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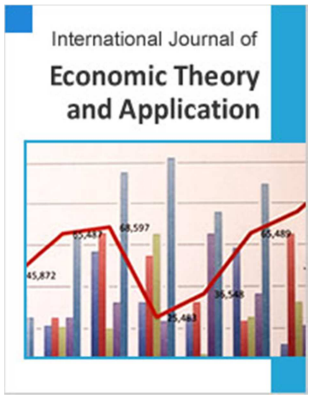

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Study on the Comprehensive Evaluation of the Economic Development Levels of Prefecture-Level Cities in Shandong Province

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Abstracts

The reasonable appraisal of the level of economic development can't be ignored as a guide for the adoption and implementation of the policy. In order to evaluate the level of economic development of all prefecture-level cities in Shandong Province, this paper selects 10 statistical indicators from 17 prefecture-level cities in Shandong Province and uses factor analysis method to carry out empirical analysis, and extracts the factors of comprehensive economic strength of cities and living standards of urban residents Factor of 2 public factors and clustering analysis of 17 prefecture-level cities based on public factor score matrix, the level of economic development in all prefecture-level cities in Shandong Province is divided into five levels, and accordingly for the formulation and implementation of relevant economic policies give the appropriate advice.

1. Introduction

As a large economic province in the eastern coast of China, Shandong Province has a solid material foundation and a complete industrial system. Its economic development has reached the national advanced level. At present, it has entered a crucial stage of transformation and upgrading, major breakthroughs and overall improvement. However, it still faces some new contradictions And the problem. Due to the geographical environment, nature, humanities and policies and other factors, the imbalance of economic development in different regions of Shandong Province has become more and more prominent. Therefore, a comprehensive evaluation of the economic development level of 17 prefecture-level cities in Shandong Province to get a clearer understanding of the economic strength and the gap between the prefecture-level cities in Shandong Province is an important research topic and can be used for the formulation of relevant economic policies and provide a reference for the implementation.

2. Method

2.1. Construction of Comprehensive Evaluation Index System

In order to be objective, systematic and comprehensive to reflect the level of economic development of the prefecture level in Shandong province, index selection in the systematic, comprehensive, scientific, comparability and operability principles, on the basis of combining with the situation of the economic development of the prefecture level in Shandong province to build 10 can reflect the comprehensive evaluation index system of the level of economic development in Shandong province [1]. The meaning of each index represents as follows: GDP, per capita GDP, the second industry output value, the output value of the third industry, the local fiscal revenue, budget of public finance expenditure, the whole society fixed asset investment, total retail sales of social consumer goods, urban per capita disposable income and rural per capita disposable income. According to the statistical yearbook of Shandong province in 2016, the corresponding index data of 17 prefecture-level cities in Shandong province are obtained, as shown in table 1

Table 1. *In 2015, the main economic indexes of various prefectures in Shandong province.*

City	Regional GDP (billion yuan)	Gross regional product per capita (yuan)	Second industry output (billion yuan)	Tertiary industry output (billion yuan)	Local revenue (million yuan
Jinan	610.023	85919	230.7	348.784	61431.72
Qingdao	930.007	102519	402.646	490.963	100632.20
Zibo	413.024	89235	222.883	175.653	31792.75
Zaozhuang	203.100	52692	107.019	80.67	14931.49
Dongying	345.064	163938	223.061	110.228	22008.29
Yantai	644.608	91979	332.346	268.177	54265.70
Weifang	517.053	55824	249.075	222.463	48450.57
Jining	401.312	48529	189.613	166.28	36861.66
Tai'an	315.839	56490	146.182	142.752	20531.36
Weihai	300.157	106922	142.222	136.221	24974.70
Rizhao	167.080	58110	81.306	71.714	12165.12
Laifu	66.583	49377	34.416	26.895	5017.17
Linyi	376.317	36656	168.71	172.958	28388.87
Dezhou	275.094	48062	135.8	110.923	18278.00
Liaocheng	266.362	44743	136.025	98.698	17593.18
Binzhou	235.533	61189	115.017	98.763	20414.81
Heze	240.096	28350	126.743	86.344	17765.71

Table 1. *Continued.*

City	Public finance budget expenditure (million yuan)	Total social fixed asset investment (billion yuan)	Total retail sales of consumer goods (billion yuan)	Per capita disposable income of urban residents (yuan)	Per capita disposable income of rural residents (yuan)
Jinan	65818.13	349.842	341.031	39889	14232
Qingdao	122286.64	655.570	371.369	40370	16730
Zibo	38289.05	273.160	194.972	33793	14531
Zaozhuang	23640.93	162.593	80.538	25792	12038
Dongying	25763.77	308.468	72.805	38735	13887
Yantai	64353.11	466.714	267.945	35907	15540
Weifang	61215.50	451.670	227.745	31060	14890
Jining	51508.77	289.101	191.098	27887	12570
Tai'an	32687.76	261.824	133.161	28132	13322
Weihai	33837.97	254.372	131.166	36336	16313
Rizhao	18537.45	140.781	60.387	26217	12319
Laifu	8384.37	61.907	32.088	30219	13714
Linyi	53358.71	321.919	223.498	28627	10828
Dezhou	33782.02	223.791	125.741	21039	11269
Liaocheng	34680.67	210.082	106.022	21570	10512
Binzhou	30931.04	199.024	81.363	28388	12727
Heze	40043.99	107.335	135.211	20370	9802

2.2. Factor Analysis of Economic Development Level in Shandong Province

Factor analysis is a multivariate statistical analysis method that converts multiple original variables into a small number of unrelated random variables based on the correlation size. Through factor analysis, can use less uncorrelated random variables to describe the relationship between the covariance between the original variables, under the condition of loss as little information as possible, reduce the analysis of the complexity of the problem [2].

2.2.1. Calculate the Correlation Coefficient Matrix of Each Index

The correlation coefficient matrix describes the correlation between the original variables. This can be helpful in judging whether there is a correlation between the original variables, which is important for factor analysis because doing factor analysis is not appropriate if there is no relationship between the selected variables and the correlation coefficient matrix is the basis for estimating the factor structure [3]. Calculated by R software to get the correlation coefficient of each indicator, shown in Figure 1. Correlation coefficient can be seen from the correlation between the indicators, indicating that the data is suitable for factor analysis.

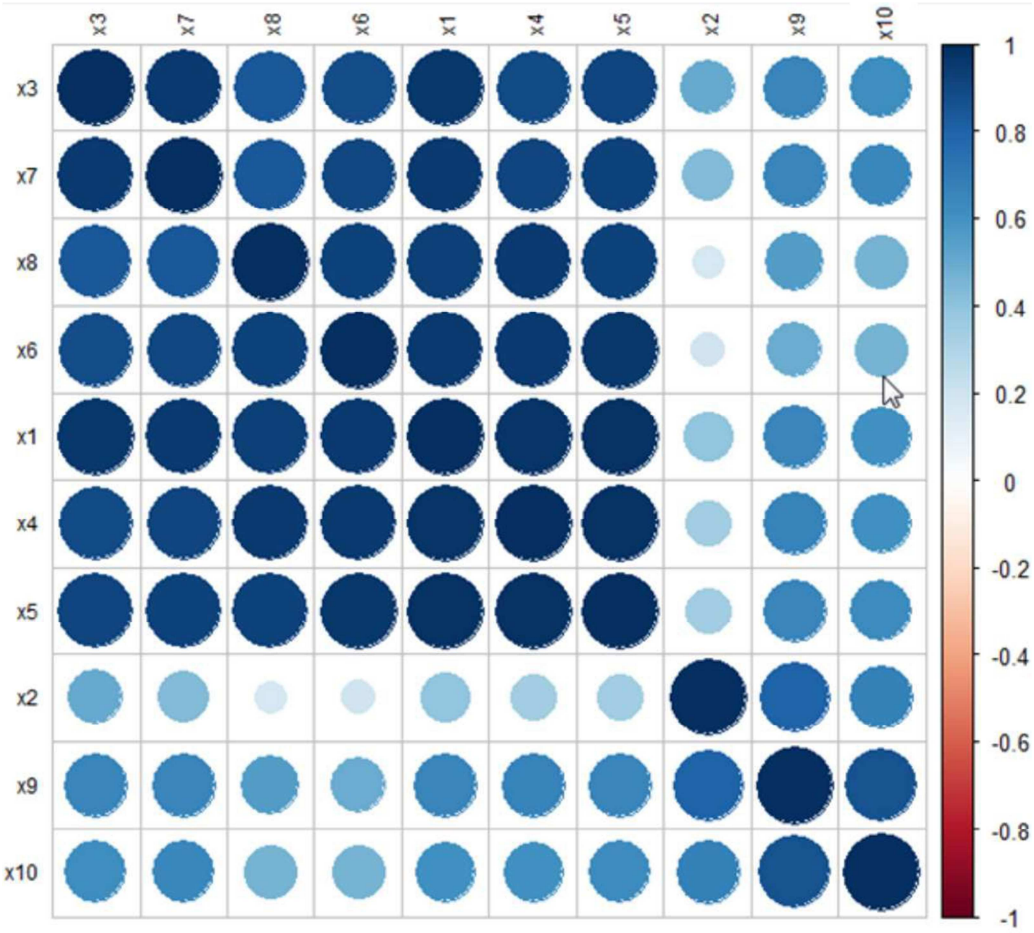

Figure 1. *Correlation coefficients of each index.*

2.2.2. Extraction of Common Factors

This paper chooses the maximum likelihood method to withdraw the public factor, and USES the eigenvalue criterion and factor with the method of cumulative variance contribution rate to determine the number of extract the public factor, namely select characteristic value is greater than or equal to 1 factor as a common factor, the cumulated variance contribution ratio factor number at the same time satisfy the above 85%. Through R software, the eigenvalue and contribution rate of the public factors are obtained, as shown in table 2, and the factor loading matrix of each index, as shown in table 3.

Table 2. *The characteristic value of public factor and its contribution rate.*

Common factor	The eigenvalue	Variance contribution rate	The cumulative variance contribution rate
F_1	7.477	0.748	0.748
F_2	1.620	0.162	0.910

Table 3. *Factor loading matrix.*

index	Common factor	
	F_1	F_2
X_1 Gross regional product	0.991	
X_2 GDP per capita	0.363	0.813
X_3 Secondary industry output value	0.936	0.112
X_4 Tertiary industry output value	0.988	
X_5 Local revenue	0.994	
X_6 Public finance budget expenditure	0.970	-0.201
X_7 Total social fixed asset investment	0.944	
X_8 Total retail sales of consumer goods	0.939	-0.124
X_9 The per capita disposable income of urban residents	0.658	0.699
X_{10} The per capita disposable income of rural residents	0.613	0.629

2.2.3. Naming of Common Factors

It can be seen from the results that the variance explained by the first two factors accounts for 91% of the whole variance, which can fully reflect the information of ten indicators. So this paper choose the first two factors as public factor, maximum variance orthogonal rotation (Varimax) method is adopted to improve the factor, characteristic value and its contribution to public factor is obtained, as shown in table 4, as well as various indicators of the orthogonal rotation factor loading matrix, as shown in table 5

Table 4. *The eigenvalue and contribution rate of the public factors after Varimax method is rotated.*

Common factor	The eigenvalue	Variance contribution rate	The cumulative variance contribution rate
F_1	6.227	0.623	0.623
F_2	2.870	0.287	0.910

Table 5. *The factor loading matrix after rotation.*

index	Common factor	
	F_1	F_2
X_1 Gross regional product	0.930	0.344
X_2 GDP per capita	0.887	
X_3 Secondary industry output value	0.849	0.410
X_4 Tertiary industry output value	0.934	0.323
X_5 Local revenue	0.942	0.317
X_6 Public finance budget expenditure	0.983	0.125
X_7 Total social fixed asset investment	0.867	0.381
X_8 Total retail sales of consumer goods	0.928	0.187
X_9 The per capita disposable income of urban residents	0.395	0.875
X_{10} The per capita disposable income of rural residents	0.375	0.794

Factor loading is the correlation coefficient between the common factor and the variable, and the greater the absolute value of the load, the more the public factor can replace the variable [4]. The rotation component matrix is the factor loading matrix after the rotation process, which makes the information of each factor load distribution clearer, and it is easier to explain the practical significance of each factor. According to the principle of absolute value is greater than 0.6 factor loading information, you can see the common factor in GDP, per capita GDP, the second industry output value, the output value of the third industry, the local fiscal revenue, the local budgetary expenditures, the whole society fixed asset investment, total retail sales of social consumer goods have larger load, these indicators represents a region's economic strength, so it named as "urban comprehensive economic strength factor". In public factor, urban per capita disposable income and rural per capita disposable income has great load, mainly reflects the local people's living standards, so it named "city residents living standards factor".

2.2.4. Public Factor Score and Comprehensive Score of Each Prefecture-Level City

Using R software to calculate bartlett factor scores, the factor scoring matrix was obtained, as shown in table 6. The variance contribution rate corresponding to each public factor is divided by the contribution rate of the accumulated variance to the weight, and the score of the comprehensive factor is obtained. The scoring values of 17 prefecture-level cities in Shandong province were calculated using R and the scores of combined factors were calculated, as shown in table 7.

Table 6. *Factor score matrix.*

city	Common factor	
	F_1	F_2
Jinan	0.992764608	0.89472055
Qingdao	2.854184686	0.53483885
Zibo	-0.201078203	0.81713025
Zaozhuang	-0.669022144	-0.44333047
Dongying	-1.074274496	2.16654679
Yantai	0.827615314	0.87914781
Weifang	0.749978275	-0.05780207
Jining	0.393255619	-0.64420051
Tai'an	-0.334916305	-0.12322294
Weihai	-0.726408218	1.33878465
Rizhao	-0.883730122	-0.25475389
Laifu	-1.450263226	0.28913505
Linyi	0.378323994	-0.95283387
Dezhou	-0.150173723	-1.18547536
Liaocheng	-0.166421744	-1.26296898
Binzhou	-0.532465585	-0.17241391
Heze	-0.007368731	-1.82330196

Table 7. *The scores and scores of public factors in different prefectures.*

City	F_1		F_2		F	
	score	ranking	score	ranking	score	ranking
Qingdao	2.854184686	1	0.53483885	6	21.2175775	1
Jinan	0.992764608	2	0.89472055	3	9.6151574	2
Yantai	0.827615314	3	0.87914781	4	8.4359503	3
Weifang	0.749978275	4	-0.05780207	8	4.9496954	4
Zibo	-0.201078203	10	0.81713025	5	1.2011537	5
Jining	0.393255619	5	-0.64420051	13	0.6592827	6
Linyi	0.378323994	6	-0.95283387	14	-0.4162744	7
Dongying	-1.074274496	16	2.16654679	1	-0.5181516	8
Weihai	-0.726408218	14	1.33878465	2	-0.7483869	9
Taian	-0.334916305	11	-0.12322294	9	-2.6804106	10
Binzhou	-0.532465585	12	-0.17241391	10	-4.1873529	11
Dezhou	-0.150173723	8	-1.18547536	15	-4.7664242	12
Liaocheng	-0.166421744	9	-1.26296898	16	-5.1220101	13
Heze	-0.007368731	7	-1.82330196	17	-5.800837	14
Zaozhuang	-0.669022144	13	-0.44333047	12	-5.9762191	15
Rizhao	-0.883730122	15	-0.25475389	11	-6.8506936	16
Laiwu	-1.450263226	17	0.28913505	7	-9.0120566	17

As can be seen from the above results, Qingdao is the city with the first score, which is much higher than that of other cities in Shandong province. As an important economic center and coastal open city in China, Qingdao city is an important reason for the economic development of its economic development and geographical advantage.

Jinan narrowly over became scoring the second city of Yantai, this paper can see from the original index data of the second industry output value is far lower than the Yantai city, Jinan this to a certain extent, shows the old industrial city of Jinan is relatively weak, the second industry development need to adjust the industrial structure, otherwise the gap as the provincial capital Jinan and coastal city of Shandong province only will be more and more big. And Yantai city as the coastal open city, its geographical advantage has gradually appeared.

Weifang city has a certain advantage over Zibo as the fourth city in the ranking, and Weifang has been strengthening its comprehensive economic strength in recent years. Zibo city, located in the middle of Shandong province, is known as the "capital of porcelain", but its economic development has been relatively slow in recent years and its comprehensive strength has been declining.

2.3. Cluster Analysis of Economic Development Level in Shandong Province

Cluster analysis is one of the methods to study the problem of "birds of a feather" in statistics, which belongs to the category of multivariate statistical analysis. The basic principle of it is, according to the sample's own properties, using mathematical method according to the index of some similarities or differences, quantitatively determine the affinity-disaffinity relationship between samples, and according to the degree of the affinity-disaffinity relationship to clustering samples [5]. The commonly used clustering methods are: k-means clustering method, system clustering method, etc. This paper adopts system clustering method. The basic idea of system clustering method is to start each sample as a class, and stipulate the distance between the samples and the distance between the class and the class; Then the nearest two classes are merged into a new class to calculate the distance between the new class and the other classes. Repeat two recent classes of merges, one at a time, until all samples are merged into one class [6].

In the cluster analysis should consider whether to reduce the index, select some representative indicators. In order to get a more accurate classification, most of the information must be obtained, so a large number of index variables are used. However, if the index variables are too many and interrelated, it is easy to cause the cluster analysis to be difficult to grasp the key points and may result in inaccurate classification. By weighing the pros and cons, this paper uses the method of factor analysis and cluster analysis to analyze: First, factor analysis to reduce the dimension, select a few key representative indicators, and then cluster analysis to ensure that more than 90% Based on the information clustering analysis, to better classification [7]. Therefore, this paper selects and uses these two public factors as the index to cluster the 17 prefecture-level cities in Shandong Province.

3. Result

Using R software to cluster Table 6, the results shown in Figure 2.

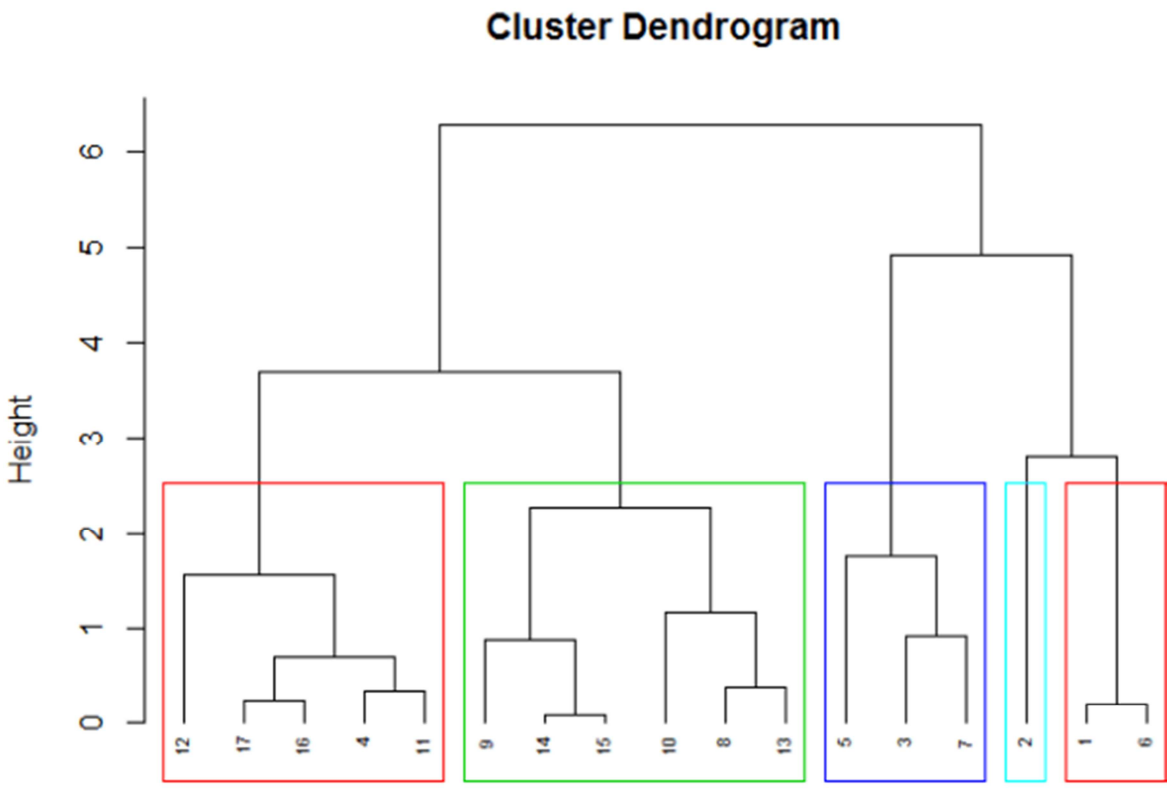

Figure 2. *The results of cluster analysis using R language.*

According to figure 2, the economic development level of 17 prefecture-level cities in Shandong province is divided into five categories. The first category: 2 Qingdao city. The second category: 1 Jinan city, 6 Yantai city. The third category: 3 Zibo city, 5 Dongying city, 7 Weifang city. The fourth category: 8 Jining city, 9 Tai'an City, 10 Weihai city, 13 Linyi city, 14 Dezhou city, 15 Liaocheng city. The fifth category: 4 Zaozhuang city, 11 Rizhao city, 12 Laiwu city, 16 Binzhou city, 17 Heze city.

4. Discussion

The first city, Qingdao city's overall development level is much higher than other cities, the indicators are ahead, in the process of development in the future, the government can consciously to invest to central and western regions in east China's Shandong province, in order to balance the economic development of each city.

The second type of cities, Jinan city and Yantai city, Jinan city is the capital of Shandong province, its political advantages to promote the economic development of Jinan, Jinan has gradually lag behind the coastal cities, but in the course of future development should pay attention to accelerate industrial structure adjustment, especially the industrial structure adjustment, the gap is bigger and the coastal cities. Yantai city's economy has entered a high-speed development stage, the advantage should continue to maintain.

Cities in the third category, Zibo city, Dongying city and Weifang city, have lagged behind Qingdao city, Yantai city and Jinan city, but are stronger than the comprehensive economic strength of the fourth category. From the index data, it can be seen that they all have their own advantage resources. In the future, they should pay attention to give full play to their advantages. Zibo city economic pillar industry, for example, as a mainly industrial city, air pollution is more serious, so the Zibo city should be in the economic development at the same time, pay more attention to the improvement of the environment, strengthen the development of the tertiary industry [9].

The fourth class city, Jining city, Tai'an City, Weihai city, Linyi city, Dezhou city and Liaocheng city, this a few cities in the general level of economic development, should according to the market demand, play to local advantages, realize own rationalization of industrial structure and the fundamentals. Weihai city is a new coastal city with superior urban environment. It should take full advantage of its environment and vigorously develop the coastal tourism industry to promote economic development. Tai'an City is famous for Mount Taishan, and should make full use of its geographical advantages to develop tourism and related services.

The fifth kind of cities, Zaozhuang city, Rizhao city, Laiwu city, Binzhou city and Heze city, the indexes of these cities are not very high, the economic development is relatively backward, the economic foundation is weak. In the future, this paper should pay more attention to the development of the city itself, seize the favorable opportunity, improve the industrial structure, and use its advantages to enhance the comprehensive economic strength.

5. Conclusion

The overall strength of most cities in Shandong Province is not strong and how to develop the economy in these regions is the key to the economic growth in Shandong. These regions should step out of a sustainable economic development path by focusing on enhancing their economic development capabilities and drawing on the successful experiences of the eastern coastal areas and the well-developed cities of Weifang and Jining in recent years.

To achieve coordinated economic development of the cities in Shandong province, it should be on the basis of guarantee the stability of the existing economic development, strengthening regional economic cooperation between, help to improve the level of economic competitiveness in economically backward. The eastern coastal areas should support and support the central and western regions of the central and western regions. In the process of economic cooperation, this paper should give preferential conditions to the central and western regions. The central and western regions should also break the traditional situation of regional blockades in the supply of energy and raw materials, and rationally allocate resources.

At the same time, cities in different levels of economic development should give full play to their local advantages in accordance with market demands, and continuously realize rationalization and high level of their industrial structure [10]. The industrial structure of east and west of Shandong province is complementary, which will be very beneficial to the coordinated development of regional economy. In this way, this paper can improve the macro-economic efficiency, enhance the economic strength of the whole province, and promote the take-off of the whole economy.

Acknowledgements

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