Research on the Evaluation System of Economic Development Environment Based on the Factor Analysis Method

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Abstract. Coordinated environment of economic development will provide power for economic development. Otherwise, it would counteract the development of economy. Aiming at this problem, using the factor analysis method and taking Chinese city for example, this article selects the 18 indexes of 36 cities throughout the country as the research object. Through calculation and analysis of the regional statistics, it is concluded that the economic operation, infrastructure, and environmental science and education are three public factors. On the basis of factor score and statistical data in past years, the paper evaluated the environment of economic development comprehensively.

1.Introduction

Study on environmental problems in economic development in our country is late, so it leads to drawbacks in many aspects of research. At present, on the economic development environment research, it mainly concentrated in evaluation of a regional economic development environment using linear weighted method through establishing the environmental evaluation indicator system. The result of study is the regional economic development environment score value. It is lack of detailed analysis of the economic development environment. Therefore, it is not conducive to deeply analyze the problems existing in the economic development environment and provide convenience for policy makers. In addition, from the point of view of dynamic development, the development of the region's economic environment is a dynamic process. Therefore, research on present situation of regional economic development environment and analysis of advantages and disadvantages existing in the regional economic development environment are key problems in the study of urban coordinated development.

2.Factor Analysis Method

2.1 Characteristics of the factor variables

The basic starting point of factor analysis method is turning many original variables into fewer common factors that could reflect the most information of original indexes and there is no correlation between the comprehensive indexes.

The characteristics of the factor variables are as follows.

(1)The number is far less than the number of original variables, but can reflect the most variance of the original variables.

(2) Variables are not related

(3) Factor variables are reconstruction of original variables

2.2 Basic steps of factor analysis

The basic steps of factor analysis are shown in figure 1.

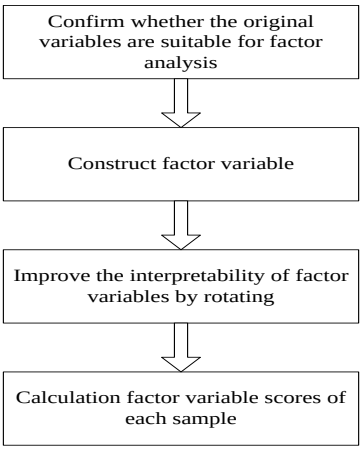

Fig.1 The basic steps of factor analysis

2.3 Mathematical model of factor analysis

Common factors in factor analysis method are not direct observation but objective existence of common influence factor. Each variable can be expressed as the sum of linear function of public factor and special factor

$$X_i=a_{i1}F_1+a_{i2}F_2+\ldots+a_{im}F_m+\varepsilon_i,\ (i=1,\ 2,\ \cdots,\ p)$$

This model adopts a matrix-form expression：$X=AF+\varepsilon$

$$X=\begin{bmatrix}X_1\\X_2\\\vdots\\X_p\end{bmatrix},A=\begin{bmatrix}a_{11}&a_{12}&\cdots&a_{1m}\\a_{21}&a_{22}&\cdots&a_{2m}\\\cdots&\cdots&\cdots&\cdots\\a_{p1}&a_{p2}&\cdots&a_{pm}\end{bmatrix},F=\begin{bmatrix}F_1\\F_2\\\vdots\\F_m\end{bmatrix},\varepsilon=\begin{bmatrix}\varepsilon_1\\\varepsilon_2\\\vdots\\\varepsilon_p\end{bmatrix}$$

3.Establish index system

According to actual requirement, taking Chinese city for example, this paper selects 36 cities throughout the country as the research object and chooses 18 major economic indicators to build the evaluation system. Cities are mainly provincial capitals and economic indicators are the comprehensive indexes in China Statistical Yearbook. As shown in Table 1 below.

Table1 Environment evaluation index system of urban economic development

Number	Indicator	Number	Indicator
1	annual total population	10	number of telephone subscribers
2	GDP	11	social total retail sales
3	passenger traffic	12	total exports
Number	Indicator	Number	Indicator
4	education investment	13	number of bus
5	financial budget income	14	number of theater and cinema
6	fixed assets investments	15	scientific research and technical workers
7	resident's savings deposit	16	number of students in colleges
8	average salary	17	number of hospital
9	number of post office	18	industrial waste emissions

4.Evaluation and analysis of economic development

Before using the factor analysis model analysis indicators evaluation system, the data must be

standardized. Then put the standardized data into the economic development environment model. This paper uses SPSS17.0 to the index system of urban development and environment factor analysis. The specific calculation steps are as follows.

Table 2 The variance contribution rate of common factor

Composition	Initial eigenvalue			Extraction of sum of squares loaded			Rotate the sum of squares loaded		
	Total	Variance contribution rate	cumulative contribution rate	Total	Variance contribution rate	Cumulative contribution rate	Total	Variance contribution rate	Cumulative contribution rate
1	10.795	59.973	59.973	10.795	59.973	59.973	6.646	36.923	36.923
2	2.604	14.466	74.439	2.604	14.466	74.439	4.873	27.073	63.996
3	1.416	7.868	82.307	1.416	7.868	82.307	3.296	18.311	82.307
4	.882	4.900	87.207						
5	.679	3.771	90.977						
6	.577	3.208	94.186						
7	.370	2.056	96.242						
8	.218	1.213	97.455						
9	.176	.977	98.432						
10	.091	.503	98.936						
11	.069	.384	99.320						
12	.044	.246	99.566						
13	.031	.173	99.739						
14	.017	.097	99.836						
15	.015	.082	99.918						
16	.007	.039	99.956						
17	.005	.029	99.986						
18	.003	.014	100.000						

(1)Extract the common factor. Principal component analysis (PCA) is used and principal component is extracted under the constraints of eigenvalues greater than 1. The variance contribution rate of common factor can be gained by calculation. It is shown in table 2. As can be seen from the table in the extraction of three common factors, cumulative contribution rate of these three common factors is 82.307%, which is meet the requirements of the principle of statistics is greater than 80%. It means that the extracted common factors have a good ability to explain the original information.

(2) Factor rotation. In order to make the extraction of various factors have the ability to better explain the original information, thus it rotates the three common factors. Maximum balance method is used in this paper and the result of it is shown in table 3. Can be seen from the table in the main cities in China development environment evaluation index system contains 18 indicators, after statistical analysis can extract the three common factors.

Table 3 Factor rotation results analysis

Economic development environmental indicators	Common factor		
	1	2	3
GDP	0.760		
financial budget income	0.703		
resident's savings deposit	0.812		
average salary	0.738		
social total retail sales	0.742		
number of telephone subscribers	0.79		
total exports	0.936		
number of bus	0.880		
passenger traffic	0.603		
fixed assets investments	0.859		
annual total population		0.903	
number of post office		0.885	
number of theater and cinema		0.716	
number of hospital		0.922	
education investment			0.638
scientific research and technical workers			0.713
number of students in colleges			0.776
industrial waste emissions			0.651

Table 4 Economy development environment evaluation results of 36 cities in China

Ranking	Factor 1	Factor 2	Factor 3	Composite scores	Ranking	Factor 1	Factor 2	Factor 3	Composite scores
1	Beijing	Chongqing	Guangzhou	Beijing	19	Harbin	Qingdao	Qingdao	Shijiazhuang
2	Shenzhen	Chengdu	Shanghai	Shanghai	20	Wuhan	Wuhan	Ningbo	Jinan
3	Shanghai	Tianjin	Wuhan	Chongqing	21	Changsha	Kunming	Kunming	Hefei
4	Guangzhou	Shanghai	Hangzhou	Shenzhen	22	Changchun	Fuzhou	Harbin	Fuzhou
5	Tianjin	Beijing	Nanjing	Guangzhou	23	Haikou	Ningbo	Hefei	Changchun
6	Ningbo	Shenzhen	Xian	Tianjin	24	Xining	Taiyuan	Changchun	Kunming
7	Hangzhou	Harbin	Shijiazhuang	Chengdu	25	Kunming	Nanchang	Taiyuan	Taiyuan
8	Nanjing	Zhengzhou	Jinan	Hangzhou	26	Xian	Hangzhou	Xiamen	Nanning
9	Qingdao	Hefei	Dalian	Wuhan	27	Taiyuan	Nanjing	Fuzhou	Xiamen
10	Lhasa	Xian	Zhengzhou	Nanjing	28	Hefei	Lanzhou	Lanzhou	Nanchang
11	Hohhot	Shijiazhuang	Tianjin	Ningbo	29	Lanzhou	Urumqi	Hohhot	Guiyang
12	Xiamen	Shenyang	Chengdu	Xian	30	Jinan	Haikou	Guiyang	Hohhot
13	Shenyang	Qingdao	Chongqing	Shenyang	31	Guiyang	Xining	Urumqi	Urumqi

14	Chengdu	Changsha	Changsha	Qingdao	32	Zhengzhou	Yinchuan	Yinchuan	Lanzhou
15	Dalian	Changchun	Shenyang	Dalian	33	Nanchang	Xiamen	Xining	Lhasa
16	Fuzhou	Guiyang	Nanchang	Harbin	34	Nanning	Hohhot	Lhasa	Yinchuan
17	Yinchuan	Jinan	Nanning	Zhengzhou	35	Chongqing	Lhasa	Haikou	Haikou
18	Urumqi	Dalian	Beijing	Changsha	36	Shijiazhuang	Guangzhou	Shenzhen	Xining

(3) Evaluation result. The table 4 shows the single factor scores ranking and composite scores ranking respectively. There is economic operation factor ranking, infrastructure factor ranking, environmental science and education factor ranking and Composite scores ranking from left to right respectively.36 cities ranking on environment in every factor in economic development can be seen from the table, as well as the city's economic development overall situation comprehensive ranking.

5.Conclusion

This paper has shown that there is a clear imbalance in the development of major cities in China. Beijing, Shanghai, Guangzhou, and other coastal cities' economic development environment are in a relatively leading level. The central and western regions are relatively poor. To such a situation, on one hand, we can adopt horizontal and mutual assistance to know the shortage of development environment by learning other urban development experience. On the other hand, it must put efforts to use its own advantages factors driving the disadvantage factors and realize the comprehensive coordinated development.

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