Comparative Advantage Analysis of Mining Industry in Anhui Province Based on Location Quotient Method

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Abstract: In this paper, the location quotient method is used to analyze and evaluate the status quo of mining development in Anhui Province, and determine the advantage ratio between the operating income of each sub-industry and the output of main mineral products in Anhui Province. The results show that the mineral resources follow-up processing industry is the main industrial sector supporting the growth of Anhui mining economy, but the advantages are not significant. Among the main mineral products in Anhui province, only copper and cement have advantages, while other mineral products have significant disadvantages. On this basis, the paper puts forward the concrete measures to promote the healthy development of mining industry in Anhui Province.

Keywords: location quotient; mining industry; comparative advantage; empirical analysis

1 Introduction

Anhui Province has a complete variety of minerals. By 2011, 158 kinds of mineral species (including subspecies) had been discovered in the province, and 126 kinds of mineral reserves had been identified. Among them, reserves of coal, iron, copper, pyrite and other mineral resources rank first in China. Mining industry is the basic industry and pillar industry of Anhui economy. The sustainable development of mining industry plays a decisive role in the development of Anhui economy[1]. In order to realize the sustainable development of mining industry, the key is to rationally exploit and utilize mineral resources on the premise of determining the advantages and disadvantages of mining industry. However, the development advantages of mining industry in Anhui Province are not clear enough, and the development potential and competitiveness of mining industry have not been given full play. Therefore, it is necessary to conduct quantitative analysis and research on the advantages of mining development in Anhui Province.

2. Status quo of mining development in Anhui Province

Mining industry is an important industry in Anhui Province's national economy and social development[2]. In 2020, the total operating revenue of mineral resources industry in Anhui Province was 3,854.929 billion yuan, accounting for 24.25% of the corresponding indicators of industrial enterprises above designated size in the province (see Table 1). Among them, the total operating income of the mining industry accounts for 3.22%, and the minerals with the largest

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value are coal, non-metal and black. The total output value of processing, smelting and manufacturing accounted for 21.03%, and the minerals with a large output value were non-metallic, non-ferrous and black. The ratio of output value of processing, smelting and manufacturing industry to that of mining and processing industry is 6.53, and the smelting and processing and manufacturing industry of mineral resources is significantly stronger than that of mining and processing industry. In terms of the number of enterprises, there are 2,915 mining and related enterprises in Anhui Province, and 2,174 non-metallic mineral products enterprises. It can be seen that the status of mining industry in Anhui Province is relatively prominent, among which mineral processing, smelting and manufacturing are more significant[3].

Table 1 Status quo of mining development in Anhui Province

category	Number of enterprises	Operating revenue (100 million yuan)	Total industrial revenue of the province (100 million yuan)	Share
Coal mining and washing industries	22	796.41	38549.29	2.07%
Ferrous metal mining	50	189.88		0.49%
Mining and processing of non-ferrous metals	32	32.02		0.08%
Non-metallic mining industry	201	223.09		0.58%
Mining auxiliary activity	2	3.33		0.01%
Petroleum processing, coking and nuclear fuel processing	51	588.04		1.53%
Non-metallic mineral products industry	2174	3015.94		7.82%
Ferrous metal smelting and rolling industry	136	2128.26		5.52%
Nonferrous metal smelting and rolling industry	247	2469.51		6.41%
total	2915	9346.48		24.25%

Data source: Table 12-2 "Main Economic Indicators of Industrial Enterprises above designated Size (2020)", Anhui Statistical Yearbook 2021.

3 Research Methods

Location quotient, also known as specialization rate, refers to the proportion of the economic scale of a specific industry in the national economic scale of the industry and the proportion of the overall economic scale of the region in the national total economic scale[4]. Location quotient method was first proposed by Hagate and used in location analysis. It is a method commonly used in economics to analyze regional industrial layout or industrial advantages, and a quantitative tool for industrial efficiency evaluation and benefit analysis[5]. By calculating the location quotient of different industries in a certain region, the status quo advantage degree of various industries in the region can be obtained, and the status quo advantage degree of certain industries in different regions can be obtained by calculating the location quotient of certain industries in different regions[6]. The calculation formula of location quotient is:

$$LQ_{ij} = \frac{L_{ij} \Big/ \sum_{j} L_{ij}}{\sum_{i} L_{ij} \Big/ \sum_{i} \sum_{j} L_{ij}} \quad (1)$$

In the above formula, i represents the i-th region; Represents the Jth industry; L_{ij} Refers to the output index of the I-th region and the J-th industry; LQ_{ij} Represents the location quotient of industry j in region i.

Based on the relevant research results and the value of advantage ratio, this paper puts forward the classification standard of industrial advantage degree (see Table 2). If LQ_{ij} >1, it indicates that j industry in region i has a high degree of industrial agglomeration in this region, and its development degree is higher than the average level of similar industries in China. It has industrial advantages and strong competitiveness. If LQ_{ij} < 1, it means that the industry is relatively dispersed in the region, the development degree is lower than the national average level, and the industry is a self-supporting sector. If LQ_{ij} =1, it indicates that the industry is equal to the national level and at an average level.

Table 2 Advantage classification criteria

Range of dominance ratio values	Degree of dominance
$LQ_{ij} \geq 2$	Significant advantage
$2 > LQ_{ij} \geq 1.2$	Subsignificant advantage
$1.2 > LQ_{ij} > 1$	Unstable advantage
$1 > LQ_{ij} \geq 0.8$	Unstable disadvantage
$LQ_{ij} < 0.8$	Significant disadvantage

4. Empirical analysis of Anhui Province's mining comparative advantages

This paper adopts the location quotient method, based on the existing statistical data, and calculates the mining output advantage ratio based on the two mining output indicators of operating income and mineral product output to reflect the degree of mining advantage in Anhui Province.

4.1 Advantage analysis of mining revenue

According to the evolution of location quotient index and formula (1), the calculation model of mining operating income advantage ratio is obtained as follows:

$$VA_{ij} = \frac{V_{ij} \Big/ \sum_{i} V_{ij}}{\sum_{k} V_{ik} \Big/ \sum_{i} \sum_{k} V_{ik}} \quad (2)$$

In the above formula: ithe i-th region;

J the JTH industry;

V_{ij} Revenue of industry j in region i;

$\sum_{i} V_{ij}$ the operating income of the j-th industry in the country;

k the first k industry;

V_{ik} the area I k industry output value;

$\sum_{k} V_{ik}$ in the ith a total economic output value, namely i region's GDP;

$\sum_{i} \sum_{k} V_{ik}$ the total economic output of the country, i.e., the GDP of the country;

VA_{ij} represents the advantage ratio of output value of industry j in region i.

Based on the formula (2), the advantage ratio was calculated by combining the operating revenue values of 10 sub-sectors of mining industry in Anhui Province and China in 2015 and 2020(See Table 3).The resources are from China Statistical Yearbook 2016 and Anhui Statistical Yearbook 2021.

Table 3 Operating income of mining industry segments in Anhui Province

Industry type	Operating revenue in 2015 (RMB 100 million)		Operating revenue in 2020 (100 million Yuan)	
	Anhui	China	Anhui	China
Coal mining and washing industries	1052.02	23770.31	796.41	20821.6
Ferrous metal mining	356.98	7207.49	189.88	4160.0
Mining and processing of non-ferrous metals	94.55	6234.91	32.02	2748.7
Non-metallic mining industry	235.95	5414.60	223.09	3662.4
Mining auxiliary activity	4.64	1739.96	3.33	2106.5
Petroleum processing, coking and nuclear fuel processing industries	455.10	34604.49	588.04	41976.6
Non-metallic mineral products industry	2284.37	58877.11	3015.94	58018.1
Ferrous metal smelting and rolling industry	1965.09	63001.33	2128.26	73054.9
Nonferrous metal smelting and rolling industry	2795.34	51367.23	2469.51	54229.8

In 2020, The operating income advantage ratio of each sub-sector of Anhui mining industry in descending order is non-metallic mining → non-ferrous metal smelting and rolling processing → non-metallic mineral products → ferrous metal mining → coal mining and washing industry → ferrous metal smelting and rolling processing industry → petroleum processing, coking and nuclear fuel processing industry → non-ferrous metal mining and processing industry → auxiliary mining activities(See Table 4). According to the advantage classification criteria in

Table 2, the first four subsectors have secondary significant advantages, coal mining and washing industry has unstable disadvantages, and the last four subsectors all have significant disadvantages. In 2015, the operating income advantage ratio of each subsector of Anhui mining industry in descending order was as follows: black metal ore mining → coal mining and washing industry → non-metallic ore mining → non-ferrous metal smelting and calendering processing industry → non-metallic mineral products industry → black metal smelting and calendering processing industry → non-ferrous metal ore mining industry → petroleum processing, coking and nuclear fuel processing industry → mining auxiliary work Move; The first three subdivided industries have secondary significant advantages.Non-ferrous metal smelting and rolling processing industry and non-metallic mineral products industry have unstable advantages.Ferrous metal smelting and rolling processing industry has unstable disadvantages, and the last three subdivided industries have significant disadvantages.

Table 4 Summary results of mining operating income advantage ratio

Industry type	2020		2015	
	Dominant ratio	sort	Dominant ratio	sort
Non-metallic mining industry	1.60	1	1.24	3
Nonferrous metal smelting and rolling industry	1.56	2	1.19	4
Non-metallic mineral products industry	1.36	3	1.11	5
Ferrous metal mining	1.20	4	1.42	1
Coal mining and washing industries	1.00	5	1.27	2
Ferrous metal smelting and rolling industry	0.76	6	0.90	6
Petroleum processing, coking and nuclear fuel processing industries	0.37	7	0.38	8
Mining and processing of non-ferrous metals	0.33	8	0.44	7
Mining auxiliary activity	0.04	9	0.08	9

4.2 Yield advantage analysis of mineral products

According to the evolution of location quotient index and formula (1), the calculation model of mineral product yield advantage ratio is as follows:

$$PA_{ij} = \frac{P_{ij} \Big/ \sum_{i} P_{ij}}{\sum_{j} P_{ij} \Big/ \sum_{i}\sum_{j} P_{ij}} - 1 \tag{3}$$

In the above formula, i represents the i-th region; j represents the output of the J-th mineral product; P_{ij} represents the output of the i th region and the j th mineral product; $\sum_{i} P_{ij}$ represents the national output of the J-th mineral product; $\sum_{j} P_{ij}$ is the GDP of the I-th region; $\sum_{i}\sum_{j} P_{ij}$ represents the national GDP; PA_{ij} represents the yield advantage ratio of j minerals in region i.

According to Formula (3), combined with the output values of major mineral products in Anhui

Province and the whole country in 2015 and 2020, the advantage ratio was calculated (see Table 5 and Table 6).

In 2020, the yield advantage ratio of main mineral products in Anhui Province is copper output → cement → raw coal → pig iron → steel → raw salt → coke → gasoline output in descending order. According to the advantage classification criteria in Table 2, copper output has a significant advantage, cement output has a secondary significant advantage, and other mineral output has a significant disadvantage. In 2015, the yield advantage ratio of main mineral products in Anhui Province in descending order is copper output → cement → raw coal → steel → pig iron → raw salt → coke → gasoline output. Copper production has a significant advantage. Cement output has a secondary significant advantage. Raw coal production has the advantage of instability. The output of steel and pig iron has an unstable disadvantage, and the output of other mineral products has a significant disadvantage.

Table 5 Output of main mining products in Anhui Province in 2015 and 2020

species	unit	2015			2020		
		China	Anhui	proportion	China	Anhui	proportion
Raw coal	Ten thousand tons	374700	13404	3.58%	390200	11084	2.84%
Raw salt		6665.54	149.65	2.25%	5852.68	155.35	2.65%
Copper		796.20	131.1	16.47%	1002.51	105.8	10.55%
gasoline		12103.56	216.6	1.79%	13171.69	256.0	1.94%
coke		44822.54	958.5	2.14%	47116.12	1228.0	2.61%
Pig iron		69141.30	2092.5	3.03%	88897.61	2537.3	2.85%
steel		103468.41	3334.7	3.22%	132489.18	3607.5	2.72%
cement		235918.83	13085	5.55%	239470.83	14176	5.92%

Sources: China Statistical Yearbook (2016), Anhui Statistical Yearbook (2016), China Statistical Yearbook (2021), Anhui Statistical Yearbook (2021)

Table 6 Summary results of yield advantage ratio of main mineral products

species	2020		2015	
	Dominant ratio	sort	Dominant ratio	sort
Copper	2.77	1	4.73	1
cement	1.55	2	1.59	2
Raw coal	0.75	3	1.03	3
Pig iron	0.75	4	0.87	5
steel	0.71	5	0.93	4
Raw salt	0.70	6	0.65	6
coke	0.69	7	0.61	7
gasoline	0.51	8	0.51	8

5 Conclusions and suggestions

5.1 Conclusions

According to the results of the above location quotient analysis, the mining development of Anhui Province presents the following characteristics:

(1) The follow-up processing industry of mineral resources is the main industrial sector supporting the growth of the mining economy in Anhui Province, but the advantages are not significant. The operating income of non-ferrous metal smelting and calendering processing industry, ferrous metal smelting and calendering processing industry and non-metallic mineral products industry is always high, while the operating income of selecting industry is not high. Compared with the national average level, non-ferrous metal smelting and calendering processing industry and non-metallic mineral products industry only have secondary significant advantages, while ferrous metal smelting and calendering processing industry is still in a significant disadvantage[7].

(2) In the output of major mineral products in Anhui province, only copper and cement have advantages, while other mineral products have significant disadvantages. The degree of advantages and disadvantages of main mineral products output in Anhui province is not consistent with mineral resource endowment. Mineral resources reserves in the country has a certain advantage such as coal, iron, etc., the output of mineral products did not show the advantage[8].

5.2 Suggestions

Based on the analysis results of Anhui Province's comparative advantages of mining industry, the following specific suggestions are put forward for the healthy development of Anhui Province's mining industry: firstly, strengthen the exploration of advantageous mineral resources, increase human, financial and material investment, strive for practical results in prospecting and increasing reserves, and provide a strong material foundation for the development of advantageous mining industry[9]. Secondly, technological transformation should be carried out in the follow-up processing links of non-ferrous metals, ferrous metals and non-metallic minerals, and capital investment should be increased to extend the industrial chain and improve the added value of products[10]. Thirdly, it is necessary to make reasonable deployment and arrangement in industrial investment, layout optimization, and industrial, product and technological structure adjustment in accordance with the dominant position of each type of mineral resources in Anhui Province, so as to transform resource advantages into economic advantages.

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