Regional Differences and Spatial Pattern Evolution of Mineral Resources Industry in China

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Abstract. The mineral resources industry is the basic industry of national economy in the world. The distribution of mineral resources industry is often not matched with the areas with rich mineral resources. This paper analyzes the distribution characteristics of industrial added value of mineral resources in the mining and dressing industry, smelting and processing industry in China. Energy and metal mineral resource industries are focused on. The results show that the distribution of each link of the mineral resources industry does not match the resource enrichment area. The scope of the mining and dressing industry has expanded, mainly in the north of China, and the smelting and processing industry continues to gather in the coastal provinces. Energy mining and dressing industry is mainly located in the north of China, and the processing industry is mainly distributed in the middle and east of China. The metal mineral resources industry mainly depends on resource endowment. Metal products industry is different, mainly distributed in the coastal provinces with relatively developed processing technology.

1. Introduction

Mineral resources are an important part of the national economy. A large number of raw materials and energy in industrial sectors are directly from mineral resources. The research of mineral resources industry mainly focuses on the agglomeration of mineral resources industry [1-3], the influencing factors of industrial structure [4, 5], industrial evolution [6], industrial ecological development [7], etc. At the same time, the regional differences of mineral resources industry [8, 9], especially the imbalance between regional economic development and resource endowment [10], have attracted great attention, while the regional differences in various links of mineral resources industry are often ignored. This paper analyzes the distribution characteristics of industrial added value of mineral resources in the mining and dressing industry, smelting and processing industry, and focuses on the 2-3 links of the energy industry and metal mineral resources industry, which is the main part of the mineral resources industry.
2. Regional differences in mineral resources industry

The study selects the industrial added value data of 31 provinces and autonomous regions (excluding Hong Kong, Macao and Taiwan) in 2002, 2007 and 2012 in China. The data comes from the input-output table of each province.

According to the standard of industrial classification of national economy (GB/T4754-2011), the mineral resources industry is divided into mining and dressing industry, smelting and processing industry. Mining and dressing industry mainly include coal mining and washing industry, oil and natural gas mining industry, metal mining and dressing industry, non-metal mining and dressing industry. Smelting and processing industry mainly include oil processing, coking and nuclear fuel processing industry, chemical industry, metal smelting and rolling processing industry.

2.1. Mining and dressing industry.

The industrial added value of mineral resources industry in all provinces in China is divided into five categories on average (Figure 1). The industrial added value of mineral resources mining and dressing industry was mainly concentrated on Heilongjiang and Shandong provinces in 2002 in China, which are rich in oil and natural gas resources. The main distribution areas of mining and dressing industry expanded to Hebei, Henan, Shaanxi and Xinjiang in 2007, while Heilongjiang and Shandong are still in the forefront in China. Heilongjiang minerals are mainly oil and natural gas, while Shandong's coal mining and washing industry, oil and gas exploration industry, and metal mining and mining industry have developed in a balanced manner in 2007. In 2012, the main distribution area of mineral resources mining and dressing industry extended to Sichuan province, while the industrial added value of mining and dressing industry in Inner Mongolia, Shaanxi, Shanxi and Hebei Province entered the top 20% in China. The share of Heilongjiang and Shandong in the country has declined.

Mineral resources are non-renewable resources and prices of various mineral resources continue to rise, but growth is slowing. In 2007, the industrial added value of mineral resources mining and dressing industry was 2.31 times of that in 2002; in 2012, it was 1.9 times of that in 2007. Generally speaking, it is mainly located in resource rich areas and extends to neighboring provinces. On the one hand, the mining and dressing industry of mineral resources relies heavily on resource endowments, and it is located near the resource enrichment area. On the other hand, with the discovery and exploitation of new mineral resources and the gradual depletion of old mineral resources, it will also cause differences in the distribution of mining industry in different years.

2.2. Smelting and processing industry.

The industrial added value of smelting and processing industry of mineral resources is significantly higher than that of mining and dressing industry, and the gap between them is widening. From the distribution of mineral resources smelting and processing industry in 2002, 2007 and 2012, it can be seen that it is mainly located in coastal provinces of China. In 2002, the smelting and processing industry was located in Sichuan province and six coastal provinces. After that, the concentration, overall scale and profit of Sichuan's mineral resources industry gradually decreased, while the coal mining industry and chemical industry in Henan Province grew rapidly. In 2007, Henan replaced Sichuan Province as the main province of smelting and processing industry, and Henan's mining industry also entered the forefront of China. In 2012, Hebei, Shandong, Jiangsu and Guangdong were the main distribution areas of smelting industry. It can be seen that the distribution provinces of mineral resources smelting and processing industry are gradually shrinking and gathering. The economy of coastal areas is developed, and there is a high level of technology in the smelting and processing of mineral resources. Therefore, the smelting and processing industry continues to gather in coastal provinces, which can reduce costs and reduce environmental pollution at the same time.
3. Regional differences in energy industry

The energy industry mainly includes coal mining and washing industry, oil and gas mining industry, oil processing industry, coking industry and nuclear fuel processing industry. Among them, the first two are the mining and dressing industry in the energy industry, and the latter is the processing industry.

3.1. Mining and dressing industry.

The main distribution provinces of energy industry mining and dressing industry are few (Figure 2). In 2002, it was concentrated on Heilongjiang and Shandong provinces. In 2007, it increased in Xinjiang and Shaanxi. In 2012, it was concentrated on Heilongjiang, Inner Mongolia, Xinjiang, Shaanxi, Shanxi and Hebei provinces. The number of large energy provinces is increasing gradually. The total amount of proven energy resources in China is increasing and the amount of exploitation is increasing. However, there are not many provinces rich in energy resources, and all of them are located in the north of China.
3.2. Processing industry.

In terms of industrial added value, unlike other mineral resources, the energy processing industry is far less than that of mining and dressing industry in the same year (Figure 2). In recent years, various industries have become more and more dependent on energy, and the proportion of energy consumption continues to increase. Energy has become an important material support sector in the national economic system. The transformation of energy consumption mode makes the economic development more dependent on energy products such as coal, oil and natural gas [11], and the industrial added value of mining and processing industry is higher. The influence of petroleum processing and coking industry represented by energy processing on the development of national economy is gradually decreasing, and the industrial added value is relatively low.

In terms of distribution area, it was mainly located in Liaoning, Shandong, Shanxi, Sichuan and Guangdong in 2002. In 2007, Shaanxi, Henan and Jiangsu provinces, which are adjacent to Shandong and Shanxi, were added, while Sichuan province did not enter the top 60% of the country. By 2012, the energy processing industries in Liaoning, Shaanxi and Guangdong were at the forefront of the country, followed by Hebei, Shandong and Jiangsu. From the evolution of distribution provinces of energy...
processing industry, it can be seen that the number of provinces ranking in the top 20% of national energy processing is increasing. In 2012, there are no top 20% - 40% provinces, but there are 3 provinces in the top 20%, and the energy processing industry keeps gathering. The main area of energy processing industry is often not the province of mining and dressing industry. The processing industry has a weak dependence on resource endowment, and the agglomeration of industries promotes the improvement of total factor productivity.

4. Regional differences in metal mineral resources industry
The classification of metal mineral resources industry only includes metal mining and dressing industry, and metal smelting and processing industry. In order to analyze the differences in various links of metal mineral resources industry, the metal products industry is also analyzed.

4.1. Mining and dressing industry.
The industrial added value of the mining and dressing industry of metal mineral resources increased significantly from 2002 to 2007, mainly distributed in 7 provinces in 2002 and concentrated to 3 provinces in 2012, including Inner Mongolia, Liaoning and Hebei. The distributions are gradually moving to the north of China. The mining and dressing industry will be concentrated on areas with rich mineral resources. Some provinces have detected new metal mineral resources, with a significant increase in reserves and a rapid increase in the added value of mining and dressing industry.

4.2. Smelting and processing industry.
The industrial added value of smelting and dressing industry of metal mineral resources is more than twice that of mining and dressing industry. In 2002, the main provinces of smelting and processing industry were Liaoning, Hebei, Jiangsu, Hubei and Sichuan, with relatively scattered distribution areas. By 2012, it will be concentrated on Inner Mongolia, Liaoning, Hebei, Shandong, Henan and Jiangsu. These six provinces are connected. It can be seen that metal smelting industry is gradually gathering.

4.3. Metal products industry
On the whole, the industrial added value of metal products industry is higher than that of metal mining and dressing industry, but the gap with mining and dressing industry is narrowing. The metal products industry is mainly concentrated on coastal provinces, especially Guangdong Province, and the industrial added value of metal products industry has always been at the forefront.

From the three links of metal mineral resources industry, in 2007 and 2012, the main distribution area of metallurgical processing industry basically covered the mining and dressing industry area, and the scope was large, extending along the mining and dressing industry concentrated provinces to the central part of China. The main distribution provinces of metal products industry are basically inconsistent with the first two links, and the dependence on resource endowment is very small, which is concentrated on the provinces with the development of processing technology.

5. Conclusions and Directions for Future Work
Mineral resource is an important material prerequisite for the development of industry. The relationship between mineral resources industry and national economic construction is very close. This paper analyzes the distribution characteristics of industrial added value of mineral resources in the mining and dressing industry, smelting and processing industry, and focuses on the energy industry and metal mineral resources industry. The study found that:

Main distribution areas of mineral resources mining and dressing industry that do not match smelting and processing industry. The scope of the main distribution areas of the mining and dressing industry has expanded, mainly in the northern provinces in China, and the smelting and processing industry continues to gather in the coastal provinces.
The energy mining and dressing industry has a small distribution range in China, which is located in the northern part of China, and the processing industry is mainly distributed in the central and eastern regions of China.

The distribution of energy mining and dressing industry in China is less, the whole country is located in the north of China, and the processing industry is mainly distributed in the middle and east of China.

The main distribution area of smelting and processing industry of metal mineral resources industry is slightly larger than that of mining and dressing industry, extending to the central part of China along the concentration provinces of mining and concentration industry. The metal products industry is different, and the dependence on resource endowment is very small, mainly distributed in the coastal provinces with relatively developed processing technology.

The influencing factors of the distribution difference of each link in mineral resources industry open up many possibilities for future research. On the one hand, many factors can be considered in the analysis of regional differences. On the other hand, a quantitative relationship model between driving factors and industrial added value of mineral resources is established to predict the future changes in mineral resources industry.

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