufacturing industry development in Xiamen is relatively high. However, from the perspective of the third main factor, Xiamen's manufacturing enterprises with high-quality development are still relatively few, and the number of the world's top 500 enterprises is relatively small, so it still needs to be continuously improved. Fuzhou, the provincial capital city, only ranks second, which is far from the goal of high-quality development of manufacturing industry in Fuzhou. From the second main factor, it can be seen that the investment level of personnel and funds for high-quality development of manufacturing industry in Fuzhou is relatively low compared with Xiamen, which indicates that the investment in high-quality development of manufacturing industry in Fuzhou is still insufficient. Although Quanzhou ranks high in terms of operating income, the other main factors are negative, indicating that it needs to be strengthened in all aspects. From the overall ranking, the regions with high-quality development of manufacturing industry in Fujian Province rank at the same level as the regional economic development, and the top three cities are still the cities with high GDP development.

V. Countermeasures to Improve the High Quality Development Level of Regional Manufacturing Industry

5.1 Step up the formulation of the development plan for the manufacturing industry

For Fujian Province, the high-quality development of manufacturing industry needs clear goals and ideas, reasonable planning and division of labor, so that it can complement science and technology services. Therefore, we should speed up the formulation of the long-term development plan for the high-quality development of manufacturing industry in Fujian Province on the basis of the investigation of the current situation of the high-quality development of manufacturing industry in Fujian Province and the research on the development of the "fourteenth five year plan". Planning should be forward-looking and adapt to the current industrial base.

5.2 Strengthen policy support for high quality development of manufacturing industry

We will introduce supporting policies to promote the high-quality development of manufacturing industry in Fujian Province, and give financial support to advanced manufacturing enterprises in all aspects. We will relax restrictions on the registration of advanced manufacturing enterprises. At the same time, we should encourage private capital and foreign investment in the development of advanced manufacturing industry.

5.3 Construction of advanced manufacturing industry cluster

Through planning and layout, policy guidance and necessary financial support, we should actively develop the gathering base of advanced manufacturing industry. Support the conditional districts and counties to integrate the manufacturing industry based on their own regional advantages, so that the advanced manufacturing enterprises are relatively concentrated in the region, and form the manufacturing agglomeration with different characteristics and brand effect.

5.4 Improve the quality of manufacturing employees

Strengthen the cooperation with the manufacturing industry of colleges and universities, and cultivate high-level manufacturing service talents; According to the market demand, strengthen the cooperation with various training institutions, train various manufacturing talents urgently needed by the market, and provide the quality of relevant personnel; to promote, support and lead the high-quality development of the manufacturing industry, we should strengthen exchanges and cooperation at home and abroad, and attract high-quality and management professionals

who are familiar with the rules and practices of the manufacturing industry.

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