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Guangxi County Special Industrial Competitiveness Analysis Based on Fuzzy Evaluation

Zhang Jingxin

Department of Economics and Trade, Guilin University of Aerospace Technology,
Guilin City, 541004, People's Republic of China

Abstract: This study evaluated Guangxi county special industrial competitiveness by using the AHP and fuzzy evaluation method and treated special industries of three counties in Guangxi as the object. The results showed that: the current level of Guangxi county specialty industrial competitiveness is still relatively low and the basis resources advantages constituted of the characteristics of industrial competitiveness is not prominent and human resources and innovation capability that exerted the advantage of resources is not strong. Therefore, it should be started from encouraging the county to realize the innovation of specialty industrial technology and to combine the development of Small and Medium Enterprises (SMEs) in the industry consolidation and then upgrade specialty of the county industrial competitiveness in Guangxi.

Key words: Guangxi, fuzzy evaluation, resources advantages

INTRODUCTION

Since, the first time proposed “the county economy” in the Party Congress, 2002, Guangxi made it an important strategic task to accelerate the regions economic as promoting the social development. As a result, the county economy in Guangxi achieved leapfrog development. In the development of Guangxi’s county economic, the county specialty industrial has played a fundamental role (Cai *et al.*, 2009). County specialty industrial means the kind of industrial sectors that relying on the county featured resource endowments, the special technical conditions and specific market needs, with local characteristics of the county. The resource endowment and technical conditions mainly contain three ways such as characteristics of agricultural industries, specialty industrial and specialty services industrialization industrialization (Liu, 2008). As a western province, Guangxi is short of the basic of products features, but it is rich in natural resource endowment. So it is the only way to improve the counties economic in Guangxi by developing the natural resource-based industries of agro-processing characteristics.

Modern regional economic growth pole theory suggests that it is a standard mode for backward areas to realize development by leaps and bounds to form a comparative advantage growth pole in a certain field by putting varieties of resources within the region. Guangxi county special industries is the growth pole of economic development and the comparative advantage in natural resources of special agriculture is the foundation of

county industrial development. However, the most counties in western China which developed based on special natural resources, have exhibited varying degrees of problems such as increasingly difficulties of sustainable economic growth, single industrial structure, environmental damage and other “resource curse”. These phenomena showed that it is the industrial competitiveness combined by comparative advantage of talent, technical and capital that is the core driving force of county industrial development. Only when the county industrial competitiveness upgraded, is it possible to turn the comparative advantages of natural resources into the county’s economic development advantages and then to form competitive advantage of counties’ economic development. Therefore, the study of how to enhance the competitiveness of the industry in Guangxi county should be the key to the development of county economy. This article will help to raise suggestions to improve Guangxi specialty industrial competitiveness based on the evaluation of the current situation of it after constructing Guangxi County Special Industrial competitiveness evaluation index system by using fuzzy evaluation method.

A LITERATURE REVIEW

As the core of our county’s economy, county characteristic industry carrying almost all of the requirements in the region’s economic and social development at the county level. The current hot issue in China’s economic and social development such as the

solving of rural issues, the development of new urbanization, the transformation of economic development mode and the adjustment of the economic structure, etc., when it specific to the county area, almost inseparable from the development of county special industries (Du and Tang, 2010). It is because of the importance of county special industries, the current characteristics of the county industrial research is increasingly valued. The relevant literature focused on the following three aspects: Firstly, it is about the identification and nurturing of the county special industries. Zhu *et al.* (2011) built a fuzzy evaluation index system by defining the characteristics of the content and features of the county industrial and was used for screening County Industrial provide actionable quantitative specification. Ma and Li (2011) summarized the four basic modes of county industrial formation according to the county's economic development foundation. According to the county's economic development conditions in Hebei Province, Song *et al.* (2012) raised an efficiency medium for how to cultivate the industry standard with its own characteristics from three aspects such as the geopolitical advantages, resources advantages and industrial basis. Cha and Dong (2006), and Bo (2010), pointed out of the path of nurturing and strengthening county special industries, from the perspective of the county industrial agglomeration characteristics, respectively use Hubei and Hebei Province as examples.

Secondly, the relationship between technological innovation and development of the county characteristics industries. Lin *et al.* (2009) summarized the features of county industrial innovation activities and pointed out that there are four characteristics in the outstanding performance of county industrial innovation activities such as the government-led, multi-stakeholder involvement, external dependence and income diversification. Yao and Fan (2009) analyze how to build support for county industrial development technological innovation system from the role of technological innovation to promote industrial development of the county characteristics. Lin and Luo (2012) take Jasmine industry in Heng County, Guangxi province as an example and analyze the risk in characteristics of industrial innovation activities in the county and the risk management. He and Du (2012) proposed ways to promote innovation to enhance the ability of our county special industries by constructing a cluster of innovative mechanisms after evaluating on the characteristics of industrial innovation capacity of the county.

Thirdly, the relationship exists between the county economy and the county characteristics of industries. Wei (2007) summarized the four modes of county economic development from the perspective of

industry-driven and supported the view that the leading industries located in characteristics and advantages of counties is the core of the county's economic development. Xia *et al.* (2008) studied the county's economic development in the industrial layout problems and thought that relying on county resources advantages was the inevitable choice of county economic development. Wang and Liu (2011) pointed out that we could effectively solve the problems of low quality of current county economic development and large differences of regions if we could realize the innovation of industrial development policy, the optimization of the industrial structure characteristics, the rational distribution of industry-wide. Ren and Ma (2010) pointed out that investment was a scarce resource in the process of county's economic development and county industrial development was the core of the counties' economic growth and the development of special industries could help to promote capital accumulation. Therefore, the county economic investment must tend to county special industries. Huang *et al.* (2010) held the view that in the process of the county's economic development, the counties' special industries was the means, new rural construction was one of the goals and there was a positive interaction between the good characteristics of industrial development of the county and new rural construction. Therefore, we should treat the county industrial development as an important means of new rural construction.

Above all these documents mentioned just now, the current studies of the county's mainly focused on external factors about county special industrial development, only few focused on the county industries' own endogenous characteristic and studied how to promote industrial development in depth based on the competitiveness point of view. Furthermore, the current research methods used in the existing literature are mostly qualitative theoretical analysis while little was on the use of quantitative methods County Industrial research. So, this essay takes Guangxi specialty industries for example, uses the method of fuzzy evaluation to research for the county in Guangxi specialty industrial competitiveness, in order to propose policy recommendations in the perspective of how to improve Guangxi County Special Industrial development to.

GUANGXI COUNTY SPECIAL INDUSTRIAL COMPETITIVENESS EVALUATION INDEX SYSTEM

Industrial competitiveness is the core dynamic characteristics of the county industrial development and also the comparative advantage in the development of the industry. This comparative advantage is based on the

resource endowment of industrial development and combined with the advantages such as human resources, level of technology and capital accumulation and together make up the competitiveness of the county industrial development. Thus competitiveness evaluation index system of Guangxi County Industrial should also be constructed from these aspects.

Principle of the evaluation index system: First, the scientific principle. Guangxi County Special Industrial competitiveness evaluation is based on Porter’s competitiveness theory and build the index system primarily from the impact of industrial development perspective of comparative advantage. Therefore, in the process of selecting the evaluation indicators, we should strive to ensure that every indicator is true and effective to reflect the contents of the different competitive aspects.

Second, the principle of comprehensiveness. Guangxi County special industrial competitiveness is the result of many factors interact within the county economy. Therefore, when measuring the characteristics of industrial competitiveness county in Guangxi, we should try to ensure to design a comprehensive and integrated index system and from different levels and different perspectives.

Third, the feasibility principle. Guangxi County Special Industrial competitiveness evaluation index asks that the indicators selected to be figured to quantify and this process can be quantified through existing statistics conducted to obtain an objective as far as possible. Even subjective indicators have to go through a certain specification conversion process to turn into a simple, intuitive objective value.

Fourth, the dynamic principle. As Guangxi county economy growing constantly, along with the improving level of external economic situation within the industry, the content and composition of industrial competitiveness is constantly changing. This requires competitiveness evaluation index can keep up with the requirements under the premise of maintaining a certain continuity with adjustable elastic space.

Evaluation index system design: Guangxi County Special Industrial Development is a united effects of the natural resources, human resources, technology, financial resources and other comprehensive response owned by county economic and is based on above index system principles, considering the current economic development of the county in Guangxi features and then construct the four-level indicator system shown in following Table 1. The target layer of evaluation is characteristic of Guangxi county special industrial competitiveness that is broken down into three subsystems layers: Resource endowments capacity, technical support capabilities and human resource capacity. Each system consists of several sub-layer and eventually is broken down sub-layer into index layer.

We should consider three types of subsystems in resource endowments capability: The quantitative advantages, quality advantages and capital accumulation capacity of natural resource endowments. Natural resources are the basis of Guangxi County Special Industrial Development and it is necessary to evaluate from the perspective of both quantity and quality. Quantity index examines the two indicators such as static and dynamic incremental stock; resource quality considers market premium rate which means a premium

Table 1: Guangxi county special industrial competitiveness evaluation index

First level indicators	Second level indicators	Third level indicators
Resource endowments capacity (B1)	Resource abundances	The proportion of resource annual output in the national output (X11) Resource growth rate (X12)
	Resource quality	Resource market premium rate (X13) Resource high quality rate (X14) National market share (X15) Margin (X16)
	Financial capacity	Investment growth rate (X17)
Technical support capabilities (B2)	Technical level	Device update rate (X21) No. of patents (X22)
	Technological innovation capability	Patent growth rate (X23) New product sales growth rate (X24) R and D investment (X25)
	Innovation support system	Innovation award system (X26) The percentage of innovation award in sales (X27) No. of external experts (X28)
Human resource capacity (B3)	Human resource reserves	The proportion of college education (X31) The proportion of intermediate professional titles (X32) Proportion of mechanic staff (X33)
	Human resource increment	Training expenses (X34) Types of training programs (X35) The average annual No. of days of staff training (X36)

price ratio of the selling price in Guangxi product market inverse national average selling price. Since, County Industrial capital accumulation mainly depends on county financial ecological environment and therefore put the capital ability into resource endowment funds capability. Examine two metrics: Profitability and investment growth, select profit margins because county characteristic industries are generally small and medium enterprises, so the profits is not only the accumulation of capital of industrial development, but also a premise to attract external funds.

We should consider three types of subsystems in technical support capabilities: Technical level, technical innovation and innovation support system. Technical level can be measured by two indicators such as sophistication of the equipment and the number of patents while technological innovation capability can be measured by three indicators such as patent growth rate, new product sales growth rate, R&D investment and it is clear that technological innovation capability is a dynamic and potential indicators layer. Innovation support system reflects the supporting role that the policy and institutional environment played on characteristic industries in Guangxi county, respectively measured by three indicators such as (represented by the number of external experts) whether using innovative reward system or not, innovative reward efforts and the outreach support system of science and technology.

We should consider two types of subsystems in the human resource capacity: The stock of human resources and the increments of human resource. Guangxi County Special Industrial Development is developing in the industrial environment, so it is not only inseparable from senior personnel management, but also inseparable from the process of manufacturing level of skilled workers. Therefore, we select to examine the talent reserves in the proportion of workers with college education, job title and the proportion of skilled workers. When it comes to human resources incremental, we can examine training expenses of the staff, the average annual number of days of training and the type of training program.

To determine the weight of each index: This study calculate the weight of each level index system, the AHP first need to determine the target layer evaluation object. This article defines Guangxi County Special Industrial competitiveness as the evaluation target layer which is labeled as A and the first level indicator is B, the third evaluation index is X. Firstly, construct judgment matrix, the matrix often use the numbers 1-9 and their countdown to indicate the degree of importance of two elements

contrast. For example, in the index system B of the target layer A, compare the degree of importance B_i ($i = 1, 2, 3$), the number 1 indicates that B_i is as important as B_j and the number 3 represents that B_i is a little more important than B_j , then $1/3$ means B_i is a little less important than B_j . The larger the number the greater the degree of importance, it represents that the number 9 is maximum. Based on the principles above, this study construct judgment matrix, respectively between target layer A and guidelines layer B and between guidelines layer B and evaluation indicators C which are showed in the following. The comparative figures in the judgment matrix is obtained from the experts survey. The 30 experts are professors and doctors majored in Industrial Economics chosen from one university in Guangxi and experts from Municipal Commission of Economy and Information Technology Development and Reform Bureau of 10 counties in Guangxi. The data is obtained by releasing questionnaires which is Table 2-5.

Calculate the largest eigenvalue λ_{max} of each judgment matrix, then calculate the consistency index C.I and then C.R which means the proportion of C.I and the average random consistency index R.I. As is shown in

Table 2: Comparison matrix A-B

A	B1	B2	B3	Weights
B1	1	1	3	0.280988
B2	1	1	3	0.457048
B3	1/3	1/3	1	0.162228

Table 3: Comparison matrix B1-X1i

B1	X11	X12	X13	X14	X15	X16	X17	Weights
X11	1	3	2	5	1/3	3	2	0.254884
X12	1/3	1	3	7	1/5	1/3	3	0.149004
X13	1/2	1/3	1	2	2	3	1/7	0.118740
X14	1/5	1/7	1/2	1	3	3	1/3	0.090552
X15	3	5	1/2	1/3	1	2	3	0.209091
X16	1/3	3	1/3	1/3	1/2	1	1/3	0.080322
X17	1/2	1/3	1/7	3	1/3	3	1	0.097407

Table 4: Comparison matrix B2-X2i

B2	X21	X22	X23	X24	X25	X26	X27	X28	Weights
X21	1	2	1/3	2	3	1/5	2	3	0.148867
X22	1/2	1	3	3	5	1/3	2	1	0.171655
X23	3	1/3	1	2	1/3	3	2	1	0.145513
X24	1/2	1/3	1/2	1	3	1	1	3	0.118039
X25	1/3	1/5	3	1/3	1	2	2	3	0.118995
X26	5	3	1/3	1	1/2	1	1/3	1/5	0.097808
X27	1/2	1/2	1/2	1	1/2	3	1	2	0.108243
X28	1/3	1	1	1/3	1/3	5	1/2	1	0.090880

Table 5: Comparison matrix B3-X3i

B3	X31	X32	X33	X34	X35	X36	Weights
X31	1	3	3	1/3	2	1/5	0.167214
X32	1/3	1	3	5	1/3	1/2	0.157354
X33	1/3	1/3	1	2	3	1/3	0.126243
X34	3	1/5	1/2	1	3	1	0.159385
X35	1/2	3	1/3	1/3	1	2	0.135069
X36	5	2	3	1	1/2	1	0.254736

Table 6: Judgment matrix consistency test

Judgment matrix	Largest eigen value λ_{max}	Consistency index C.I	Average random consistency index R.I	C.R
A-B (3 step)	2.57392800	0.081309000	0.90	0.090343333
B1-X1i (7 step)	7.02134322	0.123557203	1.32	0.093603942
B2-X2i (8 step)	5.51022103	0.081460147	1.41	0.057773154
B3-X3i (6 step)	4.81313700	0.112627000	1.24	0.090828226

Table 6, the results show that judgment matrix set with expert consistency and the weights based on judgment matrix is reasonable.

Fuzzy evaluation guangxi county special industrial competitiveness: After determining the weights of the indicators, this study continued to get the score and evaluation of each indicator by the method of questionnaire and then analyze by using the fuzzy statistical. In the evaluation questionnaires, each of the indicators is divided into four levels as “excellent, good, fair, poor”, corresponding to 5, 4, 3 and 2 points then we can get fuzzy evaluation matrix by scoring statistics of different experts. This study selects three county industries to evaluate such as cassava industry, sugar cane industry and tropical fruit industry (Zhang, 2011). Here, we take the survey data of cassava industry as an example to show the related calculation process.

Resource capacity fuzzy evaluation matrix: We can get the following fuzzy evaluation matrix through counting the questionnaires scored by experts:

$$R1 = \begin{bmatrix} 0.227 & 0.457 & 0.224 & 0.092 \\ 0.256 & 0.458 & 0.189 & 0.097 \\ 0.514 & 0.351 & 0.135 & 0 \\ 0.217 & 0.184 & 0.516 & 0.083 \\ 0.312 & 0.225 & 0.176 & 0.287 \\ 0.246 & 0.379 & 0.182 & 0.193 \\ 0.338 & 0.205 & 0.259 & 0.198 \end{bmatrix}$$

The weight collection of resource capacity (X1i) obtained by analysis above is:

$$W1 = (0.254884, 0.149004, 0.11874, 0.090552, 0.209091, 0.080322, 0.097407)$$

We can get evaluation fuzzy sets to the resource capacity:

$$B1 = W1 \times R1 = (0.51754, 0.657894, 0.59748, 0.68971)$$

which turn out to be:

$$B1^* = (0.2272, 0.1952, 0.2057, 0.2223)$$

after the normalization process.

Technical support capabilities fuzzy evaluation matrix:

$$R2 = \begin{bmatrix} 0.127 & 0.557 & 0.316 & 0 \\ 0.358 & 0.273 & 0.251 & 0.118 \\ 0.678 & 0.124 & 0.198 & 0 \\ 0.321 & 0.435 & 0.244 & 0 \\ 0.513 & 0.108 & 0.212 & 0.167 \\ 0.295 & 0.338 & 0.367 & 0 \\ 0.219 & 0.511 & 0.192 & 0.078 \\ 0.427 & 0.325 & 0.248 & 0 \end{bmatrix}$$

The weight collection of resource capacity (X2i) obtained by analysis above is:

$$W2 = (0.148867, 0.171655, 0.145513, 0.118039, 0.118995, 0.097808, 0.108243, 0.09088)$$

Evaluation fuzzy sets to the resource capacity and after the normalization process we can get:

$$B2^* = (0.2128, 0.3113, 0.2165, 0.2594)$$

Human resource capacity fuzzy evaluation matrix:

$$R3 = \begin{bmatrix} 0.469 & 0.255 & 0.106 & 0.07 \\ 0.318 & 0.397 & 0.175 & 0.01 \\ 0.536 & 0.219 & 0.245 & 0 \\ 0.351 & 0.184 & 0.465 & 0 \\ 0.407 & 0.382 & 0.211 & 0 \\ 0.546 & 0.279 & 0.175 & 0 \end{bmatrix}$$

The weight collection of resource capacity (X3i) obtained by analysis above is:

$$W3 = (0.167214, 0.157354, 0.126243, 0.159385, 0.135069, 0.254736)$$

Evaluation fuzzy sets to the resource capacity and after the normalization process we can get:

$$B3^* = (0.3234, 0.1876, 0.1792, 0.3098)$$

According to the calculating to B_i^* ($i = 1, 2, 3, 4$), combined with scores corresponding with “excellent, good, fair, poor” four-level evaluation, we can calculate the final score for each ability. Take the final score of

Table 7: Three counties specialty industrial competitiveness in Guangxi

Industry name	Industrial competitiveness		
	Resource capacity	Technical support capabilities	Human resource capacity
Sugarcane industry	2.1475	3.1028	3.1985
Tropical fruit Industry	3.1572	3.6897	4.1541
Cassava industry	2.9785	3.4775	3.5246

resource capacity of cassava industry (B1*) for example, the calculating progress is as follows: Let score vector $P = (5, 4, 3, 2) T$, then the final score of the resource capacity is:

$$B1 \cdot P = (0.2272, 0.1952, 0.2057, 0.2223) \cdot (5, 4, 3, 2) T = 2.9785$$

Similarly, we can get the final score of technical support capabilities is 3.4775 and the human resource capacity is 3.5246.

A comparative analysis of the three county industrial competitiveness: According to the calculating progress above, we can calculate the remaining two County Industries in Guangxi as sugar cane industry and tropical fruit industries based on AHP and fuzzy calculation and then get the ranking of ability of the indicators showed in Table 7.

CONCLUSION AND SUGGESTIONS

This study evaluated Guangxi County Special Industrial Competitiveness by using the AHP and fuzzy evaluation method and treated special industries of three counties in Guangxi as the object. The results showed that: the current level of Guangxi county special industrial competitiveness is not high. In the fuzzy evaluation of the three elements that constitute the industrial competitiveness, the results are all at the basic level or so, except the HR of the tropical fruit industry showed higher competition force level and the resources capabilities and technical capacity of three industries are not high. In order to enhance the competitiveness of industries in Guangxi county characteristics, this study holds that we should take measures in the following aspects.

First, in the process of developing special industries in the county of Guangxi, we should take active measures to encourage technological innovation. County industrial technology innovation is mainly dependent on the county personnel. With the continuous development of economic and social modernization in Guangxi, the trend is obvious that the personnel gather to large cities and the central areas and the phenomenon is more prominent that people engaged in agricultural science and technology do not want to stay in the county. Moreover, few people engage in agricultural science and technology learning and the

training institutions of professionals are also few which further exacerbated the contradiction between supply and demand of county personnel. At this point, governments at all levels should take a number of measures: First, to increase the welfare of the county science and technology talents and attract talents deep into the county economic development areas; second, they should take measures to encourage the personnel who grasp the use of advanced agricultural technology to carry out industrial innovation behavior associated with the county industries; third, local governments can cooperate with universities and research institutes, training professionals oriented.

Secondly, a situation in the development of Guangxi county special industries that there is dependence on natural resources, but the resources advantages are not converted into industrial development advantages which is related to the fact that small and medium enterprises (SMEs) are the main body of county special industries, thus in order to promote the development of SMEs, they should enhance industrial competitiveness. This requires the government to actively create a good environment for the development of private economy, encourage financial institutions to finance to the SMEs in the county special industries. At the same time, they need to actively support the superior and leading enterprises to grow bigger and stronger and build a number of enterprises developed in clusters by modern market centralized way such as merger and purchase. Through large-scale of industrial development, achieve economies of scale, thereby improve the efficiency of industrial development.

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