# Research on the Economic Development Level of 31 Provinces and Cities Based on Cluster Analysis and Factor Analysis

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**Abstract:** In order to measure the economic development level, get the analysis conclusions of Chinese provinces and cities, and adjust the development strategy timely, the article does research on important indicators of comprehensive development level. The analysis of the economic development level indicators of Chinese provinces and cities adopts Cluster analysis and factor analysis. The article uses those to classify the economic development level across the country, and evaluate the economic development level of each province and city. The economic development level of each province and city is uneven. It means the economically developed regions are divided into one group, while the economically backward areas are divided into another group. The economic development level of each province and city does not differ much within the group, but there are significant differences between the groups. The economic development level of economically developed regions is higher than other regions, but the same region also has differences in different evaluation factors. As a result, the article aims to discover the problems in the economic development of Chinese provinces and cities, and provide policy suggestions for formulating the economic development strategies of the provinces and cities.

**Keywords:** The economic development level; factor analysis; evaluation

## 1. Introduction

To evaluate the level of economic development, many studies usually use Gross Domestic Product (GDP). GDP can directly reflect the level of economic development in a region and has guiding significance for evaluating the economic development in regions. However, only considering the level of economic development from GDP is not comprehensive enough. So there are remained many unexplained aspects of economic development. This article selects the overall development status, Per capita development level, as well as the consumption and expenditure of households, enterprises and the government as the angle of analysis and evaluation. The regional GDP (100 million Yuan), per capita GDP (Yuan/person), per capita disposable income (Yuan), per capita consumption expenditure of residents (Yuan), real estate development investment (100 million Yuan), local fiscal general budget revenue (100 million Yuan), local fiscal general budget expenditure (100 million Yuan) are the variable corresponding to each evaluation angle so as to further the study.

Literature research shows that it is feasible to use Statistical Product and Service Solution (SPSS) software to establish a regional economic development level model using cluster analysis and factor analysis. What's more, the regional economic development level can be divided into 7 indicators for analysis and evaluation of the economic development level. The research content can use cluster analysis and factor analysis simultaneously. Judging from the main domestic research, there are many studies evaluating and analyzing the level of economic development but the content of the research is written from different angles. This article considers the status quo and future development, and based on cluster analysis and factor analysis of regional economic development level. In this work, the article tries to evaluate the economic development of Chinese provinces and cities and provides the suggestions.

Lu Di, Wang Guanhua (2019) used factor analysis and cluster analysis at the same time to conduct research [1]. Guo Ke, Pan Junfeng, Wang Lantu (2006) used factor analysis to analyze, extracted three factors of regional development: industrial development factor, benefit development Factors and agricultural development factors, and sort the different regions based on factor scores [2]. Tang Lin (2015) used SPSS to analyze the principal component of the data, dividing and evaluating the economic development level of each region [3]. Liu Qinpu (2002) established an evaluation index system, and then processed the original data to obtain indicators representing economic levels [4]. Chen Jia, Wu Runheng, and Liu Xibo (2007) used cluster analysis to study 26 major economic development indicators in 31 provinces and cities across the country in 2004 [5].

## 2. Research Foundation

### 2.1. Data Sources

The article collected the economic development indicators of 31 provinces and cities in 2019 from the website of National Bureau of Statistics. The data include 7 regional economic development analysis indicators. It contains a total of 31 cases and 8 variables. The units of each data are different, so the data were standardized and were shown in Table 1.

**Table 1.** Processed data

| **Region** | **ZX1** | **ZX2** | **ZX3** | **ZX4** | **ZX5** | **ZX6** | **ZX7** |
|---|---|---|---|---|---|---|---|
| *Beijing* | 0.13821 | 2.90488 | 3.00093 | 2.80949 | -0.11655 | 0.92613 | 0.24462 |
| *Tianjin City* | -0.68135 | 0.64639 | 0.95098 | 1.34646 | -0.42044 | -0.30802 | -0.89724 |
| *Hebei Province* | 0.12793 | -0.69994 | -0.40257 | -0.46735 | 0.02263 | 0.17465 | 0.50975 |
| *Shanxi Province* | -0.56873 | -0.71903 | -0.55105 | -0.74527 | -0.71358 | -0.33073 | -0.54456 |
| *Inner Mongolia Autonomous Region* | -0.56157 | -0.0423 | -0.00714 | -0.10682 | -0.88174 | -0.435 | -0.4319 |
| *Liaoning Province* | -0.26496 | -0.36834 | 0.09513 | 0.08408 | -0.3914 | -0.22046 | -0.2376 |
| *Jilin Province* | -0.77297 | -0.78781 | -0.49166 | -0.45582 | -0.80688 | -0.77656 | -0.77288 |
| *Heilongjiang Province* | -0.7003 | -1.01082 | -0.51667 | -0.45109 | -0.90471 | -0.72375 | -0.45718 |
| *Shanghai* | 0.24549 | 2.6926 | 3.13723 | 3.14525 | -0.00902 | 1.41445 | 0.47039 |
| *Jiangsu Province* | 2.61458 | 1.66283 | 0.86976 | 0.67199 | 2.11927 | 2.00755 | 1.75713 |
| *Zhejiang Province* | 1.17794 | 1.17403 | 1.557 | 1.36899 | 1.75633 | 1.37203 | 1.01904 |
| *Anhui Province* | 0.20536 | -0.32843 | -0.34189 | -0.3169 | 0.6584 | -0.02826 | 0.23957 |
| *Fujian Province* | 0.40888 | 1.1592 | 0.4021 | 0.49108 | 0.38549 | -0.07528 | -0.43209 |
| *Jiangxi Province* | -0.27081 | -0.49149 | -0.35423 | -0.5114 | -0.55416 | -0.2804 | -0.04986 |
| *Shandong Province* | 1.51382 | 0.04336 | 0.07712 | -0.14815 | 1.19044 | 1.18316 | 1.21928 |
| *Henan Province* | 0.86608 | -0.3929 | -0.54505 | -0.68389 | 0.87569 | 0.28294 | 1.05514 |
| *Hubei Province* | 0.54119 | 0.24931 | -0.1879 | 0.00092 | 0.23187 | 0.04631 | 0.40844 |
| *Hunan Province* | 0.30703 | -0.35766 | -0.23963 | -0.14142 | 0.04957 | -0.09185 | 0.44476 |
| *Guangdong Province* | 2.9244 | 0.76263 | 0.67688 | 0.9725 | 3.17078 | 3.40191 | 3.14523 |
| *Guangxi Zhuang Autonomous Region* | -0.40648 | -0.80344 | -0.5915 | -0.67257 | -0.12311 | -0.52478 | -0.21196 |
| *Hainan* | -1.0203 | -0.38926 | -0.32051 | -0.26229 | -0.80123 | -0.88623 | -1.38028 |
| *Chongqing* | -0.3152 | 0.20163 | -0.13931 | -0.10284 | 0.04788 | -0.40778 | -0.50513 |
| *Sichuan Province* | 0.57153 | -0.41167 | -0.48032 | -0.29062 | 0.63179 | 0.29348 | 1.10589 |
| *Guizhou Province* | -0.57865 | -0.69734 | -0.82849 | -0.88688 | -0.34847 | -0.54091 | -0.19076 |
| *Yunnan Province* | -0.32992 | -0.65113 | -0.69223 | -0.75609 | -0.0309 | -0.43 | 0.05775 |
| *Tibet Autonomous Region* | -1.15946 | -0.62184 | -0.90094 | -1.11589 | -1.1314 | -1.10073 | -1.28605 |
| *Shaanxi Province* | -0.2309 | -0.07909 | -0.4833 | -0.53567 | -0.09869 | -0.35241 | -0.24928 |
| *Gansu province* | -0.88891 | -1.10831 | -0.93024 | -0.74311 | -0.82266 | -0.87315 | -0.76606 |
| *Qinghai Province* | -1.11059 | -0.61942 | -0.64895 | -0.52522 | -1.05568 | -1.07894 | -1.37892 |
| *Ningxia Hui Autonomous Region* | -1.08043 | -0.45929 | -0.50387 | -0.42686 | -1.05655 | -1.02772 | -1.50347 |
| *Xinjiang Uygur Autonomous Region* | -0.7009 | -0.45736 | -0.60968 | -0.54461 | -0.87296 | -0.60965 | -0.38178 |

### 2.2. Ideas of Research

This article first processes the economic development data of 31 provinces and cities, then uses cluster analysis to observe the similarities and differences of economic development levels, and then uses factor analysis which is conducted by principal component analysis to evaluate the economic development levels of provinces and cities. The specific ideas are shown in the Figure 1.

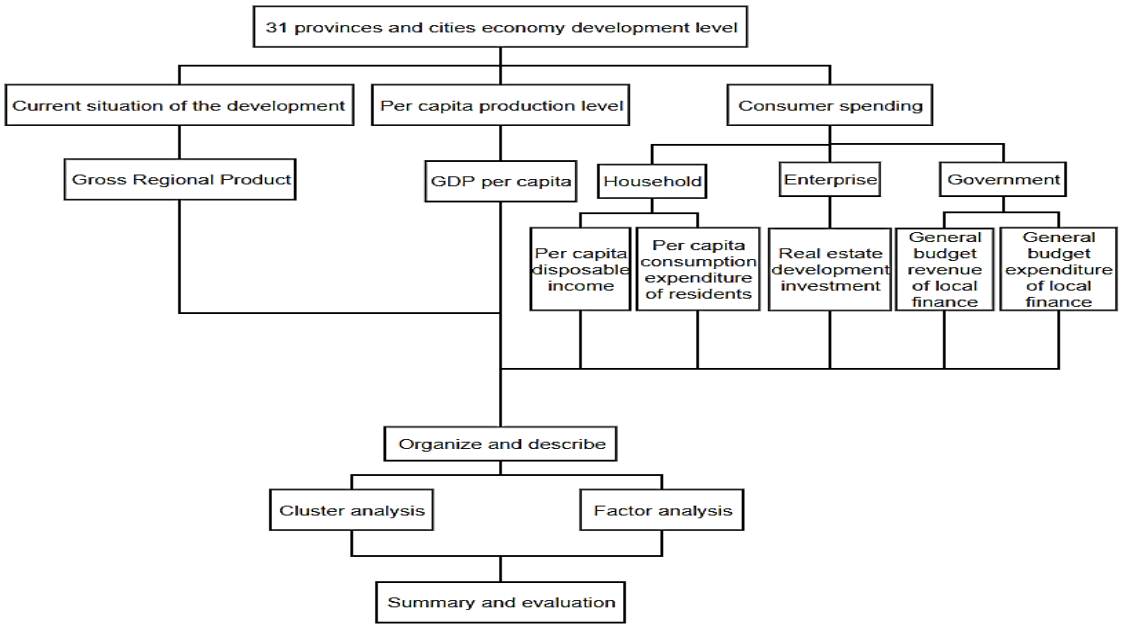


**Figure 1.** Ideas of research

2.3. Used Indicators

The 7 indicators used in this article are shown in the Table 2.

**Table 2.** Used indicators

| Point of view | Variable name | Used indicators |
|---|---|---|
| The overall development status of the region | X1 | Regional GDP (100 million Yuan) |
| Per capita development level | X2 | capita GDP (Yuan/person) |
| Consumption expenditures(Household) | X3 | Residents' per capita disposable income (Yuan) |
| | X4 | Per capita consumption expenditure of residents (Yuan) |
| Consumption expenditures(Enterprise) | X5 | Real Estate Development Investment (100 million Yuan) |
| Consumption expenditures(Government) | X6 | General budget revenue of local finance (100 million Yuan) |
| | X7 | General budget expenditure of local finance (100 million Yuan) |

Using the cluster analysis method in SPSS software, the article can classify the economic development level of each province and city. Using the principal component factor analysis, the article compares the classification results of each province and city. Therefore, the article can evaluate the economic development level of each province and city.

This article studies the economic development level of 31 provinces and cities, from the perspective of overall development status, per capita development level, and consumption expenditure. Among them, the overall development level and per capita development level refers to the regional GDP and the per capita disposable income of residents respectively. The consumption expenditure situation is further divided into the income and expenditure of households, enterprises and government.

## 3. Research and Analysis

3.1. Basic Description and Analysis of Data

**Table 3.** Descriptive Statistics Table

| Used indicators | Number | Minimum value | Maximum value | Mean value | Standard deviation |
|---|---|---|---|---|---|
| Regional GDP (100 million Yuan) | 31 | 1697.82 | 107671.07 | 31784.9390 | 25949.27701 |
| Capita GDP (Yuan/person) | 31 | 32995.00 | 164220.00 | 69235.0645 | 32698.43015 |
| Residents' per capita disposable income (Yuan) | 31 | 19139.02 | 69441.56 | 30643.2877 | 12367.04924 |
| Per capita consumption expenditure of residents (Yuan) | 31 | 13029.21 | 45605.14 | 21560.0519 | 7644.89366 |
| Real Estate Development Investment (100 million Yuan) | 31 | 129.56 | 15852.16 | 4264.3313 | 3654.56548 |
| General budget revenue of local finance (100 million Yuan) | 31 | 222.00 | 12651.46 | 3260.5426 | 2760.48426 |
| General budget expenditure of local finance (100 million Yuan) | 31 | 1438.40 | 17314.12 | 6572.8665 | 3415.08843 |
| Valid Number (list status) | 31 | | | | |

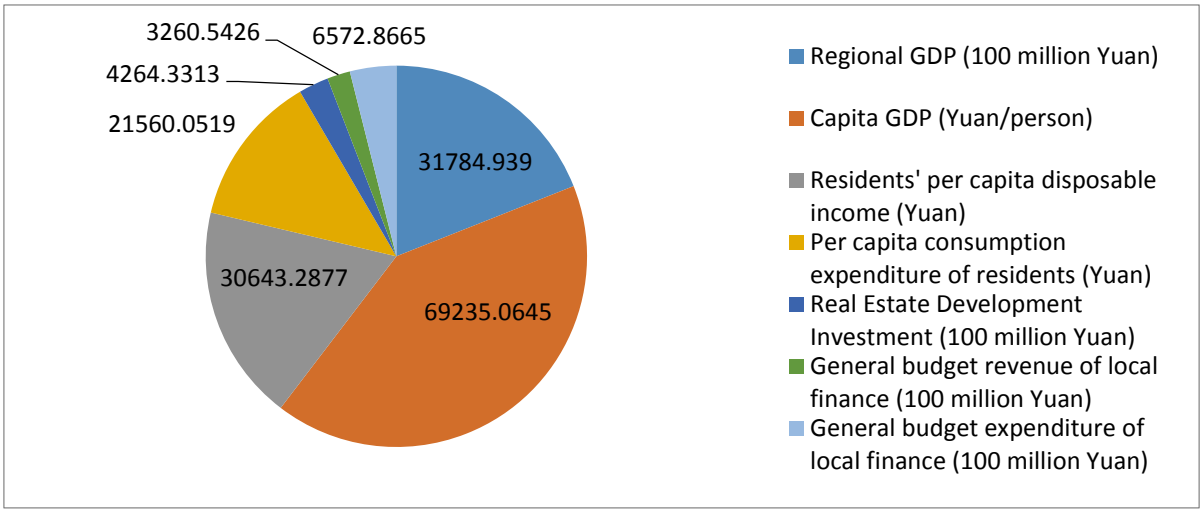


**Figure 2.** DESCRIPTIVE STATISTICS graph

From the descriptive statistics Table 3 and Figure 2, the number of cases in regions is all 31. From the average point of view, average per capita disposable income of residents is more than average per capita consumption expenditure of residents, and average general budget expenditure of local finance is more than average general budget revenue of local finances. Regional GDP, per capita GDP, and per capita disposable income of residents have high standard deviation. It shows that there is a large income gap between regions and between individuals. Furthermore, the level of economic development in regions is very different, and the income level of each person is also very different.

In each indicator, the advantages of the economic development level in each province and city are also different. At the same time, the income distribution of different regions and different groups of people is very uneven. Therefore, each province and city should coordinate income distribution, pay attention to keep balance, give full play to their own advantages, and use various policies promote economic development.

## 4. Analysis and Verification of Research Assumptions

### 4.1. Cluster Analysis

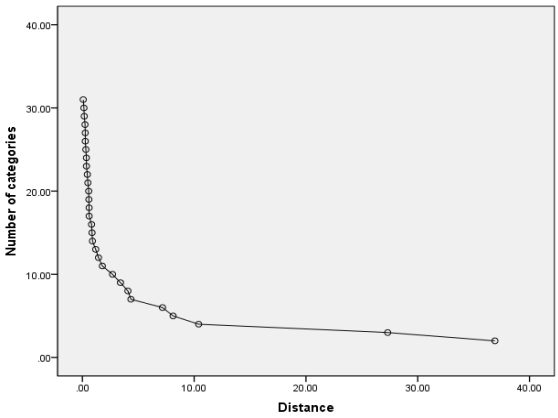


**Figure 3.** Scree plot of Cluster analysis

According to the clustering analysis method, the scree plot is drawn. Judging from the Figure 3, it should be classified into three types.

**Table 4.** The table of Cluster member

| Cluster member | | | |
|---|---|---|---|
| ***Case*** | ***3 Cluster*** | ***Case*** | ***3 Cluster*** |
| 1:Beijing | 1 | 20:Guangxi Zhuang Autonomous Region | 2 |
| 9:Shanghai | 1 | 21:Hainan Province | 2 |
| 2:Tianjin | 2 | 22:Chongqing City | 2 |
| 3:Hebei Province | 2 | 23:Sichuan Province | 2 |
| 4:Shanxi Province | 2 | 24:Guizhou Province | 2 |
| 5:Inner Mongolia Autonomous Region | 2 | 25:Yunnan Province | 2 |
| 6:Liaoning Province | 2 | 26:Tibet Autonomous Region | 2 |
| 7:Jilin Province | 2 | 27:Shaanxi Province | 2 |
| 8:Heilongjiang Province | 2 | 28:Gansu Province | 2 |
| 12:Anhui Province | 2 | 29:Qinghai Province | 2 |
| 13:Fujian Province | 2 | 30:Ningxia Hui Autonomous Region | 2 |
| 14:Jiangxi Province | 2 | 31:Xinjiang Uygur Autonomous Region | 2 |
| 15:Shandong Province | 2 | 10:Jiangsu Province | 3 |
| 16:Henan Province | 2 | 11:Zhejiang Province | 3 |
| 17:Hubei Province | 2 | 19:Guangdong Province | 3 |
| 18:Hunan Province | 2 | | |

According to the Table 4, the article classifies the regions based on 3 clusters.

The first cluster: Beijing and Shanghai. It can be known that the economic development levels of Beijing and Shanghai are significantly different from those of other regions. According to the actual situation, it can be known that Beijing and Shanghai are economically developed regions with high economic development levels.

The second cluster: Except for other regions in Beijing, Shanghai, Jiangsu, Zhejiang, and Guangdong, the economic development levels of these regions are similar. They are economically underdeveloped regions. Therefore, they should develop their economies based on their own advantages.

The third cluster: Jiangsu, Zhejiang, and Guangdong Province. These regions have approximate developed economies. Although their level is a little lower than that in the first cluster, they are still economically developed regions with a high level of economic development.

## 4.2. Factor Analysis

### *4.2.1. Judge the conditions of factor analysis*

**Table 5.** Kaiser-Meyer-Olkin and Bartlett's test

| **The Kaiser-Meyer-Olkin measure of sample adequacy.** | | **0.808** |
|---|---|---|
| Bartlett's sphericity test | *Approximate chi-square* | 406.041 |
| | *Degree of freedom* | 21 |
| | *Significance* | 0.000 |

Learning from the Table 5, if the significance level $\alpha$=0.05, because P-=0.000 is less than 0.05, the null hypothesis should be rejected. And the correlation coefficient matrix and the unit matrix are considered to be significantly different. At the same time, the KMO=0.808. According to the KMO metric, the original variables are suitable for factor analysis.

### *4.2.2. The number of factors extracted and their extraction instructions*

**Table 6.** The first Common factor variance

| **Common factor variance (1)** | | |
|---|---|---|
| ***Variables*** | ***Initial*** | ***Extraction*** |
| Regional GDP (100 million Yuan)[a] | 1.000 | 0.781 |
| Capita GDP (Yuan/person)[a] | 1.000 | 0.658 |
| Residents' per capita disposable income (Yuan)[a] | 1.000 | 0.597 |
| Per capita consumption expenditure of residents (Yuan)[a] | 1.000 | 0.584 |
| Real Estate Development Investment (100 million Yuan)[a] | 1.000 | 0.731 |
| General budget revenue of local finance (100 million Yuan)[a] | 1.000 | 0.933 |
| General budget expenditure of local finance (100 million Yuan)[a] | 1.000 | 0.706 |

[a]Extraction method: principal component analysis.

When one factor is specified to be extracted, the Table 6 shows that the information of most variables can be explained by the factors, and the loss of information on these variables is less. However, the information of capita GDP (Yuan/person), residents' per capita disposable income of residents (Yuan), and per capita consumption expenditure of residents (Yuan) is lost seriously. Therefore, the overall effect of this factor extraction is not ideal.

**Table 7.** THE second COMMON FACTOR VARIANCE

| **Common factor variance (2)** | | |
|---|---|---|
| ***Variables*** | ***Initial*** | ***Extraction*** |
| Regional GDP (100 million Yuan)[a] | 1.000 | 0.977 |
| Capita GDP (Yuan/person)[a] | 1.000 | 0.951 |
| Residents' per capita disposable income (Yuan)[a] | 1.000 | 0.989 |
| Per capita consumption expenditure of residents (Yuan)[a] | 1.000 | 0.980 |
| Real Estate Development Investment (100 million Yuan)[a] | 1.000 | 0.955 |
| General budget revenue of local finance (100 million Yuan)[a] | 1.000 | 0.972 |
| General budget expenditure of local finance (100 million Yuan)[a] | 1.000 | 0.952 |

[a]Extraction method: principal component analysis.

When two factors are specified to be extracted, it can be seen from the Table 7 that the information of all variables can be explained by factors. And the information of each variable is less lost, so the overall effect of this factor extraction is ideal.

**Table 8.** Explained total variance

| **Component** [a] | **Initial eigenvalue** | | | **Extract the sum of square loads** | | | **Extract the rotating square sum load** | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***Total*** | ***Percentage of variance*** | ***Cumulative percentage*** | ***Total*** | ***Percentage of variance*** | ***Cumulative percentage*** | ***Total*** | ***Percentage of variance*** | ***Cumulative percentage*** |
| 1 | 4.991 | 71.297 | 71.297 | 4.991 | 71.297 | 71.297 | 3.696 | 52.794 | 52.794 |
| 2 | 1.785 | 25.502 | 96.799 | 1.785 | 25.502 | 96.799 | 3.080 | 44.005 | 96.799 |
| 3 | 0.114 | 1.622 | 98.421 | | | | | | |
| 4 | 0.054 | 0.771 | 99.192 | | | | | | |
| 5 | 0.030 | 0.432 | 99.624 | | | | | | |
| 6 | 0.016 | 0.235 | 99.859 | | | | | | |
| 7 | 0.010 | 0.141 | 100.000 | | | | | | |

[a]Extraction method: principal component analysis.

According to the Table 8, since 7 factors are extracted in the initial solution, the total variance of the original

variables is explained, and the contribution rate of the cumulative variance is 100%. After the factor is rotated, the total cumulative variance contribution rate does not change, that is, it does not affect the commonness of the original variables. But it redistributes each factor to explain the variance of the original variables, changes the variance contribution of each factor, and makes the factor be explained easily.

Since 2 factors are specified to be extracted, 2 factors explain 96.799% of the total variance of the original variables. In general, the original variables have less information lost, and the effect of factor analysis is better.

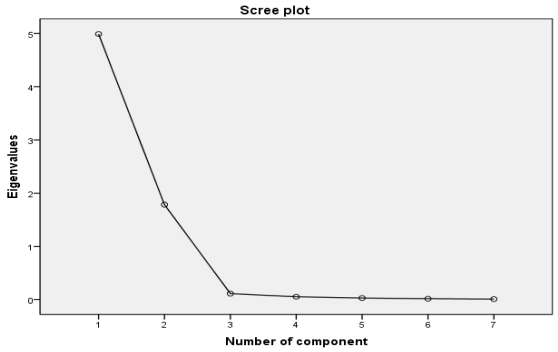


**Figure 4.** Scree plot of factor analysis

According to the Figure 4, the eigenvalue of the first factor is very high and contributes the most to the explanatory variable. The eigenvalues of the third and subsequent factors are all small and contribute little to the interpretation of the original variables, so it is appropriate to extract two factors.

**Table 9.** Component matrixb

| Variables | Component | |
|---|---|---|
| | ***1*** | ***2*** |
| Regional GDP (100 million Yuan)[a] | 0.966 | -0.197 |
| Capita GDP (Yuan/person)[a] | 0.884 | -0.443 |
| Residents' per capita disposable income (Yuan)[a] | 0.855 | -0.473 |
| Per capita consumption expenditure of residents (Yuan)[a] | 0.840 | -0.496 |
| Real Estate Development Investment (100 million Yuan)[a] | 0.811 | 0.541 |
| General budget revenue of local finance (100 million Yuan)[a] | 0.773 | 0.626 |
| General budget expenditure of local finance (100 million Yuan)[a] | 0.764 | 0.629 |

[a]Extraction method: principal component analysis.

[b]2 component have been extracted

According to the results in the Table 9, the article obtains factor analysis model:

Regional GDP (100 million Yuan) $=0.966f_1-0.197f_2$

Capita GDP (Yuan/person) $=0.844f_1-0.443f_2$

Residents' per capita disposable income (Yuan) $=0.855f_1-0.473f_2$

Per capita consumption expenditure of residents (Yuan) $=0.840f_1-0.496f_2$

Real Estate Development Investment (100 million Yuan) $=0.811f_1+0.541f_2$

General budget revenue of local finance (100 million Yuan) $=0.773f_1+0.626f_2$

General budget expenditure of local finance (100 million Yuan) $=0.764f_1+0.629f_2$

7 variables have high loads in the first factor, which means they have a high degree of correlation with the first factor, so the first factor is very important. The second factor has low correlation with the original. Its explanatory effect on the original variables is not significant. It can also be seen that the actual meaning of these two factors is rather vague.

*4.2.3. Factor naming*

**Table 10.** Rotating component matrixb

| Variables | Component | |
|---|---|---|
| | ***1*** | ***2*** |
| Regional GDP (100 million Yuan)[a] | 0.964 | 0.151 |
| Capita GDP (Yuan/person)[a] | 0.964 | 0.220 |
| Residents' per capita disposable income (Yuan)[a] | 0.961 | 0.178 |
| Per capita consumption expenditure of residents (Yuan)[a] | 0.871 | 0.462 |
| Real Estate Development Investment (100 million Yuan)[a] | 0.199 | 0.974 |
| General budget revenue of local finance (100 million Yuan)[a] | 0.190 | 0.971 |
| General budget expenditure of local finance (100 million Yuan)[a] | 0.282 | 0.933 |

[a]Extraction method: principal component analysis.

[b]Rotation method: Orthogonal rotation method with Kaiser standardization. The rotation converges after 3 iterations.

In the Table 10, Regional GDP (100 million Yuan), Capita GDP (Yuan/person), Residents' per capita disposable income (Yuan), and Per capita consumption expenditure of residents (Yuan) have a higher load on the first factor. The first factor mainly explains these variables, which can be interpreted as microeconomic development level. Real Estate Development Investment (100 million Yuan), General budget revenue of local finance (100 million Yuan), and General budget expenditure of local finance (100 million Yuan) have a higher load on the second factor. The second factor mainly explains these variables, which can be interpreted as the level of macroeconomic development level. Compared with the result without rotation, the meaning of the factor is clearer.

**Table 11.** Component score covariance matrix

| Component | ***1*** | ***2*** |
|---|---|---|
| ***1*** | 1.000 | 0.000 |
| ***2*** | 0.000 | 1.000 |

[a]Extraction method: principal component analysis.

[b]Rotation method: Orthogonal rotation method with Kaiser standardization.

It can be seen in the Table 11 that there is no linear correlation between the two factors, and achieves the design goal of factor analysis.

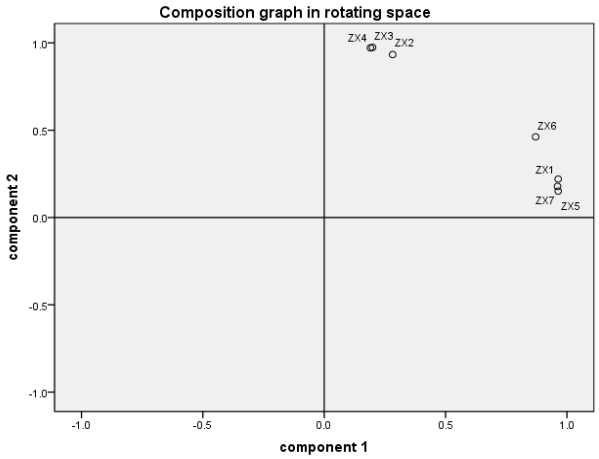


**Figure 5.** Composition graph in rotating space

According to the Figure 5, variables X2, X3, X4 are close to the coordinate axis of the first factor, and variables X5, X7 are close to the coordinate axis of the second factor. Other variables can all be described by two factors. It shows that there is less information lost when using two factors to describe each variable. The analysis is effective.

*4.2.4. Factor score function*

**Table 12.** Component score coefficient matrixb

| Variables | Component | |
|---|---|---|
| | ***1*** | ***2*** |
| Regional GDP (100 million Yuan)[a] | 0.294 | -0.079 |
| Capita GDP (Yuan/person)[a] | -0.067 | 0.337 |
| Residents' per capita disposable income (Yuan)[a] | -0.103 | 0.369 |
| Per capita consumption expenditure of residents (Yuan)[a] | -0.106 | 0.369 |
| Real Estate Development Investment (100 million Yuan)[a] | 0.301 | -0.096 |
| General budget revenue of local finance (100 million Yuan)[a] | 0.220 | 0.038 |
| General budget expenditure of local finance (100 million Yuan)[a] | 0.307 | -0.107 |

[a]Extraction method: principal component analysis.

[b]Rotation method: Orthogonal rotation method with Kaiser standardization. The rotation converges after 3 iterations.

According to the results in the Table 12, the article obtains two factors.

$F_1$=0.294 Regional GDP (100 million Yuan)-0.067 Capita GDP (Yuan/person)-0.103 Residents' per capita disposable income (Yuan)-0.106 Per capita consumption expenditure of residents (Yuan)+0.301 Real Estate Development Investment (100 million Yuan)+0.220 General budget revenue of local finance (100 million Yuan)+0.307 General budget expenditure of local finance (100 million Yuan)

$F_2$=-0.079 Regional GDP (100 million Yuan)+0.337 Capita GDP (Yuan/person)+0.369 Residents' per capita disposable income (Yuan)+0.369 Per capita consumption expenditure of residents (Yuan)-0.096 Real Estate Development Investment (100 million Yuan)+0.038 General budget revenue of local finance (100 million Yuan)-0.107 General budget expenditure of local finance (100 million Yuan)

When calculating the two factor scoring variables, the weights of local fiscal general budget expenditure, per capita disposable income of residents, and per capita consumption expenditure of residents are higher, but in the opposite direction. It is consistent with the actual meaning of the factors.

*4.2.5. Analysis and evaluation formula of the economic development level in provinces and cities*

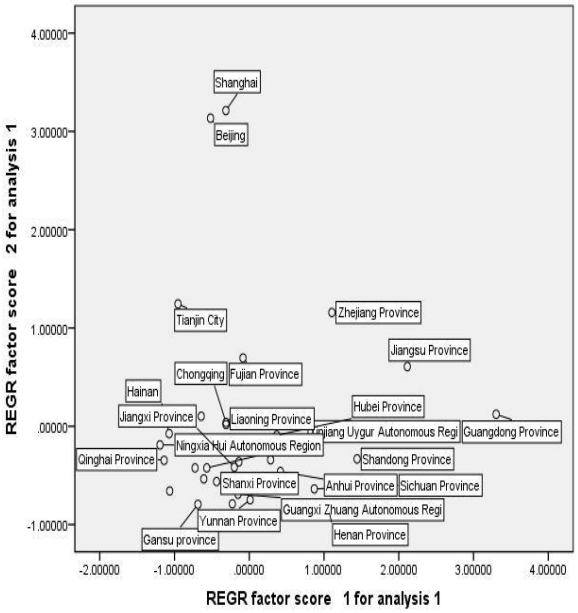


**Figure 6.** Scatter plot of two factor scores

According to the Figure 6, Shanghai, Beijing, Zhejiang, Jiangsu, and Guangdong are more special points while other regions are similar. Shanghai has the highest score for the second factor, indicating that its level of microeconomic development is much higher than that of other provinces. The score for the first factor is near the average, indicating that its level of macroeconomic development is not much different from other regions, and is on average. The scores of each factor in Zhejiang are high and above average. Therefore, Zhejiang's economic development level is relatively high. Guangdong's first factor scores the highest, indicating that the macroeconomic development level is much higher than that of other provinces. And the second factor score is on average, it indicates that the level of microeconomic development in Guangdong is not much different from other regions. Generally speaking, it can be seen that most of these regions are economically developed regions, and the level of economic development is at the forefront of the country no matter whether it is micro or macro.

Taking the variance contribution rate of the two factors as the weight, the calculation formula is F=0.53/ (0.53+0.44) $F_1$+0.44/ (0.53+0.44) $F_2$

Obtain the scores and rankings of 31 provinces and cities on 2 factors and their comprehensive factors, as

shown in the following Table 13.

**Table 13.** The table of scores of every region

| Region | F1 | Rank of F1 | F2 | Rank of F2 | F | Rank of F |
|---|---|---|---|---|---|---|
| Guangdong Province | 3.304284 | 1 | 0.122938 | 3 | 1.859953 | 1 |
| Jiangsu Province | 2.115461 | 2 | 0.607552 | 4 | 1.43087 | 2 |
| Shanghai | -0.31189 | 6 | 3.210531 | 11 | 1.28729 | 3 |
| Beijing | -0.51713 | 5 | 3.132278 | 5 | 1.139702 | 4 |
| Zhejiang Province | 1.105518 | 8 | 1.156773 | 7 | 1.128788 | 5 |
| Shandong Province | 1.442855 | 9 | -0.33097 | 2 | 0.637536 | 6 |
| Fujian Province | -0.08411 | 12 | 0.694298 | 1 | 0.269289 | 7 |
| Henan Province | 1.059342 | 14 | -0.84052 | 19 | 0.196804 | 8 |
| Sichuan Province | 0.870133 | 10 | -0.63619 | 15 | 0.186262 | 9 |
| Hubei Province | 0.367034 | 13 | -0.09193 | 16 | 0.158662 | 10 |
| Tianjin City | -0.95407 | 20 | 1.244078 | 27 | 0.043889 | 11 |
| Anhui Province | 0.416696 | 7 | -0.45991 | 10 | 0.018716 | 12 |
| Hunan Province | 0.285157 | 17 | -0.34123 | 29 | 0.000776 | 13 |
| Hebei Province | 0.377239 | 21 | -0.61707 | 6 | -0.07418 | 14 |
| Chongqing | -0.3113 | 18 | 0.037454 | 13 | -0.15297 | 15 |
| Liaoning Province | -0.31119 | 22 | 0.01755 | 30 | -0.16194 | 16 |
| Shaanxi Province | -0.13979 | 16 | -0.36166 | 17 | -0.24052 | 17 |
| Jiangxi Province | -0.19979 | 15 | -0.41578 | 18 | -0.29785 | 18 |
| Inner Mongolia Autonomous Region | -0.64391 | 3 | 0.102388 | 24 | -0.30509 | 19 |
| Yunnan Province | 0.011903 | 23 | -0.74735 | 26 | -0.3328 | 20 |
| Guangxi Zhuang Autonomous Region | -0.15104 | 4 | -0.69053 | 12 | -0.39597 | 21 |
| Guizhou Province | -0.22651 | 24 | -0.78895 | 25 | -0.48186 | 22 |
| Shanxi Province | -0.438 | 25 | -0.56152 | 23 | -0.49408 | 23 |
| Xinjiang Uygur Autonomous Region | -0.56899 | 19 | -0.4232 | 14 | -0.5028 | 24 |
| Heilongjiang Province | -0.60903 | 28 | -0.53416 | 9 | -0.57504 | 25 |
| Jilin Province | -0.7265 | 26 | -0.4234 | 31 | -0.58889 | 26 |
| Hainan | -1.07296 | 11 | -0.0747 | 21 | -0.61975 | 27 |
| Gansu province | -0.68739 | 31 | -0.79298 | 20 | -0.73533 | 28 |
| Ningxia Hui Autonomous Region | -1.19541 | 27 | -0.18962 | 22 | -0.73878 | 29 |
| Qinghai Province | -1.14095 | 30 | -0.34639 | 28 | -0.78022 | 30 |
| Tibet Autonomous Region | -1.06567 | 29 | -0.65778 | 8 | -0.88049 | 31 |

## 5. Summary

This article studies the level of economic development on the overall development status, per capita level of development, and consumption and expenditure of households, enterprises and the government. And selects 7 indicators related to these aspects, which are somewhat innovative.

From the analysis, it can be seen that Guangdong Province has the highest F score, followed by Jiangsu Province, Shanghai, Beijing, and Zhejiang Province. These are all economically developed provinces and cities in the country with a high level of economic development. Hainan Province, Gansu Province, Ningxia Hui Autonomous Region, Qinghai Province, and Tibet Autonomous Region have low F scores. Most of them are economically underdeveloped provinces and cities with insufficient resources and low economic development.

On the whole, the results of factor analysis and cluster analysis are basically the same, which proves that such an analysis is effective.

Scientific evaluation of the economic development level in provinces and cities is of great significance, and it provides reference and basis for scientifically formulating policies in the 14th Five-Year Period.

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