ISSN 2616-5902 Vol. 4, Issue 5: 1-5, DOI: 10.25236/AJBM.2022.040501

Study on the upgrading of industrial structure of resource-based cities in Heilongjiang Province

Sun Ai, Mu Jiaqi, Zhang Zhennan, Li Na, Meng Yingyu, Dong Dapeng*

School of Economics and Management, Heilongjiang Bayi Agricultural University, Daqing, China
**Corresponding author:64719202@qq.com*

Abstract: *China is in a crucial period of transforming its development mode, optimizing its economic structure and transforming its growth impetus. The key way to realize economic transformation and development is to upgrade the industrial structure in order to cultivate new economic growth power and change economic development mode for the resource-based cities. Based on the data of industrial structure, this paper analyzes the trend and characteristics of industrial structure evolution of resource-based cities in Heilongjiang Province, and put forward the countermeasure suggestion on the resource-based city industrial structure transformation and the advanced development.*

Keywords: *Heilongjiang Province; Resource-based city; Upgrading of industrial structure*

1. Introduction

Under the strategy of revitalizing the old industrial base, the economy of Northeast China has achieved rapid growth in the first ten years of the implementation of the strategy. However, the problems of low industrial level, structural convergence, excess production capacity, weak technical support ability and weak independent innovation ability in Northeast China have not been fundamentally solved. When China's economic development has entered the new normal, the economy of Northeast China has experienced a cliff like decline. The "new northeast phenomenon" has attracted extensive attention from all walks of life, and the economic transformation and development of Northeast China is still difficult. The core of economic transformation is industrial transformation. Industrial structure transformation can reduce resource dependence and consumption and reduce environmental damage. It is the focus and key to achieve sustainable development in Northeast China[1-2]. It is precisely because of paying too much attention to the speed of economic growth and ignoring the quality of economic development that the problem of industrial structure transformation in Northeast China is difficult to be fundamentally solved[3]. Especially for many resource-based cities in Northeast China, industrial development rises due to the advantages of local natural resources, and falls into development difficulties due to the gradual decline and depletion of advantageous resources. The transformation and upgrading of industrial structure is particularly difficult (Chen Yan et al., 2021)[4]. Nine prefecture level cities in Heilongjiang Province are identified as resource-based cities, including coal resource-based cities Jixi, Hegang, Shuangyashan and Qitaihe, oil resource-based city Daqing, forest industry cities Yichun, Mudanjiang, Heihe and Daxinganling. There are many resource-based cities in Heilongjiang Province. In the new era, there are many urgent problems to be solved, such as single industrial structure, insufficient industrial development, insufficient development of emerging industries and so on. Therefore, in order to help resource-based cities get rid of resource dependence as soon as possible and realize sustainable economic development, this paper objectively calculates the upgrading status of industrial structure of 9 resource-based cities in Heilongjiang Province, in order to objectively evaluate the effectiveness of industrial structure upgrading of resource-based cities in the province, and provide scientific reference for further formulating resource-based city transformation policies and promoting the industrial transformation and development of resource-based cities.

2. Analysis of industrial structure of resource-based cities

2.1 Coal-resource-based cities

From 2013 to 2019, among the four coal-resource-based cities in Heilongjiang, Qitaihe has the lowest primary sector of the economy share and has basically remained between 12% and 16% , while

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Jixi, Hegang and Shuangyashan have high primary industries, in most years it was above 30 per cent, with Shuangyashan peaking at 38.22 per cent in 2015. The secondary sector of the economy share in Qitaihe fell from 46.29 per cent in 2013 to 41.32 per cent in 2019, a relatively small decline, with the remaining three cities declining by more than 15 per cent, particularly Shuangyashan, which fell from 43.06 per cent to 21.36 per cent, the industrial decline caused by resource depletion is the most obvious. Except for Qitaihe, where the tertiary sector of the economy increased from 40.56% to 44.48% , the tertiary sector of the economy of the other three cities all increased substantially, from 23.25% to 46.80% in Shuangyashan and from 25.94% to 41.86% in Hegang. This shows that the industrial structure of Heilongjiang's coal-resource-based cities has evolved from "231"to "312". However, the sharp rise in the share of tertiary sector of the economy in regional gross domestic product does not reflect the strength of the service sector, but rather the relative weight of the tertiary sector of the economy as a result of industrial decline due to resource depletion.

2.2 Oil-resource-based cities

From 2013 to 2019, the proportion of primary industry in Daqing is small and shows a certain upward trend, but the growth rate is not big, only from 4.2% to 8.56%. The secondary sector of the economy's share has been declining steadily, from 79.36 in secondary sector of the economy to 52.62 percent in 2019, but it remains high as a share of regional Gross Domestic Product, daqing's economy is still dependent on oil. The tertiary sector of the economy's share rose steadily, from 16.44 percent to 38.82 percent. This shows that the adjustment and optimization of industrial structure in oil-resource-based cities in Daqing has a more obvious effect. On the one hand, it is because of the decline in crude oil production capacity, which has led to a certain downward trend in the industrial output value of oil-based cities, on the other hand, Daqing is striving to be the leader in the transformation and development of the country's resource-based cities. It has actively introduced new and strategic industries such as automobiles, new materials, new energy and information technology as alternative industries. The pace of industrial restructuring has accelerated, is gradually moving away from industrial development and dependence on oil resources. However, the current industrial structure of Daqing is still in the "Two-three-one"structural model, the role of the service sector to promote economic development in Daqing has yet to be improved

2.3 Forest-resource-based cities

Among the forest resource-based cities in Heilongjiang, Mudanjiang has the most reasonable industrial structure and the highest proportion of tertiary sector of the economy, rising from 42.78% in 2013 to 56.9% in 2019. The proportion of primary industry in secondary sector of the economy fell from 41.02% to 21.39%, while the proportion of primary industry remained stable at 15% to 20%. Mudanjiang has made good use of its superior forest resources to develop new service industries such as trade and tourism. The transformation and development of resource-based cities have achieved remarkable results. The industrial structure of Yichun, Heihe and Greater Khingan is similar, with a slight fluctuation in the primary sector of the economy ratio of about 40 per cent, showing a strong dependence on the primary industry for economic development. The secondary sector of the economy share is low and declining, such as Heihe's secondary sector of the economy, which peaked at 17.48 per cent in 2013 and fell to 12.08 per cent in 2019. In 2019, each of the three cities had a share of about 45%, slightly higher than that of the primary industry, but the advantages were not so prominent, said tertiary sector of the economy, director of the tertiary sector of the economy, yichun, Heihe and Greater Khingan are still strongly dependent on forest resources for their industrial development. How to get rid of the dependence on resources for industrial development, and how to optimize and upgrade the industrial structure to realize the transformation and development of resource-based cities is an arduous task.

3. Analysis of industrial structure upgrading

3.1 Measuring method of industrial structure upgrading

The traditional method takes the proportion of non-agricultural output as the measurement index according to the Petty-Clark theorem. Although according to The Petty-Clark theorem, the increase in the proportion of non-agricultural output value is the general law of the evolution of industrial structure, since the 1970s, due to the development of information technology, economic servitization has become the main trend of the development of industrial structure, and the traditional measurement indicators

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cannot reflect the trend of economic structure servitization. Relevant studies can scientifically measure the degree of industrial structure advancement by the ratio of three industrial structures, such as structure similarity coefficient, Moore value and other indicators. However, the above indicators only simply reflect changes in industrial structure. For example, Jiao Yong (2015) [5] used the ratio of added value of tertiary industry and secondary industry to reflect the trend of "economic structure servitization" driven by informatization, but failed to reflect the degree of industrial structure optimization. In order to better reveal the degree of advanced industrial structure, the advanced change value of industrial structure defined by Fu Linghui (2010)[6] is selected as the measurement index to reflect the degree of advanced industrial structure of three provinces in Northeast China(Fu, 2010).The advanced change value of industrial structure is defined as follows:

First, the proportion of the added value of the three industries in GDP is taken as a component respectively to form a set of three-dimensional vectors $x_0 = (x_{1,0}, x_{2,0}, x_{3,0})$.

Next, calculate the angle $(\theta_1, \theta_2, \theta_3)$ between x_0 and the vector of the industry from lower to higher, which is:

$$\theta_j = \arccos\left(\frac{\sum_{i}^{3} x_{i,j} x_{i,0}}{\sqrt{\sum_{1}^{3} x_{i,j}^2 \sum_{1}^{3} x_{i,0}^2}} \right) (j = 1,2,3)$$

Finally, the advanced change value of industrial structure is calculated as follows:

$$W = \sum_{k=1}^{3} \sum_{j=1}^{k} \theta_j$$

3.2 The result of industrial structure upgrading

According to the calculation formula of the Industrial Structure Upgrading Index mentioned above, using the output data of resource-based cities in Heilongjiang from 2013 to 2019, this paper calculates the trend of the industrial structure upgrading since the implementation of the national resource-based city transformation strategy, the advanced industrial structure is measured in the following Table 1.

Table1: Measurement of industrial structure upgrading

	2013	2014	2015	2016	2017	2018	2019
Jixi	5.8087	5.7714	5.7862	5.8763	5.9167	5.8921	5.8740
Hegang	5.7243	5.6706	5.7313	5.7706	5.8050	5.8981	6.0401
Shuangyashan	5.5795	5.7100	5.8080	5.9235	5.9506	5.8800	5.7121
Qitaihe	6.4398	6.4863	6.4975	6.5801	6.6484	6.6272	6.4874
Daqing	6.3452	6.3733	6.4447	6.5626	6.5913	6.6088	6.5555
Yichun	5.6751	5.6378	5.6789	5.7359	5.8561	5.8652	5.9702
Heihe	5.6283	5.6750	5.7036	5.7036	5.7522	5.8068	6.0362
Mudanjiang	6.2322	6.3209	6.3055	6.3313	6.6758	6.7443	6.6413

From the horizontal comparison of the industrial structure of the resource-based cities in Heilongjiang, among all the resource-based cities, the trend of the industrial structure in Daqing is obvious under the transformation strategy of the resource-based cities. Among the coal-resource cities, Qitaihe has the most advanced industrial structure, while Jixi, Hegang and Shuangyashan have the least. In forest resource-based cities, the degree of industrial structure upgrading in Yichun and Heihe is relatively low, while the degree of industrial structure upgrading in Mudanjiang is relatively high and the effect of industrial transformation is good. In terms of the evolution trend of industrial structure upgrading, the trend of industrial structure upgrading in Jixi, Shuangyashan and Qitaihe is not obvious, for example, Jixi increased from 5.8087 in 2013 to 5.8740 in 2019 and Qitaihe from 6.4398 in 2013, by 2019,6.4874. Changes in the advanced industrial structure of Yichun, Daqing and Hegang were relatively stable, rising by about 0.3 per cent. The upgrading trend of industrial structure in Mudanjiang and Heihe is the most obvious, with an increase of more than 0.4.

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The above analysis of the horizontal comparison and vertical trend of the upgrading of the industrial structure shows that under the national strategy of transformation of resource-based cities, the resource-based cities in Heilongjiang have made efforts to adjust their industrial structure, except for some cities, the industrial structure as a whole has shown a trend of advanced development. The transformation and development of the industrial structure have achieved certain results, and the dependence of the industrial development on natural resources has been gradually reduced, in particular, the effect of industrial transformation of oil-resource-based cities in Daqing and forest-resource-based cities in Mudanjiang has been outstanding. However, Jixi, Hegang, Shuangyashan and other coal-resource-based cities, due to the depletion of coal resources, industrial transformation and development is still more difficult.

4. Policy suggestions

Northeast China is a typical region affected by the strategy of giving priority to the development of heavy industry. Relying on its resource advantages, northeast China took the lead in building an industrial system dominated by heavy and chemical industries and became the most important industrial base in China before the 1990s.However, with the deepening of reform and opening up and the improvement of the socialist market economy, the pace of industrial restructuring in resource-based industries and heavy and chemical industries is slow, the proportion of the original industrial system is too large, the development of emerging industries is insufficient, and the old industrial base in northeast China with prominent structural contradictions is rapidly declining. Especially for resource-based cities, because of the over-dependence of industrial development on resources, it is particularly difficult to develop industrial transformation under the background of resource depletion. Based on the research results of the upgrading of industrial structure of resource-based cities in Heilongjiang, this paper puts forward the following countermeasures and suggestions to promote the transformation, development and overall revitalization of resource-based cities.

First, we will develop and strengthen modern agriculture. Heilongjiang has a good agricultural foundation and great potential for development. It should take the rural revitalization strategy as an opportunity to give full play to its advantages in agricultural resources endowment, comprehensively improve the quality, efficiency and competitiveness of agriculture, and then realize the industrial development goal of developing and strengthening modern agriculture. We should take market demand as the guidance, further promote agricultural supply-side structural reform, give full play to the characteristics and advantages of agricultural resources in each region of the urban agglomeration, and appropriately increase the planting area of crops with high market popularity and good economic benefits. Develop multi-functional agricultural industry around the extension of modern agricultural industry chain, and promote the integration, interaction and integrated development of agriculture, industry and service industry.

Second, revitalize industrial competitive advantage. The mode of production and development of traditional industries in resource-based cities is to rely on high input, high consumption, high pollution, the government should give full play to the macroeconomic regulation and control of industrial development, provide policy and financial support for the transformation and upgrading of traditional industries, at the same time, the optimization of industrial structure should be comprehensive docking national "2025" made in China, with innovative ideas to promote the intelligent development of manufacturing industry. We should focus on improving the independent innovation capacity of industrial development from various aspects, including policy guidance, financial support, environmental optimization, scientific research support and talent guarantee, so as to form an internal driving force for the optimization and upgrading of industrial structure.

Third, we will actively develop modern service industries. We will give priority to developing modern producer services such as financial services, modern logistics and information services, make them more refined and of high quality, and increase the effective supply of producer services. While actively developing producer services to inject power into manufacturing and other real economies, we should promote refined and high-quality consumer services to meet the changing lifestyle and consumption needs of residents and improve the quality and level of life services for residents in the Northeast. The investment in technological innovation of modern service industry should be increased, the allocation efficiency of technological innovation input should be improved, the relevant scientific and technological research and development of modern service industry should be accelerated, the application system of scientific and technological innovation should be improved, the ability of scientific and technological achievements to be transformed into actual productive forces should be enhanced, and

ISSN 2616-5902 Vol. 4, Issue 5: 1-5, DOI: 10.25236/AJBM.2022.040501

the synchronous development of scientific and technological progress and modern service industry should be promoted.

Acknowledgment

This paper is supported by National College Students' innovation and entrepreneurship training program in Heilongjiang Bayi Agricultural University(No. 202110223030）and Philosophy and social science planning project in Daqing(No.DSGB2022053).

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