Analysis of Grey Correlation Degree between Mining Structure and Economic Growth in Henan Province

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Abstract: Based on the theory of gray correlation, this paper selects the relevant data of the mining structure and GDP of Henan Province in recent years, and uses the gray correlation analysis method to quantitatively analyze the degree of correlation, and quantitatively analyze the mining structure of Henan Province from 2008 to 2015. The relationship between various industries and economic growth. The results show that in recent years, the degree of correlation between the mining structure and economic growth in Henan Province is in the order of coal mining and washing industry>ferrous metal smelting and rolling processing industry>non-metallic mining and dressing industry>non-ferrous metal mining and dressing industry>non-metallic mineral products industry >Non-ferrous metal smelting and rolling processing industry>Petroleum and natural gas mining industry>Ferrous metal mining and dressing industry. The primary processing industry still occupies the main part of the existing industrial structure in Henan Province, and the raw material industry and processing industry are still the foundation of Henan Province's economic development. In order to make the mining industry make a more substantial contribution to the economic development of Henan Province, it is recommended that: (1) While attaching importance to the role of raw materials in economic growth, we should also attach importance to the coordinated development of the raw material processing industry, and face the deep processing industry as the economy of Henan Province. Contributions from development. (2) Take the intensive and efficient development path of "high technology content, good economic benefits, excellent mining structure, low resource consumption, less environmental pollution, and full utilization of the advantages of mining resources".

1. Introduction

Mineral resources are precious wealth bestowed by nature to mankind, and an important material basis for human development and survival. Human necessities for food, clothing, housing and transportation are closely related to the enrichment of mineral resources and the rationalization of the mining structure. Whether the mineral resources are abundant and the mining structure can reflect the economic development potential of a country or region.

As a large province in the central region, Henan Province is also a large province of mineral resources. Its economic growth is highly dependent on the demand for mineral resources. The development of mineral resources and the processing industry are the pillar industries of Henan Province. As the province is in the critical stage of the coordinated development of new "urbanization, industrialization, and agricultural modernization" [1], its consumption demand for mineral resources is still increasing year by year. Therefore, only by taking advantage of the rich mineral resources of Henan Province, rationally optimizing the mining structure, and driving the development of other related industries with the development of the mining industry, can the process of industrialization in Henan Province be accelerated and Henan's economy will be more healthy, sustained and stable.

The rich mineral resources of Henan Province have spurred the development of the national economy of Henan Province and transformed it into huge economic advantages. At the same time, it has also brought about negative effects that cannot be ignored. The mining industry already exists or is about to face a severe situation. The contradiction between the supply and demand of mineral resources has become increasingly prominent. The unreasonable industrial structure, the

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unreasonable layout of the development and utilization of mineral resources, the single economic structure of the mining industry, the backward mining technology, and the backward development of the mineral processing industry are all restricting the more stable economic development of Henan Province. Therefore, optimizing the industrial structure of the mining industry to promote economic growth is an important issue for promoting the economic development of Henan Province.

2. Overview of the Mining Structure of Henan Province

2.1 Status of Mineral Resources

Henan Province is a large province in China's minerals and mining industry, and it has made a huge contribution to the economic growth of the province. Its mining output value and ore mining volume have been at the forefront of the country for many consecutive years [1]. Since entering the 21st century, the added value of the mining economy and industry has long accounted for more than 55% of the added value of the province's industrial economy. In 2015, the province's energy and raw materials industry accounted for 39.1% of the added value of industries above designated size. Among the more than 130 kinds of mineral resources discovered in Henan province, there are more than 80 kinds of proven reserves, 78 kinds of mining and utilization, more than 2,300 mineral deposits, and about 9,000 mining enterprises. The raw material processing and manufacturing industry occupies a very important position in the province's industry. After many years of development, Henan has now become an energy base for China’s petroleum, coal, and electric power industries; non-ferrous metals such as molybdenum, aluminum, lead, and zinc, as well as precious metals such as gold and silver, steel, building materials, rock salt, trona, and chemicals An industrial base for important raw materials in other industries. Relying on the resource advantages of Henan Province, Henan has gradually formed a relatively complete industrial system. At the same time, it has spawned a large number of mining industry cities such as Hebi, Jiaozuo, Puyang, Pingdingshan, Yima, and Yongcheng, and cultivated building materials, coal, chemicals, non-ferrous metals, etc. A series of advantageous industries, and the establishment of a number of important energy and raw material production bases, have more strongly supported the healthy and sustainable development of the economy of Henan Province.

2.2 Current Status of Mining Structure

Recently, Henan Province is in the development stage of “heavy industrialization”, and its dependence on mineral resources is still gradually expanding, and the influence of mineral resources on the economy of Henan Province is also increasing. However, due to the strong development of mineral resources for many years and other reasons, the continuous support intensity of many advantageous minerals in Henan Province for the development of the national economy and social development has gradually shown a downward trend, even directly threatening energy, coal, steel, electricity, and Long-term sustainable development of other pillar industries such as petrochemicals. The structure of the mining industry is unreasonable, the economic structure of the mining industry is single, the mineral raw material industry and the primary processing industry are still the main forces of the industry, and the development of the deep processing industry is backward [2]. The extensive business model of “high energy consumption, low utilization, unreasonable structure, and high consumption” recently presented by the mining structure has made mineral resources long-term in a strong and over-loaded development environment. The mineral industry is for the people of Henan Province. While bringing huge wealth, it also restricts the better and healthy development of the national economy of our province in some aspects [2]. At present, the restrictive effect of the continuous and rapid economic and social development of Henan Province of mining resources has been highlighted.

Therefore, it is necessary to study the relationship between Henan's mining structure and economic growth, find out the problems that restrict economic development, and at the same time recognize how various mining structures promote economic growth in our province, and understand

each of the mining structures. The impact of the industry on the economic growth of our province will better promote the healthy and sustainable development of our province's mining economy.

3. Grey Correlation Analysis of Mining Structure and Mining Economic Growth

3.1 Research Methods

Grey relational analysis is a system analysis method in the grey system theory proposed by the famous Chinese scholar Professor Deng Julong in 1982 [3]. For the factors between two systems, the measure of the degree of relevance that varies with time or different objects is called the degree of relevance. In the process of system development, if the changing trends of the two factors are consistent, that is, the degree of simultaneous change is higher, it can be said that the two factors have a higher degree of correlation; on the contrary, it is lower. Therefore, the gray correlation analysis method is based on the degree of similarity or difference between the development trends of factors, that is, the "grey correlation degree", as a method to measure the degree of correlation between factors. The grey system theory puts forward the concept of grey relational analysis of each subsystem, with the intention of seeking the numerical relationship between the subsystems (or factors) in the system through a certain method. Therefore, gray correlation analysis provides a quantitative measure for the development and change of a system, which is very suitable for dynamic process analysis. Gray correlation analysis treats the research object and the factor values of influencing factors as points on a line, and the object to be identified Compare with the curve drawn by the factor values of the influencing factors, compare the closeness between them, and quantify them respectively, calculate the closeness of the research object and the object to be identified, and compare the closeness of each influencing factor. To determine the degree of influence of the object to be identified on the research object. Because the gray correlation analysis is based on the development trend, it does not have too high requirements for the size of the sample, and the analysis does not require a typical distribution law, and the results of the analysis are generally consistent with the qualitative analysis. Based on this advantage and the reality Abstract systems are gray systems with multiple factors acting together. Compared with other methods, they can better reflect the order of distance and space distribution among various factors, so they have a wide range of practicability [4].

3.2 Theoretical Model

This article uses GDP as the reference data and reference series, and selects relevant economic data such as the total production value of each industry in the mining industry and the proportion of each industry in the value added of the above-scale industries.

First, determine the reference series and comparison series, and do the original data transformation. The total production value of each industry in the mining structure is used as the comparison series. Transform the original data, eliminate the dimension, and convert it into a series of data that can be compared.

$$f(x(k)) = \frac{x(k)}{x(1)}, \mathrm{k} = 1,2,3,4,5,6,7$$

By calculating the absolute difference sequence Ai(k), and finding the maximum (small) absolute difference (ie $\triangle$ max, $\triangle$ min), the absolute difference between the standardized comparison sequence and the reference sequence forms a new sequence, which is the difference sequence.

$$\Delta i(k) = | Xi(k) - Xo(k) |$$

Among them (i=l,2,3,4,5,6,7,8, k=l,2,3,4,5,6,7). Substitute the data in Table 1 into formula 2, get the absolute difference series, and find $\triangle$max and $\triangle$min.

i(k) to determine the resolution coefficient ρ, ρ=0.5 used in this paper

$$\varepsilon i(k) = \frac{\min \Delta i(k) + \rho \max i(k)}{\Delta i(k) + \rho \max \Delta i(k)}$$

Among them (i=l,2,3,4,5,6,7,8; k=l,2,3,4,5,6,7) Substitute the previous step data into the above formula to get the correlation coefficient sequence.

The degree of relevance directly reflects the pros and cons of each comparison sequence to the reference sequence. The greater the degree of relevance, the greater the impact of the comparison sequence on the reference sequence [5].

$$\gamma i = \frac{1}{N}\sum_{k=1}^{n} \varepsilon i(k)$$

3.3 Sources of Information

The data in this article comes from the statistical yearbook of Henan Province over the years. The GDP is selected as the characteristic index of the system reflecting the basic skills and overall growth. The coal mining and processing industry, oil and gas mining industry, ferrous metal mining and processing industry, non-ferrous metals are selected. Mining and dressing industry, non-metallic mining and dressing industry, non-metallic mineral products industry, ferrous metal smelting and rolling processing industry, non-ferrous metal smelting and rolling processing industry, various related indicators of the eight mining industries are factors, and the information is true and reliable .

3.4 Index Selection and Calculation

According to the industrial added value and production output value of various industries in the mining structure of Henan Province inquired in the Henan Statistical Yearbook, the gross production value of each industry in the mining structure is obtained for calculation. In order to reveal the gray correlation between the development of various sub-sectors in the mining structure and the economic development and economic growth of Henan Province, several economic development indicators in the mining structure of Henan Province from 2008 to 2015 are collected, as shown in Table 1.

Table 1 the Development Status of Various Mining Industries in Henan Province in 2015

Proj.	Number of units/piece	Number of employees/ten thousand		Total assets/100 million yuan	
Coal mining and washing industry	282	47.36		3328.68	
Oil and gas extraction industry	4	5.51		340.99	
Ferrous metal mining and dressing industry	106	1.27		144.95	
Non-ferrous metal mining and dressing industry	320	8.22		1017.24	
Non-metallic mining and dressing industry	277	4.33		309.06	
Non-metallic mineral products industry	3899	75.38		6074.14	
Ferrous metal smelting and rolling processing industry	579	21.24		2423.33	
Non-ferrous metal smelting and rolling processing industry	553	22.22		4238.31	
Metal products industry	998	18.82		1286.1	

According to the relevant data in the above table, by selecting coal mining and processing industry, oil and gas mining industry, ferrous metal mining and processing industry, non-ferrous metal mining and processing industry, non-metallic mining and processing industry, non-metallic mineral products industry, ferrous metal The smelting and rolling processing industry, non-ferrous metal smelting and rolling processing industry in the mining structure from 2008 to 2015, each industry accounted for the proportion of industrial added value above designated size, combined with the total output value of Henan Province, and further obtained the 2008-2015 mining structure of each industry The total output value, see the table below

Table 3 2008-2015 Total Output Value of Various Industries in the Mining Structure

Proj.	2008	2010	2011	2012	2013	2014	2015
GDP	18018.53	23092.36	26931.03	29599.31	32191.30	34938.24	37002.16
Secondary industry GDP/100 million yuan	10068.47	12822.81	14837.13	15898.30	16742.90	17816.56	17917.37
Coal mining and washing industry	926.30	1269.46	1424.36	1271.86	1071.55	944.28	609.19
Oil and gas extraction industry	231.57	141.05	207.72	158.98	133.94	124.72	71.67
Ferrous metal mining and dressing industry	50.34	76.94	74.19	79.49	66.97	71.27	53.75
Non-ferrous metal mining and dressing industry	322.19	435.98	474.79	524.64	485.54	427.60	376.26
Non-metallic mineral processing industry	110.75	115.41	133.53	143.08	150.69	142.53	143.34
Non-metallic mineral products industry	1067.26	1628.50	1839.80	2050.88	2159.83	2333.97	2400.93
Ferrous metal smelting and rolling processing industry	704.79	653.96	652.83	874.41	920.86	908.64	806.28
Non-ferrous metal smelting and rolling processing industry	644.38	692.43	816.04	715.42	669.72	623.58	627.11

4. Result Analysis

Through the above table and calculation results, the correlation degree and correlation order of Table 4 can be seen. The analysis result of the correlation degree is: xl>x7>x5>x4>x6>x8>x2>x3, that is to say from the gray correlation degree From the perspective of analysis, coal mining and washing industries have the greatest impact on GDP. The gray correlation degree shows the correlation between various industries in the mining structure and Henan Province's GDP, which directly reflects the contribution of various industries in the mining structure to the economic growth of our province. Coal mining and washing industry is the most important factor affecting Henan Province's GDP in recent years, and it is also the most influential factor on Henan Province's economic growth, followed by ferrous metal smelting and rolling processing industry, followed by non-metallic mining and processing industry , Non-ferrous metal mining and dressing industry, non-metallic mineral products industry, non-ferrous metal smelting and rolling processing industry, oil and natural gas mining industry, ferrous metal mining and dressing industry.

(1) First, the industry with the highest correlation is xl in the table, that is, coal mining and washing industry. From 2008 to 2015, the gray correlation degree between the coal mining and washing industry in Henan Province and the GDP of Henan Province's secondary industry in the mining structure is as high as 0.478, which shows that the coal mining and washing industry in our province is related to the GDP. Growth is highly correlated. The coal mining and washing industry has an extremely important position for Henan Province's GDP growth [6]. Henan is a major mineral and mining province in my country. Its mining output value has been in the forefront of the country for many years. The current economic growth of Henan cannot be separated from the development of the mining industry. The rapid development of the economy needs the support of the mining industry, especially the coal mining and washing industry. The main mining structure is the support. Although the structure of the mining industry continues to develop in the direction of high quality, in terms of the current development situation, the coal mining and washing industry will still occupy an important position for a long period of time in the future.

(2) Secondly, the x7 ferrous metal smelting and rolling processing industry is the second most relevant to the economic growth of Henan Province. From the research results, the gray comprehensive correlation between the ferrous metal smelting and rolling processing industry and the province's GDP is lower than that of the coal mining and washing industry, but it is still as high

as 0.450, which means that the mining structure of Henan Province The medium and ferrous metal smelting and rolling processing industry also shows a high correlation with the province's GDP. Fully reflects its importance to Henan's economic development.

(3) Third, the non-metallic mining and dressing industry's influence on the economic growth of Henan Province occupies the third place. In the 15-year Henan Provincial Statistical Yearbook, the total assets of the non-metallic mining and dressing industry reached 30.906 billion yuan, accounting for The proportion of the added value of the industrial enterprises above designated size has also reached 0.8%. The gray correlation degree between non-metallic mining and dressing industry and Henan Province's GDP reached 0.443, which proves that the role of this industry in Henan Province's mining structure on the province's economic growth cannot be underestimated.

(4) In the mining structure, the correlation between other industries and economic growth is 0.442, 0.419, 0.407, 0.398, 0.344, all of which play an indispensable role in the economic growth of Henan Province.

The analysis of the above gray correlation shows that the current industrial structure of Henan Province is still dominated by primary processing industries, and raw materials and processing industries are still the foundation of its economic development. In 2015, the assets of non-metallic mineral products totaled 607.414 billion yuan, the assets of coal milling and washing industry totaled 332.868 billion yuan, and the total assets of ferrous metal smelting and rolling processing industry totaled 242.33 billion yuan. The total production value of the eight major mining industries was 5088.53. 100 million yuan. This shows that Henan's economic growth is still mainly supported by resource-based industries and raw material industries. The economic development of Henan Province is still very dependent on the coal mining and washing industry, and the coal mining and washing industry still occupies a dominant position in the mining structure of Henan Province.

4.1 There Are Problems

(1) The adjustment of the mining industry structure is lagging. The growth of the province's mining economy is mainly supported by the resource extraction industry and the crude raw material processing industry, which is not closely related to the development of the mining follow-up industry. For the early-stage resource exploration industry and the follow-up mining industry in the mining industry chain The product processing industry and sales industry have been neglected [7].

(2) The level of scientific and technological innovation in the development of mineral resources and the mining structure is not high, resulting in the low-end and single structure of the produced mineral products. The research level of the mining resource recovery rate and the comprehensive utilization level of the deep processing of the mining structure needs to be strengthened. At the same time, mining equipment and facilities tend to be aging, leading to the loss of potential economic benefits and waste caused by low resource utilization.

(3) Due to the low degree of implementation of mineral resources planning, the distribution of mineral resources does not match the production layout [7]. At the same time, the national mining order is chaotic, mining enterprises are over-extensive, and the mineral consolidation system is not perfect.

5. Relevant Countermeasures and Suggestions for Improving the Supporting Capacity of the Mining Structure for Henan's Economic Development

5.1 Deepen the Optimization of the Mining Structure, Stably Develop the Mining Raw Material Industry, and Strengthen the Development of the Mining Deep Processing Industry

Expand the scope of the mining structure of resource integration, and further deepen the integration of the mining structure of the province or region in the coal mining and washing industry, ferrous metal smelting and rolling processing industry, and non-metallic mining and processing industry. The current industrial structure of Henan Province is still dominated by the primary processing industry. Raw materials and processing industries are still the foundation of its economic development. While attaching importance to the role of raw materials in economic

growth, it must also pay attention to the coordinated development of the raw material processing industry. Face up to the contribution of the deep processing industry to the economic development of Henan Province, improve the processing technology of the industry in the mineral structure, strive to gradually shift from the mining structure of raw materials to the primary processing industry or even the deep processing industry, and improve the mineral resource processing enterprises Occupation of resource structure. Although the proportion of processing industry in Henan's mining structure is basically on the rise, and the gray correlation with economic growth is also showing an increasing trend. However, it still lacks market competitiveness, its correlation with economic growth still needs to be improved, and its internal industrial structure is optimized and reasonable. On the basis of the continuous and stable development of the mining raw material industry, the development and support of the mining product processing industry should be increased, especially the development of the intensive processing industry [8]. The development of the mining intensive processing industry is the fundamental guarantee for the mineral industry to promote more efficient economic development.

5.2 Apply Scientific and Technological Progress and Innovation to Promote the Improvement of Mining Technology

By relying on the advanced science and technology of the mining industry, to improve the resource utilization level of the mining industry and the optimization level of the structure of the market as the guide, strengthen the development of mineral resources and the new technology and high technology of the mining structure, as well as the research and research of the theoretical methods with innovative processes The development, promotion and application of the mining structure, in particular, should strengthen the research on improving the recovery rate of mining resources and the comprehensive utilization level of deep processing of the mining structure, and support the promotion of science and technology and the research and development of the deep processing industry. Accelerate the development of high-tech industries, increase investment in the research of mineral processing industry technology, strive to improve the overall level of the mining structure of Henan Province, and improve the correlation between the mining structure and economic growth, so as to contribute to the healthy, sustainable and rapid development of Henan Province’s economy Lay a solid foundation [9].

5.3 Strengthen the Management of the Executive Department of Mineral Resources Planning, and Improve the Long-Term Mechanism of the Mining Structure Development Order

Starting from strengthening the large-scale mining and processing of mineral resources, do a good job in the planning and management of mineral resources, revision and sorting, strengthen the government’s ability to macro-control the mineral structure, and at the same time strengthen the understanding of the contribution of Henan’s mining structure to economic growth, and formulate mining development Planning is an important measure to guide the healthy, orderly and sustainable development of the mining industry. From the perspective of the sustainable development of the mining economy, the corresponding economic theories and industrial development theories are used to analyze the current situation of the mining market and formulate corresponding mining development plans and industrial policies [9]. Meet the needs of Henan Province's national economic and social development for the mining structure. When formulating the economic development plan of Henan Province, it is necessary to predict the relationship between various industries related to the mining structure and the economic growth of our province, so as to ensure the healthy and sustainable development of the mining industry and the economy of Henan Province. Establishing a model of promoting economic growth with the development of the mining structure with the characteristics of our province has very important strategic significance for the sustainable development of our province's social economy. Establish and improve the mineral structure system, strengthen the centralized and unified planning, management, protection and rational utilization of various industries in the mining structure, and realize the fundamental transformation of the mining structure. Further increase development efforts, increase the development and development of these industries in the mining structure of the coal mining and

washing industry, ferrous metal smelting and rolling processing industry, non-metallic mining and processing industry, etc., to ensure the development order of the mining structure and better Promote the development of mining economy in Henan Province.

6. Conclusion

This paper makes a correlation analysis of the relationship between the mining structure and economic growth in Henan Province through the gray correlation analysis method. The results show that the coal mining and washing industry are the most important factors affecting Henan Province's GDP in recent years. The most influential factors for the economic growth of the province are followed by ferrous metal smelting and rolling processing industry, followed by non-metallic mining and dressing industry, non-ferrous metal mining and dressing industry, non-metallic mineral products industry, non-ferrous metal smelting and rolling processing industry, petroleum And natural gas mining industry, ferrous metal mining and dressing industry. Accelerating the development and growth of the mining and processing industry is the top priority to promote the economic development of Henan Province. The slow adjustment of the internal structure of the mining industry has led to the unreasonable structure of the mining industry and restricted the rapid development of the economy [11]. At the same time, it also shows that in order to promote the current economic development of Henan Province, it is necessary to vigorously develop and develop raw materials and primary processing industries on the basis of [6], and more development of follow-up processing industries. Therefore, we should strengthen the planning and management of the mineral structure, apply scientific and technological progress and technological innovation, pay attention to the coordinated development of the raw material industry and the subsequent processing industry in the mining industry chain, face up to the contribution of the deep processing industry to the economic development of Henan Province, and promote Henan Province Efficient, healthy and coordinated growth of economic and social benefits and resource and environmental benefits.

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