Development of circular economy and optimization of industrial structure for Shandong Province

Wang Lihong, Zhang hui*

College of Population, Resources and Environment Shandong Normal University, Jinan, Shandong, China

Abstract

This paper analyzes the status of industrial structure and resources and environment in Shandong Province, and discusses the problems in adjusting Shandong’s industrial structure. Using circular economy theory, we propose countermeasures for adjustment and optimization of Shandong’s industrial structure, which is important for conversion of economic growth pattern and improvement of the overall national economy’s quality and efficiency in Shandong Province.

Keywords: Shandong Province, the industrial structure, the circular economy

After reforming and opening, Shandong Province's economy grows rapidly, and economic structure reform is deepening, so economic and social development has undergone major changes, while the industrial structure of Shandong Province has been greatly improved. However, with economic development, resources and environment are greatly affected. With the increase of population and income, the expansion of economic activity scale. To maintain sustained rapid economic growth, we need to improve the structure of output, improve the efficiency of input and output, and reduce environmental pollution of input per unit. This requires us to change the current model of economic development, namely, we should develop circular economy and optimize the industrial structure of Shandong Province.

1. Existing Condition of Shandong Province Industrial Structure and Resources and Environment Assessment

1.1 The current problem of Shandong Province industrial structure

* Wang lihong. Tel.:0531-86188175
E-mail address: wlh_sd1 @163.com.
The current industry structure in Shandong Province has been a positive trend, but due to the historical factors and system status of its industrial structure, national macroeconomic policies, environment affects and even international economic environment constraints, the adjustment of industrial structure in Shandong Province still have many problems. At the day of that interdependent of national and regional economic development increasingly osculates, we objectively summary the problems and defects of industrial structure in Shandong Province, which has important theoretical and practical significance.

- **Industry of Shandong Province is in transition, and technology is low and structure upgrades slowly**
  Since the nineties, industry of Shandong Province is in transition, and industrial structure adjustment and upgrading are slow, and technical composition is relatively low. Although the manufacturing sector has been rapid developed, compared the advanced level of the manufacturing sector of that with the developed countries or regions, the proportion of technology-intensive industrial manufacturing in Shandong Province is low, and the proportion of intermediate inputs industry of iron and steel industry and non-metallic materials are high. The proportion of consumer goods manufacturing is close to the world average, but a higher proportion for the textile industry and a lower proportion for the food industry. This structure reflects the international competitiveness of the manufacturing sector in Shandong Province is not strong enough. In addition, the proportion of the raw materials industry that has intensity of resource consumption and pollution emissions is higher than the world average, but proportion of low consumption and low pollution industry is lower than the world average. Therefore, we must actively adjust the industrial internal structure, vigorously develop the sectors of high technology, high added value low resource consumption and low pollution, and improve the technological level of the industry, thus to upgrade the industrial structure level.

- **The tertiary industry develop rapidly but the structure is low-level**
  The tertiary industry develop rapidly, but compared with other countries or regions, the structure of that is relatively low level, and the proportion of gross domestic product (GDP), compared with the national average, has a big gap, and even degree of convergence of industrial structure among the regions remains high. From the internal structure of the tertiary industry, we can see in Shandong Province the traditional tertiary industry has a higher proportion, while the newly tertiary industry has a shortage development. At present the growth of tertiary industry mainly rely on traditional tertiary industry, but traditional industry products widespread have low-tech, low value-added features, and its product performance and quality fall behind, so while they compete with foreign products they are at an obvious disadvantage. The development of tertiary industry is still in its infancy. Compared with other countries and regions, the consumer services sector in Shandong Province has a low share in GDP, and share of producer services has a large gap. The reform and management of the tertiary industry is lagging behind, and traditional institutions and mechanisms which tie the development of the tertiary industry have not been fundamentally broken, all this are the reasons for the slow development of tertiary industry.

- **The level of the industrial structure increases generally, but there are marked regional differences**
  Shandong Province, as other nationwide provinces, is a province of agriculture. Since reformed and opening, the industrial structure of Shandong Province has an initial optimization of and adjustment. While industrial structure changes with time, space form also is changing, that is, changes in industrial structure trend to regional differences. Based on the gradient among cities of Shandong Province in industrial structure, we divide our province into high, medium and low gradient. The high-gradient region includes Jinan, Qingdao, Zibo, Dongying, Yantai, Weifang, and Weihai seven cities, which are the highest level areas of economic development and urbanization in Shandong areas. And tertiary level of that is higher than that in the western region. Qingdao and Jinan have a higher proportion of tertiary industry, and these distribution sectors are relatively developed, and they access to the fast development period of production and living services. The medium-gradient region includes Zaozhuang, Jining, Taian,
Rizhao, Laiwu five cities. On the whole, its level of industrial structure is lower than that in the east. Low-gradient areas include Linyi, Dezhou, Binzhou, Liaocheng, Heze five cities. Compared with the eastern region, industrial structure is in the low level, and share of primary industry declines, share of secondary and tertiary industries increases, and the industrial output value in most cities is more than agriculture value.

In addition, there are many problems in the industrial structure of Shandong Province, such as stagnated development of private economic, the coexistence of industry competition excess and ignoring, low industry disposition and so on, which greatly restricts the sustainable economic development in Shandong Province. Therefore, the industrial structure of Shandong Province also needs to further adjust. From an economic sense, the industrial structure adjustment and upgrading has become a top priority and important decisive factor in our economic work.

1.2 Industry Structure and Energy Consumption

Energy is an important material basis for human activities. Energy production and consumption are closely related with the recycling economy, on the one hand, energy supports sustainable socio-economic development, on the other hand, in the process of energy production and consumption we generate large amounts of waste, resulting in environmental pollution. All the result, it endangers human survival and livelihood, especially greenhouse gases produced from energy production and consumption have a significant impact on the global environment. To develop circular economy is to reduce energy consumption, reduce environmental pollution, and achieve sustainable economic development. In our province, impact of energy production and consumption based on coal to sustainable economic development is very prominent, so we can study from the relationship between energy, industrial structure and environmental protection.

Economic development needs energy to “Go”, and along with economic growth, energy demand and consumption have increased. From three general changes in industrial structure, in the environmental protection work we can not know what the problems of the industrial structure in Shandong are. For which, based on available statistics, we use energy consumption and pollution emissions these two important indicators to renew industrial structure of Shandong. In energy consumption structure, production consumption accounts for most. From the industrial structure, energy consumption of the secondary industry is large, and its energy consumption accounts for nearly 80% in the total production consumption, and accounts for 74% in total consumption. Meanwhile, the secondary industry has the highest energy consumption intensity. The energy consumption of added value per million for second industry is far higher than that of other industries. In three industries, the secondary industry, especially industry, is the largest energy consumers and energy consumption per unit output value greatly exceeds the other sectors. (See Table 1)

| Table 1 Three industrial energy consumption of Shandong Province in 2007 |
|------------------|------------------|------------------|
| Primary Industry | Secondary Industry (where: Industry) | Tertiary Industry |
| Primary energy consumption (ten-thousand tons) | 26.8 | 2184.3 | 2178.1 | 282.9 |
| Value added (a hundred million Yuan) | 370.24 | 2025.33 | 1856.73 | 1492.98 |
| Energy consumption per ten-thousand increased value (ton / ten-thousand Yuan) | 0.07 | 1.08 | 1.17 | 0.19 |

Note: we calculate with the dates in 2008 from 《Statistical Yearbook of Shandong》.

1.3 Impacts on Environmental Quality from Industrial Structure
The impacts that industry does on the environment are major caused by the waste discharge in the production process. Therefore we analyze waste emissions in different industrial sectors, which will help us to study the impacts that industrial structure has on environmental quality. In the composition of the "the three wastes" emissions over the years in Shandong Province, industrial waste generally has been accounted for the majority, so we focus on the impacts industrial waste emissions on environmental quality.

In aspect of pollution emissions, secondary industry, especially industry, is a major source of "the three wastes" emissions. In recent years, industrial "the three wastes" discharge is increasing in Shandong Province, and the increasing is growing. (Figure 1). Therefore environmental pollution in recent years is intensified.

![Figure 1 Emission of industrial pollutants in Shandong Province in recent years](image)

Note: The unit of waste water and solid waste is ten-thousand tons; the unit of gas is hundreds million Nm³. And the dates are from 《Statistical Yearbook of Shandong》 in 2000, 2003, 2006 and 2009.

2. Countermeasures for industrial structure adjustment and optimization of Shandong Province

Adjustment and optimization of industrial structure in Shandong Province is related to the change of economic growth pattern and the overall quality and efficiency improvement of the national economy. According to the actual situation, countermeasures for industrial structure adjustment and optimization of Shandong Province are as follows:

2.1 Countermeasures for adjustment and optimization of agricultural structure

The basic idea for Shandong agricultural structure adjustment and optimization is to increase the effective supply of agricultural products and to increase farmer’s real income. And we should focus on the development of grain and cotton production and township enterprises, and actively promote rural economy system and agriculture economic growth to fundamentally change. We also should promote agricultural production and rural incomes to increase, rural economic to develop and rural social to be stability. Main measures are: to consolidate and strengthen the foundation position of agriculture; to expend rural incomes channels; to increase support for agriculture; to develop efficient agriculture and hi-tech agriculture; and to strengthen the construction of small towns to create the necessary conditions for the transfer of rural surplus labor.

2.2 Countermeasures for adjustment and optimization of industrial structure

To adjust and optimize industrial structure of Shandong, the overall idea is to adapt the requirements of the two fundamental changes, and to accelerate industrial structure adjustment and optimization in the process of development and to develop in the process of industrial structure adjustment and optimization.
We adhere to take the market as guide, and combine market demand with exploiting comparative advantage to fully play basic regulatory roles of market mechanism. Taken the basic national conditions as a basis, adaptation to local conditions and category guidance, we priority solve structural bottlenecks that constrain the constraints of economic development in Shandong Province. We take efforts to adjust and optimize the organizational structure, corporate layout structure, technology structure, corporate debt structure, corporate human resources structure and ownership structure. Relying on technological progress and institutional innovation, we implement the optimizing and upgrade of industrial structure and initially format a more reasonable industrial layout that agree with the direction of socialist market economic development. Specific measures are as follows:

• To strengthen the infrastructure and the construction of basic industries, and to revive pillar industries

We have a huge investment for infrastructure and basic industries and its cycle is long, and there are phenomena of the blind distribution point and low-level duplicated construction. Therefore, we must balance, rationally distribute, focus on focal point and concentrate on building a number of key projects to avoid blind development and low-level duplicated construction.

• To increase the transformation of the processing industry

1) To adapt to changes in consumption structure of urban and rural residents, and to develop and produce marketable industrial consumer goods.

Such as food, textile, light industry, electronics, machinery, chemicals, building materials, medicine and so on, according to market demand, we targeted develop and produce production to adapt to different consumption levels and consumer demand. Because of changes in income levels and structure, consumer demand shows diversified situation. Now the market’s demands are both the high-end brand and cheap products. Only facing to market, we should research seriously in order to produce marketable products.

2) To adapt to a wide range of international markets, and to promote foreign exchange of mechanical and electrical products and textile products.

In exports, we not only need to increase export of high-tech products but also turn on quality and market diversification to avoid simply expanding the number and traditional chafing the single market. For textiles and other light industrial goods, now we should turn to improve product quality from expanding textile products to increase foreign exchange earning capacity per unit of product. For mechanical and electrical products we have to take appropriate measures to expand the export of complete sets of equipment.

3) Using advanced technologies, taking efforts to develop and heavy chemical products and raw products of light industry.

Large-scale equipment, precision machinery, synthetic materials, organic chemical raw-materials, pulp and other products have widely used-way in the national economy and high demand. But production capacity of Shandong Province and all the country is still inadequate. Currently the most imported products mainly are those products. Thus, by the renovation and expansion of existing businesses, we increase potential energy, which is very promising. To do this work seriously will have a significant impact on adjusting and optimizing Shandong industrial structure.

4) To take energy-saving, improving quality and increasing the varieties as focal point, and to improve the structure of raw-material products.

At present steel, the production capacity of cement and chemical products is large, and the key are unreasonable product structure, large production and energy consumption, poor product quality. Therefore, we should improve the technological progress of industrial raw materials, adjust product structure, reduce energy consumption, improve quality, reduce pollution, and save water and land.

• To develop high-tech industry

We fully display technology portfolio advantage, comprehensive advantages and external advantage to cultivate high-tech industries of domestic and international competitiveness. We focus on accelerating
high-tech industry of electronic information, biological engineering, new energy, aerospace and new materials, and actively use high technology to transform traditional industries. We should speed up the process of information for national economy and format new internationally competitive high-tech industrial system.

- Actively to develop environmental protection industry

Environmental protection industry is one of the world's largest emerging industries. Shandong’s environment is seriously polluted, so environmental protection industry has become a key developing area. When we exploit environmental protection equipment, we should focus on developing pollution treatment equipment of industrial urban, and even focus on the development process of advanced wastewater treatment, air pollution control, waste disposal and other environmental equipment. And we strongly advocate pollution-free pesticides, chemical fertilizers and other products.

2.3 Countermeasures for adjustment and optimization of tertiary industrial structure

To adjust and optimize tertiary industrial structure, it plays a greater role not only in continua boosting up proportion of the tertiary industry but also in steady increase of labor productivity. And it played an important role in promoting services exports and optimization of export structure to grow faster. Therefore, if we want to promote adjustment and optimization of the tertiary industrial structure and the efficient development of tertiary industry, we should take the following countermeasures: promoting the reform and opening up of the tertiary industry; gradually increasing the output proportion that the tertiary industry accounts in the entire national economic; establishing a sound market system, the social security system and an integrated social service system of urban and rural; improving the investment environment to increase investment; adjusting internal investment structure of the tertiary industry; taking great efforts to train more and more talented person who suit for market economic development.

2.4 Taking the international and domestic market as the guide to adjust the industrial structure in Shandong province

In the history of our country there were two adjustment of industrial structure. But these two adjustments of industrial structure are substantially different from the adjustment now. One of the differences is that the adjustment of industrial structure is being taken under the situation that much more opening, old system transition, the establishment of socialist market economic system in china, thus the adjustment of industrial structure must take the market as the guidance to give full play to the function of market mechanism. The development of the world economy also proved that the market mechanism is the power to realize the industrial structure adjustment and upgrading. Only in this way, the product structure may adapt to the demand structure. So, in the promoting of the upgrading of the industrial structure, we should give full play to the function of market mechanism and to be market-oriented, Facing to the market and the demand, production should be drove by the demand.

2.5 To promote the optimization of industrial structure in Shandong Province by the progress of science and technology

Now we are in the era of knowledge explosion, new industries based on the high-tech continuously generate, simultaneously, high-tech is widely used in the original industry to make the original industries sustained conversion and form higher-level of industrial structure system. According to statistics, in the agricultural era contribution to economic growth taken by science and technology is less than 10%, and in the post-industrial economy it is in more than 40%, and even in the knowledge economy it will reach
more than 80%. The substantive content of contribution rate improvement for scientific and technological progress is using technology to develop new industries to upgrade and optimize industrial structure, technology and using technology innovation to promote industrial upgrading.

The ultimate goal of industrial restructuring is to enhance industrial competitiveness, therefore, when we consider the adjustment of industrial structure, we not only consider solving the current problem of the economic structure but also consider the development of a new growth point to support future economic growth. And we consider the upgrading and updating of industrial structure and combine resolving the structural contradictions with industry development in the long-term and with the upgrading of the industry. And to achieve this goal, we primarily depend on technological innovation. One is to promote technological innovation and increase product competitiveness. All businesses use certain products to characterize market presence, to meet market competition, and all the products are taking a certain level of technology as basis. Therefore, improving the technical level of enterprises is the main way to enhance their international competitiveness of the international and domestic market.

Economy in different regions has its own special characteristics. During the industrial restructuring, Shandong Province should combine its own features to explore the potential and discover the new growth point of economy. For instance, the new industry of the information technology or network technology has formed new growth point of national economic development. For another example, the developing tourism has contributions on hotel trade and restaurant business. The new growth point of national economy plays a significant role in adjusting the industrial structure.

2.6 Making full use of the functions of the government

Essentially, the industrial restructuring is a progress of resources’ reconfiguration among various industrial in the whole society. In an open market, respecting and following the object economic law, the adjustment of industrial structure and the allocation of resource should be merely in supervisions of the market. Only in this way, the role of the market mechanism can be played perfectly. But it doesn’t mean that the government will do nothing in the industrial restructuring, on the contrary, the government should make full use of its functions.

In short, the adjustment, optimization and upgrading of industrial structure is an important guarantee for optimal allocation of resources, and it is related to the sustainability healthy and stable development of Shandong economy too. Therefore, we must rely on the role of market mechanisms and market discipline, supported by the government's science and technology, economic policies. And we should vigorously carry out scientific and technological innovation and develop the tertiary industry, agriculture, basic industries and education, and we improve the intensive level, technology content, quality and competitiveness of secondary industries. After that we can meet the challenges of the era by the overall economic strength.

References

[22] Zhang lizhu, Wangxinhua, Guo zhonghua, A Brief Account of China's Industrial Structure Optimization and Quantification Methods[J], Journal of Shandong University of Science and Technology (Social Sciences), 2001, 1, p: 62-65