Research on the Relationship between Industrial Structure and Employment Structure in Beijing-Tianjin-Hebei Region

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Abstract. This paper analyzes the coupling effect between industrial structure and employment structure by taking the economic data of Beijing-Tianjin-Hebei region as a whole sample. Through the structural deviation and employment elasticity coefficient to analyze the internal mechanism of the industrial structure on the employment structure, it can be seen that the overall coordination of the industrial structure in the Beijing-Tianjin-Hebei region has been improved, and the pulling effect on employment has been enhanced. At the same time, using the regression model to analyze the mechanism of employment structure on the industrial structure, it is found that the three industries in the region have different degrees of impact on economic growth.

1. Introduction

China's economy is in the transition phase from high-speed growth to high-quality development. The transformation of growth momentum, transformation methods and optimized structure are in the process of tackling the offensive. The factor input structure, regional structure and industrial structure restrict the transformation of economic structure. Therefore, improving the total factor productivity, balancing regional economic development, and optimizing industrial structure are the main directions for transforming the economic structure. Based on the economic data of Beijing-Tianjin-Hebei region, this paper analyzes the coupling effect between industrial structure and employment structure and the interaction mechanism between the two, and explores the transformation path of Beijing-Tianjin-Hebei economic structure in the process of economic growth.

2. Literature references

Liu Wen and Tian Lizhen (2009) compared the employment structure and industrial structure relationship of the three major economic zones. They believed that the three industries in the three regions had greater employment elasticity, and the tertiary industry was increasingly important in the national economy [1]. Zhang Meiling, Zhao Xuqiang et al. (2015) believed that the industrial upgrading of Taiyuan City required labour mobility, and the flow of labour caused changes in the employment structure [2]. Jing Jianjun (2016) analysed the evolution of China's industrial structure and employment structure, and believed that the transformation of China's employment structure lags the industrial structure [3]. Xia Jianhong et al. (2018) believed that the industrial structure of Shandong Province had an increased role in employment, and the increase in labour force had a direct effect on economic
growth\textsuperscript{[4]}. Sun Na, Liu Zhengyong, et al. (2018) believed that the industrial structure of Hebei Province and the evolution of employment structure are basically consistent, but there is still a certain deviation\textsuperscript{[5]}. Zheng Hongling, Liu Yumin et al. (2018) used correlation coefficient, deviation degree and employment elasticity to analyse the employment structure, industrial structure and economic growth of Hebei Province\textsuperscript{[6]}. Song Jin(2018) believed that the large supply of low-skilled labour force has led to the development of China's industrial structure in the direction of low-skilled and low-income, and the contribution of industrial transformation to income growth has been strengthened\textsuperscript{[7]}. Wang Yongming(2018) found the effect of industrial structure changes on economic growth is long-lasting. Changes in employment structure can increase employment and improve labour efficiency, but the effect on economic growth was not significant\textsuperscript{[8]}. Hua Deya and Tang long(2019) Compared and analysed the coordination between industrial structure and employment structure in the Yangtze River Economic Belt and its internal regions, it was found that the rationalization of structural rationalization in each region was gradually optimized, and the trend of regional structural convergence was significant, but the regional differences are large\textsuperscript{[9]}. 

3. Analysis on the Evolution Path and Characteristics of Industry and Employment Structure in Beijing-Tianjin-Hebei Region

In 2014, the state advocated the integration of Beijing-Tianjin-Hebei, aiming at promoting the upgrading and transfer of industries, promoting the joint construction and sharing of public services, accelerating the process of market integration, and creating a modern new-type metropolitan area. The economic aggregate of the Beijing-Tianjin-Hebei region continued to grow, from 1,138.64 billion yuan in 2002 to 82,559.78 billion yuan (Figure 1). In 2005, the economic growth rate dropped sharply, from 29.38% to 15.52% in 2006. After that, the growth rate remained between 10% and 20%. In 2013, it fell to below 10%, and reached nearly four years in 2017. The fastest growth rate is 9.17%, and the economic development has entered a transition period (Figure 2).

The changes in industrial structure tend to be optimized, the changes in the second and third industries are relatively large, and the growth rate shows a trend of growth and decline. The growth rate of the output value of the primary industry is relatively stable, and the proportion of output value remains at around 6%. In 2014-2017, it was the transition period of industrial structure development in the Beijing-Tianjin-Hebei region. The tertiary industry contributed the most to economic growth. The output value increased from 53% in 2014 to 58% in 2017, while the output ratio of the secondary industry was 41. % dropped to 37% (Figure 3).

The industrial structure changed from "two one three" to "three two one" mode, and the structure began to optimize. The period of 2005-2017 is the adjustment period of the industrial structure of the Beijing-Tianjin-Hebei region. The proportion of industrial structure changed from 10:49:41 in 2004 to 8:45:58 in 2005 and finally to 5:37:58 in 2017. The secondary industry continued to decline, while the tertiary industry grew steadily, the primary industry remained basically stable, and the industrial structure optimization was more obvious (Figure 4).

Figure 1 Production value of region (unit: 100 million yuan) Figure 2 Growth rate of output value in region

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From the perspective of employment structure, the overall employment structure in the Beijing-Tianjin-Hebei region lags the industrial structure. In 2017, the number of employees was 64,475,900, which was 1.40 times that of 2002, with an average annual growth rate of 2.67% (Figure 5).

4. Analysis of Coupling Effect between Industrial Structure and Employment Structure in Beijing-Tianjin-Hebei Region

4.1. The mechanism of influence between industrial structure and employment structure

4.1.1. Structural deviation. Structural deviation can not only measure the degree of coordination between industrial structure and employment structure, but also judge the industrial structure's push-pull effect on employment structure. Structural Deviation equals Industry Percentage of GDP divided by Industry Composition Percentage of Employment and minus 1. The deviation is positive, which indicates that the labour productivity of the industry is relatively high, and it has the effect of absorbing the external labour. This paper uses the relevant data of the Beijing-Tianjin-Hebei region from 2002 to 2016 to calculate the deviation and total deviation of the three industrial structures, as shown in Figure 6.

First, the primary industry has a thrust on internal employment, with low labor productivity and a large surplus of labor. It can be seen from Figure 7 that the primary industry in the Beijing-Tianjin-Hebei region from 2002 to 2016 was negatively deviated, and the average value of the absolute value was 0.76, indicating that the primary industry had a negative effect on employment and the agricultural labor surplus was serious. The labor productivity of the second and third industries is relatively high, which has a negative effect on external employment, and the tertiary industry has a substitution effect on the secondary industry.
Secondly, the labor productivity of the secondary industry is relatively high, and it has exerted a pulling effect on external employment, but its absorption capacity is not strong, and both are positively deviated and the overall trend is declining. Before 2008, the second production deviation was higher, which may be due to the introduction effect of foreign investment in the policy liberalization of management rights. In 2002-2008, the structural deviation was relatively stable and remained near 0.5. In 2017, it fell to 0.2, indicating that the secondary industry has reduced its employability and has great room for transformation and improvement.

Finally, the tertiary industry has developed rapidly and has become the main driving force for employment. The structural deviation of the tertiary industry is positively deviated, and the magnitude of change remains between 0.2 and 0.45 with a mean of 0.26. The trend of the deviation of the tertiary industry and the phenomenon of the second industry are changing, but the overall trend is on the rise. The labor productivity of the tertiary industry is lower than that of the secondary industry, but the employment absorption capacity exceeds the secondary industry.

4.1.2. Employment elasticity. Employment elasticity reflects the impact of economic growth on labour employment. Employment elasticity coefficient equals employment growth rate of an industry divided by growth rate of output value of an industry. When the coefficient of elasticity is positive, the greater the value, the more obvious the effect of economic growth on employment, and vice versa. The employment elasticity coefficient of the three industries in the region is calculated as shown in Table 1.

| Year | Primary Industry | Secondary Industry | Tertiary Industry | Overall Flexibility |
|------|------------------|--------------------|-------------------|--------------------|
| 2003 | 0.0383           | 0.0386             | 0.3438            | 0.1098             |
| 2004 | -0.1234          | 0.1701             | 0.9730            | 0.2201             |
| 2005 | -0.3243          | 0.1867             | 0.1044            | 0.0583             |
| 2006 | -0.4089          | 0.1620             | 0.3821            | 0.1391             |
| 2007 | -0.2396          | 0.3062             | 0.2480            | 0.1433             |
| 2008 | -0.0103          | 0.0861             | 0.3547            | 0.1448             |
| 2009 | -0.0432          | 0.7920             | 0.2255            | 0.1260             |
| 2010 | -0.0548          | -0.0571            | -0.0395           | 0.2084             |
| 2011 | -0.1418          | 0.5515             | 0.5465            | 0.1644             |
| 2012 | -0.1136          | 0.5719             | 0.4650            | 0.3423             |
| 2013 | -0.1709          | 0.4473             | 0.5942            | 0.3494             |
| 2014 | 0.5458           | -0.1999            | 0.3061            | 0.1501             |
| 2015 | 2.0722           | 0.6632             | 0.3844            | 0.2177             |
| 2016 | -0.4384          | -0.2191            | 0.2137            | 0.0898             |

It can be seen from Table 1 that the overall employment elasticity in the Beijing-Tianjin-Hebei region is between 0.0583 and 0.3494, with an average of 0.1760. The employment elasticity is positive, showing that economic growth has a pulling effect on employment. In 2002-2016, the GDP of Beijing-Tianjin-Hebei region grew at an average annual rate of 14.29%, but the average annual growth rate of employment was only 2.28%. It shows that the economic growth of the Beijing-Tianjin-Hebei region does not depend entirely on capital investment and labor, and the improvement of comprehensive technology will also promote economic growth.

The employment elasticity of the secondary industry has a negative value in the three years, indicating that the economic growth of the secondary industry has a pulling effect on employment. The economic growth rate was 5.18 times of the employment growth rate. The negative values in 2010, 2014 and 2016 may be due to the impact of the international economic and domestic policy situation in 2008 and 2014, which have formed a certain impact on the industry.

The elasticity coefficient of the tertiary industry showed a negative value with a mean value of 0.3644, which exceeded the secondary industry for employment. During the period of 2002-2016, the
output value of the tertiary industry increased by 16.97% annually, and the employment growth rate was 5.35%. The growth rate of the tertiary industry's output value was higher than that of the secondary industry.

4.2. The mechanism of employment structure on industrial structure

In 2002-2017, the total economic volume of the Beijing-Tianjin-Hebei region increased from 1,138.64 billion in 2002 to 825.597 billion yuan in 2017. This paper takes the proportion of labor employment in the three industries as the independent variable and the proportion of the industrial output value as the dependent variable to construct a one-way regression model to explain the impact of the employment structure on the industrial structure. The proportion of the output value of the three industries is recorded as $y_1$, $y_2$, and $y_3$, respectively, and the proportion of employment in the three industries is recorded as $x_1$, $x_2$, and $x_3$, respectively, the regression results are shown as Table 2.

| Industry category | Regression equation | Correlation coefficient | F statistic | T statistic | $R^2$ |
|-------------------|---------------------|-------------------------|------------|------------|-------|
| Primary Industry  | $y_1 = -8.96x_1 + 17186.03$ | 0.91 | 129.00 | -11.36 | 0.90 |
| Secondary Industry| $y_2 = 36.07x_2 - 44307.34$ | 0.97 | 566.15 | 23.79 | 0.97 |
| Tertiary Industry | $y_3 = 26.15x_3 - 35991.25$ | 0.97 | 385.57 | 19.64 | 0.96 |

According to the regression results, the proportion of employment in the primary industry increases by 1 percentage point, and the proportion of output value decreases by nearly 8.96 percentage points. It can be considered that increasing labour input will inhibit the increase of the output value of the primary industry. The marginal productivity level of the labour force is declining. The employment of the primary industry is squeezing out and the surplus labour flows to the secondary and tertiary industries. For every second percentage increase in the proportion of employment in the secondary industry, the proportion of output value increased by 36.07 percentage points. For every 10 percentage points increase in the proportion of employment in the tertiary industry, the proportion of output value can be increased by 26.15 percentage points. The increase in the proportion of the third-generation employment has a significant effect on the output value, but it is not as good as the secondary industry.

5. Conclusion

First, the basic performance of the Beijing-Tianjin-Hebei region is that the first industrial structure has a low degree of deviation, and the employment elasticity is small, which has a thrust on employment. Before 2015, the secondary industry had the highest degree of deviation. After 2015, the structural deviation of the tertiary industry began to exceed Secondary industry. The annual employment elasticity of the secondary industry is higher than that of the primary industry but lower than that of the tertiary industry. It has both tension and thrust for employment.

Secondly, from the characteristics of the industrial structure of each province and city, Beijing's tertiary industry is the fastest growing, and the proportion of primary industry and secondary industry is declining. The proportion of the secondary and tertiary industries in Tianjin is equivalent, and the development of the secondary industry is growing steadily. The development of the tertiary industry in Hebei is backward, the proportion of the primary industry is relatively large, and the development of the secondary industry tends to be stable.

Finally, from 2002 to 2016, the industrial structure of the Beijing-Tianjin-Hebei region is continuously optimized and upgraded. However, the differences between the three provinces and cities are large, mainly because the Beijing-Tianjin upgrade rate is significantly higher than that of Hebei. From the perspective of employment structure, the tertiary industry in Beijing and Tianjin is more capable of absorbing labour. The number of employees in the primary industry in Hebei is higher than that in Beijing and Tianjin, and the proportion is still high.
References
[1] W. Liu, L. Z. Tian. (2009) A Comparative Study of Industrial Structure and Employment Structure in Three Economic Regions. Social Science Forum, 10: 49-57.
[2] M. L. Zhang, X. Q. Zhao. (2015) Research on the coordinated development of industrial structure and employment structure. Economic Issues, 3: 76-79.
[3] J. J. Jing. (2016) Research on the Coordination of China's Industrial Structure and Employment Structure. Economic Issues, 1: 60-65.
[4] J. H. Xia, W.H. Jiao. (2018) Analysis of the evolution path and coupling effect of industry and employment structure: taking Shandong Province as an example. Economic Issues, 10: 65-71.
[5] N. Sun, Z. Y. Liu, and A. R. Wang. (2018) An Empirical Analysis and Policy Suggestions on the Coordination Degree of Industry and Employment Structure in Hebei Province under the Coordinated Development of Beijing, Tianjin and Hebei. Regional Economy, 10: 39-43.
[6] H. L. Zheng, Z.M. Liu, L. L. Lu. (2018) A Linkage Analysis of Employment Structure, Industrial Structure and Economic Growth in Hebei Province. Regional Research and Development, 37: 63-68.
[7] J. Song. (2018) Industry Transformation, Employment Structure Adjustment and Income Distribution. Economics and Management Research, 10: 45-56.
[8] Y. M. Wang. (2018) Study on the Relationship between Economic Growth and Industrial Structure and Employment Structure Change—An Empirical Analysis Based on VAR Model. Journal of Gansu Institute of Government, 3: 87-97.
[9] D. Y. Hua, L. Tang. (2019) Study on the Coordination of Industrial Structure and Employment Structure and Regional Convergence. Statistics & Decision, 9: 145-149.