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The TOPSIS Analysis on Regional Disparity of Economic Development in Zhejiang Province

ANALYSE TOPSIS SUR LES DISPARITES REGIONALES DU DEVELOPPEMENT ECONOMIQUE DANS LA PROVINCE DE ZHEJIANG

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Abstract
This paper is aimed to evaluate the regional disparity of economic development in Zhejiang Province. According the principals of the criteria and the practical situation of the 11 cities, this paper makes the analysis by TOPSIS method through ten indicators, with the data from 2007 to 2009. This evaluation shows that there exists regional disparity of economic development among the 11 cities. Further, this paper investigates the reasons behind the disparity and discusses those cities' roles in the whole province.

Key words: Regional Disparity; Economic Development; TOPSIS

Résumé
Cet article est destiné à évaluer les disparités régionales de développement économique dans la province du Zhejiang. Selon les principes de critères et de la situation concrète des 11 villes, ce document fait l'analyse par la méthode TOPSIS travers dix indicateurs, avec les données de 2007 à 2009. Cette évaluation montre qu'il existe des disparités régionales de développement économique parmi les 11 villes. En outre, ce document examine les raisons derrière la disparité et discute des rôles de ces villes dans toute la province.

Mots clés: Disparité régionale; Développement Economique; TOPSIS

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INTRODUCTION
Zhejiang Province, located on the southeast coast of China, covers a total land area of 101,800 square kilometers and has 11 cities under the direct jurisdictions, including Hangzhou, Ningbo, Wenzhou, Shaoxing, Jiaxing, Jinhua, Taizhou, Lishui, Quzhou, Jinhua and Zhoushan. As an important part of Yangtze River Delta, Zhejiang Province is regarded as the most economically vibrant and developed province in China. In 2009, the GDP of Zhejiang province was 2283.2 billion RMB, an increase of 8.9% over the previous year calculated at comparable price, ranking the forth in China in term of overall economic aggregate. The add value from the primary, secondary and tertiary industries were 116.2 billion RMB, 118.4 billion RMB and 982.7 billion RMB, up by 2.3%, 6.8% and 12.5% respectively. And the per capita GDP was 44335 RMB, up by 7.6% over the previous year.

As a leader of the market-oriented economic reform in China, Zhejiang Province has gained first-mover advantage in the reform, setting up a competitive system, and the its featured part, the private economy is where the economy's vigor, advantage and potential lie. The traits of the private economy of Zhejiang Province, "small commodities, large market and low cost" have promote the 11 cities' development, and cultivated more than 500 industrial cluster in the whole province. If making the comparison among all the cities in China, the 11 cities could be regarded as the developed cities, however, within the province, there still exists some regional disparity among those 11 cities, some may make the promotion, while others could be the lags. In order to improve the efficiency of the production factors and foster the economic development, it has become clear that the

economic integration and balanced development would be crucial.

Under this background, this article aims to make a study on the contributions of the 11 cities by a quantitative approach, TOPSIS. From this analysis, we could get the overview of the economic feature of the 11 cities and their role played on the whole province.

1. LITERATURE REVIEW

The research on the regional economic development by various quantitative methods has attracted more and more attention. And the economic development has been always complicated with more than one criterion under consideration, that is called multiple criteria decision making (MCDM, Hwang and Yoon,1981). MCDM has been often applied for complex decision in construction when lots of criteria were involved. The MCDM problems could be divided into two kinds, one is the classical MCDM problem, among which the rating and the weights of criteria are measured in crisp numbers. Another is the fuzzy multiple criteria decision making problem, among which the ratings and the weights of criteria evaluated on imprecision ,subjective and vagueness are usually expressed by linguistic terms, fuzzy numbers or intuition fuzzy numbers (Liu, 2009)

Accordingly, MCDM is supplemented by the elements of mathematical statistics and the MCDM methodology that considered statistical relations between criteria is developed.(Jurjita.A,2010).There are several MCDM methods presented in the literature, including Theil's entropy, JINI Coefficient ,TOPSIS and ELECTER (Elimainaiton Et Choix Traduisant la Realite) and so on . It is no rule for how to choosing those methods, every way has its own advantage and drawbacks. So, the characteristics of the research objective and data become the criteria of judgment. In this article, TOPSIS is selected because of its simple and programmable computation procedure.(Chackraborty, 2011). In addition, TOPSIS has an advantage of its user friendly application where users may directly input judgment data without any previous mathematical calculation. Besides, it can also be combined with other MCDM method, such as AHP and operations research models to allow users to structure complex problems.

Classical literature on economic development described the trends of regional disparity as an inverted U-curve, as Williamson(1965) expressed " regional income differentials increase in early development stages, then stabilize, and then diminish in mature period of growth." The early classical literature didn't explain sufficiently the reasons behind the observations, while the later Growth Theory compensated this shortcoming, such as The Solow-Swan model, predicting that "under a fixed saving rate, a lower capital-labor ratio is associated with a fast proportionate increase in capital stock on the path toward a steady state or equilibrium."(Masahisa Fuita, 2001)

Since 1990, the studies on regional disparities in China have been lively. Lin (1998) examined the regional divergence after opening up in china by GINI coefficient method , and got a conclusion that it is the big discrepancy among the East, the Middle and the West that result the unbalance development for the whole country.Yang (1994) calculated the weighted coefficient of variation for per capita national income from 1952 to 1990, and the conclusion was that the trends of the divergence of the different cities of china present the "U" curve with the turning point in 1978.Mei and Xu (2005) analysis the economic development of the 13 cities in Jiangsu Province based on Theil coefficient method. Lyons and Tsui (1991) measured the inter-provincial disparities in China form 1950s to the mid-1980s. From the regional growth approach, the World Bank (1995), adopting per capita GDP growth rate as the indicator, analyzed the disparity for the period 1977-1992. In addition, Tian et al.(1996) further studied the tendency of regional convergence from 1953-1993 , and got the conclusion , that is, the inter-provincial disparity fell during this period, although some debate this. (Ergun et al., 2011)

2. METHODOLOGY

2.1 Topsis

The TOPSIS method (Technique for Order Preference by Similarity to Ideal Solution) is based on the concept that the best chosen alternative should have the shortest distance from the ideal solution and the farthest distance from the negative ideal solution. Through consistent and systematic criteria, TOPSIS analyzes the distance relationship between the ideal solution, which is the maximal benefits solution, and the negative ideal solution, regarded as the minimal benefits solution. TOPSIS is always used for multi-attribute decision making, by ranking the alternatives according to the closeness between the alternative and the ideal alternative. Te main advantage of this approach is its user could directly input judgment data without any previous mathematical calculations and locate both the ideal solution and the negative ideal solution easily.

The steps involved in TOPSIS are as follows:

(1) Step1 Inputs is expressed in the matrix form

$$A=\begin{Bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{Bmatrix}$$

(2) Step2 The normalized decision matrix is constructed using equations (1)

$$b_{ij}=\frac{a_{ij}-a_{\min(j)}}{a_{\max(j)}-a_{\min(j)}}$$

$$b_{ij} = \frac{a_{ij} - a_{\min(j)}}{a_{\max(j)} - a_{\min(j)}} \quad (1)$$

(3) Step 3 Calculation of the weighed normalized decision matrix

(4) Step 4 To determine the ideal (S+)and worst (S-) alternative

$$S^+ = \{ r_j^+ \mid j = 1, 2, \cdots, 10\} = \{\max r_{ij} \mid j = 1, 2, \cdots, 10\} \quad (2)$$
$$S^- = \{ r_j^- \mid j = 1, 2, \cdots, 10\} = \{\min r_{ij} \mid j = 1, 2, \cdots, 10\}$$

(5) Step 5 To calculate the distance of each alternative from the ideal and worst alternative

$$d_i^+ = \left[\sum_{j=1}^{10} (r_{ij} - r_j^+)^2\right]^2$$
$$d_i^- = \left[\sum_{j=1}^{10} (r_{ij} - r_j^-)^2\right]^2 \quad (i = 1, 2, \cdots\cdots, 11) \quad (3)$$

(6) To calculate the integrated evaluation index C

$$c = \frac{d_i^-}{d_i^+ + d_i^-} \quad (4)$$

2.2 Criteria of Regional Development

The determination of the development level of the 11 cities is required to elaborate the multi-criteria. According to the principal of choosing indicators, scientificity, reasonableness, comparability and controllability, this paper adopts 10 indicators to measure the economic level of 11 cities of Zhejiang Province. The whole evaluation system is expressed as table 1 as follows:

Table1
The Evaluation System of the Economic Development

Criteria	Sub-criteria
Economic Scale	(1) Per Capita GDP
	(2) GDP
	(3) Total Retail Sales of Consumer Goods
Industry Structure	(4)Composition of GDP
	(5)Total Investment in Fixed Assets
	(6)Total Profits of Industrial Enterprise Above Designated Size
People's Living Conditions	(7)annual per capita disposable income of households
	(8)savings deposit o households
Foreign Trade and Economic Cooperation	(9)Number of Projects for Contracted Foreign Direct Investment
	(10)Total Value of Imports and Exports

According to the indicator described above, the data, from 2007 to 2009, were mainly taken from Zhejiang Province 's government yearbook, Since each evaluation index with its own specific dimension was incomparable, not allowing the comparison of index value with different dimension, a direct comparison could be done between indexes in different units, also reduce the impact on the comprehensive evaluation due to fluctuation range of index value and dimension so as to minimize the loss of information. So, Undimensionalization is essential in the analysis process. In SPSS cluster analysis menu provide four Undimensionalization methods, and this study takes the Standardization method, by which a variable is rescaled to have a mean of zero and a standard deviation of one. Table 2, taking the data of 2009 as an example, shows the standardization variables.

Table 2
Standardization

	x1	x2	x3	x5	x6	x7	x8	x4	x9	x10
Hangzhou	0.6465	0.1334	0.6066	0.6353	0.6363	0.3401	0.6929	0.3325	0.6804	0.9791
Ningbo	0.5474	0.1503	0.4925	0.5599	0.5671	0.3681	0.4995	0.3531	0.5129	0.4643
Jiaxing	0.2494	0.1086	0.2675	0.3686	0.2493	0.3198	0.2212	0.3341	0.33	0.0294
Huzhou	0.1453	0.0792	0.1441	0.1648	0.154	0.3146	0.1071	0.3412	0.4391	0.1814
Shaoxin	0.3202	0.9936	0.255	0.2978	0.3714	0.3968	0.2536	0.3112	0.2056	0.1759
Zhoushang	0.0625	0.1014	0.0589	0.114	0.0535	0.3255	0.0548	0.3267	0.0143	0.0247
Wenzhou	0.292	0.0591	0.413	0.246	0.2625	0.3088	0.3899	0.3172	0.0257	0.0508
Jinhua	0.2079	0.0677	0.249	0.1874	0.1844	0.3031	0.2558	0.2874	0.1129	0.0917
Quzhou	0.0772	0.0503	0.0885	0.1061	0.0583	0.2631	0.0593	0.2622	0.0251	0.0137
Taizhou	0.2454	0.067	0.293	0.2201	0.1954	0.3059	0.2254	0.317	0.0314	0.0414
Lishui	0.0647	0.0417	0.0881	0.0775	0.0601	0.257	0.0805	0.2556	0.0118	0.0066

2.3 Results

According the steps described above, combing with the standardization variables of 2009, the TOPSIS method is applied to evaluate the regional disparity of economic development of the 11 cities in Zhejiang Province, and gets the results as follows

Table 3
Ranking of the 11 Cities with TOPSIS Method

	D+	D-	CI (%)	rank
Hanghzou	0.2106	1.6225	95.64	1
Ningbo	0.3336	1.4071	87.4	2
Jiaxing	1.1301	0.6318	39.01	5
Huzhou	1.3846	0.5497	31.68	7
Shaoxing	1.0739	0.7018	42.5	3
Zhoushang	1.6767	0.2586	14.3	9
Wenzhou	1.1292	0.6585	41.15	4
Jinhua	1.3205	0.4629	27.2	9
Quzhou	1.6805	0.1614	9.59	10
Taizhou	1.2885	0.4706	30.78	7
Lishui	1.7133	0.112	7.08	11

Applying the same procedure on the data of 2007 and 2008, then compare the ranking of those three year, which could reveal the trends of the regional disparity as Table 4.

Table 4
Ranking from 2007 to 2009

	2007		2008		2009	
Hanghzou	68.61	1	87.18	1	95.64	1
Ningbo	58.42	2	86.05	2	87.4	2
Jiaxing	28.04	5	41.9	5	39.01	5
Huzhou	25.61	6	31.25	7	31.68	7
Shaoxing	52.92	3	46.92	3	42.5	3
Zhoushang	5.96	9	18.17	9	14.3	9
Wenzhou	31.05	4	41.28	4	41.15	4
Jinhua	19.58	8	28.15	9	27.2	9
Quzhou	2.66	11	2.61	10	9.59	10
Taizhou	20.51	7	33.05	7	30.78	7
Lishui	1.95	12	8.97	11	7.08	11

CONCLUSION AND DISCUSSION

Table 3shows scores (Ci) by TOPSIS of the 11 cities, furthermore, Table 4 makes the ranks of the 11 cities from 2007 to 2009. The former shows the economic development lever of the 11 cities, while the later exhibits their trends during the later three years, which has little change actually. According those two tables, we could divide the 11 cities into three levels. The first level includes four cities, Hangzhou, Ningbo, Wenzhou and Shaoxing. Those four cities are treated as the developed cities with strong economy. And the second lever also enables four, that is, Jiaxing, Huzhou and Taizhou and Jinhua, represent the middle situation, moderate but not strong enough. The last three cities, Zhoushang, Quzhou, and Lishui are the third level, which are less developed compared to others. Those results are got by the TOPSIS approach; furthermore, we want to analysis the reasons by details.

In the four cities of the first level, Hangzhou, as the captain of Zhejiang Province, no doubt, has the most fame for its history and culture, renowned as “Paradise on Earth”. Actually, for the economic development, Hangzhou also takes the leading role. According to the policy of “building the city with industry and strengthening the city with industry, Hangzhou aims to establish the four manufacturing bases of featured electromechanical industry, medical and chemical industry, modern textile industry and modern building material industry, which have become the most dynamic ones among China’s relevant industries. Besides the local industry development, Hangzhou also attaches importance to the foreign investment, by introducing series of relevant policies in favor of foreign investor.

Ningbo, neighboring Hangzhou, is located in the east of Zhejiang Province. As to the south of the Yangze River, Ningbo has an advantageous foundation for port economy. Located on the main route of international container shipping in Pacific Region, Ningbo enjoys favorable geographical advantage, with the distance to the world –class ports, such as Hong Kong, Singapore, within 1000 nautical miles. Since 1989, Ningbo Port has been listed by the State Council as one of the four international deep-water transshipping ports in china. Now, Ningbo Port has been regarded as the second largest port in China and the 4th in the world. It is the port industry makes this city prosperous and promotes the further development.

Shaoxing, enjoying the high reputation of its history and culture, was founded about 2,500 years ago. For this old city, the light textile is the mainstay industry, which is regarded as the textile production base of china, with its chemical fiber manufacturing output accounting for 47% of the total industry output. Now, after year effort and development, Shaoxing textile industry has formed a large enterprise cluster, making Shaoxing the area with the most advanced equipment, the highest density of shuttleless looms, and the largest output in the national textile industry.

It is reasonable for those three cities above, Hangzhou, Ningbo, and Shaoxing, becoming the first level of Zhejiang Province. In addition to the accumulation of the long history, those cities have a unique advantage, that is, closing to Shanghai, the key city of the Yangtze River Delta., benefiting from the development of Shanghai and turning into significant strengths in the process of economic strengths. What’s more, as to keep this benefits, the Bay Bridge has been constructed to greatly shorten the distance between those cities and Shanghai.

However, far away the above three cities, Wenzhou is on the edge of the Yangtze River Delta with less benefits from the economics cluster of Shanghai compared to other cities. It is this situation that stimulates this city becomes the pioneer during the economic reform and opening up in China. With the spirit of diligent and braveness, Wenzhou took the leader in the market-oriented economics reform, and fundamentally established a market economic system with its own features. Now, this city has formed many specialized markets, covering most the basic categories of the means of living and production, such as shoes, eyeglasses, lighter and so on.

The four cities on the second level, Jiaxing, Huzhou,

Taizhou and Jinhua, considering about resource and geography condition, have developed their own mainstay industries gradually. Thought not being distinctive at present, however, they would be competitive and vigorous in the future.

Those three cities on the third level, Lishui, Quzhou and Zhou, could be called the emerging cites in Zhejiang Province, who has made remarkable progress in the every aspect of the economic development, however, are less developed comparing to other cities, which could blame to their location somewhat. It is the reorganization that the less distance from the key city of Yangtze River Delta, Shanghai, the more benefits would get from the spread of the economic cluster, which has been proven by the performance of the cites on the first level. However, Lishui and Quzhou are on the west of Zhejiang Province, Zhoushan even an island, is situated on the East China Sea at the south, and the negative geography conditions delayed the opening and marketization reform of those city.

Though the analysis above, we get the overview of the economic feature of the 11 cities, the regional disparity among them and their role played on the whole province. In order to put forward the economic progress of Zhejiang Province, the government of Zhejiang Province has taken the plan, which making the development of the less developed cites a priority, and emphasizing "reducing the regional disparity" as one important principle, and those methods include enhancing the developed cities' function of integration and radiation, strengthening the communications and cooperation among the cites by policies, what's more, taking huge investment on the infrastructure, especially the transportation system, for example, the high-speed railway shorten the trip from the two pole cities into about four hours, which was more then eight hours before, and those policy would help the coordination and balanced program of development among the cites in Zhejiang Province.

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