Analysis on the Spatial-Temporal Evolution of Zhaotong's Industrial Structures Under the Background of Rural Revitalization

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Abstract. In the context of rural revitalization, the application of big data can accurately provide data support for industrial revitalization and agricultural development. Based on the statistical data of Zhaotong City from 2006 to 2020, this paper adopts shift-share analysis, industrial structures conversion speed/direction coefficient and relevant methods and technologies of GIS, the temporal and spatial evolution of the industrial structures in Zhaotong City since 2006 are qualitatively and quantitatively analyzed, and the diversification and evolution of the industrial structures in Zhaotong City are explored, in order to provide references for adjusting the internal structure of the three industries in Zhaotong City and promoting rural revitalization.

Keywords: rural revitalization · industrial structures · shift-share analysis · spatial-temporal evolution

1 Introduction

It was advanced rural revitalization in the 19th National Congress of the Communist Party of China, which clarified the general requirements to build rural areas with thriving businesses, pleasant living environments, social etiquette and civility, effective governance, and prosperity. It also emphasized that thriving businesses-which was related to the adjustment of industrial structures, was the top priority. And the industrial structures refers to the mutual proportional relationship between the various industrial sectors of the national economy in terms of production scale and the way of mutual connection between various industries [1, 2]. The industrial structures is the foundation and core of the economic structure. The key to regional economic competition lies not only in the industrial scale and development rate, but also in the optimization and improvement of the industrial structures [3]. The evolution of industrial structures refers to the improvement of its structure and content in both quantity and quality in the process of industrial development [4]. Therefore, it is of great theoretical and practical significance to study the evolution of industrial structures in a certain region. Due to its special location conditions, cultural environment and resource endowment, Zhaotong City is blessed with the differentiated characteristics of its industrial structures. With the policy support of the country's targeted poverty alleviation and rural revitalization, the industrial structures of Zhaotong City has undergone great changes with the development of the economy.

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In recent years, many scholars have made useful explorations on the industrial structures and economic development of Zhaotong City from different aspects, but most of the studies focus on the development of agriculture or a certain sector within agriculture. For example, Wang Min et al. [5] studied vulnerable ecological region and Population Carrying Capacity of Zhanotong City, Li Pumin and others conducted research on the conversion of economic development mode from poverty-stricken areas [6]. There are few studies on the analysis of the spatial-temporal evolution of industrial structures, and most of studies use qualitative methods. This paper adopts a combination of qualitative and quantitative methods such as shift-share analysis to analyze the spatial-temporal evolution of Zhaotong's industrial structures from various aspects, in order to provide data support and reference for the rural revitalization and industrial structures adjustment of Zhaotong City through big data analysis.

2 Data Sources and Research Methods

2.1 Data Sources

This study selects 11 counties (districts) in Zhaotong City as the spatial unit, taking 2006–2020 as the time range. The economic development data are mainly from "Yunnan Bureau of Statistics" (2006–2020) and "National Bureau of Statistics" (2006–2020), the map data comes from the National Geomatics Center of China.

2.2 Research Methods

2.2.1 Diversification Coefficient of Industrial Structures

The diversification coefficient of industrial structures is an evaluation method used to analyze the evolution of the regional industrial structures and evaluate the relationship between the industrial structures diversification and the level of economic development [7]. The formula is as follows:

$$ESD = \sum (P/P, S/P, T/P) \tag{1}$$

ESD represents the diversification coefficient of industrial structures, P is the output value of the primary industry, S is the output value of the secondary industry, T is the tertiary industry [8].

2.2.2 Industrial Structures Conversion Speed/direction Coefficient

The conversion speed of industrial structures is used to measure the difference in the speed of industrial growth in a region [9]. According to Rostow's diffusion effect of leading industry, the differences of growth rate of each industry in a region is used as V to measure the conversion speed of industrial structures, and the direction coefficient of industrial structures θ_i [10] is constructed at the same time.

$$V = \sqrt{\sum \frac{(A_i - A_j)^2 K_i}{A_j}} \theta_i = \frac{1 + A_i}{1 + A_j} \tag{2}$$

2.2.3 Shift-Share Analysis

Shift-share analysis is a comprehensive and dynamic method that is widely used to analyze industrial structures changes and regional development differences. The basic principle is that the economic changes of the area are regarded as a dynamic process in the selected time and region. The changes of the region's own economic aggregate in a certain period are decomposed into the share component N, the structural component P and the competitiveness D [11–17].

It is assumed that after the time [0, t], the economic aggregates of the area and the whole country have changed. The economic aggregate of the area in the initial period is set as e_0, the final period as e_t, B_0, B_t respectively represent the national economic aggregate in the initial period and the end period. The economy of the area is divided into n sectors. $b_{j,0}$, $b_{j,t}$ (j = 1, 2, ..., n) represent the scale of the j industrial sector in the study area in the initial period and the end period; with $B_{j,0}$ and $B_{j,t}$ respectively represent the scale of the j industrial sector in the initial and final periods of the country. Then the change rate of any industrial sector j in the area and the whole country in a certain period of time is:

$$r_j = \frac{b_{j,t} - b_{j,0}}{b_{j,0}}, R_j = \frac{B_{j,t} - B_{j,0}}{B_{j,0}} (\mathrm{j} = 1, 2, 3, \ldots \mathrm{n}) \tag{3}$$

Standardize the scale of each industry sector in the study area by the share of it in the country:

$$b_j = \frac{b_{j,0} * B_{j,0}}{B_0} (\mathrm{j} = 1, 2, 3, \ldots \mathrm{n}) \tag{4}$$

The total growth of the study area can be written as:

$$G = N + P + D = \sum\nolimits_{j=1}^{n} b_j{\prime} * R_j + \sum\nolimits_{j=1}^{n} (b_{j,0} - b_j{\prime}) * R_j + \sum\nolimits_{j=1}^{n} b_{j,0} * (r_j - R_j) \tag{5}$$

Introducing $K_{j,0}=\frac{b_{j,0}}{B_{j,0}}$ and $K_{j,t}=\frac{b_{j,t}}{B_{j,t}}$ as the proportion of the j sector in the study area to the corresponding sector in the country during the initial period and the end period, the relative growth rate L of the study area to the whole country can be expressed as:

$$\begin{aligned} L &= \frac{\sum\limits_{j=1}^{n} b_{j,t}}{\sum\limits_{j=1}^{n} b_{j,0}} \Big/ \frac{\sum\limits_{j=1}^{n} B_{j,t}}{\sum\limits_{j=1}^{n} B_{j,0}} = \frac{\sum\limits_{j=1}^{n} K_{j,t} * B_{j,t}}{\sum\limits_{j=1}^{n} K_{j,0} * B_{j,0}} \Big/ \frac{\sum\limits_{j=1}^{n} B_{j.t}}{\sum\limits_{j=1}^{n} B_{j,0}} \\ &= \left[\frac{\sum\limits_{j=1}^{n} K_{j,0} * B_{j,t}}{\sum\limits_{j=1}^{n} K_{j,0} * B_{j,0}} \Big/ \frac{\sum\limits_{j=1}^{n} B_{j,t}}{\sum\limits_{j=1}^{n} B_{j,0}}\right] * \left[\frac{\sum\limits_{j=1}^{n} K_{j,t} * B_{j,t}}{\sum\limits_{j=1}^{n} K_{j,0} * B_{j,t}}\right] = W * u \end{aligned} \tag{6}$$

W and U respectively represent the structural effect index and the regional competition effect coefficient.

3 Evaluation of the Spatial-Temporal of Zhaotong's Industrial Structures

3.1 Evolution Stage and Overall Characteristics of Industrial Structures

According to the social and economic development and industrial structures characteristics of Zhaotong City, the industrial structures evolution from 2000 to 2020 is divided into three periods: the first period (2006–2010), entering the initial stage of industrialization; the second period (2011–2015), in the early stage of industrialization and rapid economic growth; the third period (2016–2020) is still in the early stage of industrialization. In order to facilitate the description of the evolution of the industrial structures, this paper use A, B, and C to represent these three periods.

According to Fig. 1, in period A, although the output value of the primary industry increased, its proportion continued to decline; the secondary industry increased rapidly with its proportion larger than that of the primary and tertiary industries; the tertiary industry increased, but its proportion kept slowly declining. During this period, with the development strategy of "Developing City by Industry" fully implemented, the industrial park of Zhaotong City became the "locomotive" of industrial development.

In period B, with the proportion of the primary and secondary industries continuing to decline, the tertiary industry increasing, the proportion of the secondary industry was still larger than that of the tertiary industry. During the "Twelfth Five-Year Plan" period, Zhaotong City faced a difficult situation with frequent occurrence of major natural disasters such as drought, hail, landslides, mudslides and earthquakes.

In period C, the proportion of the output value of the primary industry continued to decline, the secondary industry began to decline after rising with its proportion continuing to decline, the tertiary industry began to rise after a slight decline. The proportion of the tertiary industry in this period In the mid-term, it is larger than the secondary industry. From 2018 to 2020, with the proportion of the tertiary industry increased, it is already in a dominant position; the development of modern service industry, tourism, and trade and logistics industry has accelerated.

The output value of the primary industry in Zhaotong City has risen slowly with its proportion continuing to decline. In 2020, the proportion of the primary industry will be about 17.54%., compared to Zhaotong City, the proportion of the primary industry is still too large. The development of the secondary industry is relatively stable, and the overall fluctuation is not large. The development trend of the tertiary industry shows an upward trend and has great potential. The government has attached great importance to the construction of the tertiary industry in recent years, thereby increasing the economic vitality of Zhaotong City.

3.2 The Degree of Diversification of the Industrial Structures is Low, but there is an Increasing Trend

By calculating the industrial structures diversification coefficient of 10 counties and 1 district in Zhaotong City from 2006 to 2020, using ArcGIS software for mapping analysis, the temporal and spatial evolution of the industrial structures diversification coefficient of each county is obtained. Since 2005, the industrial structures diversification

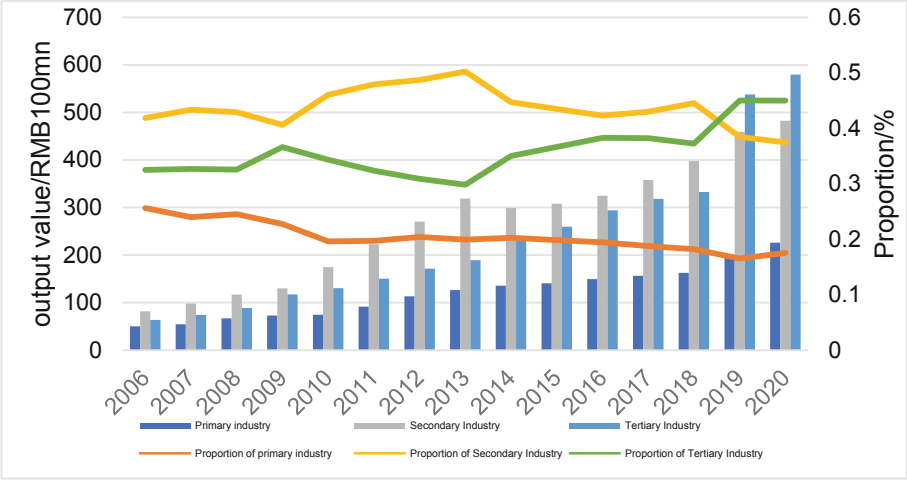

Fig. 1. The evolution of the three industrial structures in Zhaotong City from 2006 to 2020

coefficient of Qiaojia County has changed very little with the growth rate slow, showing the agricultural economy occupies a dominant position in the mountainous agricultural counties, resulting in the weak industrial base, small scale and low sustainable development ability. The industrial structures diversification coefficient of Shuifu County has the fastest growth and the largest value, reaching 24.3 in 2020, which is much higher than 6.63 in Yunnan Province and 11.3 in the whole country. This is because Shuifu County is one of the counties with a small population in Yunnan Province. It is the third largest hydropower station in the country, Xiangjiaba Hydropower Station. In particular, there is Yuntianhua Co., Ltd., one of the top 100 state-owned chemical companies in China. Accelerating the construction of the industrial economy provides a good foundation for development.

3.3 The Speed of Industrial Structures Conversion is Slowing Down, and the Direction of Conversion Tends to be Reasonable

Rostow's leading industry theory points out that the existence of leading industries and advantageous sectors will lead to differences in the growth rate of various industries in the region [18]. According to formula (2), the industrial structures conversion speed coefficient V and direction coefficient θ_i in different stages of Zhaotong City are calculated. It can be seen from Table 1: ① During the period from 2006 to 2020, the industrial structures conversion speed was first fast and then slow. The conversion speed coefficient is 0.1053. During 2010–2020, the conversion speed of the industrial structures became faster because the primary and secondary industries developed slowly, and the tertiary industry developed rapidly; Due to the low degree of industrialization, the heavy industrial structure formed under the old system has become a serious obstacle to Zhaotong's economic development, resulting in the lack of economic development stamina and the industrial structure entering a period of adjustment. ②The transformation direction coefficient of the primary industry structure first rises and then falls, the second keeps

Table 1. The speed coefficient and direction coefficient of industrial structures conversion in different periods of Zhaotong City from 2006 to 2020

Period		2006–2010	2010–2015	2016–2020
Structural conversion speed factor V		0.0991	0.0815	0.1053
Structural conversion Direction Coefficient	θ_1	0.9353	0.9761	0.9745
	θ_2	1.0241	1.0138	0.9702
	θ_3	1.0138	1.0315	1.0413

decreasing, and the tertiary keeps rising. We can seen that the proportion of the primary industry and secondary industry has decreased, and the tertiary industry has an obvious upward trend. It shows that the direction of industrial structures conversion in Zhaotong City tends to be reasonable.

3.4 Evolution Process of Industrial Structures

The calculation period of the shift-share analysis method generally takes 5 years or 10 years. (6) Calculation, the results are shown in Table 2 and Table 3.

The analysis results show that: from the perspective of the national share component, the total growth of the primary industry in the three periods is greater than the national share component, indicating that the agriculture of Zhaotong City has been in a basic position in the past 15 years with the growth rate higher than the national average. Since 2006, the growth of the secondary industry in Zhaotong has been higher than the national average. The total growth of the tertiary industry in the previous period was lower than the national share, respectively −17.04% and −10.34%. In the third stage, it was higher than the national share. After the gap gradually narrowed, it exceeded the national share.

For the structural deviation components, the structural deviation components of the primary industry are all positive. The values of the secondary industry in the three periods are −9.32, 1.67, and 6.22, respectively, indicating that their structure is constantly being optimized. The tertiary industry is negative, −17.91, −32.46, −13.31, respectively. With the poor internal structure, the development of the tertiary industry is relatively backward. The backward industry and tertiary industry of Zhaotong City seriously restrict the evolution of the industrial structures of Zhaotong City. Therefore, it is the main content of future economic work to adjust and optimize the industrial structures of Zhaotong City.

From the perspective of the deviation of competitiveness, the overall competitiveness of Zhaotong City is on the rise. The competitiveness deviation component of the primary industry of the three periods is negative and then positive, the secondary industry is positive in the three periods with the value getting larger and larger. The tertiary industry is

positive with the competitiveness higher and higher. It shows that the overall competitiveness of Zhaotong City is rising. It is relevant to national and local implementation of economic development policies.

The data in Table 3 shows that the relative growth rate L and the regional competition coefficient u of Zhaotong City from 2006 to 2020 were both greater than 1. It can be seen that the economic growth rate of Zhaotong City during this period was higher than the national average speed with the regional competitiveness continuing to increase. The industrial structures effect coefficient W of Zhaotong City is all less than 1, indicating that with the low industrial structures level, the structural contradictions within the industry are prominent. In fact, the economic growth of Zhaotong City is mainly driven by the secondary and tertiary industries with relatively large structural contradictions, and the future industrial structures needs to be further adjusted and optimized.

Table 2. Shift-share Analysis of Different Periods in Zhaotong City from 2006 to 2020/10 8 Yuan, %

Period	Industry Type	Total growth G_j	National share component N j	structural deviation Component P j	competitive deviation Component D j	Total Deviation (PD) j
2006–2010	Primary industry	24.33	14.30	20.19	−10.17	10.02
	Secondary Industry	92.93	77.80	−9.32	24.45	15.13
	Tertiary Industry	66.77	80.48	−17.91	4.20	−13.71
	Total	184.02	172.58	−7.03	18.47	11.44
2011–2015	Primary industry	49.06	13.98	15.20	19.88	35.08
	Secondary Industry	85.26	50.87	1.67	32.72	34.39
	Tertiary Industry	109.04	121.63	−32.46	19.88	−12.59
	Total	243.36	186.47	−15.59	72.48	56.89
2016–2020	Primary industry	76.68	18.13	25.64	32.91	58.55
	Secondary Industry	158.02	91.43	6.22	60.37	66.59
	Tertiary Industry	285.80	167.92	−45.18	163.05	117.88
	Total	520.50	277.48	−13.31	256.34	243.02

Table 3. L, W and u values of Zhaotong City during different periods from 2006 to 2020

Period (year)	Relative growth rate L	Structural Effect Coefficient W	Regional competition coefficient U
2006–2010	1.0311	0.9809	1.0511
2011–2015	1.0873	0.9761	1.114
2016–2020	1.2324	0.9873	1.2483

4 Conclusions and Recommendations

Through the analysis of temporal and spatial evolution, it can be seen that the development of the primary, secondary and tertiary industries in Zhaotong City is uncoordinated with the level of structures and agricultural industrialization low. Because of the weak industrial foundation, the small scale, the large proportion of resource industries, the slow development of modern service industries, the development of the capital market is lagging behind. In the future adjustment of the industrial structures of Zhaotong City, we shall "ensure the development of the primary industry, focus on supporting the secondary industry, and optimize the structure of the tertiary industry". For example, it needs to increase investment in the primary industry, speed up the pace of agricultural transformation, and make rational use of local agricultural resources. Besides, it is necessary to develop advantageous agricultural industries, such as vegetables, fruits, flowers and other traditional labor-intensive industries in Zhaotong City. It should gradually phase out backward industries, speed up the development of agricultural products processing industry and the construction of industrial parks. High-tech industries to upgrade and transform traditional industries can be used. On the basis of local abundant hydropower and coal resources, to expand and strengthen the energy industry is feasible. Further planning and guidance by the government will create a more suitable social environment for the development of the tertiary industry by promoting vigorous development of the tertiary industry and absorbing rural surplus labor. We also need to develop the modern service industries focusing on cultural tourism, finance, logistics to improve competitiveness of the tertiary industry. To strengthen the linkage between industries and enhance the endogenous driving force of industrial development, the government needs to formulate development strategies "acts according to conditions" to ensure industrial development and promote rural revitalization.

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References

1. Ma Dongmei, Ma Xiaofeng, Li Penghao. Exploration of Rural Industry Revitalization Planning Based on Coupling Symbiosis Theory——Taking the Gardening Village of Minning Town, Ningxia as an Example [J]. Small Town Construction, 2021,39(10):77–83+ 108.
2. Zhuang Liang, Wang Xinmin, Ma Wei, etc. Research on the temporal and spatial differentiation of industrial structures in Gansu Province and its dynamic mechanism [J]. Geography of Arid Regions, 2016, 39(3): 638–646.
3. Liu Yanjun. Evolutionary law of urbanization response to the evolution of regional industrial structures [J]. Human Geography, 2011(3): 65-70
4. Scherer F M.Assesing progress in research on industrial evolution ang economic small business.Economics,2001,16:237–242.
5. Wang Min, Zhang Xiaoping. Research on the degree of coupling coordination between social economy and resource environment in ecologically fragile areas: a case study of Zhaotong City, Yunnan Province [J]. Journal of the University of Chinese Academy of Sciences, 2017, 34(06): 684-691.s
6. Li Pumin, Ye Libin. Research on accelerating the transformation of economic development mode in poverty-stricken areas: Taking Zhaotong City, Yunnan Province as an example[J]. Macroeconomic Management, 2010(07), 26-30
7. Qian Liying, Wu Yingmei, Xu Yanmiao, etc. Coordination Analysis of Economic Development Level and industrial structures Evolution in Minority Areas in Northwest Yunnan [J]. Economic Geography, 2010, 30(8): 1278–1282.
8. Qian Xingduo, Mo Guofang. Research on the evolution of spatial and temporal pattern of industrial structures in Yunnan Province [J]. Journal of Changjiang Normal University, 2020, 36(01): 59-68
9. Teng Tangwei. Research on the speed of industrial structures conversion and industrial structures efficiency in Gansu [J]. Development, 2007(04):39-40
10. Xiong Youyun, Zhang Mingjun, Liu Yuanyuan, etc. Analysis on the evolution of Gansu's industrial structures from 1978 to 2006 [J]. Geography of Arid Regions, 2010, 33(2): 285–292.
11. Wan Nianqing, Li Hongzhong, Shi Benlin, etc. Inter-provincial comparison of the evolution of my country's farmers' income structure based on shift-share analysis method [J]. Acta Geographica Sinica, 2012, (4): 672–686.
12. Liu Lijun, Kang Jiani, Liu Youjin. Analysis on the Evolution Characteristics and Transfer/Inheritance Situation of Manufacturing Development Types in the Yangtze River Economic Belt Based on shift-share Method [J]. Journal of Chongqing University (Social Science Edition), 2020, 26(01): 31-44.
13. C. Casotto, V. Silva, H. Crowley, R. Nascimbene, R. Pinho. Seismic fragility of Italian RC precast industrial structures [J]. Engineering Structures. 2015
14. Manisha Singal. How is the hospitality and tourism industry different? An empirical test of some structural characteristics [J]. International Journal of Hospitality Management. 2015
15. Lionel Artige, Leif Neuss. A New Shift-Share Method [J]. Growth Change. 2014 (4)
16. Soichiro Takagi, Hideyuki Tanaka. Globalization of Information Services and the Industrial Structure of the Japanese Economy [J]. The Review of Socionetwork Strategies. 2014 (1)
17. John V. Mitchell, Beth Mitchell. Structural crisis in the oil and gas industry [J]. Energy Policy. 2014
18. Wen Qi. Research on the evolution characteristics and mechanism of regional industrial structures based on set pair analysis: Taking Yulin City as an example [J]. Agricultural System Science and Comprehensive Research, 2009, 25(02): 176–180+187.