RESEARCH ARTICLE

Construction of Economic Index System of High and New Technology Industry Based on Data Mining Emerging New Technology

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Abstract

At present, with the era of knowledge economy, the competitiveness of the country in terms of its economy is greatly related to its own advanced technique and professional capabilities to a certain extent. The promotion of high and new technology industry development and the achievement of industrial goals are powerful measures to strengthen national competitiveness. In this paper, data mining technology was used to build economic indicators of high and new technology industry. Under the premise that economic indicators of high and new technology industry are clear, factor analysis method was used to carry out dimension reduction operation, the key indicators were acquired, and the system was constructed and used to evaluate high and new technology industry owned by Zhejiang. It can be found that Zhejiang Province has a relatively solid foundation for economic development, and has a great correlation with the local human resources, but compared with Jiangsu and Shanghai, there are still some disadvantages.

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1. Introduction

Under the background of knowledge economy, the economic competitiveness of the country is closely related to the high and new technology and the industrialization ability. The promotion of high and new technology industry development and the achievement of industrial goals are powerful measures to strengthen national competitiveness. High and new technology is now the key point of global science and technology and economic competition. To a certain extent,

the development of new and high technology plays a key role in the change of the global economic structure [1]. Therefore, countries around the world have begun to focus on new and high technologies in terms of economic competitiveness and overall national strength. Based on the background of the deep understanding of high and new technology industry, the method of quantitative economic model is used to carry on the empirical analysis to the development of high and new technology industry in Zhejiang Province [2]. A multi factor quantitative economic model index system is constructed, and the factors that influence the continuous development of high and new technology industry are explored and commented. In addition to this, the differences and influencing factors of the development of high and new technology industry in regional benefits are effectively analyzed. Based on this background, an effective measure is drawn to promote the continuous improvement and development of high and new technology industry in China, and a scientific forecast is launched for the trend of high and new technology industry development in universities and colleges in China and Zhejiang Province, which provides the development strategy of high and new technology industry for the development of all relevant departments in China, and brings key reference to the development of new industrialization, provides effective help on how to do the future quantitative economic model and statistical analysis of high and new technology industry in theory and practice [3].

2. Stateoftheart

Overall, the development of high and new technology industry in China can be divided into two periods, so the first period is from the 50s of the last century to the beginning of 80s. After the 1950s, the global high and new technology industry showed a rapid development trend, the high and new technology industry in China was concentrated in the national defense high and new technology industry, which achieved key results in the aerospace and electronics industries; from the 60s to 70s of the last century, China began to eliminate technical and economic constraints brought by the Western and other countries, and obtained the important achievement of atomic bomb, hydrogen bomb and artificial satellite, which made China's political status obviously improved, but the pace of industrialization and marketization of high and new technology industry was relatively slow [4]. The second period is from the early 80s to the present, after that, China has begun to continue to promote innovation and reform of science and technology system, and gradually developed part of the high and new technology research and industrial development programs, so as to promote the development of China's high and new technology industry. After China has carried out the 863 Program, the Torch Program and other related measures to promote the development of high and new technology industry, China's high and new technology industry development has been significantly improved, and gradually occupied the global leading position in some areas, and built a relatively complete development framework of high and new technology industry. After entering the 90s, under the leadership of the central government, all regions have begun to take the development of high and new technology industry as the key measures to promote economic development, and formulated a very large number of matching development programs [5].

3. Methodology

3.1 Index design principle

Indicators are the absolute numbers, relative numbers, and averages that can show certain social conditions. The index system mentioned here is to show the relationship between things by means of a multi-level and multi-index approach [6]. It transforms the problem with higher complexity into many of the associated parts, and constructs a hierarchical structure with order to ensure that it becomes easy to understand. Its impact on the various parts, factors and the impact of the system are used to achieve the goal of promoting the system [7]. Therefore, based on the reference of results obtained by domestic and foreign researchers in this field, the fully associated knowledge and technology intensity owed by high and new technology industry, as well as the high input and high risk and high yield characteristics, this paper argues that in the process of constructing the evaluation index of the competitiveness of high and new technology industry in Zhejiang Province, it is necessary to follow the principles of scientificalness, systematicness, feasibility and comparability.

3.2 Index construction

In terms of the composition of the index system, the high and new technology industry has shown a high degree of density characteristics, innovation ability belongs to main point of competitiveness of high and new technology industry, and the essential difference between it and the ordinary manufacturing industry is in this respect [8]. In terms of the components of the competitiveness of high and new technology industry, the main body of competitiveness is the

industry's income and output capacity. With the competitiveness of high and new technology industry, the industry can avoid being easily imitated, and the rest can provide a key role in promoting demand. In addition, contribution is the most important access to benefit; the innovation capability of the industry belongs to the basic competitiveness, which belongs to the prerequisite for the stable development of high and new technology industry. In addition, the industry's policies, technical support and incubation environment are key drivers to ensure that the competitiveness of high and new technology industry continues to be maintained, so as to form a comprehensive evaluation system for the competitiveness of high and new technology industry [9]. The structure of factors influencing competitiveness of high and new technology industry is as follows.

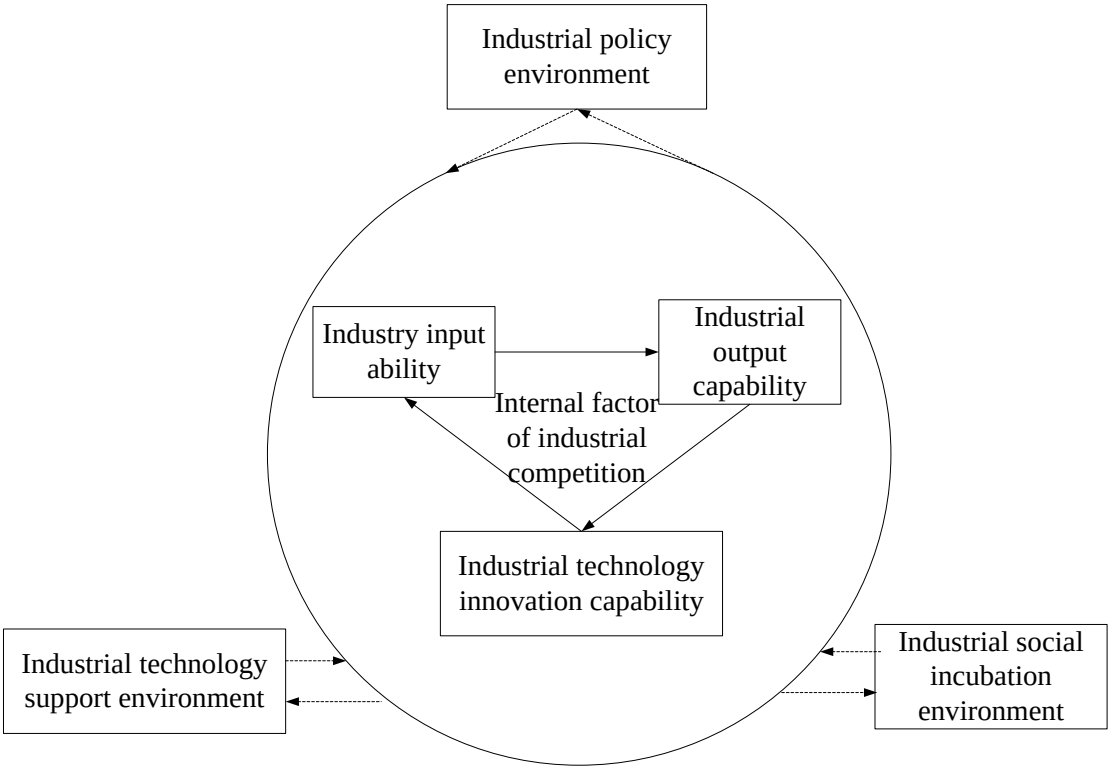

Fig.1 Structure chart of influencing factors of high-tech industry competitiveness

Based on the Porter's competitive theory mentioned above, the key functions of technological innovation are effectively combined, and the IMD index system contained in the report of China's international competitiveness development is effectively referred. Under the premise of considering the characteristics of high and new technology industry development, the competitive factors of high-tech industries are effectively divided. The evaluation index system of competitiveness of high and new technology industry is specific as shown in table [10]. This includes concrete input indicators, which can show the technological innovation capability possessed by competitiveness of high and new technology industry, such as spending capacity of research and development, input amount of funds of research and development, input ability of technical workers and research worker input. Output indicators can show the proportion of the value of industrial upgrading in the overall industrial output value and additional value. Technological innovation indicators can demonstrate the basic ability of technological innovation in high and new technology industry, such as invention patents and the quantity of technological innovation products. Policy environment indicators are the proportion of research and development expenses in GDP and the proportion of government research and development funds in all research and development funds. Technical support environmental indicators are the proportion of research and development workers in research and development and the number of high and new technology enterprises [11]. In combination with the above indicators, there are two first-level indicators, namely, endogenous and exogenous competitiveness; the six two-level indicators are industry input, output, technology innovation, policy environment, technology level and incubation environment; thirty three-level indicators are the output value of high and new technology industry, the amount of research and development funds and so on.

Table.1 Evaluation index system of high-tech industry competitiveness

High-tech industry competitiveness（A）	Intra industry production competitiveness（B）	Industry investment (D)
		Industrial output (E)
		Industrial technology innovation capability (F)
	Industry exogenous competitiveness (C)	Industrial policy environment (G)
		Industrial technology support environment (H)
		Industrial incubation environment (I)

Based on the purpose of accurate and efficient use of the evaluation index, it is necessary to clearly understand the economic connotation of the relevant evaluation index. Some typical indicators are selected to start the description, as shown in Table 2 below.

Table.2 Connotation and significance analysis of indicators

Name	connotation	Significance
D11	Total research and development expenditure	Higher factor development requires large funds. According to authoritative statistics, industries with high research and development investment often have higher competitiveness
D12	D11/ product sales X 100%	The intensity of industry research and development funds reflects the importance of sustainable development within the industry
D13	Total number of employed research and development	The total number of employees in research and development is an important indicator of industrial development and scientific and technological strength
D14	D13/ practitioners X 100%	Industry research and development personnel intensity is an important indicator of industrial development, scientific and technological content

D21	Industry added value /GDP X 100%	It reflects the contribution of the accelerated development of high-tech industries to the economic development of the region

3.3 Factor analysis method

After constructing a factor analysis model, it is necessary to verify, divide and arrange all the samples, so that it is more convenient to analyze specific problems. The statistical model must show the linear combination of variables x used by the main factor Fj, which is used to estimate the scores of any sample factor.

(1) The principal factor F is represented by a linear combination of variables x, then the factor score function is:

$$F_j = \beta_{j1}x_1 + A + \beta_{j\,PxP} \qquad (j = 1,2,..., m)$$

Among them, β is the index coefficient, x is the corresponding index, A is the shadow analysis matrix, according to the least squares method, and it is estimated that:

$$F = A`R^{-1}x \quad (1)$$

Among them, R is the correlation coefficient matrix of the original variable.

$$F = (F_1 + F_2 + A + F_m)'$$
$$X = (x_1 + x_2 + A + x_p)'$$
$$A' = (a_{ij})_{m\times p}$$

When the factor is orthogonal, A` is the transposition of the factor load matrix A after rotation.

(2) Assuming that the variance contribution rate K_i of each principal factor is the weight of F_i, the comprehensive factor evaluation model of each sample is:

$$F = \sum_{j=1}^{m} K_j F_j \quad (2)$$

Among them: F stands for synthesis factor score; $K_i$represents the contribution rate of the main principal factors to the original data, $K_j = \lambda_j / \sum_{j=1}^{m} \lambda_j$, from the original data and the formulas (1) and (2), the main factor scores and the comprehensive factor scores can be obtained, so as to classify and rank the study samples.

4. RESULT ANALYSIS AND DISCUSSION

According to the constructed index system of high and new technology industry and the difficulty of information acquisition, in view of the proportion of high-tech industry added value in GDP, this study chose the proportion of research and development in GDP that can represent the background of industrial policy, and the proportion of research and development workers in the number of research and development personnel that can show industrial technology support environment to carry on the analysis [12]. The factor analysis was used to start the analysis, and the variable was defined at the outset:

X1: the proportion of added value of hi-tech industry in GDP in the region

XZ: high and new technology industry output value

X3: amount of exports of high and new technology industry

X4: the proportion of research and development funds in GDP

X5: the proportion of the number of the scientists and engineers in the number of research and development staff

X6: the number of high - tech enterprises in high - tech development zone

In order to ensure the availability and comparability of the original data, this study adopted the official statistical data of all provinces, municipalities and autonomous regions in 2005 for analysis (Due to incomplete index data, Tibet and Qinghai were excluded from the analysis).

Based on the data normalized by the raw data, SPSS 13.0 was used to obtain the test result, the KMO statistic was 0.699, and the partial correlation was weak, which was suitable for factor analysis; The Bertlett spherical test rejected the original hypothesis of the unit correlation matrix, P <0.001, so it was appropriate to use the factor analysis method. According to the normalized data, SPSS 13.0 statistical analysis software was used to choose the main factor based on the principle that the cumulative variance was greater than 90%. From the analysis of Table 2, it can be seen that the cumulative contribution rate of the variance of the first three factors was 96.531, reaching more than 90%, so it was determined that the three main factors F1, F2 and F3 were extracted.

Table.3 Analysis of total variance

factor	Initial eigenvalue results Initial eigenvalue results			Pre rotating factor extraction		
	characteristic value	Variance contribution rate (%)	Cumulative variance contribution rate (%)	characteristic value	Variance contribution rate (%)	Cumulative variance contribution rate (%)
1	4.478	74.634	74.634	4.478	74.634	74.634
2	.854	14.228	88.862	.854	14.228	88.862
3	.460	7.669	96.531	.460	7.669	96.531
4	.173	2.887	99.419			
5	.032	.541	99.959			
6	.032	.541	99.959			

Since the load values of the main factors F2 and F3 were not well explained on the original variables, the factor rotation was further carried out. In this paper, the variance maximization was used to maximize the orthogonal rotation. After four rotations, the factor load matrix was obtained.

Table.4 Post rotation factor loading matrix

Variable index	Main factor		
	F1	F2	F3
X1	.409	.865	.112
X2	.409	.865	.112
X3	.883	.424	.154
X4	.471	.807	.164
X5	.146	.130	.980
X6	.916	.358	.121

From the factor load matrix in the table, according to the factor analysis method, the factor analysis model of the competitive strength evaluation system of high-tech industry in Zhejiang can be obtained as follows:

$$\begin{cases} x_1 = 0.409F_1 + 0.865F_2 + 0.112F_3 \\ x_2 = 0.874F_1 + 0.453F_2 + 0.170F_3 \\ x_3 = 0.883F_1 + 0.424F_2 + 0.154F_3 \\ x_4 = 0.471F_1 + 0.807F_2 + 0.164F_3 \\ x_5 = 0.146F_1 + 0.130F_2 + 0.980F_3 \\ x_6 = 0.916F_1 + 0.358F_2 + 0.121F_3 \end{cases}$$

From the factor rotation load matrix and factor analysis model, it can be understood that the first principal factor F1 contains three indicators, namely, the output value of high-tech industry, the export quota of high-tech industry and the number of high-tech enterprises, which shows the advantages and disadvantages of achievements of the high-tech industry in the region, and the specific score can show the output capacity of the high-tech industry, and the variance contribution rate of the main factor F1 is as high as 74.6070, which means that the principal factor F1 is a key factor affecting the competitiveness of high-tech industries. Therefore, in order to enhance the competitiveness of high-tech industries in Zhejiang, it is necessary to pay more attention to it. The main factor F1 is defined as the output factor; the second factor F2 is the proportion of the industrial added value in the region's GDP and the proportion of the research and development cost in the GDP, which shows the development of high-tech enterprises and the scale of research and development. Because the influence efficiency of the proportion of indicator research and development costs in GDP is more significant than the proportion of index industry added value in GDP in the region, the main factor F2 is considered as the scale factor of industrial development. Determinant influence factor of the third factor is research and development worker, which shows that in the actual development process, high-quality talents will have a very obvious impact on the competitiveness of high-tech industries, so this factor is called "talent factor"[13].

In the end, the regression method was selected to find the scores of each factor, and the proportion of the variance contribution rate of each factor in the total contribution rate of the three factors was chosen as the weight of each factor, so as to expand the weighted aggregate operation and obtain the comprehensive factor score [14]. From the factor score coefficient table 5, the factor Fj score function can be obtained:

$$\begin{cases} F_1 = -0.402x_1 + 0.434x_2 + 0.473x_3 - 0.295x_4 - 0.125x_5 - 0.572x_6 \\ F_2 = -0.857x_1 - 0.176x_2 - 0.224x_3 + 0.708x_4 - 0.109x_3 - 0.345x_6 \\ F_3 = -0.081x_1 - 0.020x_2 - 0.36x_3 - 0.023x_4 + 1.050x_3 - 0.066x_6 \end{cases}$$

At the same time, a comprehensive factor scoring function can also be obtained:

$$F = (74.634F_1 + 14.228F_2 + 7.669F_3)/96.531$$

Table.5 Factor score coefficient table

Variable index	Main factor		
	F1	F2	F3
X1	-.402	.857	-.081
X2	.434	-.176	-.020
X3	.473	-.224	-.036
X4	-.295	.708	-.023
X5	-.125	-.109	1.050
X6	.572	-.345	-.066

From the table, it can be learned that regions in which industrial output capacity factors are the top three are Zhejiang, Jiangsu and Shanghai. Zhejiang Province is behind Shanghai, ranks in fourth position. From the original data, it can be found that compared with the provinces and cities occupying the top three, there is still a big gap between the total output value and the export quota of high-tech industries in Zhejiang province. The number of high-tech enterprises in Zhejiang is as high as 236, which is almost twice as much as that in Shanghai. Therefore, under the comprehensive impact of the relevant indicators system, the output factor score of Zhejiang is fourth, which is inevitable. The regions in which industry development scale factor is among the top three are Beijing, Tianjin and Shanghai. Zhejiang is in the seventh place. On the basis of fully contacting the original data, it can be concluded that the upgrading of the output value of high-tech

industries in Zhejiang has relatively little impact on the total output value of the economy, and there is a gap with the top three regions [15]. In terms of talent factors, Zhejiang ranks eighth, the influence factor of this factor is the proportion of research and development workers in research and development, which shows that Zhejiang has attached great importance to high-quality talents, and actively introduced and obtained relatively large achievements. In terms of the ranking factors of the competitiveness of high-tech industries, the top three are Jiangsu, Shanghai and Zhejiang respectively. It can be understood that compared with many provinces and cities, the development of Zhejiang high and new technology is higher, which is closely related to the solid economic base and abundant human resources in the province. In terms of the Yangtze River Delta region, it is still a bit smaller than Jiangsu and Shanghai, and its competitiveness is still to be further improved. Through the analysis of the original data, it can be seen that amount of exports of new and high technology in Zhejiang is few, which means, in a sense, that the international competitiveness of high-tech products in Zhejiang is insufficient. Therefore, it is necessary to take this aspect as a breakthrough point to enhance the competitive strength of its high-tech industries.

5. Conclusions

At present, the human beings have gradually entered the era of knowledge economy, high-tech industry has gradually become a key driving force to promote economic development. The level of competitiveness of high-tech industry has a decisive influence on the national and regional economic development. It can be said that the development of high-tech has gradually become the key driving force of global development. Therefore, it is critical to evaluate it. The index system and the empirical research structure are matched with the actual situation, which can be regarded as the evaluation system of judging the competitiveness of Zhejiang high-tech industry. Using factor analysis method to carry out empirical analysis of competitiveness of high-tech industry has a very strong operability. With the design of the indicators, the original data was linked, and factor analysis method was used for empirical analysis. It is found that the competitiveness of Zhejiang high-tech industry is relatively high, which is in the forefront of our country. There is also a gap between the Yangtze River Delta and Jiangsu and Shanghai, the key reason is that the foundation of the industry is relatively weak, the scale is not large, and the advantages are not obvious enough.

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