Research on the Measurement of High-Quality Economic Development in the Chengdu-Chongqing Economic Circle

Ming Jin[1], Shana Zhang[2]

[1]5925850540@qq.com, [2]zhangshana1125@qq.com

[1]School of Economics and Management, University of Electronic Science and Technology of China, Chengdu, China

[2]School of Statistics, Chengdu University of Information Technology, Chengdu, China

Abstract: With the profound understanding of the "Outline of the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China" and the "Outline of the Construction of Chengdu-Chongqing economic circle", the writers believe that in order to promote the high-quality economic development of the economic circle, it is paramount to correctly handle six major relationships. According to the connotation of high-quality economic development, a high-quality economic development system has been built, and the entropy method is used to empower the indicators. The writers introduce the principle of synergy into the study of the high-quality economic development of the economic circle. And the spatial evolution of high-quality economy (each dimension) of Chengdu-Chongqing economic circle is studied from two aspects: the synergistic development of high-quality economy from various dimensions, and the grade differences of high-quality economy from various dimensions, using modified urban gravity model and coefficient of grade differences. The results show that the degree of synergistic development of the high-quality economy from various dimensions of the Chengdu-Chongqing economic circle is relatively low, and there are large grade differences within the economic circle and inner city of Chongqing.

Keywords: High-quality economy; Chengdu-Chongqing economic circle; Entropy method; Urban gravity model; coefficient of grade differences

1 Introduction

In addition to the Beijing-Tianjin-Hebei, Yangtze River Delta and Guangdong-Hong Kong-Macao area, the Chengdu-Chongqing economic circle is the fourth region with irreplaceably important strategic position in China. At the new development stage, promoting the high-quality economic development of the Chengdu-Chongqing economic circle is conducive to complementing each other's advantages and forming a synergistic development network with radiation and driving effect. It is also helpful to promote top-level design, strengthen integrated development, and solve the unbalanced and insufficient development in the region.

Most scholars currently use the city gravity model to explore the degree of economic linkages among districts in the region. For example, this article [3] used a modified gravity model to study the spatial economic link characteristics of the Guangdong-Hong Kong-Macao Greater Bay Area, and the results showed that the economic link of the Guangdong-Hong Kong-Macao Greater Bay Area has been increasing, forming an "inverted U-shaped" spatial link network. This article [5] used the gravity model to calculate the intensity of tourist economy's link in Hainan Province, and the results showed that the intensity of tourist economy's link in 18 counties and cities in Hainan Province has been increasing, but there was large spatial difference. This paper [2] used the city gravity model, affiliation degree and coefficient of grade differences to study the characteristics of synergistic development of tourist economy in the middle reaches of Yangtze River city cluster, and the study showed that there were large differences within the city cluster, and the degree of synergistic development still needed to be further improved, although the tourist industry development of each city tends to be synergistic.

In summary, most scholars currently use a single indicator to study the degree of economic synergistic development in the region, but high-quality economy is not just about economic development, but also about public services and ecological environment so as to improve economic quality. Therefore, this paper combines the index system to explore the degree of economic high-quality synergistic development and spatial development characteristics in the Chengdu-Chongqing economic circle in terms of comprehensive indicators. Moreover, most scholars still use a single method to study the interconnection between cities, but the development of each district in economic circle is unbalanced, so coefficient of grade differences is introduced to explore the development differences of the economic circle, part of Sichuan and Chongqing, to analyze the degree of differences, and to provide relevant suggestions to solve the unbalanced and insufficient development in the region.

2 Indicator system and measurement

2.1 The building of indicator system

This paper gives a certain connotation to high-quality economy from the perspective of correctly handling the multiple relationships of high-quality economic development with the deep understanding "Outline of the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China" and the "Outline of the Construction of Chengdu-Chongqing economic circle".

On the basis of previous scholars [2] and with the understanding the connotation of high-quality economic development and following the principles of the building of the indicator system, the indicator system is built in this paper as shown in Table 1.

2.2 Data sources and pre-processing

Data sources: The data in this article are mainly derived from the "Yearbook of Chongqing Statistics in 2017-2021", "Yearbook of Sichuan Statistics in 2017-2021", "Yearbook of the Chengdu-Chongqing economic circle in 2017-2021".

Handling of the Missing values: This article uses the average method and the geometric mean method to deal with missing values respectively.

2.3 Indicator weights

This article uses the entropy method to empower indicators [4]. The weights of the indicators are shown in Table 1.

According to the above weight calculation results, linear weighting method is used to calculate the index of high-quality economic development of the Chengdu-Chongqing economic circle.

Table 1 Indicator system and metric weights

First-level indicators	Secondary indicators	Three-level indicators	unit	attribute	weight	relative weights
Innovation-driven	Innovation input	Intensity of funding on R&D	%	+	0.0761	0.3362
	Innovative output	Number of patent applications	item	+	0.0811	0.3583
		Number of patents granted	item	+	0.0692	0.3055
economic development	Economic benefits	Per capita gross regional product	Yuan	+	0.0429	0.1895
		Per capita local general public budget revenue	Yuan	+	0.0325	0.1436
		Investment efficiency	%	+	0.0014	0.0063
	Industry coordination	Industrial added value	100 million yuan	+	0.0676	0.2988
		Industrial structure upgrading coefficient	-	+	0.0287	0.1269
		Service industry attention	%	+	0.0478	0.2113
	Foreign exchanges	Import and export dependence	%	o	0.0053	0.0234
	Ecologically livable	Proportion of days with good air quality	%	+	0.0230	0.0639
		Increase of energy consumption of industrial value added	%	+	0.0075	0.0208
Ecologically livable	Public services	Number of health institutions	unit	+	0.1040	0.2885
		Per 10000 people number of beds in health institutions	bed	+	0.0271	0.0750
		Per 100 students enrolled full-time teachers in regular secondary schools	person	+	0.0350	0.0972
		Per capita expenditure on education	yuan	+	0.0235	0.0651
		Per 10000 people numbers of libraries	unit	+	0.0478	0.1325
		Per 100 people numbers of books in public libraries	volume	+	0.0721	0.2000
		Per capita social safety and employment expenditure	yuan	+	0.0206	0.0570
	Regional coordination	Urbanization rate of resident population	%	+	0.0257	0.1377
	Urban-rural coordination	Per capita income ratio of urban and rural residents	%	o	0.0221	0.1181
		Ratio of per capita consumption expenditure of urban and rural residents	%	o	0.0240	0.1283
People's lives	Consumption structure	Consumption rate	%	o	0.0112	0.0597
	Financial level	Loans of financial institutions by region at Year-end	100 million yuan	+	0.0764	0.4091
	Transportation facilities	Road infrastructure	km/km^2	+	0.0275	0.1470

3 Spatial characteristics

3.1 High-quality synergistic development

Urban gravity model: At present, the urban gravity model is widely used, but this is only a basic model transformed from universal gravitation, and it does not fully consider the development characteristics of the region, the economic operation trend and other factors, so it is necessary to revise it [1].

The revised urban gravity model is as follows equation (1):

$$F = K \frac{Q_i Q_j}{D_{ij}^{2}}$$

$$(1)$$

Among them, Q_i and Q_j are the average level of high-quality economic development from various dimensions of i and j cities, D_{ij} is the distance between i and j cities. In order to facilitate comparison, this paper sets k to 100.

Synergy strength analysis: From Figure 1, it can be seen that the degree of synergistic development in across-administrative regions is relatively low, and the gravity value of only Beibei District and Guang'an City, Guang'an City and Yubei District reaches above 18. The two areas whose gravity value is over 156.17 are concentrated in Chongqing. The degree of synergistic development in Sichuan is lower than that of Chongqing, and its gravity value is below 35.
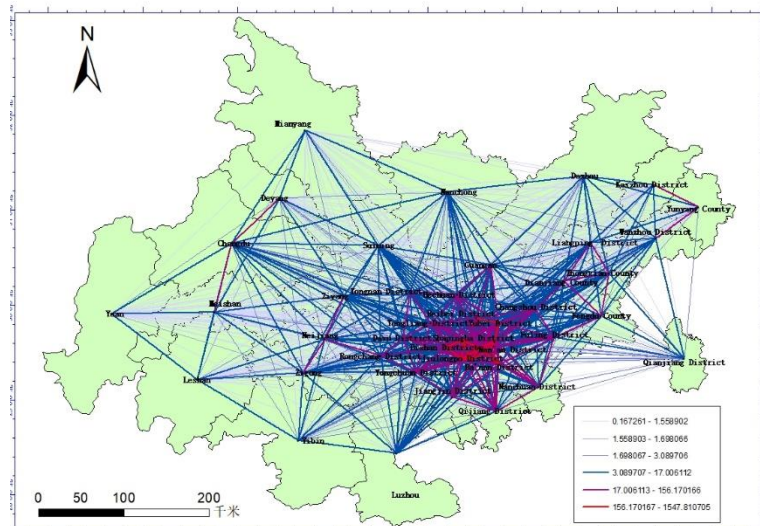

Figure 1 Coordinated network map of high-quality economy

Figure 2 Innovation-driven collaborative development network diagram

From Figure 2, the degree of innovation-driven synergistic development in across-administrative districts in the economic circle is weak, and the gravity value of the areas is below 8, except in Guang'an City and Beibei District. The areas with gravity values above 70.21 are all in Chongqing, including Dadukou and Jiulongpo District, Jiangbei and Nan'an District, Yuzhong and Nan'an District, Shapingba and Bishan District, Beibei and Yubei District, Nan'an and Banan District. There is a strong mutual attraction between these regions and a high level of synergistic development. However, the degree of innovation-driven synergistic development in Sichuan is low, and the gravity values are all below 34.

From Figure 3, the economic development synergy network of Chengdu-Chongqing economic circle has a large gap. The synergy level in across-administrative regions in the economic circle is low. Except for Guang'an City and Hechuan District, Guang'an City and Yubei District, whose gravity value is above 24, and the synergy degree between the rest of the regions is below 20. The intensity of synergistic development in Chongqing is higher than that of Sichuan. The degree of synergistic development of the Sichuan is relatively low, and the only cities with gravity values between 28.45 and 262.20 are Chengdu and Deyang, Neijiang and Zigong.
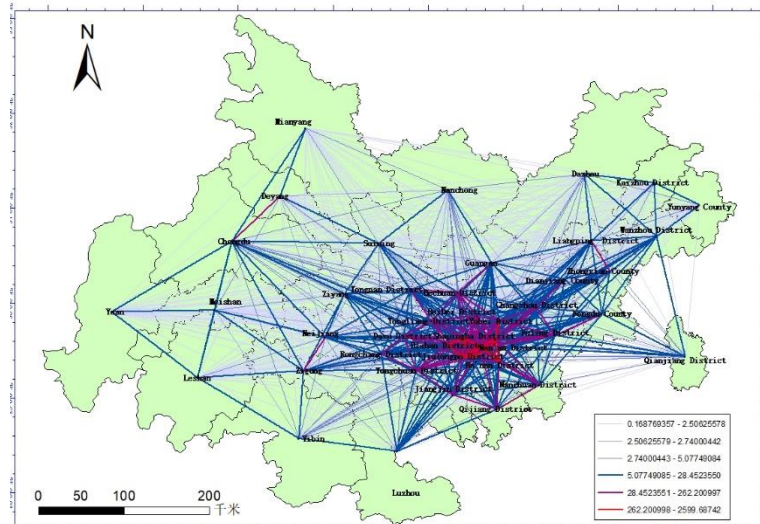
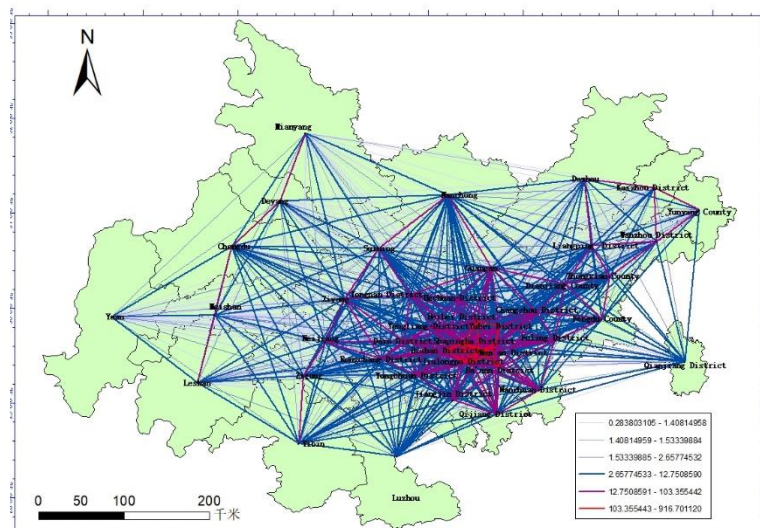Figure 3 Synergistic network for economic development

Figure 4 Synergistic development network of ecological livability index

From Figure 4, the ecological livability index of the Chengdu-Chongqing economic circle has a relatively high degree of synergistic development in across-administrative regions and Sichuan Province. Suining, Guang'an, Ziyang and Dazhou City have higher interactions with areas in Chongqing, with gravity values between 12.75-103.36. The area with gravity value above 103.36 are still concentrated in Chongqing.

From Figure 5, the degree of synergistic development of the people's living index in the cross-administrative regions and Sichuan Province in the economic circle is relatively weak, and the internal differences are relatively large. The mutual attraction of cross-administrative regions in

the economic circle is weak, and the gravity value is below 44. Moreover, Guang'an City has a high degree of synergistic development with areas in Chongqing. The areas with gravity value above 142.98 are concentrated in Chongqing. The degree of synergistic development in Sichuan Province is low, with the gravity value of only Chengdu and Deyang City, Ziyang and Neijiang City and Neijiang and Zigong City between 29.31 and 142.98.
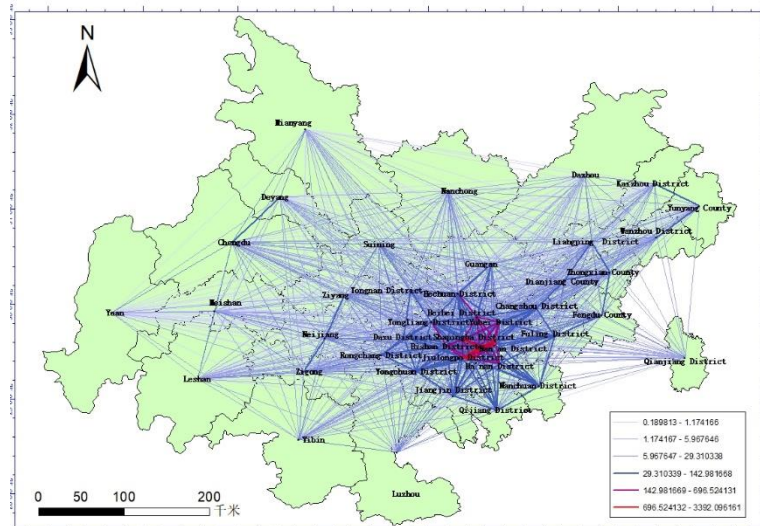

Figure 5 People's Living Index Collaborative Development Network

3.2 Difference analysis of grade synergy

Coefficient of grade differences: This section introduces the coefficient of grade differences to study the grade change of the high-quality economy in the regions [1]. Calculated as equation (2):

$$CV = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(F_i - \overline{F})^2}}{\overline{F}}$$

(2)

F_i is the high-quality economy from various dimensions of the i region. The larger the value, the larger the internal differences in the region, the more significant differences in the grade of the high-quality economy from various dimensions, the lower the degree of synergistic development, the weaker the stability of regional development, and vice versa.

Synergistic evolution of high-quality economic grades: This section divides the area in the Chengdu-Chongqing economic circle according to administrative regions into the Sichuan part and the Chongqing part respectively.

From Figure 6, the overall grade synergy of the Chengdu-Chongqing economic circle has the largest difference. Among them, the coefficient of grade differences of economic development is the largest, which is 1.71. This indicates that the grade synergy of economic development in the economic circle is poor, which needs to be further improved. The coefficient of grade

differences of ecological livability and innovation drive are relatively small, which are 1.33 and 1.45 respectively, and the difference in grade synergy is small.
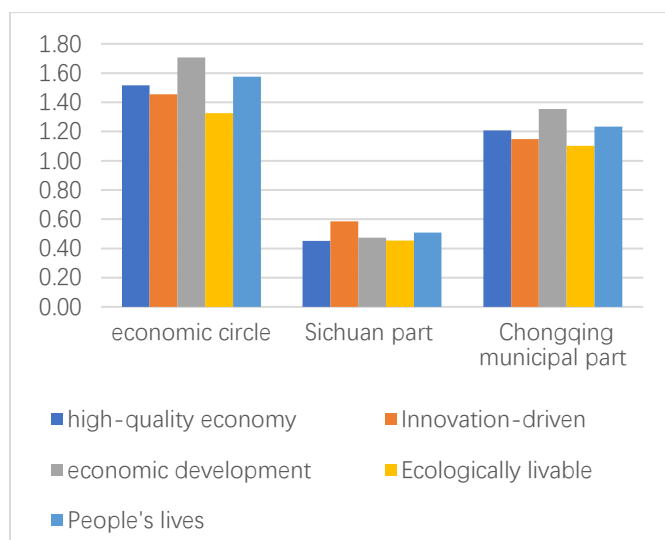

Figure 6 The coefficient of grade differences

Seen from different regions, the difference in the grade synergy in high-quality economy from various dimensions in Chongqing is larger, the coefficients of grade differences are all above 1.1. And the difference in Sichuan is relatively small, and the coefficients of grade differences fluctuate between 0.45 and 0.60, indicating that the synergistic development of high-quality economy is more stable.

4   Conclusion

In terms of spatial synergy of high-quality economy from various dimension indexes, the degree of synergistic economic development of high-quality economy in Chengdu-Chongqing economic circle is low, registering below 40 (before multiply 100). The degree of synergistic development in across-administrative regions is lower than that of Sichuan and Chongqing. And the degree of synergistic development in Sichuan is lower than that of Chongqing.

Judging from the evolution of grade synergy of high-quality economy from various dimensions, the grade synergy of the economic circle varies greatly. The difference in the economic circle is greater than that in Chongqing and Sichuan, indicating that there are large internal differences in the affiliation of high-quality economy from each dimension in the economic circle and the stability of regional development is low, which need to be adjusted.

Through the research on the synergistic development, the writers deeply explored the spatial evolution characteristics and interaction pattern of high-quality economic development in the Chengdu-Chongqing economic circle, which is of great significance to the building of the radiation-driven network. The writers analyzed the grade differences in high-quality economic development, discussed the degree of change in the grade structure of the high-quality economic

development in the economic circle, Sichuan and Chongqing. Reasonable guidance of the synergistic development between regions and improvement of the radiation-driven role of the "two cores". can advance the building of the high-quality economic system and optimize the spatial layout of the Chengdu-Chongqing economic circle, which is of strategic importance to the balanced development of the region.

In the next step, we will try to replace the economic distances and further study the layout of the synergistic development network of high-quality economy. And we will explore the characteristics and laws of synergistic distribution of maximum attractiveness from the perspective of maximum attractiveness.

References

[1] Cui S Q. Zhu P J. Wu X S. Zeng W P. (2018) Study on the co-evolution and influencing factors of tourism in the middle reaches of the Yangtze River [J]. Journal of Central South University of Forestry and Technology (Social Science Edition), 12(01):65-74. (In Chinese)

[2] Li J C,Shi L M. Xu W T.(2019) Discussion on the Evaluation Index System of High-quality Development[J].Statistical Research,36(01):4-14.(In Chinese)

[3] Liu Q F, Wang Z F. (2022) Evolution of economic spatial association characteristics and network effects in Guangdong-Hong Kong-Macao Greater Bay Area[J]. Geography and Geographic Information Science, 38(02):55-62. (In Chinese)

[4] Zhu X A. Wei G D. (2015) Discussion on the excellent standard of dimensionless method in entropy method [J]. Statistics and Decision Making,2015(02):12-15. (In Chinese)

[5] Zhang J H, Xiao M L, Wang C, Hu WJ, Wang J W. (2022) Research on tourism economic linkage and its spatial structure in Hainan Province based on gravity model and social network analysis[J]. China Famous Cities, 36(03):46-52. (In Chinese)