

Measurement and Analysis of The Development Level of Open Economy: A Case Study in Jiangsu Province

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Abstract. In recent years, the international landscape has rapidly evolved, presenting new challenges and opportunities for open economies. Using Jiangsu as a case study, this article assesses the province's open economy level through global factor and cluster analysis. Research has found that the overall development level of open economies in various cities has shown a tortuous growth trend, with significant regional differences between cities, indicating that the previous model of winning by quantity is no longer applicable. This article further analyzes the existing problems and provides relevant basis for policy improvement.

Keywords: Open economy; Jiangsu Province; Global factor analysis; Cluster analysis.

1. Introduction

Openness is the only way for a country to prosper and develop. During the deliberation of the Jiangsu delegation, General Secretary Xi Jinping emphasized the need to deepen reforms in key areas, coordinate the construction of a modern infrastructure system and a high standard market system, and steadily expand institutional opening-up in accordance with the requirements of building a high-level socialist market economy system and promoting high-level opening up to the outside world.

Jiangsu is one of the provinces in China that opened up earlier and developed rapidly economically. Since the reform and opening up, Jiangsu's open economy has maintained a rapid development trend, with major indicators of openness such as foreign investment, foreign trade, and foreign economy consistently ranking among the top in the country. From China's accession to the WTO in 2001 to the early stage of the 11th Five Year Plan, Jiangsu's openness has surged. However, due to the ongoing impact of the 2008 financial crisis, the global economic recovery has been slow, and the domestic and international economic environment is not optimistic. The total import and export volume and actual utilization of foreign capital in Jiangsu have both shown a slowing trend year by year. To promote better and faster development in Jiangsu, we can no longer rely solely on external demand to drive and attract foreign investment. We need to explore new development models to transform and upgrade Jiangsu's open economy from quantity based development to quality based development.

For a long time, influenced by various factors, the development level of Jiangsu's open economy has shown that it is stronger in southern Jiangsu and relatively weaker in northern Jiangsu. The practical experience of economic development in southern Jiangsu fully proves that a high-level open economy is an important "engine" for the economic development of southern Jiangsu. Jiangsu should actively seize the strategic opportunities such as the "the Belt and Road" initiative and the Yangtze River Delta integration upgrading to a national strategy, expand cooperation in breadth and depth, promote the transformation and adjustment of economic structure, and effectively promote the development of high-quality open economy in Jiangsu, so as to promote the realization of high-quality economic development goals in Jiangsu.

This article analyzes the changes in the development level of Jiangsu's open economy in recent years through objective weighting method, identifies possible problems, attempts to provide policy recommendations for higher quality development in Jiangsu, and explores how Jiangsu should leverage its own advantages to contribute to the economy of Jiangsu and even the whole country.



2. Literature Review and Research Methods

2.1. Literature

For many years, foreign scholars have been committed to constructing indicators to measure the degree of trade openness and capital openness in the study of open economies, in order to determine the degree of economic openness in a certain region. Kiyoshi Kojima [1] proposed using foreign trade dependence to measure the degree of trade openness, that is, the proportion of goods trade imports and exports to a country's GDP. Miniane [2] used the average proportion of capital inflows and outflows to measure the degree of financial openness to the outside world. Sachs [3] believes that a country's level of openness can be measured by an indicator of its international trade openness, which is the proportion of imports or exports to a country's gross domestic product. Zhang et al. (2021) [4] conducted a spatiotemporal perspective and quantitative diagnosis on the prominent problems and potential growth effects of the open economy development in the western region since the implementation of the Western Development Strategy from two dimensions: statistical description and quantitative evaluation. Zhang (2024) [5] combines multiple dimensions such as the field, scale, and network of human geography to analyze the spatial production experience of the construction of Hainan Free Trade Port, and proposes a path for building a new system of higher-level open economy.

In terms of the construction of the evaluation index system for the development level of open economy, Zhang et al. (2017) [6] further studied the development potential of regional open economy development level, added land openness, information openness, and ecological civilization index, and based on this, constructed an evaluation index system consisting of 17 secondary indicators with four primary indicators as the core: openness foundation, internal openness, external openness, and openness potential. He (2016) [7] constructed an indicator system for the open economy of provinces and cities in the Yangtze River Economic Belt from five aspects: open foundation, open scale, open structure, open benefits, and open potential, divided into 27 secondary indicators. Wu et al. (2023) [8] used entropy method and spatial autoregression analysis to explore the spatial characteristics and influencing factors of the development level of open economy in the Pearl River Delta urban agglomeration.

In terms of measuring the level of development of an open economy, Wang (2014) [9] used factor analysis to study the openness of the Central Plains urban agglomeration. OuYang(2018) [10] constructed a single dimensional indicator evaluation system for the scale and degree of openness, and then used principal component analysis to evaluate the level of openness in Hunan. Zhang (2021) [11] measured and evaluated the level of open economic development in 30 provinces in China from 2010 to 2017 using a grey relational model based on entropy weight. Xia (2022) [12] used methods such as grey relational analysis model and geographic detector to measure and analyze the development level and influencing factors of Jiangsu's open economy.

2.2. Global Factor Analysis

The main purpose of this article is to scientifically evaluate the development level of open economy in 13 provincial cities in Jiangsu Province. Therefore, it is necessary to consider both the dynamic evolution characteristics in the time dimension and the regional distribution characteristics in the spatial dimension. This article adopts the global factor analysis method, which can transform cross-sectional data and geographical area data from different times to a unified global principal hyperplane through global principal component common factors, ensuring that the principal component common factors of different years have the same composition. Evaluation is carried out by comparing the comprehensive scores of different years. The steps of the global factor analysis method for evaluating the development level of open economy in 13 cities in Jiangsu are as follows: constructing a data table of the main carrying capacity of temporal spatial entities in 13 cities in Jiangsu; Standardize the evaluation indicators; Applicability testing, analyzing whether the selected indicator data is suitable for global factor analysis method; Obtain matrix eigenvalues, eigenvectors, and cumulative contribution rates through matrix analysis, and perform factor extraction; Using the maximum

variance method for factor rotation to highlight the representativeness of the global principal and common factors; Construct an evaluation function for the level of open economic development based on the contribution rate values of the global principal and common factors; Calculate the comprehensive score of the development level of open economy in 13 cities in Jiangsu and rank them accordingly.

2.3. Cluster Analysis

The basic idea of this method is to treat a certain number of samples or indicators as a single class, merge the two classes with the highest degree of similarity based on their different degrees of similarity, and then continue to compare the similarity between the merged class and other classes. After that, perform a secondary merging process by repeating the above process until all samples or indicators are merged into one class. Finally, based on the similarity relationship between different classes, draw a complete classification tree diagram.

3. Construction of evaluation index system

This article starts from the development characteristics of open economy in 13 cities in Jiangsu Province from 2006 to 2017, and based on the evaluation index system of open economy development level constructed by relevant scholars, establishes an index system that includes four major aspects: open foundation, open scale, open structure, and open potential. Taking into account the availability of data and the scientificity of indicators, this article ultimately constructed an indicator system for the level of open economy in 13 cities in Jiangsu Province, including a total of 19 relevant indicators. The indicator system for the development level of open economy in 13 cities in Jiangsu Province is shown in Table 1.

Table 1: Indicator System for the Development Level of Open Economy

	Indicator Name
Open Foundation	Per capita GDP (X1)
	Per capita fixed capital formation (X2)
	Urbanization rate (X3)
	Proportion of tertiary industry (X4)
	Proportion of total postal and telecommunications business to GDP (X5)
	Proportion of added value of industrial enterprises above Designated size to GDP (X6)
Open scale	Foreign trade dependence (X7)
	Proportion of foreign investment (X8)
	Proportion of outward investment (X9)
	Degree of foreign economic cooperation (X10)
	Dependence on domestic trade (X11)
	International tourism dependence (X12)
	Domestic tourism dependence (X13)
Open structure	Contribution of foreign-funded enterprises to employment (X14)
	Proportion of international tourism revenue (X15)
Open potential	Public finance science and technology budget expenditure ratio (X16)
	Education expenditure ratio (X17)
	Loan to deposit ratio of financial institutions (X18)
	Information openness (X19)

4. Empirical analysis

4.1. Data Sources

The main purpose of this article is to evaluate the level of open economic development in all 13 cities in Jiangsu Province from 2006 to 2017. Nineteen indicator data from these 13 cities were selected for processing, including per capita GDP, per capita fixed capital formation, urbanization rate, proportion of the tertiary industry, proportion of postal and telecommunications services to GDP, proportion of industrial added value above designated size to GDP, foreign trade dependence, proportion of foreign investment, proportion of foreign investment, degree of foreign economic cooperation, degree of domestic trade dependence, degree of international tourism dependence, degree of domestic tourism dependence, degree of employment contribution of foreign-funded enterprises, and proportion of international tourism revenue from Nanjing, Wuxi, Xuzhou, Changzhou, Suzhou, Nantong, Lianyungang, Huai'an, Yancheng, Yangzhou, Zhenjiang, Taizhou, and Suqian from 2006 to 2017. Public finance science and technology budget expenditure ratio, education expenditure ratio, financial institution loan deposit ratio Data on information openness.

The data in this article mainly comes from the "Jiangsu Statistical Yearbook" from 2007 to 2018, the "Statistical Yearbook" of various cities in Jiangsu, the relevant annual "National Economic and Social Development Statistical Bulletin" of each city, the Jiangsu Provincial Bureau of Statistics, and the official website of the Jiangsu Provincial Department of Commerce. Among them, various indicators regarding the amount of foreign investment in individual years are obtained through exchange rate conversion.

4.2. Global Factor Analysis

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This article selects 13 cities in Jiangsu Province as samples for analyzing the level of open economic development. Each sample city contains 19 evaluation indicator variables, forming a 13-19 order matrix $K_{13 \times 19}$ with a time span of 12. A time-series global three-dimensional data table can be constructed as $L = \{x_{t \times 13 \times 19}, t = 2006, 2007, \dots, 2017\}$. Using x_1, x_2, \dots, x_m as indicators for time series variables, t can be represented as:

$$\begin{bmatrix} x_{11}^t & \cdots & x_{119}^t \\ \vdots & \ddots & \vdots \\ x_{131}^t & \cdots & x_{1319}^t \end{bmatrix}, \quad t=2006, 2007, \dots, 2017 \quad (1)$$

The indicators of development level of various open economies Y_i^t ($i=1, 2, \dots, 13$, $t=2006, 2007, \dots, 2017$), There are different units of measurement, and simply selecting raw data for analysis often results in dimensional errors. In order to eliminate the influence of dimensionality on empirical results, it is first necessary to standardize them, that is:

$$Z(Y_i) = \frac{Y_i^t - \mu_{y_i}^t}{\sigma_{y_i}^t} \quad (2)$$

Among them, $\mu_{y_i}^t$ represents the estimated value of the expected level of open economic development in city i in year t , which is replaced by the sample mean; $\sigma_{y_i}^t$ represents the estimated sample volatility of the level of open economic development in city i in year t , which is replaced by the standard deviation within the sample.

Not all multivariate data are suitable for factor analysis, as factor analysis requires correlations between variables. Firstly, standardize the original variables, and then combine the results of Bartlett's sphericity test and KMO test to make judgments. Using statistical analysis software SPSS24 for Bartlett's sphericity test and KMO test, the stronger the correlation, the closer the KMO value is to 1. Generally, factor analysis can be performed when the KMO value is greater than 0.6. According to the standard judgment given by statistician H. Kaiser, factor analysis is suitable when the KMO test value is greater than 0.6. The KMO value test result of the sample data is 0.741, which is higher than the given standard, therefore it is suitable for factor analysis. If the significance of Bartlett's sphericity test is 0.000 and less than 0.05, the null hypothesis is rejected, indicating a significant correlation between the 19 indicators. Factor analysis can be used for dimensionality reduction.

Further analysis of variable commonality, which represents the proportion of total variance explained by all common factor variables to the original variables. The closer the explanatory ratio is to 1, the more information the common factor explains for the original variable. Generally speaking, factors with a commonality of more than 0.75 have a strong explanatory power for each variable. As shown in Table 2, the majority of variables have a commonality of more than 0.75, indicating that the factor analysis conducted in this article has a good effect.

Table 2: Common factor variance

Indicator	Initial	extraction
X1	1.000	0.947
X2	1.000	0.803
X3	1.000	0.783
X4	1.000	0.873
X5	1.000	0.737
X6	1.000	0.874
X7	1.000	0.811
X8	1.000	0.708
X9	1.000	0.699
X10	1.000	0.717
X11	1.000	0.855
X12	1.000	0.863
X13	1.000	0.790
X14	1.000	0.857
X15	1.000	0.850
X16	1.000	0.733
X17	1.000	0.919
X18	1.000	0.825
X19	1.000	0.874

Extract factors by analyzing the matrix to obtain its eigenvalues, cumulative contribution rate, and eigenvectors. Using statistical software SPSS24, the correlation coefficient matrix between variables of open economic development level was calculated, and the variance contribution rate of the

extracted common factors was obtained. It was calculated that the eigenvalues of the first six common factors were all greater than 1, and the line between the first and sixth factors showed a clear steep state. Starting from the seventh common factor, the eigenvalues of the common factors were less than 1. Therefore, this article uses the first 6 common factors to replace the 19 variables of open economic development level.

As shown in Table 3, the variance contributions of the first six common factors are 30.680%, 23.490%, 9.944%, 6.640%, 5.615%, and 5.305%, respectively, with a cumulative variance contribution of 81.674%. This indicates that the first six common factors can explain 81.674% of the variance in 19 indicators of open economic development level. Moreover, the eigenvalues of the first six common factors are all greater than 1, which are 5.829, 4.463, 1.889, 1.262, 1.067, and 1.008, respectively, meeting the requirement of eigenvalues greater than 1. Therefore, the common factor F1 can be obtained F2. F3. F4. F5. F6.

In an unrotated factor loading matrix, it is possible for a factor variable to have a high loading on many variables, making the logical meaning of the factor unclear. Therefore, this article adopts the maximum variance method to highlight the representativeness of the global common factors and make the meanings of the factors clearer (see Table 4 for details).

The main public factor F1 has a relatively large load on per capita GDP X1, urbanization rate X3, proportion of tertiary industry X4, proportion of outward investment X9, domestic tourism dependence X13, information openness X19, and contribution of foreign-funded enterprises to employment X14; The main factor F2 has a significant load on foreign trade dependence X7, foreign investment proportion X8, international tourism dependence X12, and international tourism revenue proportion X15; The main factor F3 has a relatively large load on the proportion of industrial added value above a certain scale in GDP X6 and domestic trade dependence X11; The main public factor F4 has a relatively large load on external economic cooperation X10, public finance science and technology budget expenditure ratio X16, education expenditure ratio X17, and financial institution loan deposit ratio X18; The main factor F5 has a significant load on the proportion of industrial added value above a certain scale to GDP X6; The principal factor F6 has a significant load on the per capita fixed capital formation X2.

Table 3: Explanation of Total Variance

Indicator	initial eigenvalue			Extract the sum of squared loads			Sum of squared rotational loads		
	Total	Variance (%)	Accumulate (%)	Total	Variance (%)	Accumulate (%)	Total	Variance (%)	Accumulate (%)
1	5.829	30.680	30.680	5.829	30.680	30.680	5.229	27.521	27.521
2	4.463	23.490	54.171	4.463	23.490	54.171	3.768	19.831	47.352
3	1.889	9.944	64.114	1.889	9.944	64.114	2.149	11.310	58.662
4	1.262	6.640	70.754	1.262	6.640	70.754	2.012	10.590	69.252
5	1.067	5.615	76.370	1.067	5.615	76.370	1.267	6.669	75.921
6	1.008	5.305	81.674	1.008	5.305	81.674	1.093	5.753	81.674
7	0.799	4.203	85.877						
8	0.524	2.756	88.633						
9	0.515	2.709	91.342						
10	0.387	2.035	93.377						
11	0.346	1.820	95.196						
12	0.292	1.537	96.734						
13	0.157	0.824	97.558						
14	0.128	0.674	98.232						
15	0.109	0.573	98.804						
16	0.088	0.463	99.268						
17	0.065	0.341	99.609						
18	0.042	0.224	99.832						
19	0.032	0.168	100.000						

Table 4: Rotated component matrix

Indicator	component					
	1	2	3	4	5	6
X1	0.962	-0.026	-0.136	0.006	0.040	-0.009
X2	0.088	-0.063	0.065	-0.047	-0.112	0.879
X3	0.800	0.118	0.130	0.224	-0.235	0.082
X4	0.773	-0.208	0.449	0.166	0.061	-0.013
X5	0.198	-0.160	0.150	0.102	0.787	-0.145
X6	0.192	0.558	-0.588	-0.242	-0.335	-0.097
X7	0.393	0.634	-0.443	0.192	0.097	0.110
X8	-0.160	0.785	-0.094	-0.132	-0.199	0.000
X9	0.692	-0.211	0.221	0.055	0.303	0.179
X10	-0.185	0.375	0.365	-0.588	0.181	0.174
X11	0.248	-0.067	0.873	-0.019	0.134	0.093
X12	0.030	0.903	0.122	-0.008	-0.132	-0.120
X13	0.613	0.182	0.448	0.129	-0.289	-0.284
X14	0.715	0.328	-0.357	0.148	0.258	0.150
X15	-0.139	0.891	-0.098	-0.151	0.065	-0.008
X16	0.501	-0.276	0.107	0.584	0.096	0.209
X17	-0.433	-0.572	0.148	0.592	0.095	0.150
X18	0.313	0.063	0.070	0.824	0.158	-0.119
X19	0.885	-0.056	0.009	0.164	0.240	-0.049

Using statistical software SPSS24, the component score coefficient matrix was obtained as shown in Table 5. Based on this, the factor score function can be derived as follows:

$$F1=0.238X1+0.005X2+0.157X3+0.148X4-0.017X5+0.102X6+0.030X7-0.058X8+0.133X9-0.021X10+0.007X11-0.052X12+0.122X13+0.120X14-0.077X15+0.030X16-0.174X17-0.069X18+0.176X19 \quad (3)$$

$$F2=-0.095X1+0.026X2+0.019X3-0.042X4+0.038X5+0.026X6+0.195X7+0.240X8-0.044X9+0.127X10+0.088X11+0.315X12+0.047X13+0.083X14+0.301X15+0.004X16-0.030X17+0.159X18-0.036X19 \quad (4)$$

$$F3=-0.131X1+0.029X2+0.069X3+0.175X4+0.000X5-0.242X6-0.174X7+0.067X8+0.035X9+0.212X10+0.435X11+0.188X12+0.255X13-0.197X14+0.058X15+0.017X16+0.052X17+0.058X18-0.059X19 \quad (5)$$

$$F4=-0.160X1+0.002X2+0.071X3-0.027X4-0.037X5-0.110X6+0.156X7+0.081X8-0.105X9-0.283X10-0.023X11+0.154X12+0.046X13+0.020X14+0.067X15+0.277X16+0.375X17+0.502X18-0.054X19 \quad (6)$$

$$F5 = -0.030X1 - 0.118X2 - 0.281X3 - 0.066X4 + 0.661X5 - 0.201X6 + 0.145X7 - 0.068X8 + 0.180X9 + 0.227X10 + 0.035X11 - 0.031X12 - 0.324X13 + 0.229X14 + 0.181X15 - 0.023X16 + 0.011X17 + 0.072X18 + 0.133X19 \quad (7)$$

$$F6 = -0.046X1 + 0.813X2 + 0.069X3 - 0.048X4 - 0.151X5 - 0.069X6 + 0.146X7 + 0.060X8 + 0.128X9 + 0.167X10 + 0.073X11 - 0.044X12 - 0.266X13 + 0.146X14 + 0.058X15 + 0.188X16 + 0.145X17 - 0.073X18 - 0.075X19 \quad (8)$$

$$F = 0.307F1 + 0.235F2 + 0.099F3 + 0.066F4 + 0.056F5 + 0.042F6 \quad (9)$$

Table 5: Component score coefficient matrix

Indicator	component					
	1	2	3	4	5	6
X1	0.238	-0.095	-0.131	-0.160	-0.030	-0.046
X2	0.005	0.026	0.029	0.002	-0.118	0.813
X3	0.157	0.019	0.069	0.071	-0.281	0.069
X4	0.148	-0.042	0.175	-0.027	-0.066	-0.048
X5	-0.017	0.038	0.000	-0.037	0.661	-0.151
X6	0.102	0.026	-0.242	-0.110	-0.201	-0.069
X7	0.030	0.195	-0.174	0.156	0.145	0.146
X8	-0.058	0.240	0.067	0.081	-0.068	0.060
X9	0.133	-0.044	0.035	-0.105	0.180	0.128
X10	-0.021	0.127	0.212	-0.283	0.227	0.167
X11	0.007	0.088	0.435	-0.023	0.035	0.073
X12	-0.052	0.315	0.188	0.154	-0.031	-0.044
X13	0.122	0.047	0.255	0.046	-0.324	-0.266
X14	0.120	0.083	-0.197	0.020	0.229	0.146

Further calculate the comprehensive score of the level of development of an open economy. The calculation results for 13 cities in Jiangsu Province from 2006 to 2017 are shown in Table 6.

Table 6: Public factors score and ranking

City	2006		2007		2008		2009		2010		2011	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Nanjing	0.8162	1	0.7794	1	0.7689	1	0.7563	1	0.7455	1	0.7682	1
Wuxi	0.0376	5	0.0783	6	0.0226	6	0.0213	6	0.1194	5	0.1895	5
Xuzhou	-0.5474	10	-0.5063	11	-0.5063	10	-0.5420	12	-0.4938	12	-0.4578	12

Changzhou	0.033 3	6	0.122 6	5	0.081 5	4	0.103 2	4	0.169 1	4	0.212 3	3
Suzhou	0.412 3	2	0.586 0	2	0.485 0	2	0.448 9	2	0.508 3	2	0.539 2	2
Nantong	0.169 8	4	0.185 5	4	0.043 5	5	- 0.020 2	7	0.014 3	7	- 0.006 2	8
Lianyungang	- 0.121 5	8	- 0.022 8	7	0.004 1	7	- 0.044 6	8	- 0.067 0	8	0.029 6	7
Huaian	- 0.589 6	12	- 0.518 5	12	- 0.532 5	12	- 0.443 0	11	- 0.357 1	9	- 0.344 1	10
Yancheng	- 0.587 6	11	- 0.492 9	10	- 0.529 9	11	- 0.427 6	10	- 0.381 1	11	- 0.347 0	11
Yangzhou	- 0.093 6	7	- 0.033 0	8	- 0.009 7	8	0.067 4	5	0.073 7	6	0.063 6	6
Zhenjiang	0.173 6	3	0.328 1	3	0.245 9	3	0.244 5	3	0.266 0	3	0.205 8	4
Taizhou	- 0.452 0	9	- 0.432 1	9	- 0.395 2	9	- 0.372 5	9	- 0.374 1	10	- 0.305 5	9
Suqian	- 0.823 9	13	- 0.793 4	13	- 0.746 7	13	- 0.674 8	13	- 0.629 2	13	- 0.669 9	13
City	2012		2013		2014		2015		2016		2017	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Nanjing	0.705 9	1	0.645 5	2	0.682 8	2	0.619 9	2	0.859 8	2	1.020 2	2
Wuxi	0.255 1	3	0.252 8	3	0.298 5	4	0.326 7	3	0.440 4	3	0.452 2	3
Xuzhou	- 0.297 5	9	- 0.477 3	12	- 0.213 7	8	- 0.159 7	9	0.005 7	8	- 0.072 8	8
Changzhou	0.187 8	5	0.093 7	4	0.079 9	5	0.129 9	5	0.310 8	4	0.285 1	4
Suzhou	0.516 0	2	0.682 8	1	0.745 8	1	0.894 1	1	1.018 8	1	1.093 9	1
Nantong	0.000 5	6	- 0.086 4	5	0.592 2	3	0.054 8	6	0.126 5	6	0.090 3	7

Lianyungang	- 0.075 4	8	- 0.136 6	7	- 0.020 8	6	0.142 8	4	0.206 3	5	0.102 0	6
Huaian	- 0.300 3	10	- 0.333 1	9	- 0.237 5	9	- 0.197 7	10	- 0.170 0	12	- 0.100 7	9
Yancheng	- 0.306 2	11	- 0.352 6	10	- 0.336 8	13	- 0.200 5	11	- 0.102 4	10	- 0.162 0	11
Yangzhou	- 0.032 1	7	- 0.285 6	8	- 0.258 2	10	- 0.155 8	8	- 0.039 8	9	- 0.144 9	10
Zhenjiang	0.217 6	4	- 0.095 8	6	- 0.090 3	7	- 0.093 5	7	0.037 0	7	0.133 3	5
Taizhou	- 0.372 9	12	- 0.363 3	11	- 0.312 7	11	- 0.286 3	12	- 0.131 1	11	- 0.251 0	12
Suqian	- 0.587 4	13	- 0.517 8	13	- 0.320 2	12	- 0.356 5	13	- 0.209 0	13	- 0.290 4	13

4.3. Cluster Analysis

The data in this article mainly comes from the "Jiangsu Statistical Yearbook" from 2007 to 2018, the "Statistical Yearbook" of various cities in Jiangsu, the relevant annual "National Economic and Social Development Statistical Bulletin" of each city, the Jiangsu Provincial Bureau of Statistics, and the official website of the Jiangsu Provincial Department of Commerce. Among them, various indicators regarding the amount of foreign investment in individual years are obtained through exchange rate conversion.

Using SPSS24 software, the comprehensive score data of the development level of open economy in 13 cities in Jiangsu Province were analyzed using systematic clustering analysis, and the Euclidean distance squared method was selected to provide a measure of heterogeneity. From 2006 to 2017, a total of 12 spectrograms can be obtained. Taking the 2017 spectrogram as an example, most of the aggregation relationships are at a level of difference below 5, and 1-4 correspond to four categories: cities with high levels of open economic development, cities with medium to high levels of open economic development, cities with medium to low levels of open economic development, and cities with low levels of open economic development. According to the results of the cluster analysis spectrum, the development level of open economy in 13 cities in Jiangsu Province from 2006 to 2017 was classified, and the results are shown in Table 7.

Table 7: Classification Table of Development Level of Open Economy

City	2006	2007	2008	2009	2010	2011
Nanjing	1	1	1	1	1	1
Wuxi	3	2	3	3	2	2
Xuzhou	4	3	4	4	3	3
Changzhou	3	2	3	3	2	2
Suzhou	2	1	2	2	1	1
Nantong	3	2	3	3	2	2
Lianyungang	3	2	3	3	2	2
Huaian	4	3	4	4	3	3
Yancheng	4	3	4	4	3	3
Yangzhou	3	2	3	3	2	2
Zhenjiang	3	2	3	2	2	2
Taizhou	4	3	4	4	3	3
Suqian	4	4	4	4	4	4
City	2006	2007	2008	2009	2010	2011
Nanjing	1	1	1	2	1	1
Wuxi	2	2	2	3	2	2
Xuzhou	3	4	4	3	4	4
Changzhou	2	2	3	4	2	2
Suzhou	1	1	1	1	1	1
Nantong	2	3	1	3	3	3
Lianyungang	2	3	3	3	3	3
Huaian	3	4	4	4	4	4
Yancheng	3	4	4	4	4	4
Yangzhou	2	4	4	4	4	4
Zhenjiang	2	3	3	4	4	3
Taizhou	3	4	4	4	4	4
Suqian	4	4	4	4	4	4

4.4. Result Analysis

According to the scores in the previous text, it can be seen that the development level of open economy in various cities in the southern Jiangsu region (Nanjing, Suzhou, Wuxi, Changzhou, Zhenjiang) ranks among the top in the province and is relatively stable; Next are various cities in the central Jiangsu region (Yangzhou, Taizhou, Zhenjiang); The development level of open economy in various cities in northern Jiangsu (Xuzhou, Lianyungang, Huai'an, Yancheng, Suqian) ranks

relatively low and has significant differences. From 2006 to 2012, Nanjing's level of open economic development ranked first in the province. In 2013 and beyond, Suzhou surpassed Nanjing to become the city with the highest level of open economic development in the province; Wuxi and Changzhou have gradually risen from 5th and 6th place in the city and stabilized at 3rd and 4th place; Compared to other cities in southern Jiangsu, Zhenjiang's level of open economic development seems to lack momentum, gradually dropping from the third place in the province to the seventh place, and rising again to the fifth place in 2017. The level of open economic development in Yangzhou and Nantong in the central Jiangsu region is basically stable in the upper and middle reaches of the province, while Taizhou is in the lower and middle reaches of the province, or even at the bottom. The cities in northern Jiangsu are basically stable in the middle and lower reaches of the province, with Lianyungang ranking higher and the other four cities remaining relatively unchanged.

5. Empirical analysis

This article takes 13 cities in Jiangsu Province as the research object, establishes an evaluation system containing 19 refined indicators, and uses global factor analysis to measure and analyze their level of open economic development. The research shows that the level of development of Jiangsu's open economy shows a decreasing trend from southern Jiangsu to central Jiangsu and then to northern Jiangsu. Among them, the level of development of Zhenjiang's open economy appears to lack momentum, consistently ranking at the bottom of the southern Jiangsu region and even in the middle reaches of the province. Nantong and Lianyungang are the opposite, leading the central and northern Jiangsu regions respectively. The level of development of open economy is in the middle and upper reaches of the province. Overall, there are significant regional differences in the level of development of open economy in Jiangsu.

In response to the development trend of Jiangsu's open economy, this article proposes the following suggestions. Firstly, strive to develop an innovative and open economy. The high-speed development advantages of introducing foreign investment and stimulating the economy through exports, which are essential for the survival of an open economy that relies on quantity to win, are no longer sustainable, and new economic growth drivers must be explored. Secondly, opening up and development should highlight the leadership of the "the Belt and Road" initiative. Actively serve the overall situation of the country's comprehensive opening up, give full play to the role of the intersection of the "the Belt and Road" in Jiangsu, make every effort to expand the opening to the east and lead the opening to the west, further expand the open space, and at the same time seize other new development opportunities. Thirdly, the province should actively promote the development of developed areas to drive the development of underdeveloped areas. Corresponding development strategies should be determined based on the different economic foundations of southern, central, and northern Jiangsu: southern Jiangsu should continue to maintain a high level of openness to drive the development of the province's open economy, while central and northern Jiangsu should actively move closer to southern Jiangsu.

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