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Research on the Regional Industrial Competitiveness of Shandong Province Based on the Spatial SSM & GIS

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Abstract- By using the statistics of national economy with 19 industries of Shandong province in 2003 and 2008 , both shift - share analysis of the traditional model and spatial model were applied to analysis the industrial competitiveness of 17 cities in Shandong . The classical shift-share approach analyses the evolution of an economic magnitude between two periods identifying three components: a national effect, a sectoral effect and a competitive effect. The spatial shift-share approach analyses the evolution of an economic magnitude identifying three components: the national effect, industry mix neighboring regions-nation effect and the competitive neighboring regions effect. The results of the two models are below: Of all the three effects, the national effect is the most important to the economic growth of all the cities in Shandong, and its contribution rate are above 80%. The rate of the total economy and the industries of all the cities were decided by their original amount. The comprehensive benefit of industries structure of Jinan, Qingdao, Weifang, Zibo, Weihai, Liaocheng, Binzhou and Dezhou and their adjacent region are conducive to the city's whole economic growth. The comprehensive benefits of industries structure of Heze, Rizhao and Jining and their adjacent areas are not conducive to the city's whole economic growth. The industrial growth rate of Rizhao, Yantai, Linyi, Jinan, Weifang, Binzhou and Jining were faster than the province and its neighboring regions, and their competitiveness were becoming stronger between 2003 and 2008. The industrial growth rate of Liaocheng, Dongying, Heze, Laiwu, Qingdao, Weihai, Dezhou and Zibo were slower than the whole province and its neighboring regions, and their competitiveness were becoming weaker between 2003 and 2008.

Keywords- Shift-Share Analysis; Spatial Model; Industry Competitiveness; Geographic Information System; Shandong Province

1. Introduction

Regional industrial competitiveness is the middle level between the national competitiveness and enterprise ones, and it is concrete manifestation of the overall competitiveness of the various industries in a country or region[1]. It is essentially refers to a country's internal competition among regions, and to the performance or status of the specific regions of the specific industry's in the domestic market[2].Regional industrial competitiveness includes regional industrial structure competitiveness and enterprise competitiveness in all aspects of specific industries in the region[3]. Shift-share analysis (SSM) of has been widely used in studying the industrial competitiveness[3、4、5]. Many scholars have had improved or expanded the model and taken an empirical study. Liu Zhenling (2009) analyzed the evolution of industrial structure of city group of the central Liaoning based on the improved shift - share models[6]. Zaccomer (2006) expanded SSM to the spatial model through a theoretical studying and empirical demonstrate[7]. Shi Chunyun, Zhang Jie, Gao Wei et al (2007) [8],Wu Jiying, Zhao Xi'cang (2009) [9] summarized the spatial SSM and used it to study some regions industries. With continuous improvement and perfection, especially the spatial expansion model eliminates limitations of spatial interactions of the traditional model, SSM has been become more scientific and comprehensive to analysis regions industries. Among the Researching of regional industrial structure both the overall and specific competitiveness at home and abroad, the use of spatial SSM model is little. In this

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paper, the traditional and spatial SSM model were applied to analysis the specific and overall industrial competitiveness of Shandong Province.

2. Methods

2.1. The Traditional and Spatial SSM Model

1) The traditional SSM model

The traditional SSM was firstly proposed by the American scholar who was Daniel (1942) and Creamer (1943), and was summarized and gradually improved by Dunn (1960) [10] and other scholars later. The method takes the researching economic development of the larger (or national) area as the reference, and divide the regional economic growth into three components: national component (or lager regional component), the industrial structure component and competitive component. The details of the method are below:

Let X_{ij} indicate the initial value of economic variables of the industry j in region i. Supposing the Total economy and industry structure of the region i have been changed after a period of time of t. Let X_{ij}' indicate the final value of the variable. Then the growth rate of the total economy of nation (or the lager region) is:

$$r = \frac{\sum_{i=1}^{m}\sum_{j=1}^{n}(X_{ij}' - X_{ij})}{\sum_{i=1}^{S}\sum_{j=1}^{R}X_{ij}} \tag{1}$$

The growth rate of industry j of the nation (or the lager region) is:

$$r_j = \frac{\sum_{i=1}^{m}(X_{ij}' - X_{ij})}{\sum_{i=1}^{m}X_{ij}} \tag{2}$$

The growth rate of the total economy of region i is:

$$r_i = \frac{\sum_{j=1}^{n}(X_{ij}' - X_{ij})}{\sum_{j=1}^{n}X_{ij}} \tag{3}$$

The growth rate of industry j of the region i is:

$$r_{ij} = \frac{X_{ij}' - X_{ij}}{X_{ij}} \tag{4}$$

Let ΔX_{ij} indicate the increment of industry j of the region i, then ΔX_{ij} is:

$$\Delta X_{ij} = X_{ij}' - X_{ij} = X_{ij}r - X_{ij}(r_j - r) + X_{ij}(r_{ij} - r_j) \tag{5}$$

Equation 5 can also be written as:

$$r_{ij} = r + (r_j - r) + (r_{ij} - r_j) \tag{6}$$

Let $N_{ij}=X_{ij}\times r$, $P_{ij}=X_{ij}\times(r_j - r)$, $D_{ij}=X_{ij}\times(r_{ij} - r_j)$, then N_{ij} is national component (or lager regional component) which means the increment of an industry according to growth rate of the national(or lager regional) development of all industries. P_{ij} is the industrial structure component which means increment of an industry according to difference of actual growth rate of the industry and growth rate of all industries of the

nation (or larger region). D_{ij} is competitive component which means the difference between the actual growth rate of economic values of the studied region and that of the nation (or larger region).

The economic incremental of region i can be expressed as the G_i:

$$G_i = N_i + P_i + D_i \tag{7}$$

where N_i,P_i and D_i, are respectively the sums of N_{ij}、P_{ij}、D_{ij} .

2) The spatial SSM model

The traditional SSM does not take into account the spatial interaction between regions. According to first law of geography, Geographical factors or geographic phenomenon often exist spatial correlation. regional economic development will be influenced by other regions, especially by the neighboring regions. Nazara and Hewings (2004) considered the spatial interactions between regions, and proposed spatial SSM model.[11] They deduct 20 regional economic growth decomposition formulas with or without the spatial structure. For example:

$$r_{ij} = r + (r^{v}_{ij} - r) + (r_{ij} - r^{v}_{ij}) \tag{8}$$

where r^{v}_{ij} is:

$$r^{v}_{ij} = \frac{\sum_{k \in v} w_{ik} X^{t+1}_{ik} - \sum_{k \in v} w_{ik} X^{t}_{ik}}{\sum_{k \in v} w_{ik} X^{t}_{ik}} \tag{9}$$

where v is the number of neighbors of the region i, W_{ik} is spatial weight matrix, which means the connection intensity between regions i and k. Its value is limited, non-negative. Many scholars studied and defined the spatial weight matrix. Moran(1948)[12] defined Boolean matrix based on "geographical proximity" . In the matrix, W_{ik} is 1 if region i and k is a neighbor, and else W_{ik} is 0. The values of the main diagonal of the matrix are 0. Boarnet (1998) [13] defined the spatial weight matrix which increases With the the similarity between regions. Lee(2008) [14] defined the spatial weight matrix based on the distance of cities and their economic ties. Fingleton (2001)[15] defined the spatial weight matrix which is $W_{ik}=GDP^{2}_{t=0}D_{ik}^{-2}$, where GDP is gross domestic product and D_{ik} is the distance between region i and k. All in all, the scholars defined the spatial weight matrix based on the regional economic linkages and the distance between regions or based on regional similarity .

3. Empirical STUDY of Industrial Competitiveness of Shandong Province

3.1. Study Area & Data Sources

Shandong is mostly flat in terrain. The northwestern, western, and southwestern parts of the province are all part of the vast North China Plain. In 2009, the nominal GDP for Shandong was 3.38 trillion yuan (US$446 billion), ranking the third in the country (behind Guangdong and Jiangsu). It's GDP per capita was 35,796 yuan (US$ 5,240), ranking seventh. There are 17 cities which governs districts in the province. The 17 cities are the research units in this paper. And the data of the cities are derived from the Statistical Yearbook of Shandong province between 2003 and 2009.

In this paper, the industry classification is according to China's national industry classification standards which NO. is GB/T 4754—2002. The industries include: 1.agriculture, forestry, animal husbandry, fishery; 2.mining industry; 3.manufacturing; 4. electricity, gas and water production and supply; 5. building industry; 6.transport, storage and postal industry; 7.information transmission, computer services and software industry; 8.wholesale and retail trade; 9. accommodation and catering industry; 10. the financial sector; 11. real estate; 12. leasing and business services; 13.research,technical service and geological prospecting; 14.water, environment and public facilities; 15. resident services and other services; 16. education; 17. health, social security and social welfare; 18.culture, sports and entertainment; 19.public administration and social

organization. In order to express simple, the numbers are used below to indicate the industries. For example, NO. 1 means agriculture, forestry, animal husbandry, fishery, etc.

3.2. Empirical Study of the traditional SSM

In this paper, the initial year is 2003 and the end is 2008. Studied regions are 17 cities in Shandong Province and reference region (lager region) is the whole province. Total economic growth of all the cities in Shandong province are in Figure 1. The difference of the economic growth rate between the 17 cities and the whole province is showed in table 1. The difference of economic growth rate between the 19 industries and the whole province is in table 2.

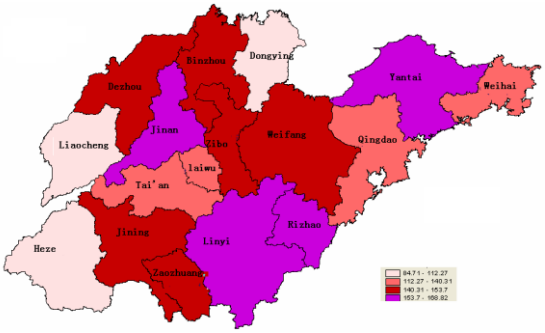

Figure 1. Total economic growth of all the cities in shandong province

TABLE 1. THE DIFFERENCE OF THE ECONOMIC GROWTH RATE BETWEEN THE 17 CITIES AND THE WHOLE PROVINCE

regions	Linyi	Yantai	Rizao	Jian	Weifang	Binzhou
r_i-r(%)	27.82	24.07	22.73	21.23	12.69	11.87
regions	Zaozhuang	Zibo	Jining	Dezhou	Tai'an	Weihai
r_i-r(%)	5.59	3.69	2.13	1.38	-0.70	-3.75
regions	Qingdao	Laiwu	Heze	Liaocheng	Dongying	
r_i-r(%)	-9.02	-10.54	-28.74	-50.97	-56.30	

TABLE 2. THE DIFFERENCE OF ECONOMIC GROWTH RATE BETWEEN THE 19 INDUSTRIES AND THE WHOLE PROVINCE

industies	15	5	11	3	10
r_j-r(%)	517.15	117.31	50.07	21.43	19.37
industies	19	9	13	12	18
r_j-r(%)	14.11	10.11	6.09	4.62	3.78
industies	16	17	2	14	8
r_j-r(%)	-0.99	-15.94	-39.87	-47.04	-50.17
industies	4	6	7	1	
r_j-r(%)	-56.92	-61.54	-67.35	-116.62	

According to the formula 7, the lager regional (the whole province) component, the industrial structure component and competitive component of the 17cities of Shandong province are calculated in table 3.

TABLE 3. THE LAGER REGIONAL COMPONENT, THE INDUSTRIAL STRUCTURE COMPONENT AND COMPETITIVE COMPONENT OF THE 17CITIES OF SHANDONG PROVINCE

regions	lager regional component	industrial structure component	competitive component	total increment
Jinan	1656463.43	110415.09	139029.68	1905908.20
Qingdao	2260796.60	89908.30	-234557.90	2116147.00
Zibo	893428.27	32772.66	-9387.73	916813.20
Zao zhuang	462775.29	-41403.06	59765.18	481137.40
Dong ying	924434.35	-157806.67	-211272.28	555355.40
Yantai	1210160.62	849.71	205753.57	1416763.90

Weifang	885356.38	27809.81	51848.41	965014.60
Jining	940801.21	-90955.94	105138.13	954983.40
Tai’an	654559.70	-55461.02	52213.62	651312.30
Weihai	541192.66	32872.33	-47249.40	526815.60
Rizhao	239382.54	-1909.53	40492.39	277965.40
Laiwu	245755.14	18008.84	-36371.89	227392.10
Linyi	646896.74	4366.17	123245.80	774508.70
Dezhou	380504.15	7701.93	-3964.88	384241.20
Liao cheng	465154.24	15207.60	-183346.54	297015.30
Binzhou	373300.73	19698.92	11730.05	404729.70
Heze	368646.04	-12075.14	-63066.20	293504.70

According to Table 4, Figure 2 was made with software ARCVIEW 3.3.

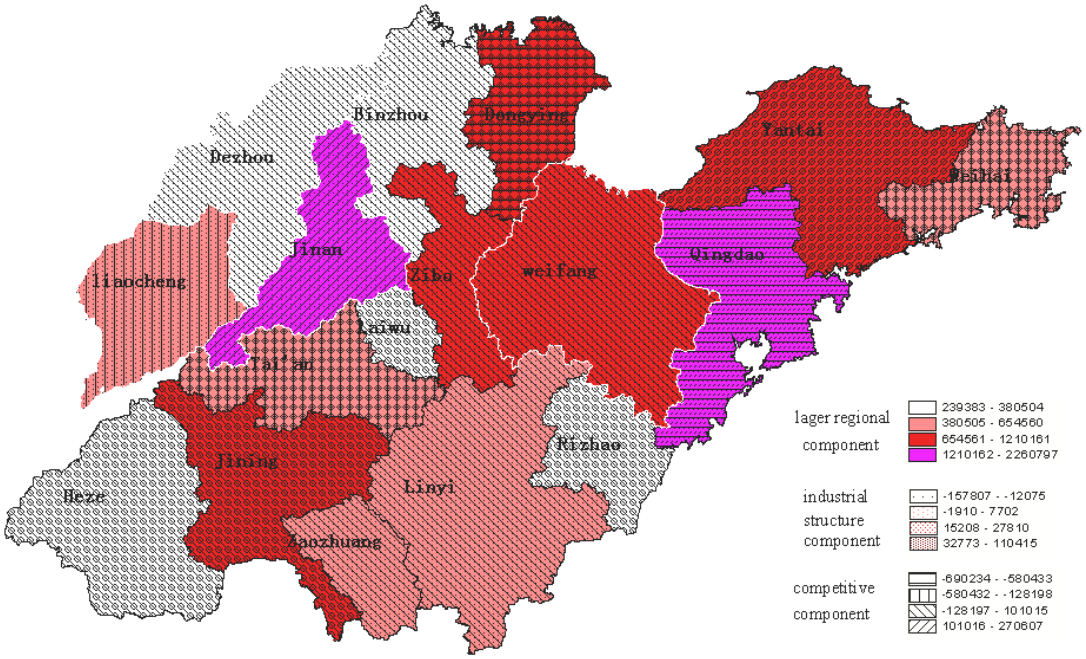

Figure 2. The results of traditional SSM of the 17 cities in Shandong province

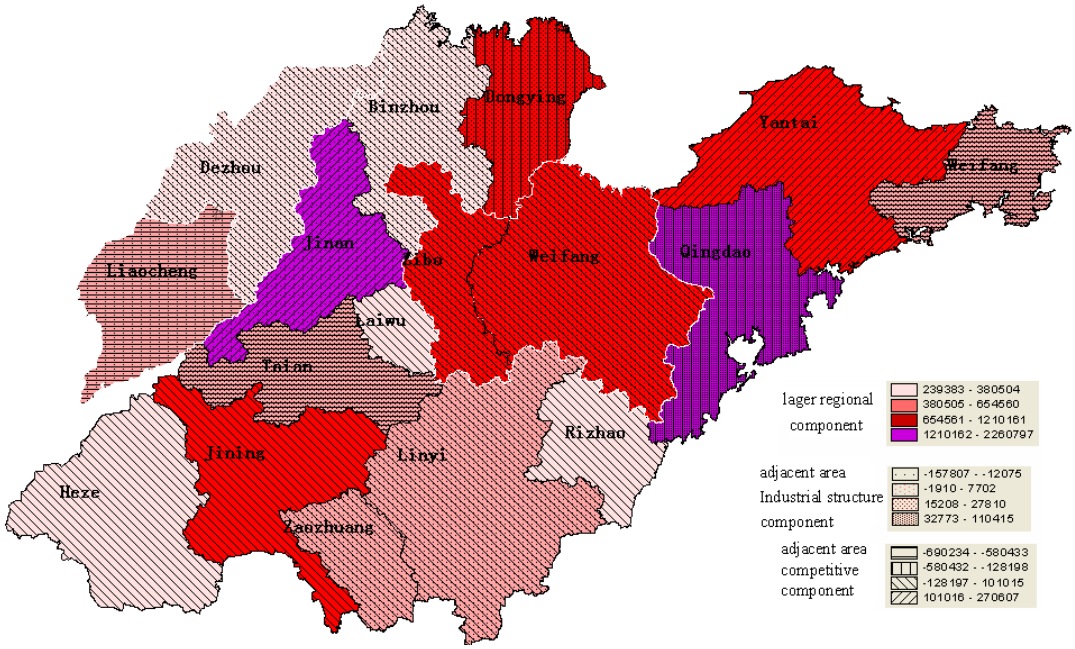

Figure 4.The results of spatial SSM of the 17 cities in Shandong province

Table 4 and Figure 2 show that the lager regional (the whole province) component are the largest contribution to regional economic growth.

3.3. Empirical Study of the Spatial SSM

In this paper, empirical research was done using formula 8. The method of determining spatial weight matrix is below: Firstly, according to the principle of spaces adjacent, the method of Moran [12] was used to determine the adjacency matrix. Then the total economic value of the adjacent area was used to amend the matrix. The lager regional (the whole province) component, the industrial structure component of the adjacent area and competitive component of the adjacent area of the 17cities in Shandong province are calculated in table 4.

TABLE 4. THE RESULTS OF SPATIAL SSM OF 17 CITIES IN SHANDONG PROVINCE

regions	lager regional component	adjacent area Industrial structure component	adjacent area competitive component	total increment
Jinan	1656463.43	110415.09	139029.68	1905908.20
Qingdao	2260796.60	89908.30	-234557.90	2116147.00
Zibo	893428.27	32772.66	-9387.73	916813.20
Zao zhuang	462775.29	-41403.06	59765.18	481137.40
Dong ying	924434.35	-157806.67	-211272.28	555355.40
Yantai	1210160.62	849.71	205753.57	1416763.90
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Linyi	646896.74	4366.17	123245.80	774508.70
Dezhou	380504.15	7701.93	-3964.88	384241.20
Liao cheng	465154.24	15207.60	-183346.54	297015.30
Binzhou	373300.73	19698.92	11730.05	404729.70
Heze	368646.04	-12075.14	-63066.20	293504.70

3.4. Conclusions

Form the results of traditional and spatial SSM, we found that the lager regional (or national) component is the greatest contribution to economic growth, and its contribution is over 80%. The values of industrial structure component and that of the adjacent area of Jinan, Qingdao, Weifang, Zibo, Weihai, Liaocheng, Binzhou, Dezhou are positive. That means the comprehensive benefits of industrial structure of these regions are better. The comprehensive competitiveness of the industries of Liaocheng, Dongying, Heze, Laiwu, Qingdao, Weihai, Dezhou, Zibo were becoming weaker in the past 5 years.

4. Acknowledgements

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