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Optimization and Upgrade of Industrial Structure in the Context of China's Supply-side Reform: An Analysis Based on Input-Output

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Abstract

Based on the input and output table of national economic accounting in 2007 and 2012, by calculating the index of industrial relevance and the index of input-output relationship, this paper analyzes the changing trend of China's industrial structure and specific industrial sectors' influence on the national economy. It also pays attention to the changes in the distribution of the industrial structure of traditional processing manufacturing and high value-added capital technology-intensive industries in China, and attempts to reflect the role of capital technology factors on China's industrial structure adjustment. The conclusion shows that the industries that have a significant role in promoting and stimulating the national economy are still mostly high value-added, capital and technology-intensive processing manufacturing industries, but the positive impact of productive services on the national economy is also significant. In addition, from the perspective of factor supply, it is found that the supply structure of China's capital factor is not reasonable, while the forward linkage between the production and supply sectors of technological factors and other industrial sectors is weakening, also the driving effect on the national economy is declining.

Keywords

Supply Side Reform, Adjustment of Industrial Structure, Input-Output Method.

1. INTRODUCTION

Since 2012, China's economy has entered a downward cycle, presenting a "new normal" of slowing growth, with insufficient economic development momentum, obvious structural differentiation trend, and serious structural imbalance in the supply-demand relationship.In the final product market, this imbalance is manifested as the over supply of middle and low-end products, but a shortage of high-end products:On the one hand, the surplus of low- and mid-end products has led to a backlog of inventory, which has precipitated a large number of production factors such as land, capital, and labor, resulting in the failure of resource allocation; On the other hand, the insufficient supply of high-end products and services in China leads to the outflow of a large number of consumption capacity, and the potential of residents' consumption has not been fully explored. For example, a large number of overseas consumption is generated, and the supply of goods cannot adapt to the transformation of residents' consumption structure. From the perspective of industrial economics, this phenomenon is shows that China's industrial structure is needed to transformas and upgrades. And product quality is needed to improve by improving the efficiency of factor allocation and optimizing the product structure.

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Therefore, the structural contradiction of social total supply and demand can not only rely on total demand management, but also need to adjust the economic structure from the perspective of land, labor, capital, innovation and other production factors. Through the reform of system and policy, the factors are better allocated, forming a power source that can support the long-term and stable development of the economy. This is the first time that General Secretary Xi officially proposed the meaning of "supply-side structural reform" at the 11th meeting of the Central Financial and Economic Leading Group in November 2015.That is to promote the optimization and upgrading of industrial economic sectors, so as to meet higher-level social needs and bring higher economic growth. Therefore, the core task of China's supply-side structural reform is still to adjust the industrial structure. From the perspective of the supply side, the main battlefield of structural adjustment is more specifically shifting to the factor market, that is, how to optimize the allocation of factor resources among industrial sectors.

2. LITERATURE REVIEW

The modern industrial structure theory appeared in the 1930s and 1940s. Representatives include Leontief, Kuznets, Clark and others. Leontief was awarded the Nobel Prize for his greater influence in the industrial structure; Fisher first proposed the classification of the three industries, and Clark conducted an empirical study on it, and published "Economic Development Conditions".

Since the 1950s, the theory of modern industrial structure has grown rapidly. Studies by economists led by Leontief, Lewis, Kuznets, Hirschman and others have made the theoretical system in this field more perfect. Since then, scholars at home and abroad have continuously carried out theoretical and empirical explorations on the motive force and influence of industrial structure adjustment and optimization and upgrading. Lydia Greunz (2004) took a sample of 153 European regions and 16 manufacturing sectors, analyzed the driving force of industrial structure adjustment, and considered that industrial specialization and industrial structure diversity are important variables affecting the production factor of innovation, and this three are significant variables that affect the industrial structure [1]. Patrik Gustavsson Tingvall (2004) believes that the industrial structure of high capital accumulation areas tends to become more specialized in capital-intensive industries, and the enterprise level is that R & D economies of scale promote productivity and competitiveness [2]. M Pender (2003) conducted an empirical test on the international data of 28 economic cooperation and development organizations, fingding that the industrial structure is a significant determinant of macroeconomic development [3].

At home, scholars pay more attention to what factors will lead to the change of industrial structure and how to adjust the industrial structure.

Some scholars are concerned about the impact of FDI. Wang Ying and Liu Sifeng (2008) calculated the grey correlation between the industrial structure of FDI and domestic industrial structure, and believed that the industrial structure of FDI is closely related to domestic industrial structure, and FDI has a significant role in promoting the improvement of China's industrial structure [4].Luo Liying and Huang Na (2008) used the method of model analysis to study the effect of FDI on domestic employment, found that FDI can stimulate the employment of the second and third industries, but it has a negative impact on the employment of the first industry; however, in general, FDI can improve the industrial structure and employment quality of the country [5].

However, the policies and guidelines issued by the state also play an irreplaceable role in improving and optimizing the industrial structure. Zhang Tongbin and Gao Tiemei (2012) found that the fiscal incentive behavior adopted by the state can effectively promote the growth of high-tech industry, which has a positive effect on the backward and forward related industries,

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and on the increase of agricultural and consumer industrial output [6]; Chu Deyin and Jian Kecheng (2014) found that the government is in the process of education from the perspective of total amount and structure through empirical test Investment in education and science and technology has a positive impetus to the improvement of China's industrial structure[7].

The level of urbanization is also an important factor, because there is a long-term stable relationship between industrial structure adjustment and urbanization. Gan Chunhui and Yu Shiji (2003) found that urbanization and industrial structure improvement and optimization are interrelated, and the improvement and optimization of industrial structure will have a certain response to the degree and progress of urbanization [8]; and Ma Yuan and Gong Xinshu (2010) found that urbanization can play a positive role in the improvement and upgrading of industrial structure by building VAR model based on the panel data of Xinjiang [9] .

Financial factors will also have an important impact on the adjustment of industrial structure: Cai Hongyan and Yan Qingmin (2004) found that the domestic financial market has obvious non market behavior, and the government's action to support the low growth industry will lead to the mature high growth industry can not grow well and continuously [10]. Zeng Guoping and Wang Yanfei (2007) found that after the economic transformation, the long-term effect of the financial industry on the industrial structure is that , it is more active in promoting the change of the output value structure of the second and third industries, but has no actual role in promoting the adjustment of the first industrial structure [11]; Zhou Zongan and Wang Xianhui (2014) found that the scale of social financing will adjust and upgrade the industrial structure in the long term Positive impact [12].

However, there are many opinions on how to adjust the industrial structure and what kind of industry to develop: Ke Shanzi and Zhao Yao (2014) used the urban panel data to estimate the impact of industrial structure and urban scale on the urban economy, and found that the actual scale of most small and medium-sized prefecture level cities is smaller than the optimal scale, so they should continue to promote the development of local manufacturing industry [13]; Li Lixing and Shen Guangjun (2015) based on the industrial enterprise database and urban statistical data, from the perspective of Economic Development Zone, it is found that if the target industry selected by the Development Zone conforms to the local comparative advantage, it can promote the optimization of industrial structure within the urban manufacturing industry [14]. Zhang Tongbin, Gao Tiemei (2012) found that the government should pay attention to promoting the scientific development of high-tech industry by investigating the impact of fiscal and tax policies on the adjustment of industrial structure [15]; Li Ping, Fu Yifu, Zhang Yanfang (2017) proposed to develop productive service industry, so as to improve the overall total factor productivity of macro economy, which is called the new driving force of high-quality economic growth under the new normal [16].

Therefore, based on the input-output relationship of the input-output table and the impact of different industries on the national economy, this paper analyzes the change trend of China's industrial structure in the past five years, and which industries can play a strong role in promoting and pulling the development of the national economy, so as to provide empirical evidence for which industries should be focused on in the optimization and upgrading of the industrial structure.

3. METHODOLOGY

3.1. Selection of Main Indexes Based on Input-Output Analysis

3.1.1. Influence coefficient

The influence coefficient refers to the extent to which the demand for production in each industry is affected by the addition of one final product during the social production process. In

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this paper, the method proposed by Professor Liu Qiyun (2002) was used to improve Leontief's method, and the calculation method of the denominator was changed to the weighted average [17]. The formula is:

$$\xi_j = \frac{\sum_i b_{ij}}{\sum_j b_{cj} \times \alpha_j} (i, j = 1, 2, \cdots, n)$$

The numerator $\sum_i b_{ij}$ is the Leontief inverse matrix, that is, the column summation of B, is the complete need of the j industry to provide a final product in social production, that is, the j industry's ability to radiate to the social economy; In the denominator, α_j is the physical composition coefficient of the final product. As a weight, the formula is expressed as: $\alpha_j = \frac{y_j}{\overset{0}{y}} (j = 1, 2, \cdots, n)$, y_j is the output of the j-th industry, $\overset{0}{y}$ is the total output of the whole society; $b_{cj} = \sum_i b_{ij}$, which is the sum of the column B of the matrix. At this time, the denominator means the driving effect of a final product of the entire society and economy on the society and economy as a whole.

At this time, ξ_j represents the ratio of the radiation effect capacity of the final product produced by an industry to the average radiation effect capacity of the final product produced by the whole society. ξ_j >1 means that the radiation effect capacity of the industry is within In the above, ξ_j <1 means that it is below the social average standard. In addition, a larger ξ_j value means that the industry's ability to radiate the other industries is more significant, and its output-driven effect is greater.

3.1.2. Sensitivity coefficient

The Sensitivity coefficient refers to the number of products that the i-th industry must supply for the social production behavior of other industries. In this paper, the method proposed by Professor Liu Qiyun (2002) is also used to improve Leontief's method, that is, to use the fully distributed coefficient matrix W to obtain the sensitivity coefficient [17]. The sensitivity coefficient calculated by the improved method can reflect the ability of an industry to promote the development of the entire society and economy. The formula is:

$$\theta_i = \frac{\sum_j d_{ij}}{\sum_i (\beta_i \times \sum_j d_{ij})} (i, j = 1, 2, \cdots, n)$$

Among them, the numerator $\sum_j d_{ij}$ is the total sum of the row distribution matrix W of the complete distribution coefficient, which is the quantity of the complete supply of a unit of i-products in the social production activities, which is the total supply of all industries in the society, that is, the promotion effect of i-products on the entire social economy.

In the denominator, the weight β_i is the sector composition coefficient of the initial input, and the formula is expressed as $\beta_i = \frac{N_i}{\overset{0}{N}} (i = 1, 2, \cdots, n)$, N_i is the initial input amount of the i-

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th industrial product in social production, and $\overset{0}{N}$ is the total initial input of the entire social economy. Therefore, β_i is the proportion of the initial investment of the i-th industry in the total investment of the entire society and economy. The denominator at this time means that the initial input of a unit has an average driving effect on the entire society and economy. The larger the value of the calculation result, the greater the promotion effect of the initial investment of the industry on the entire society and economy, and also the impact of other industries on him.

3.2. Date

Based on the input and output tables of the national economic accounts of 42 departments in China in 2007 and 2012, the calculation of indicators was performed. The data comes from the National Bureau of Statistics.

4. RESULTS AND DISCUSSION

4.1. Analysis of Calculation Results of Influence Coefficient

From the calculation, it is known that the average influence coefficient of a total of 17 industries in 42 industries is higher than 1. In 2007, the influence coefficient of 18 industrial sectors was higher than 1, which is one industry more than in 2012. In addition, it is similar to that in 2007. In contrast, the influence coefficients of 28 industries in 12 years have all increased, which shows that in five years, the backward linkages between Chinese industries have strengthened, and their output has increased the role of driving the rest of society. As shown in Table 1, they have a significant ability to pull the national economy of their country.

Table 1. China's top ten industries in terms of average influence

Industry	2012	2007	Average	Ranking
Communication equipment, computer and other electronic equipment manufacturing industry	1.3365	1.3151	1.3258	1
Electrical machinery and equipment industry	1.2905	1.2336	1.2620	2
Transportation equipment industry	1.2492	1.2287	1.2389	3
Instrument industry	1.2300	1.2328	1.2314	4
Metal products industry	1.2179	1.1624	1.1901	5
General equipment industry	1.2287	1.1489	1.1888	6
Chemical products industry	1.1854	1.1312	1.1583	7
Metal smelting and rolling products industry	1.1732	1.1164	1.1448	8
Textile, clothing, shoes, hats, leather, down and its products	1.1590	1.1224	1.1407	9
Textile industry	1.1491	1.1217	1.1354	10

From the perspective of influence, the top ten industries are all secondary industries, nine of which are manufacturing industries, indicating that manufacturing industry is the industry with the greatest impact on other industries, and the other one is processing industry. The top ten industries with average influence belong to the category of secondary industry, indicating that China's secondary industry has a great radiation effect on other industries. From the perspective of trend, the traditional textile industry still has a great influence, but the electronic

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equipment manufacturing industry such as communication equipment, chemical product manufacturing industry and other processing and manufacturing industry sectors with high technology and capital investment are gradually improving the pulling effect on other industries, which can be considered as the priority development direction of China's industry in the future. From the perspective of structure, the top ten belong to the category of secondary industry, which fully shows that in China, the secondary industry plays an irreplaceable role in promoting the sustainable development of national economy and is still the focus of supply side reform.

4.2. Analysis of Calculation Result of Sensitivity Coefficient

According to the calculation results, there are 20 industries with an average sensitivity coefficient higher than 1, and in 2007, there were 20 industries with a sensitivity coefficient higher than 1. Compared with 2012, there were 2 fewer industries and only 18 industries. In addition, the sensitivity coefficients of 24 industries in 2012 have increased compared with 2007, indicating that in five years, the forward linkages between Chinese industries have strengthened, and their ability to promote the rest of society has improved. As shown in Table 2, the industry is sensitive to the demand of social production activities in China:

Table 2. China's Top 10 Industries by Average Sensitivity

Industry	2012	2007	Average	Ranking
Oil and gas extraction	4.8917	3.6207	4.2562	1
Metal mining and processing industry	3.7497	3.4587	3.6042	2
Scrap industry	3.0935	2.4664	2.7800	3
Coal mining and beneficiation products industry	2.4270	2.1174	2.2722	4
Production and supply of power and heat	1.9451	1.9731	1.9591	5
Non metallic and other mineral products	2.3587	1.5219	1.9403	6
Petroleum, coking products and nuclear fuel processing industry	1.8570	1.8481	1.8526	7
Chemical products industry	1.6608	1.6484	1.6546	8
Instrument industry	1.7238	1.4877	1.6057	9
Metal smelting and rolling products industry	1.5773	1.5450	1.5612	10

From the perspective of the sensitivity coefficient, the top ten industries are all secondary industries. There are 2 departments related to raw materials, 4 departments related to energy required for production, and 4 processing and manufacturing industries.From the perspective of changes, the sensitivity coefficient of energy mining and processing industries such as mineral mining and dressing industry has improved significantly in 5 years. This means that China's overall production and operation activities are increasingly dependent on the needs of these industries, and the initial investment of these industries in promoting the entire society and economy is also increasing.Although the coefficient of the power and heat production and supply industry has declined slightly, it is still greatly affected by other industries, and it has no doubt the role of promoting the national economy.

From a structural point of view, they are all sectors of the secondary industry.However, the sensitivity coefficient of energy production and supply industries such as electricity and heat has declined, and the sensitivity coefficient of raw materials, energy mining, and processing

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industries has increased, indicating that in China's economic development, energy consumption has decreased slightly, and the demand for more economical energy mining supplies On the rise.

5. CONCLUSION

5.1. China's Industrial Structure Has Gradually Shifted to A High and Refined Process

From the previous calculation results, we know that the sensitivity coefficient and influence coefficient of communication equipment, computer and other electronic equipment manufacturing industry, chemical industry, metal smelting and rolling processing industry, leasing and business service industry are all greater than 1 and have been increasing continuously in five years. This shows that these four industries are continuously improving the driving and promoting role of the national economy. Not only that, in order to ensure the production needs of other sectors, the supply output capacity is higher than the social equilibrium level, and they have other industries. The degree of radiation impact also exceeds social equilibrium standards. Therefore, these four industries are industries with great development potential. Their development can better promote and promote the improvement of the economic level. If they do not attach great importance to development, they will restrict economic development. Not only that, combined with the empirical results of China's secondary industry's influence coefficient and sensitivity coefficient increasing significantly in the past five years and the top ten occupying a large proportion. It also shows that China's industrial structure is gradually transitioning to a high and deep processing degree. The adjustment of industries that invest large amounts of capital and technical production factors, and the adjustment to the tertiary industries such as the service industry, this structural adjustment is in line with the requirements of industrial structure adjustment in China's supply-side structural reform.

In addition, in 2007, compared with 2012, the sensitivity coefficient decreased in 18 sectors, most of which were primary mining and supply industries with low value content in the secondary industry, social welfare industries in the tertiary industry, and public infrastructure related industries. This indicates that the forward linkage between them was reduced, and the demand dependence between them was generally weakened, the driving force of their initial investment to the national economy is decreasing, and the impact of other industries is gradually decreasing, which also shows that the industrial structure of their country is being adjusted to high precision.

5.2. The Development of Basic Industries Is Very Important to the Economic Development of China

In addition, in 2007, compared with 2012, the sensitivity coefficient decreased in 18 sectors, most of which were primary mining and supply industries with low value content in the secondary industry, social welfare industries in the tertiary industry, and public infrastructure related industries. This indicates that the forward linkage between them was reduced, and the demand dependence between them was generally weakened, the driving force of their initial investment to the national economy is decreasing, and the impact of other industries is gradually decreasing, which also shows that the industrial structure of their country is being adjusted to high precision.

Oil and gas mining, mineral mining and other mineral mining, coal mining and processing, petroleum processing, coking and nuclear fuel processing, finance, transportation and storage industries have large sensitivity coefficients, but their influence coefficient values are low.Which means that they are more affected by other industries and have less impact on other industries. Their development mainly depends on the increase in production needs of other industries in China; Most industries are basic industries that are essential to the sustainable,

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stable and balanced development of the Chinese economy. To ensure the intermediate and final production needs of other industries, we must pay attention to these basic industries, otherwise their lagging development will limit China's supply-side structural reforms. The smooth development of the process will also restrict the improvement and upgrading of the industrial structure.

5.3. The Role of the Tertiary Industry in Economic Growth Continues to Increase

The process of supply-side structural reform requires adjustment of the industrial structure, and an important aspect is to increase the proportion of the tertiary industry in the national economy. In terms of influence coefficients, the tertiary industries such as transportation, warehousing and postal services, information transmission, software and information technology services, leasing and business services, scientific research and technical services have all increased in five years. It shows that the pulling effect of one of their final products on the national economy is increasing, and the radiation ability of other industries is also improving.According to the sensitivity coefficient, the sensitivity coefficient of most of the tertiary industry, such as finance, wholesale and retail, accommodation and catering, has increased over the past five years. This means that the initial investment of the tertiary industry in the promotion of the entire society and economy continues to increase, and the radiation effect of other industries is gradually increasing. From the perspective of the two, the leasing and business service industries in the tertiary industry have a sensitivity and influence coefficient of more than 1, and the front-to-back relationship is tight. The driving force and driving effect on the national economy are increasing. Industry with great potential.

From the perspective of final demand, the tertiary industry has 11 out of 18 industries that exceed the proportion of final consumption in the final demand of the whole society, and 7 of them provide more than 100 billion yuan in final consumption. The importance of the tertiary industry. Therefore, focusing on the development of the tertiary industry and promoting innovation and capital factors to move to industrial sectors with higher levels of technological innovation can improve China's factor supply capacity.

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