Research on the Regional Differences in the Industrial Structure Transformation of Shandong Province

Jingli Zhou

Shandong Youth University of Political Science, Jinan, Shandong Province, China

Keywords: Industrial structures, Regional differences, Industrial structure benefits, Transformation speed of industrial structures

Abstract: In 2019, Shandong's per capita GDP reached 70,653 yuan, an increase of 5.2%. Shandong Province entered a post-industrial period. In the critical period of the conversion of new and old kinetic energy, optimizing industrial structures based on the industrial structure benefits to reduce the difference in regional economic development levels has become the key to maintaining social stability and achieving coordinated development between regions. This paper focuses on the development status and evolution of the industrial structures in Shandong Province. It collects relevant statistical data, conducts a comparative analysis of the regional differences about the three industries development in various regions and cities, and then uses the comparative labor productivity difference coefficients and industrial structure conversion coefficients to measure the benefits and the transformation speed of the industrial structures of various cities within the province. Based on the coordinated development of the three major economic circles and the concept that innovation drives the industry to upgrade, this paper can provide practical countermeasures and suggestions for promoting the coordinated development of the province’s economy.

1. Introduction

Industrial structures reflect the composition ratio, trend changes, and the economic and technological correlation between industries within the economic system. The research of industrial structures involves the input structures and output structures. The research of input structures includes the changes in the number of employees, capital and their proportions in each industry, reflecting the distribution of resources among industries. The output structures emphasize the proportion of national income created by various industries in the national economy. Promoting the rationalization of industrial structures is a necessary prerequisite for enhancing the full utilization of regional economic resources and achieving healthy economic development. It is of great significance for enhancing regional industrial competitive advantages and economic benefits, continuously driving regional economic growth, and meeting economic and social development.

In order to achieve coordinated regional development, Shandong Province has established and improved specific plans for promoting coordinated regional economic development. The coordinated development strategy of the provincial capital, Jiaodong area, and southern Shandong is an important link to help Shandong Province achieve high-quality economic development. Constructing a regional development pattern of “one group, two cores and three circles” is an important goal of Shandong Province's regional development. With vigorously developing strategic emerging industries as the starting point, Shandong Province will strive to achieve that by 2020, the output value of strategic emerging industries will account for 20% of the total economic output of the province, making it an important driving force to promote industrial transformation and upgrading.

2. The Development Dynamics of the Industrial Structures in Shandong Province

Shandong Province is on the eastern coast. It has a superior geographical location. Yellow River flows into the Bohai Sea through it. As an important food production base in China, the warm

  DOI: 10.25236/ecemis.2021.025

temperate monsoon climate provides a suitable natural environment for the cultivation of local wheat, corn, sweet potato and other crops. There are abundant natural resources in various places and considerable mineral reserves. Its east is adjacent to the Bohai Sea and the Yellow Sea. The 3,000-kilometer golden coastline provides convenient shipping conditions and abundant marine resources. Many important highway and railway lines run through it. It has a unique geographical location. Relying on the implementation of the national development strategy of transforming the old and new kinetic energy, a high-quality economic growth model driven by technological revolution and industrial transformation has gradually formed. The total GDP of Shandong Province in 2019 reached 7106.75 billion yuan, ranking the third in China; the per capita GDP reached 70,653 yuan, an increase of 5.2% year-on-year; the per capita disposable income reached 31,597 yuan, which was 2.81% higher than the national average. The tertiary industry was growing rapidly, with its added value reaching 3,764.02 billion yuan, and its share in three industries had increased by 3.5% year-on-year, and the industrial structure was continuously optimized. The strategic emerging service industry and high-tech service industry achieved an average annual growth rate of 10%, which accelerated the conversion of new and old kinetic energy.

In 2018, Shandong's GDP reached 7646.97 billion yuan, with an economic growth rate of 6.4%, which was lower than the national average of 6.6%, and the economy achieved steady growth. The added value of the tertiary industry reached 3787.74 billion yuan, an increase of 8.3%, higher than the growth rate of the primary and secondary industries. The changes of three industries are shown in Figure 1. From the traditional “secondary-primary-tertiary” to “tertiary-secondary-primary”, the industrial structure gradually tends to be rationalized and advanced [1].

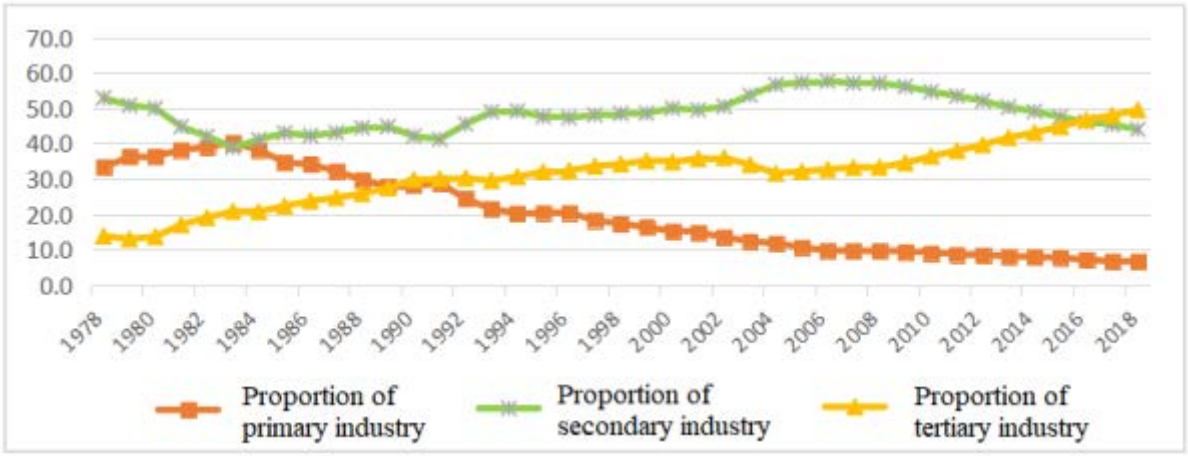

Fig.1 Changes in the Proportion of Three Industries in Shandong Province

It can be seen from Figure 1 that from 1978 to 2018, the proportion of the output value of the primary industry dropped from 33.3% to 6.5%, a significant decrease. During the same period, the change in the proportion of the secondary industry’s output value was relatively stable, falling from 52.9% to 44.0%. The proportion of the tertiary industry’s output value showed a significant growth trend, rising from 13.8% to 49.5%. It caught up with the output value of the secondary industry for the first time.

At the same time, the relative changes in the output value of the three industries have not only promoted industrial transformation, but also brought the entry and exit of labor in related industries. As shown in Figure 2, the trend chart of the change in the proportion of employment in the three industries shows that the proportion of employed persons in the primary industry dropped from 79.2% in 1978 to 27.8% in 2018, and the number of employed persons dropped from 23.509 million to 17.182 million, the industry’s labor’s exit reached 6.327 million; the proportion of employees in the secondary industry achieved rapid growth, rising from 12.3% in 1978 to 35.3% in 2018, and the number of employees in this industry rapidly increased from 3.66 million to 21.818 million; the proportion of employed persons in the tertiary industry rose from 8.5% in 1978 to 36.9%, the number of employed persons expanded from 2.523 million to 22.806 million, and the number of

newly-increased jobs was 20.283 million. With the rise of the tertiary industry represented by the Internet digital economy, a large number of job opportunities in emerging industries have emerged, broadening the employment channels for employees and helping to stimulate the vitality of the labor market.

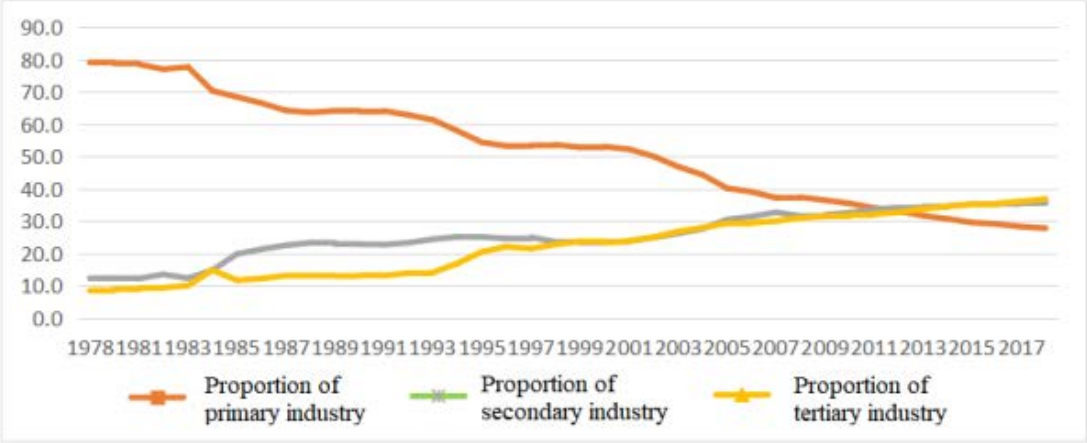

Fig.2 Changes in the Proportion of Employment in the Three Industries in Shandong Province

3. Comparison of Regional Differences in the Industrial Structure Transformation of Shandong Province

3.1 Comparison of Industrial Structure Benefits

Select the comparative labor productivity (B_i) index for analysis to compare the difference coefficient S of the comparative labor productivity, and observe the degree of equilibrium of industrial development in various regions.

$$Bi = \frac{Ci}{Li} \qquad S = \frac{\sqrt{\sum_{i=1}^{3}(B_i - 1)^2}}{3}$$

(i=1,2,3)(C_i is the proportion of industry i; L_i is the labor proportion of industry i)

(i=1,2,3)[2]

During the evolution of the industrial structures, if B_i is greater than 1, it means that the comparative labor productivity of the industry is higher than the average of the labor productivity of all industries, and the industry has a significant relative advantage. S reflects the degree of dispersion of comparative labor productivity in various industries. The larger the value, the more prominent the unbalanced development among the three industries and the lower the efficiency of their industrial structures.

When the value of S is close to 1, it means the industrial structure is good.

Table 1 Comparative Labor Productivity of the Three Industries in Shandong Province from 2010 to 2018

Year	B_1	B_2	B_3	S
2010	0.25	1.68	1.14	0.34
2011	0.25	1.59	1.18	0.32
2012	0.25	1.52	1.21	0.31
2013	0.25	1.46	1.23	0.30
2014	0.25	1.41	1.24	0.30
2015	0.26	1.35	1.27	0.29
2016	0.24	1.30	1.32	0.29
2017	0.23	1.27	1.33	0.29
2018	0.23	1.25	1.34	0.29

According to the data in Table 1, since 2010, the comparative labor productivity of the primary industry in Shandong Province had been only 0.25 at the maximum, which is much lower than 1, and is showing a slow downward trend. During this period, the output value of the primary industry accounted for an average of 7.72%, and the labor force engaged in the primary industry accounted for an average of 31.10%. The labor productivity of the primary industry in Shandong Province was low, the industrial development level could not effectively solve the labor redundancy, and the economic benefits needed to be improved. The comparative labor productivity of the secondary and tertiary industries was higher than 1. Among them, the comparative labor productivity of the secondary industry had declined significantly, and the comparative labor productivity of the tertiary industry had increased, and it surpassed the secondary industry in 2016. Compared with other industries, the tertiary industry expanded significantly and developed rapidly, which shows that the comparative advantage of the secondary industry in Shandong Province is declining in the industrialization stage. With the rapid development of the tertiary industry, its influence in promoting the sustained growth of the national economy continues increase.

3.2 Comparison of Industrial Structure Transformation Speed

The difference in the economic aggregate growth rate of each industry in a region will directly affect the transformation speed of its industrial structure. If the growth rate of the various industries in a certain region differs greatly, it indicates that the transformation of the industrial structures in the region is accelerating; otherwise, the transformation of the industrial structures is slower. Constructing an industrial structure conversion coefficient δ [3] to reflect the difference in regional industrial growth rate:

$$\delta = \sqrt{\sum (X_i - X_P)^2 \frac{R_i}{X_p}}$$

Where X_i is the average annual growth rate of industry i; X_p is the average annual growth rate of GDP; R_i is the proportion in GDP of industry i.

The geometric mean is used to calculate the 10-year average annual growth rate of GDP and the three industries in Shandong Province from 2008 to 2017, and the proportion of the three industries in the GDP as well. The specific calculation results of the industrial structure conversion coefficient of each city in Shandong Province are shown in Table 2.

Table 2 Conversion Coefficients Of Industrial Structures in Various Cities of Shandong Province

Area	X_1	X_2	X_3	X_P	R_1	R_2	R_2	δ
Shandong	0.0406	0.1014	0.1062	0.0987	0.0819	0.5119	0.4061	0.0554
Jinan	0.0434	0.0956	0.1098	0.1003	0.0523	0.3985	0.5492	0.0476
Qingdao	0.0291	0.0989	0.1126	0.1022	0.0424	0.4639	0.4937	0.0528
Zibo	0.0466	0.1019	0.1056	0.1015	0.0346	0.5835	0.3819	0.0330
Zaozhuang	0.0329	0.0986	0.1186	0.0999	0.0782	0.5708	0.3511	0.0689
Dongying	0.0417	0.0973	0.1114	0.106	0.0354	0.6914	0.2732	0.0442
Yantai	0.0350	0.1031	0.1251	0.1058	0.0725	0.5527	0.3748	0.0692
Weifang	0.0427	0.1062	0.1164	0.1036	0.0967	0.5243	0.3791	0.0640
Jining	0.0412	0.1105	0.1131	0.1046	0.1158	0.5096	0.3747	0.0703
Taian	0.0383	0.1027	0.1173	0.1050	0.0898	0.5031	0.4071	0.0665
Weihai	0.0362	0.1010	0.1194	0.1030	0.0775	0.5171	0.4054	0.0666
Rizhao	0.0407	0.1204	0.1147	0.1110	0.0903	0.5152	0.3953	0.0669
Laiwu	0.0361	0.1042	0.1028	0.0996	0.0706	0.5767	0.3528	0.0549
Linyi	0.0384	0.1093	0.1203	0.1070	0.1003	0.4754	0.4243	0.0717
Dezhou	0.0357	0.1118	0.1116	0.1061	0.1124	0.5219	0.3658	0.0743
Liaocheng	0.0421	0.1161	0.1169	0.1075	0.1229	0.5472	0.3299	0.0744
Binzhou	0.0438	0.1015	0.1167	0.1009	0.0943	0.5246	0.3811	0.0632
Heze	0.0292	0.1426	0.1306	0.1201	0.1446	0.5298	0.3257	0.1117

Combined with the data, the average conversion coefficients of Shandong Province had reached 0.0554 in the past ten years. The trend of industrial structure conversion is obvious, and the difference of industrial structure conversion coefficients between regions is significant.

Among them, the industrial structure conversion coefficients of Heze (0.1117), Linyi (0.0717), Jining (0.0703), and Zaozhuang (0.0689) in the southern Shandong Economic Circle rank in the forefront, higher than other regions, and belong to the first echelon. In the Jiaodong economic circle, there are Yantai (0.0692), Rizhao (0.0669), Weihai (0.0666), Weifang (0.0640), and Qingdao (0.0528). Except for Qingdao, the other four cities are higher than the average level of the province, belonging to the second echelon. The provincial capital economic circle is polarized. Except for Liaocheng (0.0744), Dezhou (0.0743), Taian (0.0665), and Binzhou (0.0632) which are above average, Laiwu (0.0549), Jinan (0.0476), Dongying (0.0442) and Zibo (0.0330) have lower conversion coefficients, causing the overall ranking of the provincial capital economic circle to lag behind. It is worth noting that Jinan and Qingdao, which account for a quarter of the province's total economic output, have industrial structure conversion coefficients lower than the province's average level, and it is necessary to dig deeper into their transformation momentum [4].

4. Conclusion

The optimization of the spatial allocation structure of economic resources is the key to achieving the coordinated development of the regional economy. With the help of the government's planning and guidance, the market mechanism is the lead to realize the improvement of the efficiency of the province's resource spatial allocation. It is necessary to conform to the trend of productivity development, combine supply-side reforms, deepen innovation drive, take industrial transformation and upgrading and orderly conversion of new and old momentum as an opportunity to achieve advanced economic structure, and promote the steady, healthy and sustainable development of the province's economy [5].

Shandong's economy is strong in the east and weak in the west, and the regional economic development level and industrial structure differ significantly. If things go like this, it will not be conducive to regional economic stability and sustainable development. In order to narrow the regional gap and realize the common prosperity of economic cooperation, accelerate the free flow of labor, capital, and technological elements, and guide the rational layout of industries at the same time, realize regional economic integration, the government should focus on the five- in-one construction idea of “function-industry-population-space-public service” to build an integrated development strategic plan for the provincial capital, Jiaodong and southern Shandong. Under the premise of clarifying their own functional positioning, cities in Shandong Province can carry out inter-regional cooperation such as infrastructure interconnection, industrial innovation and collaborative progress, cultural and tourism integration, and ecological co-governance, and undertake the division of labor within the industrial chain and guide industrial transfer direction based on the functional positioning of different cities in the economic circles. The core cities and the surrounding cities form a “geese formation” industrial cluster development model. They can use the close relationship between upstream and downstream to realize the expansion of factor resources and the accelerated flow of personnel, so as to enhance the radiation driving ability of core cities, expand the development space of central cities, and improve the development level of surrounding cities as well. As a result, the “gradient transfer” of economic development can be realized. Cities in Shandong Province should make use of their own different location conditions, economic foundations, and industrial characteristics to choose leading industries suitable for their own development, so as to achieve complementary advantages and dislocation competition. They should give full play to the role of the market mechanism in the allocation of factor flow, reform the institutional barriers to factor flow, build a mechanism for benefit-sharing and cost-sharing of inter-regional cooperation, and release the maximum value of factors.

Talents are important support to promote the conversion of new and old kinetic energy in Shandong Province. Focusing on the high-end talents needed for the development of the “top ten” industries, the government needs to implement support policies for talent introduction, strengthen

policy guidance in terms of funding, welfare and housing, and achieve high-end extensions of talent incentives. In fields of achievement transformation, benefit sharing, platform and team building and talent services, more effective incentive policies should be adopted to enhance the sense of belonging and loyalty of talents. The government must create a relaxed and fair talent competition environment, stimulate talent innovation vitality, encourage young innovative talents to innovate and start businesses, and continue to deepen the reform of “openness, regulation, and service” in the field of science and technology. It can also rely on the platform of industrial talent gathering bases and entrepreneurial bases to realize the scale effect of talent gathering in the new kinetic energy field, and create an innovative and entrepreneurial talent ecosystem with open and shared information and resources [6].

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