Analysis of Energy Industry Upgrading in Northeast China

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Abstract: Promoting regional economic growth and realizing the transformation of the mode of economic growth are in industrial upgrading essence. The product is a carrier that represents a series of links of production, management and marketing behind the enterprise, and is a comprehensive reflection of the knowledge and ability of a country or region. Based on the industrial spatial structure, this paper visualizes the industrial space in Northeast China from 2005 to 2015, analyzes the comparative advantages of the energy industry in Northeast China, and examines the status quo of the upgrade of the energy industry according to the industrial upgrading status. Based on the industrial spatial structure, Industry intensity in the industrial space, put forward the future direction of the energy industry upgrade and upgrade path.

1. Introduction
Northeast China used to be China's most important industrial base. However, the weight of its economy in the national economic map has been on a continuous decline in recent years and has been sluggish and has yet to show any signs of improvement. Hausmann (2006, 2007) firstly analyzed the industrial upgrading based on product characteristics, proposed evolutionary comparative advantage theory of industrial upgrading, and designed and built a global product space. It pointed out that the industrial upgrading is constrained by the existing product capabilities and is robust. Test results show that industrial upgrading more inclined to industry-related industries to upgrade, pointed out the direction of industrial upgrading. China's use of product space theory to analyze the issue of industrial upgrading begins with a series of studies conducted by Zhang Qi-zai (2008, 2013 and 2014), using Hausman's theory of comparative advantage evolution to construct the structure of China's product space and further the choice of China's industrial upgrading pathways, out of stock risk upgrade process of opportunities for industrial upgrading, screening in industry as well as industrial policy whether to follow the comparative advantage of such study in detail. Deng Xiangrong (2016) used the product space structure to visualize China's industrial upgrading path, explored the path dependence of industrial upgrading from the perspective of comparative advantage evolution, and empirically tested the relationship between industrial upgrading and comparative advantage.

2. Data sources and screening
This article studies the industrial upgrading based on the product space structure. Most scholars use the international trade data to establish the product space. However, these data can not analyze the spatial conditions in various regions of the country and can not establish the spatial structure of the region. For a more detailed study Domestic industrial upgrading within the scope of the region, this article "China Industrial Economic Statistical Yearbook" in the industry data instead of the trade data of each product as a test sample, the individual missing data using the average growth rate method to
supplement, as in 2011 China's industrial sector The code has changed. In order to make the research of this article consistent and consistent in data caliber, this article excludes the metal products, machinery and equipment repair industry, mining auxiliary activities and other mining industries, and increases the subsequent increase in the number of railway vessels in aerospace and other transportation Equipment manufacturing and automobile manufacturing are merged into transportation equipment manufacturing industry, 37 industrial data with consistent data before and after are retained as sample data, and $37 \times 37$ industrial space has been established in the past 10 years. On the basis of this analysis, the energy industry The industrial space at the bit .

3. Indicators of measurement and calculation

3.1 Comparative advantage measure

In calculating the comparative advantage of each industry RCA, this paper uses the output results to measure the comparative advantage of a country, with the main business income of each industry as output data to each region of the industry's market share and the country's share of the industry Of the market share of the ratio to represent, not only reflects the industry in all industries in the relative level of advantage, but also removed the regional economic level and the impact of changes in the national economic level, RCA greater that the region's industries in the country The stronger the comparative advantage.

$$RCA_{c,i,t} = \frac{\text{income}_{c,i,t}}{\sum_{c,i} \text{income}_{c,i,t}}$$

In the formula, RCA represents the industrial comparative advantage; $\text{Income}_{c,i,t}$ Said the main business income; c said the region; i said that the industry; t said time.

3.2 measure of industrial upgrading index

The measures of industrial upgrading are based on the methods of Hausmann.R and Klinger.B (2007) and draw on the evaluation criteria of Deng Xiangrong (2016) to classify the measurement of industrial upgrading into four categories: successful upgrade, unsuccessful upgrade and loss of comparative advantage , Continue to maintain its comparative advantage. Use the assigned RCA, or X, as a measure of industrial escalation. Generally RCA = 1 is set as the critical point whether the industry has a dominant comparative advantage. RCA> 1 indicates that the industry has a dominant comparative advantage, X is 1, and RCA <1 means that the industry does not have a dominant comparative advantage.

| Indicator measurement | Measure the result | Qualified |
|-----------------------|--------------------|-----------|
| $X_{c,i,t}$           | 0                  | other     |
|                       | 1                  | RCA>1     |

3.3 Industrial spatial indicators to measure

Industrial space reflects the technological distance between industry and industry. Industrial density refers to the number of edges associated with nodes in industrial space. Taking the sum of the industries that have comparative advantages in the region and their proximity to all industries in the region and its proximity And the ratio to reflect the industry's subsequent industrial upgrading opportunities, that is, the industry's productivity endowment (Deng Xiangrong, 2016). The greater the industrial density, the more accumulated endowments of productive capacity, the more chances of subsequent upgrading to the industry. At the same time, the industrial density will also affect the upgrading cost of the industry. The greater the degree of industrialization, the greater the
industrialization." The less likely it is to be "caught" and the less the "tide" of industrial concentration investment (Zhang Qizi 2008).

\[ \omega_{i,t} = \sum_j (\phi_{i,j,t} x_{j,t}) / \sum_j \phi_{i,j,t} \]  

(2)

In the formula, \( \omega \) said the degree of industry; \( \phi \) said the industry proximity; \( i, j \) that industry; \( t \) that time.

The industrial proximity in the above formula is an intermediate measure of industrial density. It reflects the similar relationship between industries and industries, that is, the possibility that different industries have comparative advantages at the same time. The proximity between industry and industry is one of them. Under the condition that the category industry has the comparative advantage, the other category also has the minimum value of the conditional probability of the comparative advantage.

\[ \phi_{i,j,t} = \min \{ p(x_{i,t}, x_{j,t}), p(x_{j,t}, x_{i,t}) \} \]  

(3)

In the formula, \( \phi \) said the industrial proximity; \( P \) said conditional probability; \( i, j \) that industry; \( t \) that time.

4. Comparative Analysis of Energy Industry in Northeast China

According to the position of dominant comparative advantage RCA in the energy industry in the eight major integrated economic zones, this article determines the rankings of the five major energy industries in the eight major integrated economic zones in northeast China and finds out the development level of each energy industry in northeast China and the gap situation.

Table 2. Northeast Comparative Advantage of Energy Industry in the Eight Comprehensive Economic Zone in the rankings

| Industry | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2012 | 2013 | 2014 | 2015 |
|----------|------|------|------|------|------|------|------|------|------|------|
| Petroleum Processing Coking and Nuclear Fuel Processing | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Oil and gas exploration | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    | 2    |
| Coal mining and washing | 5    | 6    | 6    | 5    | 6    | 6    | 6    | 6    | 6    | 6    |
| Gas production and supply | 5    | 7    | 8    | 8    | 8    | 7    | 7    | 8    | 8    | 8    |
| Thermal power production and supply | 5    | 5    | 5    | 6    | 6    | 7    | 7    | 7    | 7    | 4    |

According to the comprehensive rankings of the comparative advantages of various energy industries in Northeast China, the dominant comparative advantage of petroleum processing and nuclear fuel processing, oil and natural gas exploitation in the five major energy sources has been ranked No. 2 for many years and the comparative advantage is in the upper reaches of the whole country; coal mining and washing industry ranked No. 5 or No. 6, in the middle and lower reaches of the country; thermal power generation and supply industry, the dominant comparative advantage of large fluctuations in 2005-2014 showed a downward trend, ranked from the first 5 dropped to 7, but the level of advantage began to rise sharply in 2015, jumped from 7 to 4, from the national lower reaches to the middle reaches. Overall, the energy industries in Northeast China dominates the comparative advantages of a large gap between the different energy development is not balanced.

5. Analysis of Northeast Energy Industry Upgrading

According to Deng Xiangrong (2016) on the division of industrial upgrading results, this article will be divided into four states industrial upgrading: (1) successful industrial upgrading that never has the comparative advantage into a comparative advantage; (2) the failure of industrial upgrading that the industry has been in (3) Loss of comparative advantage means that it has changed from comparative advantage to no comparative advantage; (4) Industry continues to maintain its comparative advantages,
indicating that the industry has always had comparative advantage.

Table 3. Industrial upgrading classification

| Status | t-1 | t | Classification |
|--------|-----|---|----------------|
| I      | \( x_{i,t-1} = 0 \) | \( x_{i,t} = 1 \) | Success |
| II     | \( x_{i,t-1} = 0 \) | \( x_{i,t} = 0 \) | Unsuccessful |
| III    | \( x_{i,t-1} = 1 \) | \( x_{i,t} = 0 \) | Lose |
| IV     | \( x_{i,t-1} = 1 \) | \( x_{i,t} = 1 \) | Maintain |

According to the overall situation of energy industry upgrading in northeast China, the oil and natural gas exploration industry, oil and gas exploration industry have had a dominant comparative advantage over the years and their advantages have been maintained. In the "Eleventh Five-year Plan" period, in the early stage, it had a dominant comparative advantage, but later lost its dominant position. After entering the "12th Five-year Plan", it has not yet been upgraded and has not had a dominant comparative advantage over the years and has lost its initial superiority. The coal mining and cleaning industry, The dominant comparative advantage of production and supply has always been less than zero, indicating that coal mining and washing industry, coal gas production and supply industries in Northeast China is the northeast of the inferior industries in Northeast China in order to stimulate economic growth, do not have the resource endowment Competitive Advantage.

Table 4. Northeast China’s energy industry upgrade status

| Industry                                           | 2005-2010   | 2010-2015 | 2005-2015 |
|----------------------------------------------------|-------------|-----------|-----------|
| Coal mining and washing                            | Unsuccessful| Unsuccessful| Unsuccessful|
| Gas production and supply                          | Unsuccessful| Unsuccessful| Unsuccessful|
| Oil and gas exploration                            | Maintain    | Maintain  | Maintain  |
| Petroleum Processing, Coking and Nuclear Fuel Processing | Maintain    | Maintain  | Maintain  |
| Thermal power production and supply                 | Lose        | unsuccessful| Lose      |

6. Space Density Analysis of Energy Industry in Northeast China

According to the theory of product space (Hausmann, Klinger, 2006), the more industries there are, the more advantageous industries gather around them, the more industries will be upgraded, the more opportunities for industrial upgrading and the possibility of surging. Smaller (Zhang Qizi, 2008), a higher proportion of successful upgrade.

Table 5. Northeast China’s energy industry spatial density ranked 37 major industrial industries

| Years | Coal mining and washing | Oil and gas exploration | Petroleum Processing | Coking and Nuclear Fuel Processing | Thermal production and supply | Gas production and supply |
|-------|-------------------------|-------------------------|----------------------|-----------------------------------|-----------------------------|----------------------------|
| 2005  | 12                      | 1                       | 3                    | 5                                 | 21                          |                            |
| 2006  | 13                      | 1                       | 2                    | 7                                 | 23                          |                            |
| 2007  | 11                      | 1                       | 2                    | 9                                 | 20                          |                            |
| 2008  | 16                      | 1                       | 8                    | 12                                | 24                          |                            |
| 2009  | 15                      | 1                       | 3                    | 17                                | 22                          |                            |
| 2010  | 16                      | 1                       | 8                    | 15                                | 24                          |                            |
| 2011  | 15                      | 3                       | 11                   | 16                                | 23                          |                            |
| 2012  | 14                      | 3                       | 7                    | 23                                | 16                          |                            |
The density of industrial space is a measure of the comprehensive connection between an industry and other industries in the region. The greater the density of industrial space, the more the industries with dominant comparative advantages around the industry. The more dense and closely linked the advantageous industries are. From the ranking of energy density in northeast China, the oil and natural gas mining industry has the highest industrial density value. It has the highest upgrade space in the energy industry in northeast China and the highest capacity in surrounding industries. The second is petroleum processing, coking and nuclear fuel. In the processing industry, the density of its industrial space in the 37 major industrial industries ranked very high in the industry, ranked in the top 10, indicating that the industry in the northeast region still have more room for further upgrades; coal mining and washing industry, thermal power production And the industrial density of the supply industry generally showed a downward trend, indicating that in the future upgrade process, the ability to absorb the surrounding industrial knowledge and to make use of the surrounding industrial technologies is gradually declining, and the difficulty of further upgrading in the future is gradually increasing. In the gas production and supply industry The change of industrial density is not big, and it is at the middle and lower reaches of 37 major industrial industries. It is located in the edge of industrial space, indicating that this industry is less capable of upgrading industries with surrounding industries in the northeast. It is also very difficult to further upgrade the industry in the future.

7. Conclusion

The development of the energy industry in Northeast China is not balanced and the energy industries in the region are greatly different in their abilities to absorb the surrounding areas. Differences in the future development path should also be adopted. So we come to the conclusion of a few points.

(1) The energy industry with a comparative advantage should absorb the advantages of the surrounding industries, continue to give full play to the advantages of natural resources, maintain the superiority level, and rely on technological innovation to promote the industrial upgrading of the advantageous industries and to develop higher value-added directions in the industrial chain.

(2) For those industries with advantageous advantages, whose positions in the industrial space are gradually getting out and the spatial density is gradually declining, it is necessary to continuously improve the matching degree of industries in the region and increase the ties with the surrounding industries so as to continue to live.

(3) For those industries that are losing their comparative advantage and are located at the edge of the industrial space, the regional governments should make rational planning and layout and consider their future development strategies in the long run. Economic restructuring can be achieved not only through technological innovation Cross-industry development, but also the introduction of "related" industries, increase industrial spatial intensity, improve regional resource allocation efficiency, promote industrial upgrading, improve energy production and absorption capacity.

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