Interval Number Comprehensive Evaluation Model for Assessing the Economic Strength of Guangxi City, China

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Abstract

This study employs an Interval Number Comprehensive Evaluation Model to assess the comprehensive economic strength of fourteen cities in Guangxi, China, including Nanning, Liuzhou, Guilin, Wuzhou, Beihai, Fang Chenggang, Qinzhou, Guigang, Yulin, Baise, Hezhou, Hechi, Laibin, and Chongzuo. Evaluation criteria encompass the overall economic scale, industrial structure, infrastructure, living standards, and education/health levels. The research adheres to principles of scientificity, conciseness, feasibility, and applicability in constructing an evaluation indicator system.

The results were indicated that Nanning, Liuzhou, and Guilin as the top three cities in terms of comprehensive economic strength during the '13th Five-Year Plan,' with corresponding interval values [0.0502, 0.0688], [0.1999, 0.2653], and [0.2236, 0.3225]. Cities with medium strength include Beihai, Yulin, Fangchenggang, Qinzhou, Guigang, and Wuzhou, exhibiting interval values between [0.2887, 0.5506]. Cities with weaker economic strength—Chongzuo, Laibin, Baise, Hezhou, and Hechi—show interval values between [0.4362, 0.7128], indicating lower development levels. The research contributes insights into the economic dynamics of Guangxi City, providing a nuanced understanding of its regional development.

Keywords: Application of Interval Number, Comprehensive Evaluation Model, Comprehensive Economic Strength

Introduction

With the acceleration of industrialization, the number of cities continues to increase and the size of individuals continues to expand, making the dominant role of cities in social and economic life increasingly significant. The world has entered an era

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of global economic cooperation, resource market competition, and economic cycle integration. As the economic, political, technological, and educational and cultural development center of a country (region), cities have become the protagonist of economic cycle. The main factor determining the position, role, and future development trend of each city in the fierce market struggle is their respective comprehensive economic strength. (Chen Liwen, Sun Baozheng, Jiang Linqi.(1995).

During the 13th Five Year Plan period, Guangxi's overall economic development trend was stable and progressing, and its comprehensive strength was further improved. Firstly, the comprehensive economic strength has reached a new level. The average annual growth rate of Guangxi's regional gross domestic product is 6.1%, and the regional gross domestic product and per capita disposable income of residents have doubled compared to 2010. The second is to form a new pattern of industrial structure with comprehensive and coordinated development. The grain production in Guangxi is 13.7 million tons, forming six characteristic agricultural industrial clusters with a value of 100 billion yuan, including vegetables and high-quality livestock. The transformation and upgrading of traditional industries have achieved significant results, forming 10-billion-yuan industrial clusters such as automobiles and electronic information. The added value of strategic emerging industries contributes more than 30% to industrial growth. The development of new industries and formats, represented by the digital economy, is accelerating. The added value of the service industry accounts for over 50% of the regional GDP, and the annual total tourism consumption exceeds trillion yuan. The annual average growth of the marine GDP is over 10%. Thirdly, significant progress has been made in infrastructure construction. Guangxi has basically achieved high-speed rail connections to cities, highways to counties, and civil aviation connections to various areas. The operating mileage of high-speed trains is 1792 kilometers, ranking first in western China. The total mileage of highways is 130000 kilometers, and the total mileage of highways is 6803 kilometers. All established villages are connected to hardened roads and buses. Build, relocate, and renovate four airports. Breakthrough progress has been made in the construction of energy infrastructure and major water conservancy projects, with 4G networks covering the entire region and 5G achieving large-scale commercial use, continuously enhancing its support for economic and social development. Fourthly, basic public services have

significantly improved. The pace of comprehensive revitalization and improvement of education in Guangxi has accelerated, and the consolidation rate of preschool education and nine-year compulsory education has reached the national average level in China, achieving a basic balanced development of compulsory education in counties. The gross enrollment rate in higher education has increased from 30.8% to 47.9%. The infrastructure of health institutions at all levels is fully up to standard, with villages and villages having health clinics, towns and townships having health centers, counties and counties having secondary public hospitals, and cities having tertiary hospitals. The basic medical treatment visit rate in the county town is close to 90%, and the number of beds in medical and health institutions in townships per thousand population is higher than the national average level in China. Guangxi Bureau of Statistics. (2016). Medical insurance settlement at the village level is fully covered, with a basic medical insurance participation rate of over 97%. 99% of administrative villages have public service centers. The comprehensive population coverage rate of radio and television is 98.6%. A number of major cultural projects such as the Xiangjiang Campaign Memorial Facilities have been built, and the supply of services such as culture, sports, elderly care, and childcare is becoming increasingly abundant. Fifth, the living standards of the people have significantly improved. The proportion of fiscal expenditure in the field of people's livelihood in Guangxi has reached 80%. The cumulative increase in rural labor force transfer employment is 3.735 million people, and urban new employment exceeds 2 million people. The registered urban unemployment rate is controlled within 3%. Social security has basically achieved full coverage. We have completed the renovation of 480000 dilapidated rural houses and solved the housing difficulties of over 6 million urban residents. The per capita disposable income of residents has increased to 24562 yuan, with an average annual growth rate of 7.8%. Among them, the income of rural residents has increased to 14815 yuan, with an average annual growth rate of 9.4%. Significant progress has been made in the construction of a safe Guangxi and a rule of law Guangxi, with a harmonious and stable society. The people's sense of happiness and security is constantly increasing. Jiang Han. (2011).

Research's objective

To evaluate a comprehensive strength of Guangxi city in China

Hypothesis

Interval number comprehensive evaluation model has an influence on comprehensive economic strength.

Methodology

Scope of Research

1. Population and sample

The research Population is cities in Guangx of the paper is fourteen cities in Guangxi, conduced by purposive selecting including Nanning, Liuzhou, Guilin, Wuzhou, Beihai, Fang Chenggang, Qinzhou, Guigang, Yulin, Baise, Huzhou, He chi, Laibin, and Chongzuo.

2. Content

The main content of the paper is the evaluation and ranking of the comprehensive economic strength of 14 cities in Guangxi during the 13th Five Year Plan period. Based on the actual situation of Guangxi, a suitable evaluation index system for the comprehensive economic strength of cities in Guangxi is constructed. The interval number comprehensive evaluation model is used to evaluate the comprehensive economic strength of cities in Guangxi, and relevant suggestions are proposed to promote the balanced and coordinated development of the economy in Guangxi.

3. Variables

3.2 The independent variables Interval Number Comprehensive Evaluation Model

3.2 The dependent Variable is the Economic Strength of Guangxi City, China, in clouding of Economic Strength, The overall economic scale, Industrial structure, Infrastructure construction, People's living standards and Education and heath level of the city

Research Methods

Combining quantitative and qualitative methods. The paper uses a combination of quantitative and qualitative methods to analyze the construction theory of the indicator system through qualitative analysis, and constructs an evaluation indicator system for the comprehensive economic strength of cities in Guangxi. Quantitative analysis of indicator data is used to comprehensively analyze and evaluate the comprehensive economic strength of 14 cities in Guangxi during the 13th Five Year Plan period. Finally, the ranking results of the comprehensive economic strength of 14 cities in Guangxi are obtained.

Literature research method. Before the start of the paper, literature on interval numbers, relevant theories of urban comprehensive economic strength evaluation, and the construction of evaluation index systems were collected. Then, the literature was organized and analyzed, laying a theoretical and methodological foundation for the study of Guangxi urban comprehensive economic strength evaluation in the paper.

Research Instruments

Principles for constructing an evaluation index system ;

The development of a city involves various aspects of the city, such as people's livelihood, industrial structure, infrastructure construction, etc. No single indicator can comprehensively, objectively, and scientifically reflect the comprehensive economic strength of the city. It is necessary to use multiple indicators to evaluate the comprehensive economic strength of Guangxi cities from different aspects, all directions, and multiple angles. To build an indicator system that can comprehensively evaluate the comprehensive economic strength of cities in Guangxi, it is necessary to pay attention to the following basic principles:

(1) The principle of scientific. Building an indicator system for the comprehensive economic strength of cities in Guangxi is a rigorous, theoretical, and professional task that requires scientific theories and construction methods as the foundation, so that the constructed indicator system has both coverage and prominent points, and each indicator can cooperate with each other to form an organic evaluation indicator system, It can meet the requirements of evaluating the development of the comprehensive economic strength of a city.

(2) Principle of conciseness. The principle of conciseness refers to the need for a concise and clear evaluation index system for the comprehensive economic strength of the entire city, with a focus on selecting the most core, critical, and important indicators related to the development status of the comprehensive economic strength, in order to avoid being too numerous, with messy categories, and without representativeness. It is also necessary to clarify the meaning, function, and positioning of indicators, as well as the statistical caliber of indicators.

(3) Feasibility principle. The feasibility principle refers to the construction of the entire urban comprehensive economic strength evaluation index system. When collecting indicator data, it is necessary to have operational, collectible, and easy to collect, practical and feasible conditions. The constructed indicators should be as few and precise as possible, representative, hierarchical, and systematic.

(4) Applicability principle. This indicator system is mainly applicable to the analysis and evaluation of the comprehensive economic strength of cities in Guangxi. It must adapt to the social and economic reality and future development positioning of various cities in Guangxi. While ensuring general scientific Ty, attention should be paid to combining it with the actual situation of cities in Guangxi.

When selecting evaluation indicators, it is advisable to choose indicators that are relatively representative, while also ensuring comparability at time points, in order to make comparisons between cities more accurate and persuasive.

Data Analysis

1. Nanning, Liuzhou and Guilin, which rank top in terms of comprehensive economic strength, have developed rapidly. They are cities with strong comprehensive economic strength during the 13th Five Year Plan period in Guangxi. These three cities have played a strong role in promoting the economic development of Guangxi. The first is Nanning. The comprehensive evaluation interval value of Nanning's urban comprehensive economic strength is [0.0502, 0.0688], and the interval ranking vector value is 0.0357. It is the first city with the strongest comprehensive economic strength in Guangxi during the 13th Five Year Plan period. Moreover, as the capital city of Guangxi, Nanning is the window and bridge for Guangxi's foreign exchange and trade, and the center of politics, economy, culture, education, health and medical care in

Guangxi. Since the 13th Five Year Plan, especially since the 19th National Congress of the Communist Party of China, Nanning has made remarkable achievements in all aspects of social and economic development. For example, the GDP of Nanning City has increased from 372.751 billion yuan in 2016 to 472.634 billion yuan in 2020, with an average annual GDP growth of nearly 20 billion yuan, with an average annual growth rate of nearly 10%. Its total urban economic scale ranks first in Guangxi; The output value of the Tertiary sector of the economy in Nanning has increased from 50.63% of GDP at the end of 2016 to 65.75% of GDP at the end of 2020, an increase of 15.12 percentage points, and its industrial structure has been further optimized and improved. In addition, during the "13th Five Year Plan" period, Nanning has completed 2340.28 billion yuan of fixed assets investment, which has greatly promoted the economic construction and development of Nanning and enhanced the comprehensive economic strength of Nanning. The second is Liuzhou City. The comprehensive evaluation interval value of Liuzhou City's comprehensive economic strength is [0.1999, 0.2653], and the interval ranking vector value is 0.0412. It is the second strongest city in terms of urban comprehensive economic strength during the "13th Five Year Plan" period in Guangxi. Liuzhou City has a prominent industrial advantage focusing on heavy industry development. In 2017, Liuzhou City's total industrial output value was 511.614 billion yuan, breaking the 500 billion yuan mark for the first time, The total output value of industries above designated size has reached 502.522 billion yuan, forming an industrial economic system with strong competitiveness and characteristics. During the "13th Five Year Plan" period, Liuzhou has not only made great achievements in industry, but also achieved good results in transportation, people's livelihood, infrastructure construction and other aspects, and won the honorary title of the first national model city with strong quality in Guangxi. The third is Guilin. The comprehensive evaluation interval value of Guilin's urban comprehensive economic strength is [0.2236, 0.3225], and the interval ranking vector value is 0.0467. It is the third strongest city in terms of urban comprehensive economic strength during the "13th Five Year Plan" period in Guangxi. There is little difference between Guilin and Liuzhou in terms of urban comprehensive economic strength. Guilin, as an old key tourist city in Guangxi, has a pleasant ecological environment and is blessed with unique advantages in the development of tourism, agriculture and

forestry. In the five years of the "13th Five Year Plan", the number of tourists received by Guilin has nearly doubled, with an average annual growth of about 17.68%, the total income of tourism has nearly doubled, the total amount of post and telecommunications business in Guilin has increased by nearly 600%, and the infrastructure construction has been further improved. Through tourism, Guilin has driven the development of regional economy, improved the construction of relevant infrastructure in Guilin, and realized the complementarity of regional functions. This has made northern Guangxi a modern city with distinctive characteristics and first-class services, and comprehensively improved the comprehensive economic strength of Guilin.

2. The comprehensive evaluation interval values of the comprehensive economic strength of six cities Beihai, Yulin, Fangchenggang, Qinzhou, Guigang and Wuzhou are [0.2887, 0.3939], [0.2892, 0.4021], [0.3013, 0.4573], [0.3539, 0.4861], [0.4029, 0.5353], [0.4126, 0.5506] respectively, and the interval ranking vector values are 0.0524, 0.0577, 0.0632, 0.0687, 0.0746, 0.0799, It is a city with medium comprehensive economic strength during the 13th Five Year Plan period in Guangxi. The comprehensive economic strength of Beihai City and Yulin City is equal, which is stronger than that of the other four cities. From Figure 4-1, the spatial distribution of comprehensive economic strength of the 14 cities in Guangxi during the 13th Five Year Plan period can be seen that they are all located in the southern and eastern coastal areas of Guangxi, with good agricultural production conditions, abundant marine and subtropical resources, and a certain industrial foundation. During the 13th Five Year Plan period, cities seized development opportunities, vigorously developed agriculture and industry, explored marine resources, fully utilized land and ocean transportation, carried out peripheral trade, and improved the comprehensive economic strength of their own cities. For example, since the "13th Five Year Plan", the total import and export volume of Beihai City has totaled 131.5 billion yuan. In 2020, the per capita GDP of Beihai City has reached 76486 yuan, an increase of nearly 36% over 2016, ranking second in the district, and the total industrial output value ranking third in the district Beihai's new economy has developed rapidly, especially the high-end service industry, whose operating revenue has reached 33.8 billion yuan by the end of 2020, an increase of 115%, Its own comprehensive economic strength has jumped to the

fourth place among the comprehensive economic strength of various cities in Guangxi; During the "13th Five Year Plan" period of Yulin, the economy has made progress in a stable way. Its total fixed assets investment has accumulated 939.56 billion yuan, with an average annual growth of 10.6%. There are 350 new industrial enterprises above designated size, and the private economy has developed actively. Yulin has been successively rated as the advanced city for high-quality industrial development in Guangxi, and the honorary title of private economy demonstration city in Guangxi [40]. Its comprehensive economic strength ranks fifth in the region. During the 13th Five Year Plan period, the economic development of the other four cities also achieved remarkable results. In the future economic development of Guangxi, Beihai, Yulin, Fang Chenggang and other medium-sized cities with comprehensive economic strength will play a leading and window role.

Results

The results of the research were as follows;

1. Nanning, Liuzhou and Guilin, which rank top in terms of comprehensive economic strength, have developed rapidly. They are cities with strong comprehensive economic strength during the 13th Five Year Plan period in Guangxi. These three cities have played a strong role in promoting the economic development of Guangxi. The first is Nanning. The comprehensive evaluation interval value of Nanning's urban comprehensive economic strength is [0.0502, 0.0688], and the interval ranking vector value is 0.0357. It is the first city with the strongest comprehensive economic strength in Guangxi during the 13th Five Year Plan period. Moreover, as the capital city of Guangxi, Nanning is the window and bridge for Guangxi's foreign exchange and trade, and the center of politics, economy, culture, education, health and medical care in Guangxi. Since the 13th Five Year Plan, especially since the 19th National Congress of the Communist Party of China, Nanning has made remarkable achievements in all aspects of social and economic development. For example, the GDP of Nanning City has increased from 372.751 billion yuan in 2016 to 472.634 billion yuan in 2020, with an average annual GDP growth of nearly 20 billion yuan, with an average annual growth rate of nearly 10%. Its total urban economic scale ranks first in Guangxi; The output value of the Tertiary sector of the economy in Nanning has increased from 50.63% of

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3. Chongzuo City, Laibin City, Baise City, Hezhou City and Hechi City, which rank lower in comprehensive economic strength, are relatively backward in development. The comprehensive evaluation interval values of their urban comprehensive economic strength are [0.4362, 0.5794], [0.4256, 0.5919], [0.4365, 0.5930], [0.4595, 0.6185], [0.5321, 0.7128], and the interval ranking vector values are 0.0878, 0.0880, 0.0957, 0.1011, 0.1070, respectively, It is a city with weak comprehensive economic strength during the 13th Five Year Plan period in Guangxi. During the "13th Five Year Plan" period, these cities have also achieved considerable development results in urban infrastructure construction, people's living standards, the development of the Tertiary sector of the economy, and the urbanization process. For example, since the 13th Five Year Plan, Chongzuo's fixed assets investment has grown at an average annual rate of 15.4%, ranking third in the district for four consecutive years, and its total foreign trade import and export volume ranks first in the district ; The annual average disposable income of urban and rural residents in Laibin City increased by 6% and 9.2% respectively , and the comprehensive economic strength of the two cities has been improved to a certain extent. However, compared with Yulin City, Wuzhou City and other secondary development cities, there is still a gap. The main reason is that most of the five cities mentioned above are located in eastern, central and western Guangxi. They are concentrated in contiguous areas and ethnic minorities are concentrated. They are one of the key poverty-stricken areas in the autonomous region, and their terrain is mostly mountainous. The main mode of transportation is land transportation. The transportation is underdeveloped, the infrastructure is not perfect, the industrial foundation is weak, the level of urbanization is not high, the farmers' income is low, and the development of the Tertiary sector of the economy is slow.

Discussion and Conclusions

1. Policy Implications for Urban Development:

Recognizing the unbalanced urban development in Guangxi, policymakers should consider targeted measures to address disparities among cities.

Strategies to enhance the economic development of cities like Baise, Hezhou, and Hechi, which lag in comprehensive economic strength, could include focused investments and development initiatives.

2. Promoting Coordinated Development:

The study emphasizes the importance of a comprehensive evaluation for identifying a city's strengths and weaknesses in the development process.

Policymakers should utilize the research findings to formulate measures and plans that promote coordinated and sustainable development across the region.

3. Integration of Interval Numbers in Evaluation Practices:

Given the innovation in applying interval numbers to comprehensive economic strength evaluation, researchers and policymakers in Guangxi and similar regions should consider integrating this approach into their evaluation practices.

Workshops, training programs, or guidelines could be developed to facilitate the adoption of interval numbers in comprehensive economic strength assessments.

4. Continuous Monitoring and Adjustment:

Acknowledging the dynamic nature of urban development, continuous monitoring of comprehensive economic strength is crucial.

Policymakers should establish mechanisms for regular evaluations and adjustments based on evolving economic and social conditions.

Sharing Best Practices:

The innovative use of interval numbers in this research serves as a model for other regions facing similar challenges.

Encourage knowledge sharing through conferences, publications, and collaborative efforts to disseminate best practices in the evaluation of comprehensive economic strength.

Further Research and Collaboration:

Encourage further research on the application of interval numbers in urban development evaluations, fostering collaboration between researchers, practitioners,

and policymakers.

Research funding and incentives could be provided to support initiatives that explore and refine the use of interval numbers in different aspects of regional development.

Capacity Building:

Given the innovative nature of the research, initiatives to build the capacity of local researchers and practitioners in Guangxi can be considered.

Training programs and workshops can be organized to enhance the understanding and application of interval numbers in the evaluation of comprehensive economic strength.

Implementing these recommendations can contribute to a more balanced and sustainable urban development in Guangxi and serve as a valuable reference for similar regions in China.

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