Analysis and Decision of Regional Economic Vitality and Its Influencing Factors

Ao Zhang*, Wenwen Zhang, Zonglin Li

Qingdao University of Technology, Qingdao, Shandong Province, China

*Corresponding Author: Ao Zhang

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Abstract: enhancing regional economic vitality is an important way to promote regional and world economic growth. Based on the gray prediction model, principal component factor analysis model and correlation analysis, this paper makes a qualitative analysis and evaluation of the current and future economic vitality of Shandong province, and draws the following conclusions.

1. Introduction

At present, china's economy has entered a critical period of transition and development of the new normal. The economic growth rate has gradually changed from high-speed growth to low-and medium-sized growth. At the same time, the power sources of economic growth are constantly rich, and the economic structure is also constantly optimizing and upgrading. Regional economic vitality has also become an important part of regional comprehensive competitiveness. In economics, “vitality” refers to the support of a city, region or country for life function, ecological environment and economy and society. These include economic vitality, social vitality, environmental vitality and cultural vitality, four kinds of vitality constitute the whole vitality system. In order to effectively improve the regional economic vitality, a suitable model is constructed to solve the following two problems.

(1) Establish a suitable relationship model that affects economic vitality from the perspective of population and corporate vitality trends.

(2) Choosing a suitable index system, establishing a mathematical model for analyzing and measuring regional economic vitality

2. Problem Analysis and Model Building

2.1 Model Establishment and Solution for Problem One

2.1.1 Data Preprocessing

By consulting relevant data, the company's vitality was selected for analysis in terms of the number of enterprises, the growth rate of the number of enterprises, government investment, social investment, the number of star brands (high-profile companies such as Qingdao's Haier), and the number of technological innovations. Taking Shandong Province as an example, the collected relevant data is processed using methods to standardize it, conforming to the normal distribution, and then using the correlation algorithm to calculate the correlation between the indicators, to obtain the heat map shown in Figure 1:

Figure 1 shows the correlation between different variables, and the stronger the correlation, the greater the correlation coefficient. When the correlation coefficient is greater, it indicates that there is a stronger correlation between the two variables, as shown in Figure 1: government investment, social investment, and number of star enterprises And the correlation between scientific and technological innovation is very strong. Select investment capital and technological innovation. At the same time, select the number of enterprises between the number of enterprises and the growth rate of the number of enterprises.

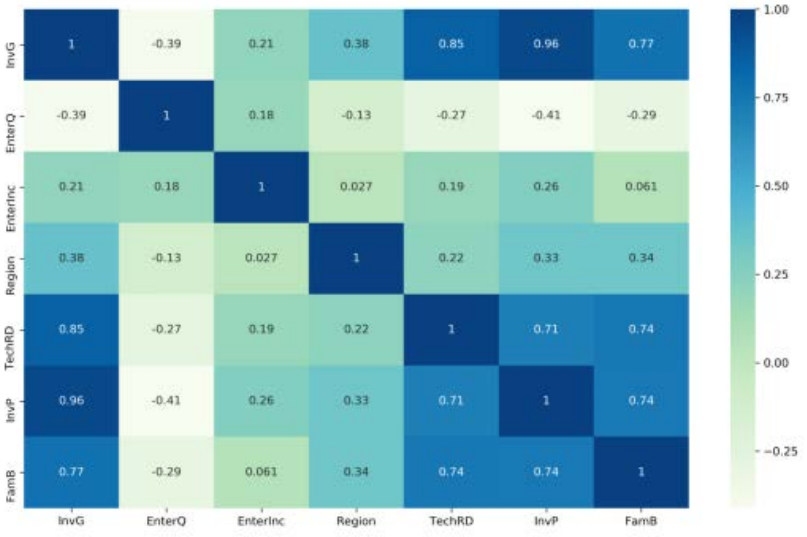

Fig.1 Correlation Heat Map between Influencing Factors of Corporate Vitality

2.1.2 Model Establishment and Solution

First, in terms of corporate vitality, through cluster analysis of data, select the number of enterprises, investment funds and technological innovation; in terms of population, select the level of education and labor force population to analyze the economic vitality of Shandong Province. May wish to set the obtained data to be true and effective, and visualize the data through excel software to obtain the graph shown in Figure 2:

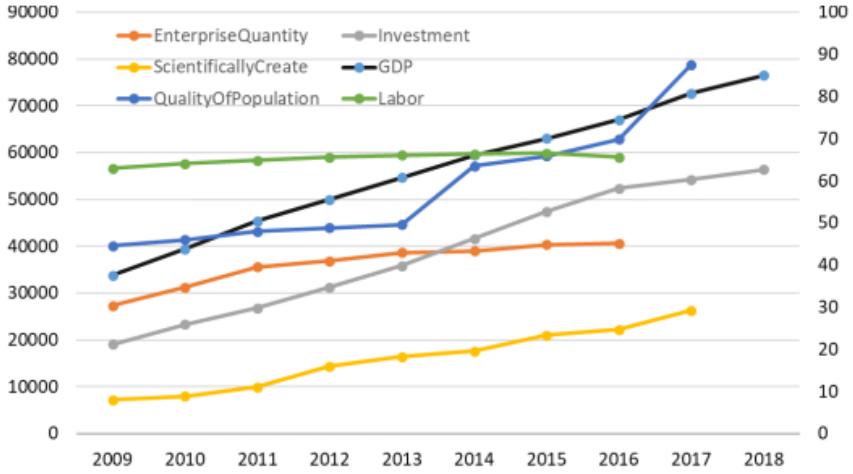

Fig.2 The Change Curve of the Number of Enterprises, the Amount of Capital Invested, and the Amount of Technological Innovation and Qingdao's Gdp

It can be seen from Figure 2 that the number of enterprises, the amount of capital invested, the number of technological innovations, the level of education, the number of labor forces, and GDP in Shandong Province are increasing year by year. From this, it can be concluded that the increase in the number of enterprises, the ratio of input to output, the number of scientific and technological innovations, the number of labor force, and the improvement in education have a certain promoting effect on GDP growth, that is, it has a positive effect on the regional economic vitality.

Secondly, using excel software to visualize the GDP of Shandong Province, we get the GDP change curve shown in Figure 3:

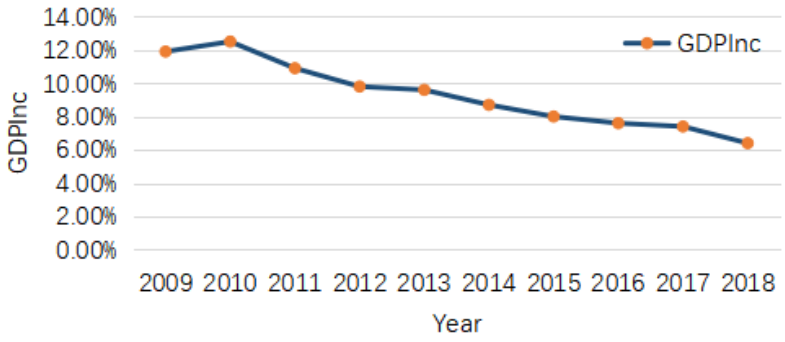

Fig.3 Annual Gdp Growth of Shandong Province

It can be seen from Figure 3 that the annual GDP growth of Shandong Province has been decreasing year by year.

When analyzing the industrial structure of Shandong Province, by finding relevant data and visualizing the data, the curve shown in Figure 4 is obtained:

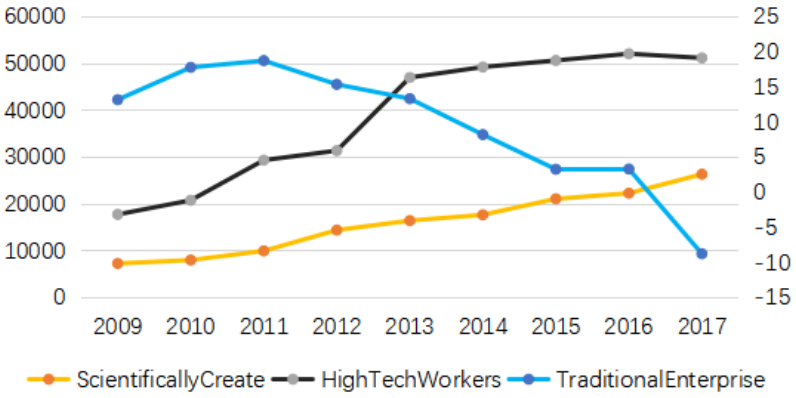

Fig.4 Changes in the Volume of Traditional and New Technology Industries

It can be seen that from 2009 to 2018, the GDP of traditional industries has been decreasing year by year. In contrast, the number of high-tech personnel engaged in high-tech industries and the GDP have been increasing year by year. The proportion is getting higher and higher.

Through the analysis of Figure 2, Figure 3 and Figure 4, in terms of population, with the continuous increase in the educational level of the population in Shandong Province and the introduction of more high-end technical talents, it is bound to promote the development of high-tech industries and drive the regional economy. In terms of corporate vitality, it can be seen that although the GDP growth rate of Shandong Province is slowing down, the proportion of traditional industries with severe environmental pollution is declining, and the contribution rate of traditional industries to GDP is also declining. And as the number of people engaged in high-tech industries increases year by year, the government's support for high-tech industries continues to increase, the proportion of high-tech industries in the industrial structure is increasing, and the development of high-tech industries has increased the economic vitality of Shandong Province.

2.2 Model Establishment and Solution for Problem Two

2.2.1 Construction of Economic Vitality Index System

Learn from the research of experts and scholars, and establish an indicator system based on the actual development of Shandong Province.

(1)Primary selection of economic vitality measurement indicators

This article aims to study the economic vitality of Shandong Province, so most of the indicators selected are quality indicators or average indicators. Based on the research experience of previous experts and scholars and the current status of economic development in Shandong Province, this article selects the ratio of fixed investment to GDP, the ratio of tertiary industry assets to GDP, the total industrial output value to GDP, social retail to GDP, and foreign trade to GDP. Number of

invention patents, per capita green area, employment rate of the population, enrollment rate of residents' endowment insurance, general middle school conditions / places, living wages / yuan, disposable income / yuan, number of enterprises, regional GDP / 100 million yuan, total population at the end of the year The 15 indicators per ten thousand people use relevant indicator data collected in the 'Statistical Yearbook of Shandong Province' from 2009 to 2017 to calculate the indicator data in the above table through calculation.

(2)Establishment of factor analysis model

The component score coefficient matrix is multiplied by the indicator normalization to calculate the factor score, that is:

$$F_i = \alpha_{i1}x_1 + \alpha_{i2}x_2 + ... + \alpha_{ip}x_p$$

Among them: F_i indicates the i factor score; $x_1, x_2, \ldots x_p$ indicates the standardized value of the indicator; $\alpha_{i1}, \alpha_{i2}, \ldots, \alpha_{ip}$ indicates the component score coefficient.

The total factor score is equal to the weighted arithmetic mean of each sub-factor score, that is:

$$F = \sum b_i F_i (\sum b_i = 1)$$

Among them, F represents the total factor score, F_i represents the score of the i factor, and b_i represents the degree of contribution of the i factor.

(3)Data selection and collection

First of all, the relevant data of the above 15 indicators are mainly derived from the 'Statistical Yearbook of Shandong Province' and the 'Statistical Bulletin of National Economic and Social Development' of each municipal administrative unit. Second, because some data are severely missing, the key indicators with severe data missing are replaced by similar indicators. Finally, because some data units are different, the data is processed accordingly, and all indicators are unified and standardized in accordance with scientific calculation methods.

2.2.2 Measurement of Economic Vitality in Shandong Province

When performing factor analysis, as this article uses 15 indicators to analyze the data of 17 cities in Shandong Province, the sample size is too large, and the correlation of some indicators is too low may cause the KMO value to be too low, so the KMO of the data is first performed. Inspection, the results shown in Table 1:

Table 1 : Kmo Inspection

Variable	kmo
V2	0.7064
V3	0.2175
V4	0.1899
V5	0.1840
V6	0.1348
V7	0.5754
V8	0.3680
V9	0.3272
V10	0.3103
V11	0.3319
V12	0.3497
V13	0.4630
V14	0.2120
V15	0.3417
V16	0.3044
Overall	0.3116

The result shows that KMO is 0.3116 less than the passing threshold value of 0.6, and the partial variable data is not suitable for the principal component factor analysis, so the partial index is removed. Through the correlation analysis, the method of z-score method is used to standardize and accord with the normal distribution of 0-1, and then the correlation between the indexes is calculated by the pearson correlation algorithm, as shown in Figure 8:

Fig.5 Indicator Correlation Heat Map

The proportion of social retail with lower GDP, average number of invention patents, per capita greening area, population employment rate, residential pension insurance coverage rate, regional GDP and total population at the end of the year will be removed. After removing the KMO and Barelett test, the results shown in Table 2 are obtained:

Table 2 : Kmo And Bartlett Inspection Mo Inspection

Kaiser-Meyer-Olkin measure of sampling adequacy

Variable	kmo
var2	**0.5115**
var3	**0.7342**
var4	**0.5827**
var5	**0.5457**
var6	**0.7260**
var7	**0.6609**
var8	**0.5256**
var9	**0.7332**
Overall	**0.6593**

It can be seen from Table 2 that the KMO value is 0.6593, which is significantly improved compared with the previous 0.3116, and at the same time is greater than 0.6. Therefore, the selected index is more effective and the sample is considered to be capable of factor analysis.

Table 3 : Common Factor Variance

Common factor variance

	initial	extract
var2	1.000	.693
var3	1.000	.469
var4	1.000	.741
var5	1.000	.653
var6	1.000	.842
var7	1.000	.911
var8	1.000	.830
var9	1.000	.844

The larger the common factor variance extracted between the variables, the stronger the ability to be interpreted by the common factor, and most of the variable factors proposed by the extracted common factor variance are explained more than 70%. Therefore, the better the extraction effect, the Less confidence in data loss. Generally speaking, but for a variance contribution rate of not less than 75%, the factor extraction component interpretation information accounts for 75% of the total information. For factors with characteristic roots greater than 1, data analysis based on stata software yields the results shown in Table 4:

Table 4 : Explain All Variance

Total variance explanation

	Initial eigenvalue			Extract load sum of squares			Sum of rotation load squares		
ingredient	total	Variance percentage	Cumulative%	total	Variance percentage	Cumulative%	total	Variance percentage	Cumulative%
1	3.485	43.564	43.564	3.485	43.564	43.564	2.819	35.237	35.237
2	1.280	15.995	59.559	1.280	15.995	59.559	1.767	22.084	57.321
3	1.219	15.232	74.791	1.219	15.232	74.791	1.398	17.470	74.791
4	.766	9.570	84.361						
5	.657	8.213	92.574						
6	.354	4.428	97.003						
7	.169	2.107	99.110						
8	.071	.890	100.000						

It can be seen from Table 4 that the cumulative variance contribution rate reaches 74.791%, which indicates that the first three factors contain 74.791% of all information, and the amount of information extracted is relatively large. Therefore, it can be explained that factor analysis is effective in extracting original variable information.

Using stata software, a graph is made of the contribution rate of each factor, as shown in Figure 6:

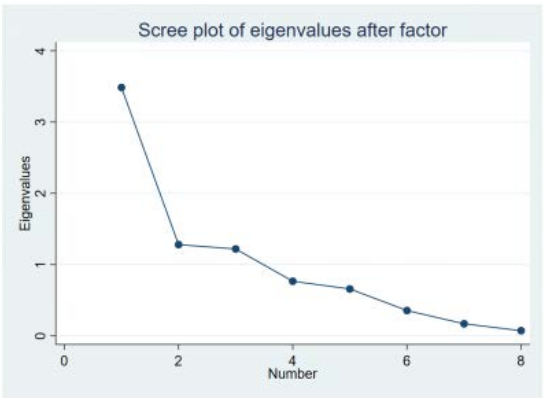

Fig.6 :Lithotripsy

It can also be seen from Figure 6 that the information contributed by the first three factors represents that the polyline is relatively steep, and the subsequent discount is relatively flat. It can also be seen that it is reasonable to extract the first three factors.

Rotation component matrix:

Table 5 : Rotation Component Matrix

Variable	Factor1	Factor2	Factor3	Uniqueness
var2	-0.2281	0.2017	-0.7748	0.3069
var3	0.4138	0.5283	0.1368	0.5310
var4	0.2288	0.5123	0.6525	0.2595
var5	0.6527	0.0739	-0.4706	0.3471
var6	0.8331	0.3187	0.2153	0.1580
var7	0.9220	0.2193	0.1145	0.0887
var8	-0.0691	-0.9052	0.0786	0.1696
var9	0.8925	-0.1536	0.1545	0.1559

It can be seen from Table 5 that the ratio of foreign trade to GDP, per capita wages, disposable income, and per capita GDP are factors 1. Since per capita wages and disposable income can determine people's consumption levels, factor 1 can be named as foreign trade and Consumption factor; the ratio of the tertiary industry's assets to GDP and the number of enterprises is factor 2, named as the ratio of the tertiary industry; the ratio of fixed investment to GDP and total industrial output value to GDP is factor 3, named as the ratio of primary industry .

To get the factor expression, extract the component matrix from the factor load matrix:

Table 6 : Component Score Coefficient Matrix

Variable	Factor1	Factor2	Factor3
var2	-0.03216	0.22321	-0.59511
var3	0.05787	0.30318	0.03193
var4	-0.06992	0.29409	0.46021
var5	0.29364	-0.02817	-0.44940
var6	0.24481	0.08068	0.05701
var7	0.30688	0.00043	-0.02721
var8	0.11188	-0.64068	0.11858
var9	0.35168	-0.26368	0.02781

The expression of the factor is as follows:

$$F_1 = -0.032v_2 + 0.058v_3 - 0.070v_4 + 0.294v_5 + 0.245v_6 + 0.307v_7 + 0.112v_8 + 0.352v_9$$

$$F_2 = 0.223v_2 + 0.303v_3 + 0.294v_4 - 0.028v_5 + 0.081v_6 + 0.001v_7 - 0.641v_8 + 0.264v_9$$

$$F_3 = -0.595v_2 + 0.032v_3 - 0.460v_4 - 0.449v_5 + 0.057v_6 - 0.027v_7 + 0.119v_8 + 0.028v_9$$

Taking the variance contribution rate of each factor as the weight, the growth index score obtained after weighting the average is as follows:

$$ECO = 0.352F_1 + 0.221F_2 + 0.147F_3$$

The final weights obtained by factor analysis, and the comprehensive scores obtained by weighting the factor score function, the results are shown in Table 7:

Table 7 : Ranking Of Comprehensive Scores of Urban Economic Vitality in Shandong Province

city	f1	Ranking	f2	Ranking	f3	Ranking	ECO	Ranking
Jinan	1.027087	5	1.766598	1	1.847553	1	1.074818	1
Qingdao	1.800147	1	0.104335	9	-0.2192	10	0.619065	2
Zibo	0.61083	6	-1.79655	17	0.964177	5	-0.01307	7
Zaozhuang	-0.79685	14	-0.36484	11	0.150673	7	-0.33504	13
Dongying	1.407219	2	-0.69385	14	1.132645	4	0.540506	3
Yantai	1.34286	3	0.777573	6	-1.09027	15	0.454433	4
Weifang	-0.18109	8	0.844405	4	-0.47616	12	0.039483	6
Jining	-0.76511	12	0.858502	3	0.164554	6	-0.05126	8
Tai'an	-0.58792	10	-0.46244	12	-0.12852	9	-0.33174	12
Weihai	1.231083	4	-1.2616	15	-1.34694	17	-0.08013	10
Rizhao	-0.05532	7	0.46094	7	-0.86766	13	-0.06928	9
Laiwu	-0.76658	13	1.24505	2	1.394916	2	0.24853	5
Linyi	-0.73943	11	0.814262	5	-1.01722	14	-0.25844	11
Dezhou	-0.96796	15	-0.33526	10	-0.28692	11	-0.46524	15
Liaocheng	-0.99769	16	-0.54244	13	-0.09135	8	-0.48731	16
Binzhou	-0.51142	9	0.109061	8	-1.32956	16	-0.3884	14
Heze	-1.04986	17	-1.52375	16	1.199277	3	-0.49693	17

It can be seen from the ranking that, taking Qingdao as an example, although Qingdao ranks in the middle of factors 2 and 3, it ranks first in factor 1 and eventually ranks second, so it can also be seen that factor 1 is in the entire The contribution rate in the growth index is higher than the factors 2 and 3. The comprehensive ranking of Jinan's economic vitality ranks first, among which the ranking among the factors is also in the forefront. It can be seen that the comprehensive strength of Jinan is relative to other cities stronger.

3. Conclusion

This paper models economic vitality based on principal component factor analysis. The research results are as follows.

In terms of population, with the continuous increase in the educational level of Shandong's population and the introduction of more high-end technical talents, it is bound to promote the development of high-tech industries and drive regional economic vitality. In terms of corporate vitality, we can see Although GDP growth is slowing down, the proportion of traditional industries with severe environmental pollution is decreasing, and the contribution rate of traditional industries to GDP is also decreasing. And as the number of people engaged in high-tech industries increases year by year, the government's support for high-tech industries continues to increase, and the proportion of high-tech industries in the industrial structure is increasing. To great promotion.

The formula for measuring economic vitality is $\mathrm{ECO} = 0.352F_1 + 0.221F_2 + 0.147F_3$

In view of the above analysis, the following suggestions are proposed for improving regional economic vitality.

(1)Eliminating pollution and developing high-tech industries

(2)Enhance technological innovation capabilities

(3)Increase funding for science and technology and investment in scientific research personnel

(4)Strengthening import and export trade

(5)Joint development

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