

Counties Economic Evaluation Research Based on Grey Correlation and Entropy

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Abstract This article takes counties of prefecture-level city and municipal development zone as study objects, establishes economic evaluation system through index system design principles, builds the relative correlation of grey system theory, integrates assessment model of entropy and scatters degree, which has theoretical significance, as well as provides use for reference of economic evaluation to prefecture-level city and municipal development zone.

Key words Grey system theory; Relative correlation; Entropy; Scatter degree

1 Introduction

Since the reform and opening up, especially, the formation of China's four major economic blocks in the new century, economy has developed rapidly around China, many east coastal prefecture-level cities' GDP (such as Nantong, Tangshan, Weifang, etc.) break through 100 billion Yuan and it took just 4 years when GDP broke through 200 billion Yuan, economic development has made remarkable achievements.

In recent years, in central part of China, some prefecture-level cities' GDP reached 100 billion Yuan; people began to study them in order to develop economy quickly. From these cities' economic development experience, they formed a pitch-industry development system, the vertical system: industries — pillar industries — industrial park — industrial clusters — leading enterprise (cultivation of leading enterprises is largely dictated by the strategy of enlarging and enhancing enterprises, market financing and brand strategy, etc.); horizontal system: government reform, investment in the soft and hard environmental improvement, technology policy and economic evaluation work of counties of prefecture-level cities, etc.

This article takes counties of prefecture-level city and municipal development zone as study objects, establishes economic evaluation system through index system design principles, builds the relative correlation of grey system theory, integrated assessment model of entropy and scatter degree, which has theoretical significance, as well as provides use for reference of economic evaluation to prefecture-level city and municipal development zone

2 Design Principles of Economic Evaluation Index

Design and formulation of counties' economic evaluation index should make clear its purpose and pay attention to its scientificness, oneness, systematicness and comparability.

2.1 Principle of purpose

The subjects investigated are the counties and municipal development zones of prefecture-level cities. Considering the importance of every index in the whole index system, we will not focus on the estimate evaluation of economic evaluation. The basic goal is to analyze the current situation in different zones in the aspects of strength, innovation level and innovation environment then to dig out reasons causing disparity. Supply different zones with scientific basis to improve their innovation capability.

2.2 Principle of scientific

Design index system of counties and municipal development zones and fix their names, meanings and diameter ranges according to a certain purpose. Namely, Formulation of the index names should have scientific basis in theory and efficiency in practice. Only by this, materials can be collected and reasonable analysis and application can be received.

2.3 Principle of oneness

Oneness consists of two aspects: one is the meaning, diameter range, design procedure and computing time should be unified from the domestic relations. The other is qualitative analysis should be combined with quantitative analysis. When we weight the three one- grade indexes, we should adopt comprehensive empowering act which combined objective one with subjective one.

2.4 Principle of systematic

This principle has two meanings. The first meaning: level is one important feature of systematicness. Index system of economic evaluation has three levels: the first level is one- grade index,

that's three factors; the second level is nine two -grade indexes; the third level is sixty five third-grade indexes. The second meaning: considering region as a system, we should combine environment and system for index including internal one and environment index.

2.5 Principle of comparability

On the precondition of fixing the purpose, scientificness, oneness and systematicness are service as guarantee of comparability. Only comparable competitiveness index can supply us with correct information materials. Then analysis and decision can be made and decision-making services can be given. Comparability requires three meanings: firstly, comparability can be carried out in different regions and spatial dimension. For example, index with currency unit (total industrial output value and high-tech industrial added value) must deduct price element from it; secondly, caliber and range of index should be combined with each other when compare high-tech zones in different regions. Generally, relative numbers, proportional numbers, index and average are used to compare. Thirdly, in the evaluation process, absolute number and relative numbers are listed in the same index system. In order to avoid accident, it is necessary to deal with the index data to achieve standardization, normalization, maximization and mineralization. Thereby, data can be compared in a zero dimension condition.

3 Economic Evaluation Index System Design of Counties of Prefecture-Level City and Municipal Development Zone

Establishing evaluation indicator system based on the principles of indicators construction as follows:

Economic level includes 9 secondary indicators: GDP per capita growth rate, tax revenue proportion of GDP, tax revenue growth, total retail sales growth rate, import and export volume growth rate, exports growth rate, the actual utilization of foreign investment growth, local fiscal income growth, the proportion of local finance of total tax revenue, reflects economic growth and the quality of economy.

Industry level has 10 secondary indicators and includes the growth of agricultural exports, value-added growth rate of agricultural processing enterprises, integrated mechanization level of agriculture, industrial value-added tax revenue growth rate, main business income growth rate of large-scaled industries, increased percentage point of the industrial economic efficiency index, increased percentage point of industrial increased value to the contribution growth rate of economic growth, the proportion of the modern service industry to the tertiary industry, service sector growth in tax revenue, growth rate of sales of commercial housing space, mainly reflects the growth level of modern agricultural, industrial efficiency and modern service industry.

Science and technology input and output levels have 12 secondary indicators, which include increased percentage point of high-tech industries' investment accounts to the investment of industries, the growth rate of cultural industry investment, technological innovation investment accounts to investment of industries, optimizing rate of fixed assets investment structure, growth rate of the actual investment for 50 billion projects, growth rate of trade and investment promotion, growth rate of the registered capital of new enterprises, the proportion of financial institutions' loans to savings, the proportion of large industrial enterprises' R&D expenditure to GDP, the proportion of high-tech industry output value to industrial output, growth rate of high-tech industry output value, number and growth rate of high-level talents, growth rate of high-level talents per 10,000 people.

People's living standard has 16 secondary indicators, including corporate employees' average wage growth rate, the Engel coefficient, growth rate of the number of hospital staff per 10,000 people, compliance rates of urban community health service, standard rate of rural health office service ability promotion project, funding amount per capita of new rural cooperative medical care, coverage of basic medical insurance for urban residents, collection amount of employees' basic old-age insurance, urban workers basic medical care, collection amount of unemployment insurance, collection amount of rural old-age insurance, growth of urban and rural residents' minimum living standard assistance, urban and rural residents' medical standards and growth, the living standard of the beneficiaries and growth, release rate of urban low-rent housing finance, renovation number of dilapidated buildings of rural poor disabled persons.

Education level has 10 secondary indicators, primarily reflects the counties' culture, education standards and physical standard. It includes senior secondary education coverage, the proportion of government teaching achievement awards, teachers' salaries brought into the county fiscal convergence criteria, public cultural service system compliance rates, and cultural construction of compliance rate, the number of culture, news reports awards above the provincial level, cable TV households rate and the

number of new users, the proportion of 10,000 people that transporting athletes to sports teams which above the city level, the proportion of 10,000 people that getting competition medals, courage rate of sporting facilities in rural areas,

Energy conservation standard has 6 secondary indicators, mainly reflects the friend degree of local economy and environment. It includes decreased rate of 10,000 Yuan GDP energy consumption, decreased rate of 10,000 Yuan GDP water consumption, added value energy consumption rate of 10,000 Yuan industries, emissions reduction rate of chemical oxygen demand (COD), emissions reduction rate of sulfur dioxide,

Harmony building level has 7 secondary indicators, mainly reflects the harmonious development degree in the counties. It includes the coverage rate of standardized urban community service centers (stations), coverage rate of standardized rural areas' community, the standard rate of urban community management of the "three-have" (there are certain officials to provide service for people, there are enough money to do things, there are enough land to do things), the standard rate of rural community management of the "three-have", control of petition, soft environmental comprehensive assessment of economic development, the rate of criminal cases per 10,000 people,

Infrastructure level has 9 secondary indicators, mainly reflects infrastructure facilities of the county level. It includes urban piped gas penetration, city bus number for every 10,000 citizen, the proportion of new energy bus of total buses, village paved road rate, the new reform mileage, new-added beneficiary population of running water, transformation and increase of the beneficiary population, per capita green cover, green tracts of forest land completion rate, completion rate of forest construction.

4 Evaluation Model of Counties Economic Evaluation Research

4.1 Determining evaluation matrix and correlation coefficient

Matrix X_k is n second-grade index data of s counties cities and municipal development zones of the Kth First-Grade Index in a prefecture-level city

$$X_k = \begin{bmatrix} x_{11}^k & x_{12}^k & \cdots & x_{1n}^k \\ x_{21}^k & x_{22}^k & \cdots & x_{2n}^k \\ \cdots & \cdots & \cdots & \cdots \\ x_{s1}^k & x_{s2}^k & \cdots & x_{sn}^k \end{bmatrix} \quad (K = 1, 2, \dots, 8) \quad (1)$$

Establish a sequence

Two second-grade index in the same level are $X_i(k)$ sequence and $X_j(k)$ sequence, $X_i = \{X_i(k) | k = 1, 2, \dots, n\}$ $X_j = \{X_j(k) | k = 1, 2, \dots, n\}$,

the original sequence deal with dimensionless, that each sequence divide its original value, create a new dimensionless sequence X_i^1, X_j^1 .

Calculate $|T_i^1| = \left| \sum_{k=2}^{n-1} X_i^1(k) + \frac{1}{2} X_i^1(n) \right|, \quad (i = 0, 1, 2, \dots, m)$

$|T_i^1 - T_j^1| = \left| \sum_{k=2}^{n-1} (X_i^1(k) - X_j^1(k)) + \frac{1}{2} (X_i^1(n) - X_j^1(n)) \right|, \quad i = 0, j = 1, 2$

Calculate relative degree of association

$$\rho_{ij} = \frac{1 + |T_i^1| + |T_j^1|}{1 + |T_i^1| + |T_j^1| + |T_i^1 - T_j^1|}$$

4.2 Calculating the entropy values in the second-grade index

$$H_i^k = -\frac{1}{\ln n} \sum_{j=1}^n \left[\frac{\rho_{ij}}{\sum_{j=1}^n \rho_{ij}} \ln \frac{\rho_{ij}}{\sum_{j=1}^n \rho_{ij}} \right], \quad j = 1, 2, \dots, n; i = 1, 2, \dots, t \quad (2)$$

Calculate the weight of the second-Grade Index

$$w_i^k = \frac{(1 - H_i^k)}{\left(S_k - \sum_{i=1}^{s_k} H_i^k \right)}, \quad 0 \leq w_i^k \leq 1, \quad \sum_{i=1}^{s_k} H_i^k = 1$$

4.3 Evaluation value of the first-grade index

$$F_k = \sum_{i=1}^s w_i^k x_{ij}^k \quad (k = 1, 2, \dots, 8)$$

4.4 Confirmation of the eight first-grade’s significance

According to the above factor analysis, we can get n number of counties economic evaluation research. Use matrix to express, it is $B = (b_{ij})_{n \times 8}$, b_{ij} is the i th counties economic j the evaluation value of the first-grade index.

4.5 Theory of “widening the difference between different grades”

Several subjects being evaluated can be regarded as several points in three dimensions which are formed by three indexes from geometry aspect. To get the evaluation value of several subjects is like to project points ‘shadow to a certain dimensional space. It will expand the disparity between subjects .According to the m- dimensional space, built a best one dimensional space .Every point shadow in this dimensional space will be scattered. Then the dispersion will receive greatest degree .Select linear function of enormous evaluation index $t_1, t_2, t_3 \dots t_8$:

$$y = \omega_1 t_1 + \omega_2 t_2 + \dots + \omega_8 t_8 = \omega^T t \tag{3}$$

In the formula $\omega = (\omega_1, \omega_2, \dots, \omega_8)^T$ vector is to be determined of m(role as weight coefficient vector) . $t_1, t_2, t_3 \dots t_8$ is status variable of evaluation sample collection. Put the three standard observations value of the 1th $t_{i1}, t_{i2}, \dots, t_{i8}$ into (3), then will receive

$y_i = \sum_{j=1}^8 \omega_j t_{ij} \quad (i = 1, 2, \dots, 3)$. The principle of determination the weight coefficient vector ω can display the disparities between samples to a biggest degree. Find different index vectors’ linear function $\omega^T t$ and scatter several samples as widely as possible. As for the variable $y = \omega^T t$, put $y = B\omega$ into the sample variance formula

$$S = \frac{1}{n} \sum_{i=1}^n (y_i - \bar{y})^2 = \frac{y^T y}{n} - \bar{y}^2 \tag{4}$$

and we know $\bar{y} = 0$.Take notice of the original data’s standardization. Then have $nS^2 = \omega^T B^T B \omega = \omega^T H \omega$. In the formula (4), any large value can be selected with no limitation on ω . If $\omega^T \omega = 1$, it can prove that $\max(nS^2) = \lambda_{\max}$ λ_{\max} is the biggest eigen value of $H = B^T B$. ω is eigenvector vector of the biggest eigenvalue. Normalize it then will find weight coefficient vector and

$$\sum_{i=1}^8 \omega_i = 1 .$$

4.6 Confirmation of independent innovation capability’s evaluation value

According to the above competitive evaluation in eight regions and the confirmation of the significance, we can get the formula of overall evaluation in regional competitiveness

$$F = \sum_{k=1}^8 \omega_k F_k$$

5 Conclusions

(1) This article takes the relative correlation to study correlation coefficient; the reason is that correlation Analysis takes zero as the starting point to do initial treatment, when the factors have large difference, variables’ dimensions are different, and analysis will be affected, it is difficult to get a reasonable result. (2) The process of obtain index data has availability (China Statistical Yearbook, Statistical Yearbook of Science and Technology of China) (3) It needs further research if

we are going to give a more correct definition of counties economic evaluation research. (4) Quite scientific, comprehensive index system of counties economic evaluation research was established. Model has operability (SPSS software). Index data has availability (China Statistical Yearbook). They can reflect the status of regional competitiveness objectively and correctly. How to give a more correct definition of counties economic evaluation research needs further research.

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