Journal of **Systems Science and Information**
2004, Vol.2, No.3, pp. 503–508
Published by Research Information Ltd(RIL), UK

Evaluation for Rationalization of the Industrial Structure Based on Grey Relevancy Degree

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(Received July 30, 2003)

Abstract: Rationalization of Industrial Structure is essential characteristic of economic development and key to promote sustained, stable, coordinated economic development as well. Based on Grey Relevancy Degree, the paper is to analyze industry structure in Wenzhou, China. And give the evaluation for rationalization of industrial structure.

Key words: grey relevancy degree; rationalization of industrial structure; evaluation

1. Introduction

Deng Julong (1982) first puts forward the concept of Grey System and establishes the theory of Grey System which indicate information system is part of certainty, and part of uncertainty. Because people' cognition has extensive grey nature, the relevant theory of Grey System is used to research evaluation problem[1–3].

On the basis of William Petty' research, C.G.Clark (1940) demonstrated relativity between industry and economic development and drew a conclusion that is the famous Petty-Clark theorem: with the economic progress, labour population is transferring from agriculture into manufacturing, and into business or service. The theorem addressed allocation structure of human resource in the production factors would change regularly with the economic development, which prove statistically and concisely the relativity between the economic development and industry structure[4]. After this, American economist S.Kuznets (1966) studied and analysed the alteration of many years industrial structure in thirteen countries including America, Japan, Britain etc. And educed an important conclusion that the proportion of output value of the primary industry would have being declined continually, but the secondary industry and the tertiary industry went up. The conclusion was proved not only by the latter many economists, but also by the facts of the economic development in many countries. Those show one of the essential characteristic of the economic development is that the industrial structure evolve and transform constantly from simpleness into complex, from low-grade into high-grade. So it is necessity to evaluate the complex system of the industrial structure.

With the rapid development of economy in Wenzhou known as in China after reform and opening up to the outside world, its industrial structure has took place change greatly. Evolution and transformation of structure is the essential characteristic of the economic development in the area, and key to promote sustained, stable, coordinated economic development as well. Thus, based on Grey Relevancy Degree, the article has evaluated the rationalization of its industrial structure in order to provide scientific evidence for the area' implementing the sustainable development.

2. The Design of Evaluation Index on the Basis of Analysis of Industrial Structure

According to standard divided by the World Bank and reference index of industrialization standard[5], the value of each index of industrial structure in Wenzhou from 1995 to 1999 is shown in Table 1.

Table 1 The value of each index of industrial structure in Wenzhou from 1995 to 1999

Index	Medium-term level of industrialization	1995	1996	1997	1998	1999
GDP per capita ($)	2500	967.07	1212.5	1429.33	1582.5	1697.67
Percent increase of the secondary industry	40 – 70	55.8	56.9	53.2	52.8	51.94
Percent increase of the tertiary industry	30 – 60	31.4	31.4	32.8	33.8	35.3
Rate of population of the primary industry (%)	30 – 15	35.4	34.6	33.4	35.1	34.81
Rate of population of the secondary industry (%)	20 – 30	28.3	27.7	27.9	28.4	26.71
Rate of population of the tertiary industry (%)	35 – 50	36.3	37.7	38.7	36.5	38.48

Source: Wenzhou Statistic Annual (1996 – 2000)

3. Evaluating Rationalization of Industrial Structure Based on the Grey Relevancy Degree

The previous system analysis of relevancy factors adopted mostly those methods such as the regression analysis, the variance analysis, the principal component analysis, however, which had some faults[6].

• demand a great lot of data, and it is difficult to find out statistical law if want of data.

• demand sample obedience to one of typical probability distribution, and data between factors and system characteristic being assumed linear relation, moreover each factor being independence, however, the demand being difficult to satisfy.

• appear phenomenon that the result of quantitative analysis unconformity with qualitative analysis, which result in the relation and law of system encountering to be distorted and inversed.

The rationalization of industrial structure is analysed in the following by Grey Relevancy Degree.

Grey Relevancy Degree

Grey Relevancy Degree, which is used to analyse relevancy degree of each factor in system, is a quantitative method measuring relevancy degree. Because the interior of system and between system and environment need exchange material and energy and information, the intercourse displays a serial of orderly structural quantity. Thus analysis of structure and function of system need research those flow and carry through factor analysis. To require relatively great sample size is to deal with the above case with using generally statistic method. However, the statistic method is invalid for the grey system of the inadequate information[7]. The Grey Relevancy Degree is a basic method of system analysis, which virtually substitutes approximate convergence for infinite, finite number series for infinite space, and dispersal number series for continuous concept. Therefore, the Grey Relevancy Degree indicates two orderly structural quantities, namely the numerical value of serial relevancy degree[8].

Its basic idea is to judge relevancy degree according to similar level among curves, as shown in Fig.1. We can see the similar level between curve ① and curve ② is larger than between curve ① and curve ③, so similar level between curve ① and curve ② is taken for larger, and between curve ① and curve ③ for less.

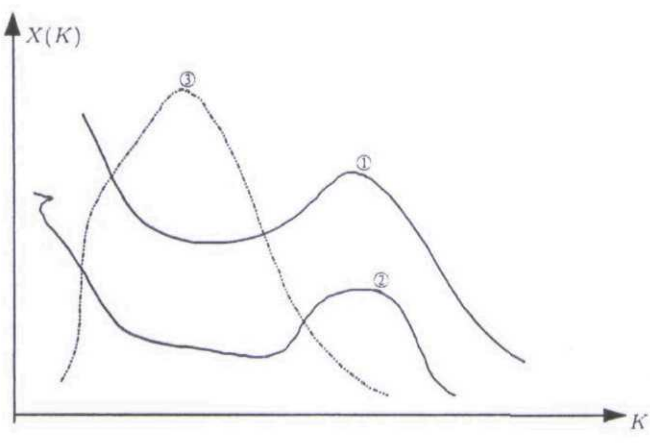

Fig.1 Relevancy relationship among curves

Given that a reference numeral series is x_0, a comparable numeral series is x_i, $i = 1,2,\cdots,N$, and $x_0 = \{x_0(1), x_0(2), \cdots, x_0(n)\}, x_i = \{x_i(1), x_i(2)\cdots, x_i(n)\}, i = 1,2,\cdots,N$, then

$$\xi_i(k) = \frac{\min\limits_i \min\limits_k |x_0(k) - x_i(k)| + \rho \max\limits_i \max\limits_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max\limits_i \max\limits_k |x_0(k) - x_i(k)|}$$

is relevancy coefficient between curve x_0 and curve x_0 at dot k. In the above formula:

- $|x_0(k) - x_i(k)| = \Delta_i(k)$ represents absolute error between x_0 and x_0 at dot k.
- $\min\limits_i \min\limits_k |x_0(k) - x_i(k)|$ represents minimal error between two extremes, and $\min\limits_k |x_0(k) - x_i(k)|$ is the minimal error of the first extreme that denotes the minimal distance between each dot on the curve x_i and x_0, and $\min\limits_i(\min\limits_k |x_0(k) - x_i(k)|)$ is the minimal error of the second extreme that denotes the minimal distance among between each curve $x_i (i = 1, i = 2, \cdots, i = N)$ and curve x_0 on the basis of the first minimal error.
- $\rho (0 \le \rho \le 1)$ is distinguishing coefficient, and assume commonly $\rho = 0.5$. Integration of relevancy coefficient at each dot, hence relevancy degree r_i between reference curve x_0 and entire curve x_i is $r_i = \frac{1}{N} \sum\limits_{k=1}^{N} \xi_i(k)$.
- When numeral series have different initial value or measure unit, it need be got rid of measure unit and become unitary in general.

4. Empirical Specification and Evaluation Step

In the following, rationalization of industrial structure in Wenzhou is evaluated using data from Wenzhou Statistic Annual (1996 – 2000).

- Step one: data in Table 1 is processed without measure unit. (Table 2)

Table 2 Processing data with measure unit

Serial	GDP per capita	Percent increase of the secondary industry	Percent increase of the tertiary industry	Rate of population of the primary industry	Rate of population of the secondary industry	Rate of population of the tertiary industry
$x_{(0)}$	1	55	40	25	25	45
$x_{(1)}$	0.3871	55.8	31.4	35.4	28.3	36.3
$x_{(2)}$	0.485	56.9	31.4	34.6	27.7	37.7
$x_{(3)}$	0.5717	53.2	32.8	33.4	27.9	38.7
$x_{(4)}$	0.633	52.8	33.8	35.1	28.4	36.5
$x_{(5)}$	0.6791	51.94	35.3	34.81	26.71	38.48

- Step two: data in Table 2 is processed with initial value. Its result is sown in Table 3.

Table 3 Processing data with initial value

$x_{(0)}$	1	0.55	0.4	0.25	0.25	0.45
$x_{(1)}$	1	1.4415	0.8112	0.9145	0.7311	0.9377
$x_{(2)}$	1	1.1732	0.6474	0.7134	0.5711	0.7773
$x_{(3)}$	1	0.9306	0.5737	0.5842	0.488	0.6769
$x_{(4)}$	1	0.8341	0.534	0.5545	0.4487	0.5766
$x_{(5)}$	1	0.7648	0.5198	0.5126	0.3933	0.5666

• Step three: yield the absolute error $\Delta_{i(k)}(i = 1,2,3,4,5)(k = 1,2,3,4,5,6)$ of the reference serial $x_{(0)}$ against each serial $x_{(i)}$ in the each index, and its value is computed in the following table 4. Then get the minimal absolute error $\Delta_{\min} = 0$ and the maximum absolute error $\Delta_{\max} = 0.8915$.

Table 4 Yielding the absolute error $\Delta_i(k)$

$\Delta_{1(k)}$	0	0.8915	0.4112	0.6645	0.4811	0.4877
$\Delta_{2(k)}$	0	0.6232	0.2474	0.4634	0.3211	0.3273
$\Delta_{3(k)}$	0	0.3806	0.1737	0.3342	0.238	0.2269
$\Delta_{4(k)}$	0	0.2841	0.134	0.3045	0.1987	0.1266
$\Delta_{5(k)}$	0	0.2148	0.1198	0.2626	0.1433	0.1166

• Step four: assume $\rho = 0.5$, and compute the relevancy coefficient of each index from 1995 to 1999. (Table 5)

Table 5 The value of the relevancy coefficient

$\xi_{1(k)}$	1	0.33	0.52	0.4	0.48	0.48
$\xi_{2(k)}$	1	0.42	0.64	0.49	0.58	0.58
$\xi_{3(k)}$	1	0.54	0.72	0.57	0.65	0.66
$\xi_{4(k)}$	1	0.61	0.77	0.59	0.69	0.78
$\xi_{5(k)}$	1	0.68	0.79	0.63	0.76	0.79

• Step five: get the relevancy degree between $x_{(0)}$ and $x_{(i)}$ every year. According to $r_i = \frac{1}{N}\sum_{k=1}^{N}\xi_i(k)$, then getting $r_1 = 0.535, r_2 = 0.618, r_3 = 0.69, r_4 = 0.74, r_5 = 0.775$. We can see, $r_5 > r_4 > r_3 > r_2 > r_1$. It shows the industrial structure in Wenzhou is close to the medium-term level of industrialization and trend toward rationalization.

5. Conclusion

The method based on the Grey Relevancy Degree provides an efficiency tool of mathematical analysis. Compared with the traditionally statistic method, its advantage is to offer a new approach that solve the problem of evaluation for rationalization of industrial structure with inadequate information and the small size of sample and without typically statistic law. Moreover, it can provide scientific grounds for implementing the sustainable development.

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