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Study on Urbanization in Liaoning Province

Hongyun Gao[1, a], Dan Li[1, b], and Shuang Chen[1, c, *]

[1] College of Information Engineering, Dalian University, Dalian, Liaoning, China;

[a] gaohongyun@dlu.edu.cn, [b] lidandlm@163.com, [c,*] chenshuang0707@163.com

Abstract. In recent years, there are some problems in the urbanization of Liaoning Province, such as slow economic growth, serious brain drains, unbalanced regional development and so on. If there is no scientific research guidance, the development of new urbanization in Liaoning Province will only be like a headless fly, and ultimately affect the healthy economic and social development of Liaoning Province. In order to solve these problems properly, the comprehensive level of the new type of urbanization in Liaoning Province should be studied. In the paper, a comprehensive evaluation index system is constructed, 13 specific evaluation indexes are selected. Principal component analysis is used to analyze the factors influencing the process of new urbanization. The evaluation index and statistical method can be used as a reference for the study on the comprehensive level of new urbanization in the future prediction.

Keywords: new urbanization, principal component analysis, comprehensive evaluation index system, grey prediction model.

1. Introduction

Urbanization is a social trend. The more accommodated conditions that built-up cities and town offer are attractive for both families and individuals that are looking for a higher life quality. In 2012, promotion of high-quality development of urbanization is put forward by CPC, and it is named as new-type urbanization [1].

In a broad sense, it is the people-oriented new-type urbanization, which is based on urban and rural overall development, unify between city and countryside, industrial interaction, conservation and intensive use, pleasant living environment, accord development [2,3]. The purpose of urbanization is harmonious development of large, medium, small cities and rural areas. New-type urbanization is not simply moving people from rural area to urban area. It underlines the transformation of economic development, infrastructure, industrial support, people's life, environment protection, social security from “rural” to “urban”.

In a narrow sense, key point of the new-type urbanization is people centered[4,5]. Strength the leading role of center cities in the middle and west of China, accelerate urban space developing balanced. We believe that transportation infrastructure is fundamental for a region’s development. In recent years, high speed railway has developed rapidly. High speed railway connects the relationship among the cities, people, goods and materials import and export easily, and more job opportunity is created in middle and west of China. Lucid waters and lush mountains are invaluable assets. Environment protection should not be neglected in urbanization. Urban economic life should include green production and consumption.

Study on urbanization is developing recent years. Overall, they are divided into single index way and complex index way. At an early stage, most researchers used the ratio of urban population to total population. As time passed, standard of demographic statistics in different districts are different. Moreover, the administrative division might change. Single index way lack of factors that effecting urbanization.

2. Establish Index System

Principal component analysis (PCA) is a statistical model of dimensionality reduction. It is essentially a data reduction technique, that is used to aggregate a set of correlated indicators into a synthetic index. The principal component is a linear combination of the indicators which better

reproduce the observe variance. As a result the weighting structure is directly derived from the data, based on the covariance matrix. It is considered to be a more appropriate solution for data reduction partly because it uses the total variance instead of only the common or shared variance between the indicators, Under certain circumstances it can produce the same results as factor analysis.

2.1 Basic theory of PCA

Object of study is related to p indexes [6]. The indexes are shown as $X_1, X_2, \cdots, X_p$, and a matrix of $X = (X_1, X_2, \cdots, X_p)^T$ is constructed. The expectation of X is μ, and covariance matrix is Σ. Taking a linear transformation of X, and Y satisfies an equation:

$$\begin{cases} Y_1 = \mu_{11}X_1 + \mu_{12}X_2 + \cdots + \mu_{1p}X_p \\ Y_2 = \mu_{21}X_1 + \mu_{22}X_2 + \cdots + \mu_{2p}X_p \\ \vdots \\ Y_p = \mu_{p1}X_1 + \mu_{p2}X_2 + \cdots + \mu_{pp}X_p \end{cases} \quad (1)$$

Since the linear transformations are various, different comprehensive viables Y are defined using different linear transformations. The transformation of maximum variance $Y_i = \mu_i^T X$, and all the variables Y_i independent is preferred. The constraint condition includes $\mu_i^T \mu_i = 1$, and Y_i is uncorrelated to Y_j ($i \neq j$). Based on the constraint condition, comprehensive variables of $Y_1, Y_2, \cdots, Y_p$ are named as the first principal component, second principal component, and so on[7].

2.2 Index Selection

The process of data searching is hard. There are 14 cities in Liaoning Province, and the data is feasible if it could be obtained in 14 cities. The indexes should be related to urbanization. They reflect the affect in economics, living, culture, ecology and so on. All the indexes have the property of representativeness, which reflect the characters of urbanization in Liaoning Province. Moreover, the indexes and the evaluation system have the property of scientific.

13 indexes include per capita gross national product x_1, total output value of high-tech industries x_2, urban per capita disposable income x_3, rural per capita disposable income x_4, the proportion of primary industry in GDP x_5, the proportion of secondary industry in GDP x_6, kilometers of roads x_7, number of beds in health institutions per 1000 people x_8, number of doctors per 1000 people x_9, number of college students x_{10}, urban registered unemployment rate x_{11}, park green area x_{12}, and sewage treatment capacity x_{13}. The range of year is from 2015 to 2021.

2.3 Factor Analysis Applicability Test

Before using factor Analysis, data need to verify the multicollinearity through the KMO test and Bartlett test[8,9]. It shows that the KMO test is 0.557, which is larger than 0.5, and the significance value is less than 0.05 in Bartlett test. It means data of indicators in 2020 has significant collinearity, and the data is suitable for factor analysis.

The total variance explanation in 2020 is shown in Table 1. Three factors could explain more than 85% information of original data. Therefore, 3 common factors could express more than 80% information. So 3 common factors are kept.

Table 1 Explain the Total Variance

factor	Initial eigenvalue		Extraction Sums of Squared Loadings	
	Total	Var %	Total	Var %
1	7.9	60.6	7.9	60.6
2	2.4	18.4	2.4	18.4
3	1.4	10.5	1.4	1.4
4	0.6	4.7		
5	0.4	2.7		
6	0.2	1.8		

3. Disscussion

3.1 Interpretations of Factors

Using Varimax rotation with maximum variance to rotate the component matrix. Related results are shown in Table 3, which is represent the data of 2020.

From the table, first principal component is named as economic factor of urbanization which includes x_3, x_7, x_2, x_{13}, x_{12}, x_{10}, x_1, x_4. The second principal component is named as urbanization industry factor which includes x_5 and x_6. The third principal component is named as urbanization medical factor which includes x_8 and x_9. Comprehensive indexes Y_1, Y_2 and Y_3 are calculated as:

$$\begin{aligned} Y_1 &= 0.30X_1 + 0.34X_2 + \cdots + 0.32X_{13} \\ Y_2 &= 0.27X_1 + 0.26X_2 + \cdots + 0.26X_{13} \\ Y_3 &= 0.1X_1 - 0.06X_2 + \cdots + 0.06X_{13} \end{aligned} \quad (2)$$

From the timeline, the urbanization of most of the cities in Liaoning Province has developed slightly. To be specific, the F value of Chaoyang increased 0.43, and Tieling, Yingkou and Huludao also increased slightly. It indicates that the urbanization in these cities makes great headway. However, Shenyang, Dalian and Fushun have a negative growth rate. It indicates that the development of urbanization in these cities are short of power. Moreover, the component scores are studied, the urbanization medical factor is relative low, it indicates that the number of doctors and medical structure is low. The reason is that large number of immigrants move to Dalian. Some of them are retiree, since the climate of Dalian is pleasant. Some of them are fresh college students, since Dalian creates jobs to attract students. However, the doctors and structures don't increase. Urbanization industrial factor score is low. It indicates there exists problems in industrial structure. It is also the mainly problem that cities in northeast face. The industrial structure needs to upgrade, and attract more workforce.

From the space, polarization is serious among the cities in Liaoning Province. The comprehensive value F is high in Shenyang and Dalian. Fuxin, Tieling Chaoyang and Huludao get low in comprehensive value. Although some of the cities developed not well, the trend of the range of maximum and minimum score is gradually shrinking. Overall, the development gap of urbanization in Liaoning Province is increasingly smaller.

3.2 Urbanization Value Prediction

Using grey model, the comprehensive value is predicted, and results are shown in Table 2.

Table 2 Comprehensive Value

	2021	2022	2023
Shenyang	4.53	4.47	4.41
Dalian	3.45	3.41	3.38
Anshan	0.60	1.02	1.72
Fushun	-0.02	-0.01	-0.01
Benxi	-0.06	-0.04	-0.03
Dandong	-1.07	-1.14	-1.22
Jinzhou	-1.15	-1.20	-1.25
Yingkou	-0.02	-0.02	-0.02
Fuxin	-1.52	-1.55	-1.57
Liaoyang	-0.01	-0.003	-0.001
Panjin	0.95	1.16	1.42
Tieling	-2.37	-2.57	-2.78
Chaoyang	-2.03	-2.21	-2.40
Huludao	-1.90	-1.95	-2.01

From the table, in the next three years, the urbanization in Dalian and Shenyang will still decreases. Anshan and Panjin would get high comprehensive value. The effect of industrial structure and COVID-19 still exist in urban development.

4. Conclusion

All the data are collected using statistical yearbook in Liaoning Province. PCA model is established, and grey model is used to predict the comprehensive value in the future.

From the space and timeline, all the cities in Liaoning Province show a polarization in urbanization development. Shenyang is the provincial capital city. The government always leans forward to Shenyang, Shenyang has developed to maturation in medical structure, industrial structure, environmental construction and so on. In the future, it should play a leading role. Dalian is on the north of Liaoning Province. The city has pleasant climate, and it is close to Japan and North Korea. Dalian should create more jobs to attract more workforce, and develop the foreign trade. Moreover, tourism is an important industry. The government should host more major events, and strengthen the urban management to attract more tourist.

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