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Comprehensive Evaluation of Economic Development Level of Beijing, Tianjin and Hebei Cities Based on TOPSIS Method

Xiaomei Zou[1], Renhao Jin[2]

[1]School of Law, Beijing, [2]School of Information
[1,2]Beijing Wuzi University, Beijing, China

ABSTRACT

The balance of regional economic development is very important for coordinated development. As the "Capital Economic Circle" of China, Beijing-Tianjin-Hebei region plays an important role in the national economic development. However, due to the factors of resources, education and culture, the economic development levels of cities in Beijing-Tianjin-Hebei are unbalanced. This paper constructs a comprehensive evaluation index system of economic development level, makes empirical analysis by using the method of entropy weight-TOPSIS, and ranks the comprehensive scores. It is concluded that Beijing ranks first, Tianjin ranks second, and Hebei ranks relatively lower.

KEYWORDS: *Beijing-Tianjin-Hebei, Economic Development Level, TOPSIS*

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1. INTRODUCTION

Urban development includes economic, political, cultural, social and environmental factors. Among them, economy is the basis to promote the all-round development of society. In the 13 cities of Beijing, Tianjin and Hebei, the uneven distribution of talents and the uneven accumulation of commercial resources lead to great differences in the level of economic development of each city, and the gap between rich and poor is increasing. It is necessary to evaluate objectively and correctly the economic development level of Beijing, Tianjin and Hebei, to understand comprehensively the economic development situation and its differences, and to better reflect the strengths and weaknesses of each city in all aspects.

The contribution of each city to the economic development of Beijing, Tianjin and Hebei is different, and there are also significant differences in the advantages and disadvantages. This paper adopts the research method of multi-index comprehensive evaluation, uses the entropy weight-TOPSIS analysis and cluster analysis, objectively gets the conclusion of evaluating the economic development of each district, finds out the positioning of each city, and defines the developed cities. With the pattern of backward cities, the government can give full play to its functions more pertinently, take effective improvement measures according to the actual situation of the cities themselves cultivate and develop the characteristic economy of the region, and narrow the differences among the cities. It is of great significance to realize the sustainable development and comprehensive development of the economy of Beijing, Tianjin and Hebei.

2. TOPSIS Method

Entropy weight method is an objective weighting method. The basic idea is to determine the objective weights according to the variability of indicators. If the information entropy of the index is smaller, the information provided by the index will be larger, and the weight of the comprehensive evaluation should be higher. On the contrary, if the information entropy is large, the amount of information provided is small and the weight is low. TOPSIS is a method to rank the approaching degree of idealized objects according to a limited number of evaluation objects. It is a method to evaluate the relative advantages and disadvantages of existing objects. TOPSIS method is a sort method which keeps approaching the ideal solution. The so-called ideal solution is the optimal solution, and its attribute values reach the best value in each scheme. The negative ideal solution is the worst solution, which makes its attribute values reach the worst value in all schemes. The rule of scheme ranking is to compare all calculated ideal solutions with negative ideal

solutions. If one of the schemes is the closest to the ideal solution and at the same time far from the negative ideal solution, then the scheme is the best one. This paper will use the method of Entropy Weight-TOPSIS to analyze and evaluate the level of economic development with 11 secondary indicators based on the data of 13 cities in Beijing, Tianjin and Hebei.

The calculating steps for TOPSIS method:
<1> Standardization
Because the indicators are different, and there are different units, so they are transformed, that is, standardized processing.

Suppose there are m index labels from X_1, X_2 to X_m, and Xi={ x_1, x_2, ...x_n} 。It is assumed that the standardized values of each index data are Y_1, Y_2, ...Y_m, and the Standardized formula is

$$Y_{ij} = \frac{X_{ij} - \min\ (X_i)}{\max(X_i) - \min\ (X_i)}$$

<2> Calculating Information Entropy

$$E_j = -K\sum_{i=1}^{m} y_{ij} ln y_{ij}, \qquad where, \text{K is a constant, K} = \frac{1}{ln_m}$$

Next, standardized data need to be normalized and information entropy value calculated to prepare for the weight of evaluation index.

<3> Calculating the Weight of Evaluation Index Based on calculated Information Entropy, i. e., E_1, E_2, ...E_m, calculating the weight for each index

$$W_i = \frac{1-E_i}{m-\sum E_i},\ \mathrm{i} = 1, 2, \ \ldots, \ \mathrm{m}$$

<4> Calculating Entropy Weight Matrix
Accumulative evaluation of all indicators in a region by using the entropy weight matrix: R = WY, where, $R_{ij} = (r_{ij})\ r_{ij}$ is the ith objects to be evaluated on the jth values standardized by evaluation indicators.

<5>Determining positive ideal solution S+ and negative ideal solution S-

$$S^+ = max_j(r_{ij}),\ \ i = 1,2, \ \ \ldots, \ \ m\ ; j = 1,2, \ \ \ldots, \ \ n;$$

$$S^- = min_j(r_{ij}),\ \ i = 1,2, \ \ \ldots, \ \ m\ ; j = 1,2, \ \ \ldots, \ \ n$$

<6> Calculating the distance from indicator vector to ideal solutions

$$d_i^+ = \sqrt{\sum_{j=1}^{m}(r_{ij} - r_j^+)^2}, \quad (i = 1, \ 2, \ \ \ldots, \ \ m\ ; j = 1,2, \ \ \ldots, \ \ n$$

$$d_i^- = \sqrt{\sum_{j=1}^{m}(r_{ij} - r_j^-)^2}, \quad (i = 1, \ 2, \ \ \ldots, \ \ m\ ; j = 1,2, \ \ \ldots, \ \ n)$$

<7> Calculating Comprehensive Score

$$F_j = d_j - (d_j^+ + d_j^-)$$

where, F_j is the closeness between the evaluated object and the optimal scheme. If the value is larger, it proves that the evaluated object is better.

3. Construction of the Index System of Economic Development Level

Economic development is a comprehensive concept. No single index can fully reflect the influencing factors of economic development. There are many kinds of urban economic indicators. In order to fully and systematically describe the economic development level of Beijing, Tianjin and Hebei, this paper finds out some indicators that can reflect the comprehensive economic level. On the basis of referring to relevant literature and combining with the characteristics of Beijing, Tianjin and Hebei, 11 relevant indicators are selected to construct the evaluation index system of economic development, so as to reflect the economic development level of each city comprehensively and objectively.

The index system is divided into three categories of first-level indicators and 11 second-level indicators. Among them, economic development indicators are designed to show the impact of macroeconomic variables on economic development; medical insurance indicators show the impact of medical level and social security on the economy; and educational science and technology indicators show the impact of scientific and technological talents on the economy.

According to the theoretical basis of each index, the evaluation index system of economic development level as shown in Table 1 is obtained.

4. Results and Conclusion

The weight results of 11 evaluation indicators obtained by the Entropy Weight Method are shown in table 2.The following conclusions can be drawn: the value-added of tertiary industry has the greatest impact on economic development, followed by the amount of patent authorization, the number of ordinary secondary schools and the number of people participating in basic endowment insurance for urban and rural residents have a weak impact, and the number of people participating in basic medical insurance for urban and rural residents has a minimum impact.

Table1. Evaluation Index of Economic Development Level

First level index	Two level indices	Symbol
Economic Development Category	Gross regional product	X1
	Total retail sales of consumer goods	X2
	Value added of tertiary industry	X3
	Per capita disposable income of urban residents	X4
	Per capita consumption expenditure of urban residents	X5
Medical insurance category	Number of beds in health institutions	X6
	Number of health technicians	X7
	Number of participants in basic old-age insurance for urban and rural residents	X8
	Number of Participants in Basic Medical Insurance for Urban and Rural Residents	X9
Educational Science and Technology	Patent authorization	X10
	Number of General Secondary Schools	X11

Table2. Index weight

Two level indices	Weight
X1	0.11742339
X2	0.10532077
X3	0.16762678
X4	0.0722955
X5	0.06991955
X6	0.06600793
X7	0.11176024
X8	0.04033325
X9	0.0371525
X10	0.16553236
X11	0.046628

According to the comprehensive score obtained by the Topsis method, the total score ranking of 13 cities in Beijing, Tianjin and Hebei in 2017 is obtained, as shown in Table 3.

Table3 TOPSIS Composite score

City	Score	Rank
Beijing	0.872892	1
Tianjin	0.501636	2
Shijiazhuang	0.198816	3
Baoding	0.184877	4
Tangshan	0.162345	5
Handan	0.160152	6
Cangzhou	0.129136	7
Xingtai	0.118116	8
Langfang	0.107106	9
Qinhuangdao	0.05461	10
Hengshui	0.04798	11
Zhangjiakou	0.040931	12
Chengde	0.031098	13

The economic development evaluation value of Beijing, Tianjin and Hebei is between 0-1. The larger the value, the better the development and the better the comprehensive evaluation. There is no doubt that Beijing ranks first, followed by Tianjin, and most of the cities in Hebei Province which are close to the capital Beijing rank first and develop better. The rankings are Shijiazhuang City, Baoding City, Tangshan City, Handan City, Cangzhou City, Xingtai City, Langfang City, Qinhuangdao City, Hengshui City and Zhangjia City. Kou City and Chengde City. Shijiazhuang City ranked third and Chengde City ranked last have far different scores, which indicates that the development level of each city in Hebei Province is quite different.

Generally speaking, the level of economic development in Beijing, Tianjin and Hebei is uneven. In order to change this gap and promote the economic development of each city, corresponding measures must be taken. Firstly, according to the characteristics of each city, the existing problems and the different trends of development, combined with the economic development situation of each city, according to the local conditions. In order to gradually narrow the development gap between Beijing, Tianjin and Hebei and make people's lives more prosperous, it is necessary to tap their respective development potentials and help and support each other so that each city can find its own way of development.

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