

Fuzzy Integrated Network Monitoring and Perception Development of Regional Economic System

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Abstract: This study aims to investigate on the fuzzy integrated network monitoring and perception development of regional economic system. Since the change of some indicators in the evaluation of regional economic differences may lead to the change of the overall evaluation effect from good to bad or from bad to good, it is necessary to select the most sensitive, easy to measure and rich in connotation leading indicators among the many indicators as the evaluation indicators. According to the algorithm of fuzzy integration and fuzzy data fusion, this paper constructs a comprehensive fuzzy evaluation index system of regional economic differences from four aspects, such as economic development scale. Based on the system, this paper studies the fuzzy integrated network monitoring and sensing method. Then, the principal component analysis method of fuzzy control is further applied. With the help of SPSS statistical software, taking the national economic development in 2021 as an example, the general method and specific steps of constructing the comprehensive evaluation index system of regional economic differences are given. The experimental results show that this method has certain reference value for the fuzzy integrated network monitoring and perception development of regional economic systems.

Keywords: Regional Economic Differences, Evaluation Indicators, Fuzzy Data Fusion, Network Monitoring, Perception.

1. Introduction

There are two index systems for evaluating regional economic differences: single index and comprehensive index [1]. The single index is mainly gross domestic product (GDP), which has the advantages of authority and easy

access to data. It is undeniable that the research of GDP index is simple and intuitive, which brings a lot of convenience to the research [2-3]. Moreover, GDP is the most general and important index of the regional economic development level. However, a single GDP index has many limitations, which can not fully reflect the overall situation of regional economic development. Therefore, when evaluating regional economic differences, it is necessary to establish a comprehensive evaluation index system [4-6]. The comprehensive evaluation index system refers to selecting a series of indicators, including many aspects of economic development, to build an evaluation system, hoping to reflect regional economic differences more comprehensively and accurately.

The indicator system is used to reflect or measure things. It helps to transform information into a form that people can understand more easily and describe complex situations in a concise manner [7]. The indicator system generally includes more general contents, and describes the interrelated aspects and the relevant aspects that can be obtained by using a more comprehensive form than data and statistics. The index system is an effective tool to evaluate the evaluation results [8]. It can show the development of something related to an important goal or motivation. Nevertheless, the things reflected by the indicator system usually need to be explained. Of course, the determination of the indicator system must strictly comply with the provisions.

2. Methods

The construction principles of the evaluation index system of regional economic differences have not been seen in the literature. Due to the change of some indicators of regional economic difference evaluation, the whole evaluation effect may change from good to bad

or from bad to good. Therefore, it is not easy to select the most sensitive, easy to measure and rich in connotation leading indicators among the numerous indicators as the evaluation indicators. The evaluation of regional economic differences should consider the characteristics of regional economy. In order to objectively, comprehensively and scientifically measure the degree of regional economic differences, the following guiding principles should be followed when studying and determining the evaluation index system and evaluation methods: integrity principle, scientific principle, forward-looking principle, universality principle and feasibility principle.

Integrity principle. Things are always connected with each other to form a whole. The construction of the evaluation system of regional economic differences should be based on the overall situation. We should deal with the problems of regional economic differences in an isolated and one-sided way from a systematic perspective. We can only understand the surface phenomenon of regional economic differences, but not the essence of regional economic differences. The study of regional economic differences should not only involve various elements included in economic development, but also involve external factors related to economic development. The internal and external factors should be studied as a whole, and the principles of systematic design and overall evaluation should be adopted to comprehensively, comprehensively, objectively and reasonably evaluate regional economic differences. Regional economic development is an organic whole that integrates the scale of economic development, the speed of economic development, the structure of economic development and the quality of economic development. Therefore, when evaluating the differences in regional economic development, we consider these four aspects so as to comprehensively understand the current situation of regional economy and the differences between regions, and also facilitate the horizontal comparison between regions.

Scientific principle. The evaluation system of regional economic differences should be highly scientific, but it is not a simple theoretical exploration, but a system that can play a practical role. The establishment of the

evaluation index system should follow the principle of integrating theory with practice, be operable, and describe the objective reality abstractly. The indicator system should be able to objectively and correctly reflect regional economic differences, the setting of indicators should be reasonable and relatively independent, and the determination of weight coefficient should correctly reflect the relationship between indicators, the status and role of indicators in the overall evaluation. In the primary selection of indicators, we should proceed from the objective reality and highly abstract and summarize the internal and external factors. The key is to grasp the most important, essential and representative things to design the indicator system. The more clear and concise the abstract description of the objective reality, the more consistent with the actual situation, the more scientific it will be. Specifically, the indicator levels should be correctly divided according to the objective actual situation. The indicators at the same level should have the same status, be independent of each other, and cover the overall situation of the level as much as possible to avoid omission and repetition, so as not to affect the accuracy of the evaluation.

Forward looking principle. The forward-looking principle means that the established evaluation index system should not only reflect the history and current situation of regional economic differences, but also reflect the future development and change trend of regional economic differences. Some factors do not have a strong impact on regional economic differences, but with the changes of internal and external environment and the passage of time, the impact may increase. If the evaluation index system only focuses on the factors that have a strong impact on regional economic differences in the past and now, and does not consider the factors that may have a strong impact on regional economic differences in the future, it may not be able to grasp the change trend of regional economic differences. Especially in the process of China's economic system reform and development, the forward-looking principle is particularly important. The evaluation index system not only conforms to China's national conditions, but also can show the changing trend of regional economic differences.

General principle. The design of the evaluation scheme must have certain universal applicability, that is, as long as the evaluation index system is slightly adjusted, it can be applied to the evaluation of the same or related regional economic differences. The evaluation index system cannot only be applied to the evaluation of regional economic differences.

Feasibility principle. The feasibility principle emphasizes the desirability, comparability, measurability and controllability of indicators. The setting of the indicator system should be as clear, simple and easy to operate as possible. The number of indicator items should be appropriate, not the more the better. Too many evaluation indicators will inevitably lead to "information overload", which will make each evaluation indicator lose its importance; There are also risks if the selection range of indicators is too small, which will lead to dysfunction of system evaluation. Too many tedious statistics and complicated calculations should be avoided. The data should be easy to collect and calculate. The data should be standardized and standardized. The evaluation cost should be low.

The fundamental purpose of studying regional economic differences through evaluation indicators is to find a group of characteristic indicators that are representative and can fully reflect regional economic differences, and these indicators can properly show people's quantitative judgment on the degree of regional economic differences. Therefore, in addition to the above principles, we should also adopt the following indicator selection methods when selecting indicators.

(1) System analysis method. According to the characteristics of regional economic differences, all indicators reflecting regional economic differences should be listed as far as possible without any restrictions, so as to prevent the omission of important indicators.

(2) Frequency statistics. We have conducted frequency statistics on the current literatures on the evaluation and research of regional economic differences and coordinated development of regional economy, and selected those indicators that are used frequently, such as per capita GNP, fiscal revenue, tertiary industrial structure and other indicators. The characteristics of these indicators can not only reflect the connotation of regional economic differences, but also

most of their data are easy to obtain. Therefore, it can be used as an evaluation index of regional economic differences. (3) Expert consultation method. On the basis of preliminary selection of evaluation indicators, relevant scholars and experts with rich practical experience are further consulted to listen to their opinions and adjust the indicators to ensure the authority of the indicators. However, this method is greatly influenced by subjective factors, such as the professional level and authority of experts, the psychological state of experts, the interest of experts in regional economic differences, etc., which may affect the accuracy of regional economic difference evaluation

Results and discussion

Difference in economic development scale

The evaluation index system is an organic whole composed of several interrelated evaluation indexes, which can comprehensively, systematically, scientifically, accurately and objectively reflect the changing characteristics and development laws of regional economic differences in a certain period.

Gross domestic product (GDP) is the most important indicator to measure the development of the national economy. It is often recognized as the best indicator to measure the economic situation of a country. The per capita GDP is one of the important macroeconomic indicators and an effective carrier for people to understand and grasp the macroeconomic operation of a country or region. According to the general practice of the world bank, the per capita GDP can better reflect and measure the economic strength and development level of a country or region, and is a standard to measure the life of the people of a country or region. When studying the regional economic differences, the per capita GDP can better reflect the differences between the studied objects. For example, when studying the economic differences between China and neighboring Japan, we can see that China's GDP level in 2009 is close to that of Japan, ranking the third in the world. However, China's per capita GDP (US \$3735) is only 9.4% of Japan's per capita GDP (US \$39740). It is obvious that there is still a large gap between China's economy and Japan's economy. Fiscal revenue is an important

indicator to measure the financial resources of the first level government.

The fiscal revenue is mainly used for social public expenditure to maintain the operation of the state machinery; It is a material guarantee for promoting social equity and improving people's lives, promoting the development of science, education, culture and health, promoting the rational and effective allocation of resources, and promoting the smooth operation of the national or regional economy. It is also a material guarantee for consolidating the state power. If the fiscal revenue of a country or region is similar to that of another country or region, but the population difference is large, the function of fiscal revenue will be greatly weakened in a country or region with a large population.

3. Results and Discussion

Foreign trade, also known as foreign trade or import and export trade, referred to as "foreign trade", refers to the exchange of goods, services and technology between two countries or regions. This trade consists of import and export. Import, also known as import, refers to the purchase of goods or services from within and outside the customs; Export refers to the sale or export of goods or services from the customs to outside the customs. It reflects the dependence of a country or region on foreign economy. When the per capita foreign trade volume of a country or region is relatively large, it can promote the increase of investment in the country or region, improve the employment level and labor productivity of the country or region, accelerate the technological progress of the country or region, optimize the resource allocation of the country or region, adjust the industrial structure of the country or region, and enhance the economic strength of the country or region.

Domestic trade is usually expressed by the total retail sales of social consumer goods. The total retail sales of social consumer goods reflects the people's material and cultural life level, the purchasing power of social goods and the scale of the retail market in a certain period of time. The total retail sales of social consumer goods is determined by the scale of the supply of social goods and the demand for goods with the ability to pay. It is an important data for studying the development and change trend of residents' living standards, the

purchasing power of social retail goods, social production, currency circulation and prices.

The per capita income mainly refers to the per capita disposable income of urban residents and the per capita net income of farmers. The per capita disposable income of urban residents refers to the per capita income that urban residents can freely control, including savings, final consumption expenditure and non compulsory expenditure. It is one of the most important and commonly used indicators to observe the living and income level of urban residents. The per capita net income of farmers refers to the per capita income of farmers that can be directly used for productive and non productive construction investment, living consumption and savings. It is used to measure the actual income level of farmers and the ability of farmers to expand reproduction and improve their living.

With the continuous development of social economy, the division of labor has become more and more detailed, and thus more and more production departments have emerged. Affected and restricted by various factors, these different production departments will show great differences in the growth rate, the number of unemployed people, the proportion in the total economic volume, and the role of promoting economic growth. (as shown in Table 1).

The non-agricultural labor force refers to the ratio of the labor force engaged in the secondary and tertiary industries to the total labor force. When the ratio of non-agricultural labor force in a country or region is relatively high, it indicates that the proportion of the secondary and tertiary industries in the country or region is relatively large and the economy is relatively developed.

Under the framework of constructing the indicator system, 40 pre selected indicators (C1, C2,..., C40) were screened according to the original data of economic development indicators of various regions in the country in 2021. It can be seen from the output results that the cumulative contribution rate of variance of the first six principal components is 85.084%. These six principal components can be expressed as a linear combination of 40 indicator variables. In order to simplify the indicator system and reasonably screen the indicators, the indicators with a coefficient greater than 0.7 are retained here, while other .

Table 1. Classification of tertiary industries

Primary industry	Agriculture		Planting
			Forestry
			Animal husbandry
			Fisheries
Secondary industry	Industry		Extractive industry
			Manufacturing
			Production and supply of electricity, gas and water
			Construction
Service sector	Circulation department	The first level	Transportation, storage, post and telecommunications; Wholesale and retail trade, catering
	Service Department	The second level	Finance and insurance; Geological exploration and water conservancy management; real estate Social services; Agriculture, forestry, animal husbandry and fishery services; Transportation auxiliary industry; Comprehensive technical service industry
		The third level	Education, culture and art, radio, film and television; Health, sports and social welfare; Scientific research industry
		The fourth level	State organs, political party organs and social organizations, as well as the army and the police

Table 2. SPSS software output results

Sum of squares of extracted loads		
Total	Variance (%)	Cumulative percentage (%)
15.3	68.94	76.5
3.892	19.36	88.6

Table 3. Comprehensive evaluation score and ranking of economic development level of 20 provinces, municipalities and autonomous regions in China

Region	Beijing	Tianjin	Hebei	Shanxi	Hainan	Liaoning	Jilin	Chongqing	Shanghai	Jiangsu
F1 score	0.332	0.588	0.676	-0.132	-1.463	0.5341	-0.349	-0.658	-0.663	2.167
F2 score	2.131	1.104	-0.45	-0.871	-0.024	-0.022	-0.433	-0.031	3.779	0.011
F3 score	1.9277	1.901	0.418	-0.215	-1.17	-0.487	-0.391	-0.569	1.724	1.5188
Sort	2	5	10	13	20	9	16	17	3	4
Region	Zhejiang	Anhui	Fujian	Jiangxi	Shandong	Henan	Hubei	Hunan	Guangdong	Guangxi
F1 score	1.201	0.0399	0.427	-0.043	2.055	1.193	0.778	0.353	2.472	-0.542
F2 score	0.928	-0.827	0.866	-0.751	-0.174	-1.039	-0.574	-0.721	1.583	-0.346
F3 score	1.107	-0.084	0.563	-0.524	1.762	1.4677	0.25	0.168	2.297	-0.156
Sort	7	14	8	18	6	12	11	15	1	19

indicators are deleted. The principal component analysis is continued for the remaining 29 indicators. According to the factor score of the last principal component, the variance contribution rate of the two principal components is used as the weight to

calculate the total score. The total score can reflect the difference between the overall economic level of each region and the national average level. The specific steps are: (1) determine the weight, and the data is from

Table 2; (2) Find the total score and see Table 3 for the results.

4. Conclusion

Based on the perspective of regional economic differences, this paper tries to select the primary evaluation index system of regional economic differences by system analysis method, frequency statistics method and expert consultation method. For the primary evaluation index, according to the actual characteristics of regional economic differences in different regions, the fuzzy entropy method is used to construct a fuzzy evaluation index system suitable for regional economic differences in different regions. It is worth noting that any evaluation index system of regional economic differences has certain limitations. Therefore, in the actual evaluation process of regional economic differences, the principles of integrity, scientificity, foresight, feasibility and universality should be followed in order to obtain a more practical evaluation.

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