ISSN : 0974 - 7435 Volume 8 Issue 9

BioTechnology
An Indian Journal

FULL PAPER

BTAIJ, 8(9), 2013 [1300-1305]

Regional industrial competitiveness evaluation research of pharmaceutical manufacturing industry

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ABSTRACT

Pharmaceutical manufacturing is a knowledge and technology-intensive high-tech industry, and also a special industry on people's livelihood. How to enhance its competitiveness has great significance for the regional economic development. This paper is based on the dual theory of comparative advantage and competitive advantage, according to their different emphases, pharmaceutical manufacturing industry competitiveness evaluation index system of regional and provincial were established, then take JiangxiProvince (JX), China as an example, use factor analysis and cluster analysis methods to evaluate regional competitiveness, and use factor analysis to evaluate provincial competitiveness, so as to know about pharmaceutical manufacturing's competitive advantage among provinces in China and the comparative advantage among industries in JX. According to the results, some relevant recommendations were put forward to enhance the competitiveness of the pharmaceutical industry in JX Province.

KEYWORDS

Pharmaceutical manufacturing industry;
Competitiveness evaluation;
Factor analysis;
Cluster analysis.

INTRODUCTION

Pharmaceutical industry has long been recognized as the world's immortal "sunrise industry", shouldering the task of people's health, demand for high quality drugs. It's an important economic sector to improve people's quality of life and promote social development. People's Government of JX province successively defined the bio-pharmaceutical industry as a strategic emerging industry, and the Chinese medicine and bio-pharmaceutical industry as one of the six pillar industries, constantly increases its efforts to support their development. Meeting with new opportunities and challenges, to study the competitiveness of pharmaceutical industry has great significance.

As the pharmaceutical industry becoming China's high-tech industry, the domestic theorists and practitioners have made some theoretical and practical results. Wu Zhuoliang[1] discussed the high-tech industry evaluation system, establishes a comprehensive evaluation model from the competitive dynamics. Sun Dongqi[2] used factor analysis and location quotient analysis methods to research competition paths under industrial competitiveness mode. Other scholars have integrated use qualitative and quantitative analysis methods to establish regional industrial evaluation index sys-

tem and model, and do empirical analysis. Foreign pharmaceutical industry developed earlier, formed a relatively complete and mature system. However, foreign research of pharmaceutical industry competitiveness evaluation and research is relatively small. Michael E Porter[7] proposed a national competitive advantage analysis model (also known as the Diamond model), which is the most prominent representative model of industrial competitiveness. Mattia Bianchi[8], used expert interviews and data analysis methods to survey and analyse the well-known enterprises of bio-pharmaceutical industry. George T.Haley[10] analyzed the global competitiveness of Indian's pharmaceutical industry.

INDUSTRY COMPETITIVENESS EVALUATION METHODS

There are many methods to evaluate industrial competitiveness at home and abroad, such as the Diamond model, location quotient, DEA, fuzzy comprehensive evaluation, AHP, principal component analysis and so on. Based on the characteristics of the indexes, taking into account of the applicability and simplicity principles as well as the need to achieve the results, this paper mainly use the factor analysis and cluster analysis methods.

Factor analysis

Factor Analysis is a data reduction technique, by studying the internal dependence of the correlation matrix of a number of indicators to identify the common variables which control all variables, and they are not correlation between the common factors.

Suppose the original variable indexes are x_1, x_2,..., x_p, integrated new variable indexes are y_1, y_2,..., y_m, m d" p, turn p related original variables of x_p into m irrelevant variables of y_m, The mathematical model of factor analysis is as follows:

$y_1=u_{11}x_1+u_{12}x_2+u_{13}x_3+\ldots u_{1p}x_p$

$y2=u_{21}x_1+u_{22}x_2+u_{23}x_3+\ldots u_{2p}x_p$

$y3=u_{31}x_1+u_{32}x_2+u_{33}x_3+\ldots u_{3p}x_p$

……

$y_m=u_{m1}x_1+u_{m2}x_2+u_{m3}x_3+\ldots u_{mp}x_p$

$u_{i1}^2+u_{i2}^2+u_{i3}^2+\ldots u_{ip}^2=1$ (i=1,2,3,…p)

Cluster analysis

Cluster analysis is to classify cases based on the individual characteristics. Its essence is to use the sample data to determine the degree of similarity or affinity relationships of the sample indicator objectively, and feather flock the similar sample or indicators together under the principle of like attracts like. The differences within a group are smallest, and differences among groups are biggest, in order to achieve the purpose of classification. The degree of affinity between the samples is mainly determined by the distance and the correlation coefficient between the samples. This paper uses cases cluster method, in which individual distance using Squared Euclidean Distance, and group distance using Between-groups linkage.

Factor analysis and cluster analysis in this paper are analyzed by means of SPSS 16.0 statistical software.

REGIONAL COMPETITIVENESS EVALUATION OF PHARMACEUTICAL MANUFACTURING INDUSTRY OF JX PROVINCE

Establish evaluation index system

According to the dual theory of comparative advantage and competitive advantage, competitive advantage emphasis on comparison of the same industry among areas, focusing on market exchange relations, snatching market in the fierce competition, access to benefits, and the ability of sustained economic growth. Based on the above analysis and combined with the characteristics of pharmaceutical manufacturing industry, as well as the availability of data, this paper establishes a regional competitiveness evaluation index system with 4 first level index and 15 second level index of pharmaceutical industry, as follows:

Industry size

Gross industrial output, annual average number of employees, number of enterprises, total assets;

Market capacity: business principal revenue, sales industrial output, market share;

Innovation capability

Full-time R&D personnel, intramural expenditure on R&D, expenditure on new products development, new products output, sales revenue of new product;

Profitability

Sales profit margin, industrial output profit margin,

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ratio of profits to cost.

Combined with the development trend of pharmaceutical manufacturing and distribution of the main producing areas in recent years, this paper selects 19 provinces and cities of China for the evaluation of regional competitiveness. The statistical data of the indexes are original data above designated size of pharmaceutical manufacturing enterprises from provincial and Chinese statistical yearbooks or calculated based on original data.

Competitiveness evaluation of pharmaceutical industry between jx and other provinces

Prerequisite of factor analysis

Using SPSS 16.0 software for analysis, the significant level P = 0.000 <0.05, KMO is 0.800, suitable for factor analysis. Using principal component analysis to identify the common factors of 15 indicators, according to the total variance explained diagram, the former two factors' eigenvalues are greater than 1, and the cumulative variance contribution rate is 92.1%, so the first two factors are the common factors.

Factor extraction and solving of the factor component matrix

According to the rotated component matrix, the indexes of industry size, market capacity and innovation capability are mainly explained by the first common factor, we can defined it as an industrial strength factor. The indexes of sales profit margin, industrial output profit margin, ratio of profits to cost are mainly explained by the second common factor, we can defined it as an profitability factor.

Calculate component's scores

Using regression method to estimate each component's score coefficient, and outputs component score coefficient matrix, write the expression of factor scores, among which X_1, X_2,... X_{15} are the normalized values of the variables.

$F_1=0.094X_1+0.090X_2+0.093X_3+0.085X_4+0.094X_5+0.094X_6+0.094X_7+0.081X_8-0.084X_9+0.085X_{10}+0.084X_{11}-0.084X_{12}-0.012X_{13}-0.022X_{14}-0.009X_{15}$

$F_2=-0.048X_1-0.053X_2-0.081X_3+0.055X_4-0.050X_5—0.051X_6-0.050X_7+0.054X_8+0.055X_9+0.043X_{10}+0.053X_{11}+0.051X_{12}+0.308X_{13}+0.305X_{14}+0.307X_{15}$

Variance contribution of each factor was weighted to calculate the regional pharmaceutical manufacturing total score of F, F = 0.7083F1 +0.2127 F2, the results and sorting are shown in TABLE 1.

TABLE 1 : Scores of F1, F2, F and ranking

region	F1		F2		F	
	score	ranking	score	ranking	score	ranking
SD	2.656	1	0.240	8	1.933	1
JS	2.333	2	-0.459	10	1.555	2
ZJ	0.829	3	0.968	3	0.793	3
GD	0.540	4	0.804	6	0.553	4
BJ	-0.496	13	2.389	1	0.156	5
...	...	...	...	...	...	...
JX	-0.402	11	-1.428	19	-0.589	15

Cluster analysis

According to the results of factor analysis, select F_1, F_2 as new variables to do cases cluster, clustered all cases into four groups. Part of the results are shown in TABLE 2:

Evaluation results analysis

Results of factor analysis

According to TABLE 1, pharmaceutical manufacturing industry of JX compared to other provinces, its industrial strength factor score is -0.402, ranked 11, profitability factor score is -1.428, ranking 19,total score is -0.589, ranked 15, under the middle development level. The top five competitive provinces are SD, JS, ZJ, GD, BJ, of which the industry size, production capacity, innovation and profitability in the country are in a leading position in the development of pharmaceutical manufacturing.

Results of cluster analysis

According to TABLE 2, BJ belongs to Group 1, the score of industrial strength factor is not high, but its profitability in China has an absolute advantage. BJ as the capital city, its economy is developed, industries have strong appeal. Group 2 includes TJ, HLJ, SH, ZJ, FJ, GD, which has strong competitiveness. These provinces' economic are relatively developed in China, pharmaceutical manufacturing develops steadily. Among them, medical and pharmaceutical technology of SH,

TJ are very advanced in China, they are pharmaceutical companies' development center in China for research, manufacturing, marketing and investment. Group 3 includes HeB, LN, JL, AH, JX, HeN, HuB, HuN, CQ, SC, which has great relationship with the level of economic development of the regions. Group 4 includes SD and JS, the total score rank the first or second. JS and SD are strong provinces of pharmaceutical manufacturing in China, where medical resources are relatively abundant, industry concentration and market share are high.

TABLE 2 : Classification of group members

group	region
Group 1	BJ
Group 2	TJ、HLJ、SH、ZJ、FJ、GD
Group 3	HeB、LN、JN、AH、JX、HeN、HuB、HuN、CQ、SC
Group 4	JS、SD

PROVINCIAL COMPETITIVENESS EVALUATION OF PHARMACEUTICAL MANUFACTURING INDUSTRY OF JX PROVINCE

Establish evaluation index system

According to the dual theory of comparative advantage and competitive advantage, comparative advantage mainly refers to differences among industries on labor force, natural resources, productivity and other production factor endowment, focusing on the development potential of a particular industry. If an industry within the region has more abundant resources, lower production costs and labor consumption, indicates that the industry is more competitive than other industries in the region. Based on the theory, this paper establishes the provincial competitiveness evaluation index system, as follows:

Industry size

Annual average number of employees, number of enterprises, average income of enterprises;

Production capacity

Gross industrial output, industrial added value, overall labor productivity;

Industry benefit

Ratio of profits to cost, ratio of profits and taxes to output value, ratio of profits and taxes to funds, ratio of total assets output value;

Development potential

Ratio of demand growth, income elasticity of demand.

The date of this part is original date or calculated based on the almanac data from the National Bureau of Statistics, JX Bureau of Statistics released the most recent year, 2011. Collect and collate date of 20 major industrial sectors of JX of the main economic indicators of industrial enterprises above designated size.

Competitiveness evaluation of major industrial sectors of jx

Follow the procedure of factor analysis in the previous chapter, evaluate the competitiveness between 20 major industries. Get the level of significance $P = 0.000 < 0.05$, KMO value is 0.564. According to the total variance explained diagram, the former three factors' eigenvalues are greater than 1, and the cumulative variance contribution rate is 89.5%. Among them, ratio of profits and taxes to output value, overall labor productivity, ratio of profits and taxes to funds, average income of enterprises, ratio of total assets output value, ratio of profits to cost are mainly explained by the first common factor, we can defined it as an benefit factor; gross industrial output, industrial added value, annual average number of employees, number of enterprises are mainly explained by the second common factor, can be defined as an scale factor; ratio of demand growth, income elasticity of demand are mainly explained by the third common factor, reflecting the industry's market development potential, can be defined as an development factor. Part of the results of score and ranking are shown in TABLE 3:

Evaluation results analysis

According to TABLE 3, pharmaceutical manufacturing industry compared to other industries in JX, its benefit factor score is -0.352, ranked 12, scale factor score is -0.098, ranked 10, development factor score is -0.182, ranked 10,total score is -0.211, ranked 10, at a medium level. The top five industries with high total score are manufacture of tobacco, smelting and pressing of non-ferrous metals, manufacture of raw chemical materials and chemical products, manufacture of non-

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TABLE 3 : Scores of F1, F2, F3,F and ranking

Grouped by Sector	F1		F2		F3		F	
	score	rank-ing	score	rank-ing	score	rank-ing	score	rank-ing
Manufacture of Tobacco	3.964	1	-0.334	11	-0.719	17	1.477	1
Smelting and Pressing of Non-ferrous Metals	0.329	4	2.424	1	0.497	6	0.941	2
Manufacture of Raw Chemical Materials and Chemical Products	0.037	6	1.774	2	1.346	3	0.770	3
Manufacture of Non- metallic Mineral Products	0.254	5	1.764	3	-0.350	13	0.568	4
Mining and Processing of Non-Ferrous Metal Ores	0.594	2	-0.607	14	1.736	2	0.375	5
...	...	...	...	...	...	...	...	...
Pharmaceutical Manufacturing Industry	-0.352	12	-0.098	10	-0.182	10	-0.211	10

metallic mineral products, mining and processing of non-ferrous metal ores, which are all involved in the six pillar industries of JX province.

DEVELOPMENT PROPOSALS FOR PHARMACEUTICAL INDUSTRY OF JX

Accelerate industrial agglomeration

Enterprise above designated size of pharmaceutical manufacturing in JX is few, especially leading brands. Modern industry is characterized by a powerful combination of business through acquisitions, restructurings and joint, so as to improve the competitiveness of enterprises and form industrial clusters.

Strengthen business operations

Pharmaceutical manufacturing of JX compared to other pillar industries or other provinces in China does not have advantage in economic benefit and profitability. Therefore, enterprises need to strengthen internal operations management and control costs, in order to improve profits and the economic benefits of pharmaceutical manufacturers.

Strengthen technological innovation

Pharmaceutical products in JX are mostly generic drugs, lacking of technological innovation, which is a major factor that affect the competitive position of JX. So it needs to strengthen research cooperation and communicate with famous foreign enterprises, increase research funds to develop new products, and form local brands and features.

Optimization supportive policies

Pharmaceutical industry has high-tech, high investment, high cycle, high risk, high reward characteristics. It's necessary to put forward supportive policies in market access, government procurement, tax subsidies, investment and financing policies, etc. to promote the development of pharmaceutical industry.

CONCLUSION

This paper is based on literature research on industrial competitiveness at home and abroad, according to the theory of comparative and competitive advantage, establish competitiveness evaluation index system of regional and provincial of pharmaceutical industry of JX, and use factor analysis and cluster analysis methods to evaluate and analyze, so as to identify its competitive advantage in China and comparative advantage among industries of pharmaceutical manufacturing. The research of this paper has certain guiding significance for other areas of China to study industrial competitiveness.

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