An Analysis of Industrial Structure in Shandong Province under Gray Correlative Degree

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Abstract

In this paper, the gray relational analysis method is used to analyze and excavate the output value of Shandong Province. Firstly, we qualitatively analyzed the output value of Shandong Province, and then the gray correlation analysis result is compared with the qualitative result. Finally show that the quantitative results are consistent with the qualitative results. In the end,we put forward some suggestions and strategies on the future economic development of Shandong Province by analyzing the results.

Keywords

Gray correlation degree; Industrial structure; Grade-level city output value.

1. Introduction

Nature has a variety of things that are complex and varied, and the rapid development of society makes these things more closely linked. We call these mutual restraints, interrelated things the system [1]. How to analyze the internal structure, regularity and characteristics of the actual system has become an important part of people's research. The system is divided into white system, black system and gray system according to the completeness of the information and the construction of the model [2]. White system has sufficient information, the model structure and clearly parameters; black system is without any knowledge, no amount of information about the system [2]. Gray system is understudied the external characteristics of the part of system, but the internal factors are difficult to identify. People cannot build an objective physical model, so the quantitative description of the system is more difficult. In the real world, white and black systems are few; we can get some information from the most of the system. So, the gray system in the world is a large number of existences and the study of gray systems is important.

There are a lot of system research methods to solve a system that do not have complete information. For example: regression analysis, variance analysis, principal component analysis and so on. However, these methods have shortcomings: these methods are based on mathematical statistics, so they need for a lot of data, while the amount of calculation will increase a lot. Secondly, the sample is required to obey a typical probability distribution, requiring the factor data and the system characteristic data meet a linear relationship and the factors are not related to each other, and this requirement is often difficult to meet. In addition, t quantitative phenomena and qualitative analysis of the results will not match the phenomenon, resulting in the relationship between the system and the law has been distorted and reversed. Therefore, this paper uses a gray relational analysis. According to the development trend of factors similarity or degree of dissimilarity to measure the degree of correlation between factors, revealing the characteristics of the dynamic association and degree [3]. Because the gray correlation analysis method has no excessive requirement on the sample size, it does not need the typical distribution rule, and does not cause the quantification result of the correlation degree to be inconsistent with the qualitative analysis. Therefore, the application of gray correlation is very extensive. Zhu fulin applies gray correlation degree to analyze the influence factors of India's service outsourcing competitiveness; Han Yingchun [5] analyses of grid faults using gray relational grade; Ding Pin [6] selects of sweet sorghum materials by gray correlation and many more. This shows that the gray correlation has been widely used in the economic, technological, agricultural

and other fields [7]. Based on the gray grayness of the gray system, this paper uses the gray relational degree method to excavate the various internal relations of the total output value of Shandong Province from 2000 to 2013.

2. Gray correlation analysis

2.1 Basic principles of the gray relational degree

Gray system theory puts forward the correlation degree analysis method [3], which is based on the similarity or dissimilarity of the development trend between factors to measure the degree of correlation; it reveals the characteristics and degree of dynamic association. For factors between the two systems, the measure of the size of the association that changes with time or different objects is called the degree of relevance [8]. In the process of system development, if the trend of the two factors change is consistent, that is, the degree of change is high, that can be described as a high degree of correlation; the contrary, the lower. Therefore, the gray relational analysis method is based on the similarity or dissimilarity of the development trend between factors, that is, "gray relational degree" is a measure of the degree of correlation between methods [3]. The gray system theory puts forward the concept of gray relational analysis of each subsystem, and tries to find out the relationship between the subsystems (or factors) through certain methods. Thus, the gray relational analysis provides a quantitative measure of the evolution of a system, making it ideal for dynamic history analysis.

2.2 Gray correlation degree

As a developing and changing system, the relevance analysis is actually a quantitative analysis of the dynamic process development trend. The so-called developing trend comparison, that is geometric relationship comparison about the relevant statistical data in the system. There are many types of gray relational degrees. The following article will focus on several types of relevance of the solution.

(1) Gray absolute correlation

Set the system behavior sequence

$X_0 = (x_0(1), x_0(2), \cdots, x_0(n))$ $X_1 = (x_1(1), x_1(2), \cdots, x_1(n))$

$X_i = (x_i(1), x_i(2), \cdots, x_i(n))$ ……

$X_m = (x_m(1), x_m(2), \cdots, x_m(n))$

$X_0^0 = (x_0^0(1), x_0^0(2), \cdots, x_0^0(n))$ and $X_i^0 = (x_i^0(1), x_i^0(2), \cdots, x_i^0(n))$, is X_0 and X_i of the starting point of the image respectively.

$x_0^0(k) = x_0(k) - x_0(1)$, $x_i^0(k) = x_i(k) - x_i(1)$, $i = 0, 1, \cdots, m$; $k = 1, 2, \cdots, n$.

And then,

$$|s_0| = \left|\sum_{k=2}^{n-1} x_0^0(k) + \frac{1}{2} x_0^0(n)\right|,$$

$$|s_i| = \left|\sum_{k=2}^{n-1} x_i^0(k) + \frac{1}{2} x_i^0(n)\right| \text{ and}$$

$$|s_i - s_0| = \left|\sum_{k=2}^{n-1} (x_i^0(k) - x_0^0(k)) + \frac{1}{2}(x_i^0(n) - x_0^0(n))\right| \quad \varepsilon_{0i} = \frac{1 + |s_0| + |s_i|}{1 + |s_0| + |s_i| + |s_i - s_0|}.$$

ε_{0i} is the gray absolute correlation between X_0 and X_i, referred to as the absolute correlation[9].

(3) Gray relative correlation degree

Let sequence X_0 and X_i is the same length and the initial values are not equal to zero, X_0' and X_i' respectively for the initial values of X_0 and X_i

$$x_0'(k)=\frac{x_0(k)}{\frac{1}{n}\sum_{k=1}^{n}x_0(k)},x_i'(k)=\frac{x_i(k)}{\frac{1}{n}\sum_{k=1}^{n}x_i(k)},i=0,1,\cdots,m;\quad k=1,2,\cdots,n.$$

$$|s_0'|=|\sum_{k=2}^{n-1}x_0'(k)+\frac{1}{2}x_0'(n)|,\ |s_i'|=|\sum_{k=2}^{n-1}x_i'(k)+\frac{1}{2}x_i'(n)|$$

$$|s_i'-s_i'|=|\sum_{k=2}^{n-1}(x_i'(k)-x_0'(k))+\frac{1}{2}(x_i'(n)-x_0'(n))|,\quad R_{0i}=\frac{1+|s_o'|+|s_i'|}{1+|s_o'|+|s_i'|+|s_i'-s_o'|}$$

R_{0i} recorded as relative degree of correlation. The relative correlation degree characterizes the relationship of the sequences about the relative rate of change between the starting points. That is mean, the closer the rate of change between the sequences, the larger the value, the smaller the difference.

(4) Gray comprehensive correlation degree

Let sequence X_0 and X_i is the same length and the initial values are not equal to zero. $\theta\in[0,1]$. $\rho_{0i}=\theta\varepsilon_{0i}+(1-\theta)R_{0i}$. We called ρ_{0i} gray comprehensive correlation degree. The comprehensive relevance degree not only reflects the degree of similarity between sequences, but also reflects the degree of similarity of the sequence relative to the starting point. It is a comprehensive indicator of reflecting whether the relationship between the sequences is closely related.

3. Analysis of output value of Shandong Province in 2000-2013

Qualitative analysis is not accurate when analyzing a system factor, and some regression analysis and variance analysis in mathematical statistics can cause the quantification result to be inconsistent with the analysis result. But the gray correlation analysis can be a good way to avoid this phenomenon. This article first uses a qualitative approach that is, drawing the chart through the observation, a general understanding of the output value of the city's production structure. Then we use the gray correlation analysis method. Gray correlation degree for the sample size and the number of samples with no obvious laws are equally applicable, and the amount of calculation is small and very convenient.

To analyze an abstract system or phenomenon, first select the data sequence that reflects the behavioral characteristics of the system. We call it finding the amount of mapping in the system behavior, with the amount of mapping to indirectly represent the system behavior [10]. In this issue, we use the annual output value of Shandong Province as a mapping of the amount of mapping, the city-level cities with the correlation between the correlation, the greater the relevance of city, the greater the contribution rate.

Implementation steps:

(1) Collect of evaluation data and according to the purpose of evaluation to determine the evaluation index system

(2) Determine the reference number

(3) Gray absolute correlation degree ε_{0i}

(4) Find the relative degree of gray correlation R_{0i}

(5) Gray comprehensive correlation degree ρ_{0i}, In this paper, consider the actual situation $\theta=0.5$.

3.1 An Analysis of the Output Value of prefecture-level city in Shandong

Accurate identification which prefecture-level city has largest contribution Shandong Province has an important role for the future economic development. So, we will qualitative analysis 17 prefecture-level city's production value.

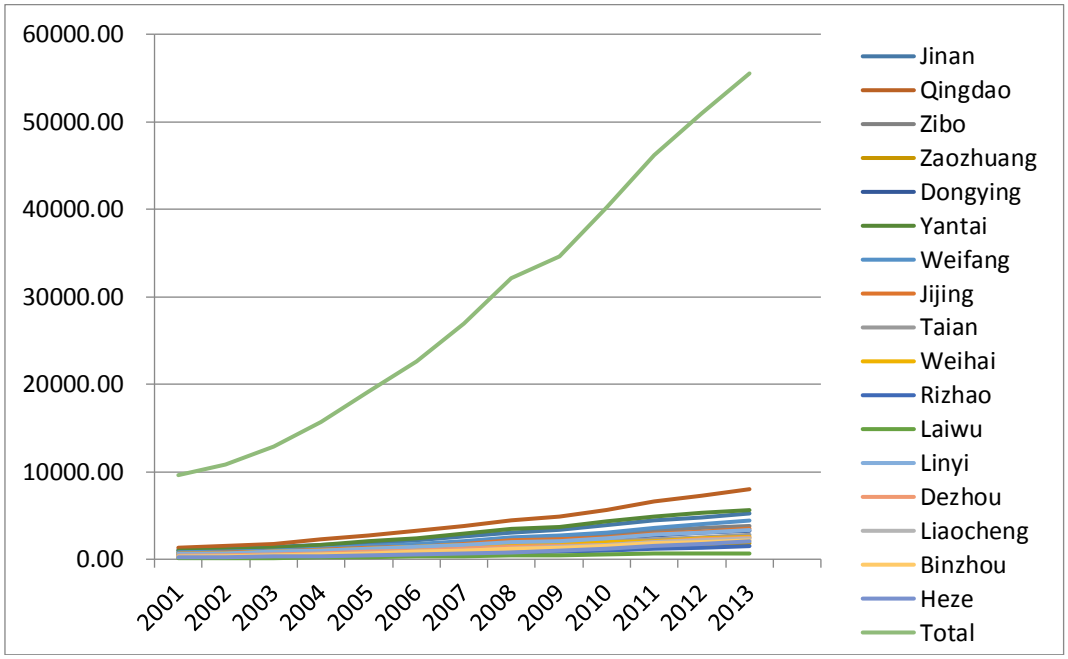

Figure 1 Production value of each city

Through Figure 1, we can see that the output value of Qingdao is the closest to the total output value of Shandong Province, but this is only qualitative analysis, with a subjective effect, we need a detailed calculation of quantitative analysis. Through the above we have learned that gray correlation method can be a good analysis of the problem, especially for some of the larger gray-scale problem. When choosing the kind of gray relational degree, this paper chooses the gray comprehensive correlation degree. First, the length of the data between the same sequence and the initial value is not zero. Secondly, it can reflect the similarity of the polyline, but also reflects the two factors relative to the starting point of the rate of change. It can be more comprehensive representation of the link between the sequence is close. By calculating the gray correlation degree of the 17 cities with the gross output value, we can get the table 1.

Table 1 Gray comprehensive correlation degree of output value of various cities in Shandong Province

ρ_{01}= 0.71463	ρ_{02}=0.72804	ρ_{03}=0.7061	ρ_{04}=0.694	ρ_{05}= 0.70179
ρ_{06}=0.71634	ρ_{07}=0.70802	ρ_{08}=0.70392	ρ_{09}= 0.69849	ρ_{010}=0.70115
ρ_{011}=0.69158	ρ_{012}= 0.68828	ρ_{013}= 0.70287	ρ_{014}=0.69718	ρ_{015}=0.69561
ρ_{016}= 0.6951	ρ_{017}= 0.69241			

Sort results are: ρ02 > ρ06 > ρ01 > ρ07 > ρ03 > ρ08 > ρ013 > ρ05 > ρ010 > ρ09 >ρ014 >ρ015 > ρ016 > ρ04 > ρ017 > ρ011 > ρ 012

Sorting results can be analyzed: In the province's output value, the output value of Qingdao, Yan tai and Jinan is the highest, which is the maximum contribution to the total output value of Shandong Province. He Ze, Ri Zhao, Lai Wu's similarity is low, the lowest contribution to the total output value. And this result is consistent with the qualitative analysis in the above figure 1.

3.2 An Analysis of Industrial Structure in Shandong Province

3.2.1 An Analysis of the Industrial Structure of the Output Value of Shandong Province

We first qualitative analysis, get Figure 2.

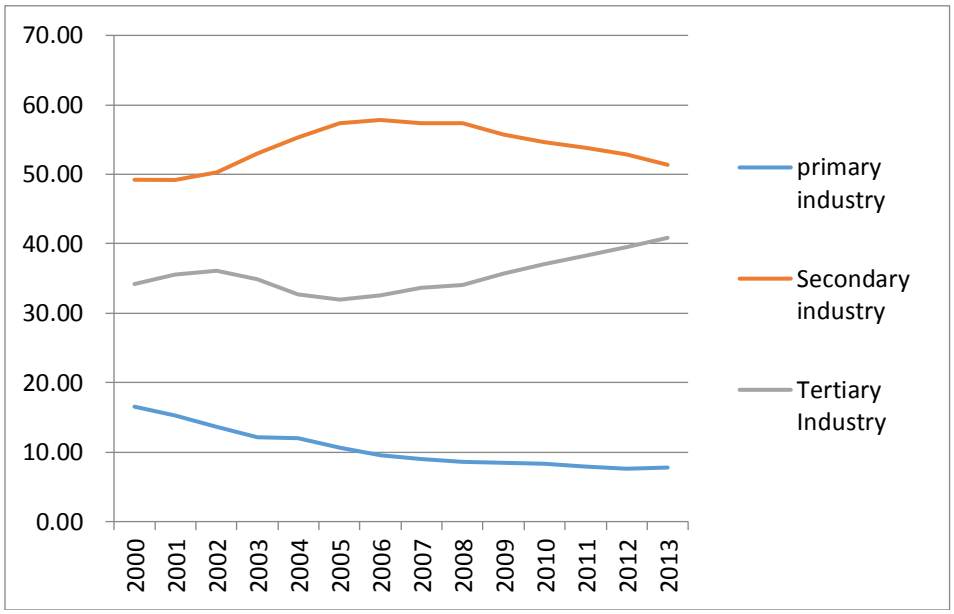

Figure 2 the province's industrial structure

From Figure 2, we can guess the secondary industry in the total output value of Shandong Province has a pivotal role.

Then the gray correlation analysis method was used for quantitative analysis. The total output value of Shandong Province is selected as the reference series. And compare the similarity between the output value of the three industries and the total output value .Through the gray relational analysis, the industrial center of Shandong Province is obtained. The results obtained are Table 2.

Table 2 Gray Correlation of Industrial Structure in Shandong Province

ρ_{01}= 0.64086	ρ_{02}=0.81088	ρ_{03} =0.72743

Sort results are: ρ02 > ρ03 > ρ01

This result is consistent with the qualitative analysis of Figure 2.

3.2.2 Analysis on the Industrial Structure of Local Cities in Shandong Province

Different prefecture-level cities have different industrial structure; this paper use the gray relational analysis to analysis different prefecture-level city's emphasis on the first, second and third industry. Methods and implementation of the code and the same section, here is not one by one repeat.

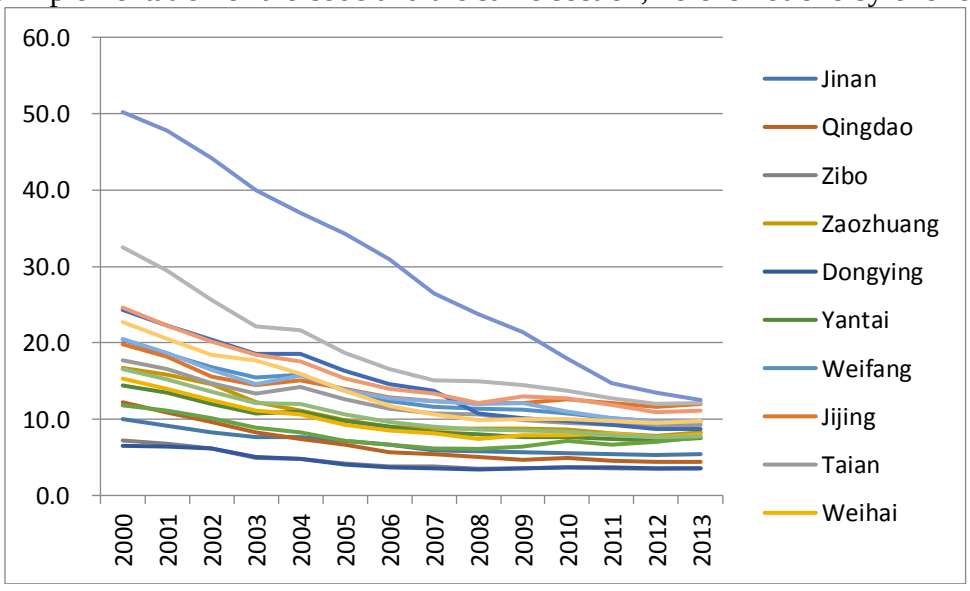

Figure 3 Distribution of primary industrial structure in various cities

Table 3 Gray comprehensive correlation degree of the primary industrial structure in Shandong Province

ρ_{01}=0.82347	ρ_{02} =0.8175	ρ_{03}=0.74157	ρ_{04}=0.9788	ρ_{05}=0.73891
ρ_{06}=0.94972	ρ_{07}=0.85786	ρ_{08}=0.8362	ρ_{09}=0.91915	ρ_{010}=0.95325
ρ_{011}=0.81553	ρ_{012}=0.87208	ρ_{013}=0.85209	ρ_{014}=0.77688	ρ_{015}=0.68878
ρ_{016} = 0.85425	ρ_{017}=0.50969			

Sort results are: ρ04 >ρ 010> ρ06 > ρ 09 >ρ 012> ρ 07> ρ016 > ρ013 > ρ08 >ρ01 > ρ02 > ρ011 > ρ014 > ρ 03 > ρ05 >ρ015>ρ017

Analysis can be obtained: in the primary industry, Zao Zhuang city is greater degree of correlation. And then is Wei Hai.He Ze is the smallest degree in the first industry.

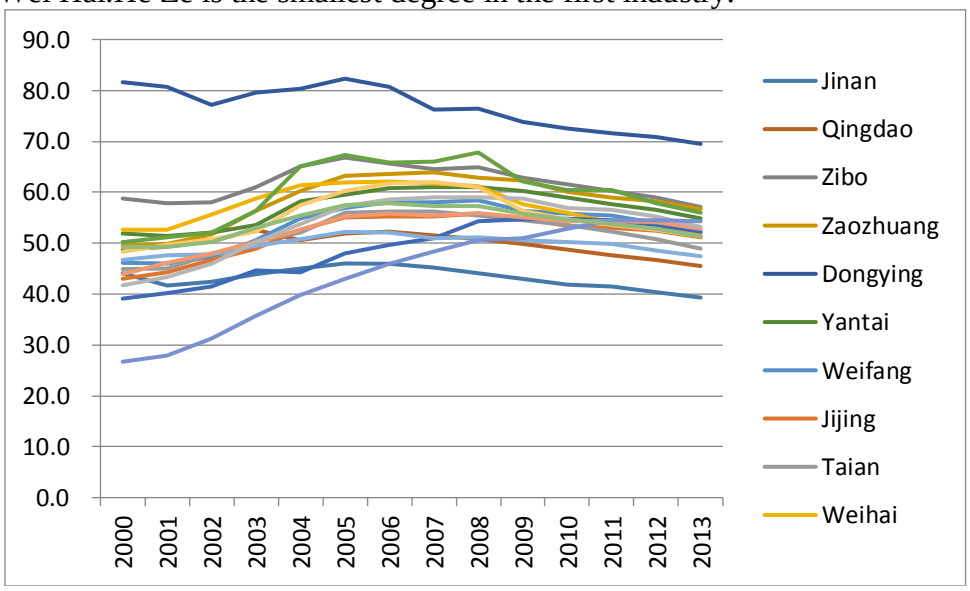

Figure 4 Distribution of Secondary industrial structure in various cities

Table 4 Gray comprehensive correlation degree of the secondary industrial structure in Shandong Province

ρ_{01}=0.60554	ρ_{02}=0.80732	ρ_{03}=0.67931	ρ_{04}=0.79392	ρ_{05}=0.4227
ρ_{06}=0.84646	ρ_{07}=0.92254	ρ_{08}=0.87884	ρ_{09}=0.88216	ρ_{010}=0.8426
ρ_{011}=0.77255	ρ_{012}=0.74643	ρ_{013}=0.79577	ρ_{014}=0.89476	ρ_{015}=0.864
ρ_{016}=0.92216	ρ_{017}=0.65417			

Sort results are: ρ07> ρ016 > ρ014 > ρ 09 > ρ08 >ρ015 > ρ06 >ρ 010> ρ02 > ρ013 > ρ04 > ρ011>ρ 012 > ρ03 >ρ017 >ρ 01 > ρ05

In the secondary industrial structure, the output curve of Wei Fang City and the province's output value of the curve would like to close in the first industry. And then is Bin Zhou City. The second industry associated with the smallest Dong Ying City.

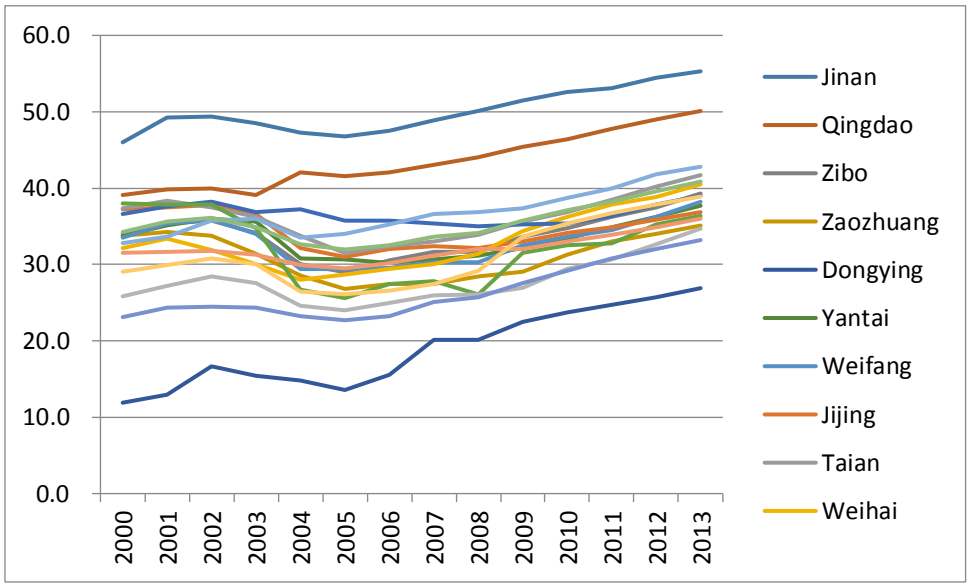

Figure 5 Distribution of tertiary industrial structure in various cities

Table 5 Gray comprehensive correlation degree of the tertiary industrial structure in Shandong Province

ρ_{01}=0.44306	ρ_{02}=0.60149	ρ_{03}=0.88285	ρ_{04}=0.73474	ρ_{05}=0.41491
ρ_{06}=0.85597	ρ_{07}=0.83824	ρ_{08}=0.85383	ρ_{09}=0.93658	ρ_{010}=0.84088
ρ_{011}=0.85261	ρ_{012}=0.73696	ρ_{013}=0.87327	ρ_{014}=0.77667	ρ_{015}=0.60104
ρ_{016}=0.74708	ρ_{017}=0.56087			

Sort results are: ρ09 >ρ03> ρ013>ρ06> ρ08> ρ011> ρ010>ρ07>ρ014>ρ016>ρ012 > ρ04> ρ02 >ρ015> ρ017 >ρ01 > ρ05

In the analysis of the tertiary industry structure, we can see Tai An City, Zibo City is larger correlation with the province's tertiary industry output value, and Dong Ying City, the lowest.

Through the analysis of the industrial structure of the prefecture-level cities in Shandong Province and the industrial structure of the total output value, we can see:

(1) Irrational industrial structure in Shandong Province and its proportion of the secondary industry is high. Although the proportion of tertiary industry in Shandong Province has increased, but the status of heavy industry that dominated the status quo has not changed. And manufacturing as one of the main contents of the secondary industry, which is an important pillar of the economy in Shandong. Therefore, the industrial pattern that “two, three, one" has not been a fundamental improvement in Shandong Province. And most of the manufacturing industry is the high-carbon industry, which also determines high-carbon industry is the dominant position in the current stage of Shandong Province.

(2) Larger regional economic development gap. The contribution rate of the eastern part of the peninsula is relatively higher than that of the central and western regions. The differences in regional economic development also put forward different requirements for various cities.

(3)Unbalanced regional industrial structure development. As the significant differences original level of economic development in Shandong Province, resource endowment and regional industrial structure are also big gap. Zao Zhuang, Yan tai, Wei hai and other cities in the province's primary industry account for a large proportion the larger proportion .Wei fang, Texas, Bin Zhou mainly developed the second industry, these cities are mainly rely on energy consumption to stimulate the economy. Zibo, Tai an, Lin yi are the most similarity in the province's tertiary industry, that is, the province's tertiary industry a higher impact.

4. Coping strategies

(1). Make full use of regional advantages and rely on the blue economic zone strategy. Shandong Province is located in the coastal areas. Strategic location, land and sea transport facilities and near the Yellow Sea and Bohai Sea make Shandong easily carry out with foreign technology, information exchange. So the eastern region could obtain external development. Shandong Province should continue to make full use of this location advantage, and strengthen economic ties with coastal provinces and foreign developed countries or regions. Strengthen the driven function of Jinan and Qingdao and give full play to its gathering and radiation functions to the development of the city.

(2). Increase government support to the west. Narrowing the gap between regions is a long-term arduous task, which not only requires both local governments to rely on their own efforts, but also need government departments give tilt support and project support in the construction, opening up, investment and science and education. They should focus on traffic, Post and telecommunications, farmland water conservancy and other infrastructure projects. Support the coastal areas to some of the primary processing, high energy consumption industries and labor-intensive industries to the west transfer, investment support, and actively guide the province's professional banks to increase the scale of investment in the western region.

(3). From the aspect of promoting the coordinated development of the eastern and western regions, the government should increase financially support and development of the western region, push the investment promotion work to the inland areas and make full use of the western region Owned resources and labor advantages, promote industrialization, nurture and strengthen the pillar industries, and achieve a new breakthrough in industrial development driven by industrialization of urbanization.

(4) Vigorously strengthen the development of other industries highly related to strategic industries. Strategic industry is a relatively dynamic concept, a specific period of strategic industries with the realization of strategic objectives. When Shandong Province determine the industrial strategy, not necessarily limited to the current size of industry in the national economy and the level of efficiency, but also subordinate to improve the level of industrial technology development and the height needs of the future industry.

5. Conclusion and discussion

Gray relational analysis is a quantitative description of the development trend of the system and comparison method [11]. Through the gray correlation analysis can make the gray system of the structure, model and relationship from black to white, so that uncertain factors gradually clear. In this paper, we use the gray relational analysis method to find the primary and secondary relations in the system factors, find out the important factors that affect the target value, so as to master the main features of the system, which can effectively promote the development of the system [12]. Through the quantitative analysis of the economic development of Shandong Province, we can get some shortcomings in the economic development of Shandong Province, there is a large gap between the regions, and industrial development is unreasonable. Therefore, in order to make Shandong Province have better development space and the future, we must seize the advantages of industry, vigorously develop the tertiary industry, in the development of high economic level areas, but also vigorously support the weaker areas, to achieve the future Shandong!

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