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An Empirical Study of Evaluation Index System and Measure Method on City's Soft Power: 17 Cities in Shandong Province

GUO Chunyan[a,b],*; WANG Yanfang[a]; JIANG Wenhua[a]

[a]School of Management, University of Ji'nan, Ji'nan, China.
[b]Soft Power Research Center, University of Ji'nan, Ji'nan, China.
*Corresponding author.

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Abstract
Based on the research of city's soft power at home and abroad, the current study was intended to build an evaluation index system and analyzed the city's soft power of 17cities in Shandong Province in 2010. Both the qualitative and quantitative methods were adopted. Frequency statistical method was used to build the evaluation index system of city's soft power, and AHP and CRITIC methods were used to determine index weight. By using the evaluation system, data from Shandong 2010 statistic yearbook and SPSS18.0, the researchers analyzed the soft power of 17 cities in Shandong province, and finally constructed a measure model for city's soft power. Results indicated that this model is practically viable and consistent with the real situation of the soft power of 17cities in Shandong Province. It is the researchers hope that this measure model would provide reference for government's decision-making in the development of promoting urbanization.

Key words: City's soft power; Evaluation index system; Comprehensive empowerment; Measure method

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INTRODUCTION
Soft power, as well as hard power, is of great importance to a country's comprehensive strength. They are in close relationship and support each other. With the rapid development of economy, soft power has a more lasting penetration to the society, and gradually became the most effective tools which can enhance national and regional comprehensive competitiveness. A province or a city in China may even be bigger than a country, and these basic national conditions and development characteristics determines the study of city's soft power has vast potential and great application value in China (Chen & Yang, 2008). Since the 17th Congress of CPC, soft power is also increasingly being introduced to urban development and urban competition. Therefore, to study the theory of city's soft power, build an evaluation index system and construct a measure model of the city's soft power is of great significance (City's Soft Power Research Group on China, 2009; Zhou, Wang & Xie, 2007).

1. CONSTRUCTION OF EVALUATION INDEX SYSTEM OF CITY'S SOFT POWER
Constructing an evaluation index system of city's soft power, using statistical method to analyze the development and changes of a city's soft power will help provide references for government in decision-making in the course of urbanization. According to the study of city's soft power at home and abroad, a city's soft power mainly includes: urban culture, human quality, public administration, urban image, urban communication and urban innovation in the paper (Zhu, Guo, & Qi, 2012).

Through the qualitative analysis, we layered the above-mentioned six factors and chose the specific indicators which can reflect the connotation of the city's soft power, then established the primary index system. There are more indicators in primary index system aiming at providing

an all-round, comprehensive set of information. There also exists a cross between indicators so as to penetrate this field from different angles. In order to achieve a quantitative evaluation framework of city's soft power, after reading a large number of relevant literatures (Gong, & Luo, 2008; Hu, 2010; Tao, 2010; Tao & Chen, 2011), we extract the primary index system and select the most representative, relatively independent and specific indicators by combining frequency statistics analysis method and the expert's opinions, we chose higher frequency and typically stronger indicators, and finally established evaluation index system. Evaluation system is shown in Table 1.

Table 1
City's Soft Power Evaluation System

First indicator	Secondary indicators	Specific indicators
City's soft power	Urban Culture	a. Per capita cultural industry output value (%)
		b. Per ten thousand people culture institutions number (one / ten thousand)
		c. Per ten thousand people museum number (one / ten thousand)
		d. Per ten thousand people library collection number (ten thousand copies/ten thousand people)
	Human quality	e. Per capita financial education expenditure (yuan / one person)
		f. The proportion of professional and technical personnel n the total population (one person /ten thousand people)
		g. Per ten thousand people higher colleges and universities number (one / per thousand people)
		h. Per ten thousand university students number (person / per ten thousand people)
	Public administration	i. Resident satisfaction (points)
		j. Per ten thousand people practicing physicians number (one person/ per ten thousand people)
		k. Public infrastructure construction level (%)
		l. Rate of Social security coverage (%)
	Urban image	m. The days of excellent or good air quality in one year (days / year)
		n. Baidu keyword search number (Article)
		o. Ability to attract foreign investment ($ / person)
		p. Per capita public green area in the city (square meters / person)
	Urban communication	q. Rate of internet coverage (%)
		r. The number of domestic tourists in one year (Per ten thousand people)
		s. Local transport passenger volume (Per ten thousand people)
		t. Per ten thousand people domestic and international routes number (Article / Per ten thousand people)
	Urban innovation	u. The rate of R & D expenditure in GDP (%)
		v. Per ten thousand people R&D personnel number (one person / Per ten thousand people)
		w. Per ten thousand people research institution number (units / Per ten thousand people)
		x. Per ten thousand people patents number (parts / Per ten thousand people)

2. COMPREHENSIVE EVALUATION MODEL OF SOFT POWER

Presently, there exists a considerable numbers of comprehensive evaluation methods when measuring a city's soft power, such as multivariate statistical analysis method, fuzzy comprehensive evaluation and gray system evaluation method. Researchers in this study chose the linear weighted sum method is more simple on the basis of determining the index weights and dimensionless. Therefore, this article uses a linear weighted sum method for comprehensive evaluation of urban soft power.

When using this method as a measurement, we complete the following two steps beforehand: (i) make each index being dimensionless in order to make the data can be processed through SPSS; (ii) Calculates the weight of each index. The weight of each index in the entire index system is different. So we should select the appropriate method to calculate scientific and reasonable weight.

2.1 Dimensionless Indicator Data

Different data has different unit and dimension in evaluation index system of city's soft power. And they can't be compared. As a result, we firstly make the index data dimensionless. The maximum value to dimensionless was used in this study.

$$x_{ij}^{'} = \frac{x_{ij}}{\max\{x_j\}} (\text{i=1,2}\ldots\ldots n)$$

Namely the value of each variable is divided by the maximum value of the variable in the same sample. The indicators having different dimensions and units can be compared. x_{ij}: the value of i object on j index; $\max\{x_j\}$: max value of the j index; x'_{ij} : the standard value after maximum value.

2.2 Determination of Index Weight

Whether the index weight is reliable or not plays a very important role in evaluating work. Currently, the method of determining the index weight in general can be divided into two categories: subjective and objective weighting method. Subjective weighting method is based on experience or preferences of decision makers. Decision makers subjectively compare and weight based on importance of each indicator such as expert consultation method, two coefficient methods, analytic hierarchy process (AHP). Although this method is simple to use, the results of decision or evaluation have a lot of subjectivity and arbitrary. Objective weighting method is from the actual data and automatically determine the weight of the indicator according to certain rules such as principal component analysis, standard deviation, entropy weight method, CRITIC (Criteria Importance through Inter criteria Correlation) method. Objective weighting method takes the intrinsic link between indicators into account avoiding highly or lowly determine the weight of indicators. But the method does not consider the experience of experts. Thus, objective and subjective weighting method has certain limitations. This study aims to determine the index weight of urban soft power using both methods. So the evaluation results are more practical.

2.2.1 Analytic Hierarchy Process to Determine Weight

Researchers in this study used the analytic hierarchy process (AHP) to calculate the index weight (Qi, 2012, pp.25-27). The main steps are as follows: (i) Build a hierarchical structure model and evaluation index system of city soft power. The author has identified 24 specific indicators of three layer structures in the process of selecting indicators. (ii) Invite scholars and experts focusing on researching the city soft power. Use the 1-9 scale method by DELPHI experts predicting to judge the importance of each indicator in index system and then obtain judgment matrix and the relative weights of each indicator and normalized. (iii) Consistency check. Sort according to evaluation index judgment matrix and calculate the weight of individual judgment matrix. If random consistency ratio CR is less than 0.1, consistency is good. (iv) Calculate the weight of each index on the target and obtain weight of each indicator according to the calculation results of the judgment matrix and the structure of evaluation index system. The weight is in Table 2.

Table 2
AHP Method to Determine Index Weight

Weight	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8
	0.03785	0.01281	0.02098	0.02089	0.12605	0.03189	0.05677	0.08827
	W_9	W_{10}	W_{11}	W_{12}	W_{13}	W_{14}	W_{15}	W_{16}
	0.06471	0.02045	0.03469	0.06489	0.00921	0.00496	0.02180	0.01427
	W_{17}	W_{18}	W_{19}	W_{20}	W_{21}	W_{22}	W_{23}	W_{24}
	0.01023	0.03523	0.02284	0.01618	0.12157	0.06531	0.03509	0.06520

2.2.2 CRITIC Method to Determine the Weights

CRITIC method can reflect the objective weights of the indexes (Guo, He, Zhang, Xu & He, 2012). The steps of CRITIC method calculating the index weight are as follows (Jiang, Xie, & Ye, 2003, pp.224-253; Yuan & Xin, 2011): Consider a finite set A having n variable and m are an evaluation system formed by m evaluation standard f_i. More evaluation indexes problems can be described as follows: $\max\{f_1(a), f_2(a), \ldots f_m(a)| \in A\}$.

(i) According to the following formula to calculate the original data and get the modified matrix.

$$x_{aj} = \frac{f_j(a) - f_j^u}{f_j^* - f_j^u}$$

$f_j(a)$: the standard value of a; f_j^*: the best effect of index j; f_j^a : the worst effect of index j.

(ii) Isolation study vector x_j generated by the j-th, Each vector x_j has the standard deviation. The standard deviation reflects value gap of the same index of evaluation object.

(iii) Build m*m symmetric matrix dimensional structure generated by the general elements r_{jt} ,. r_{jt} is correlation coefficient of x_j *and* x_t.

(iv) Each index calculated according to the weight of the target.

$$W_j = \frac{c_j}{\sum_{t-1}^{m} c_t}$$

$$c_j = \sigma_j \sum_{t-1}^{m} (1 - r_{jt})$$

The weight is as Table 3.

Table 3
CRITIC Method to Determine the Index Weight

Weight	W_1	W_2	W_3	W_4	W_5	W_6	W_7	W_8
	0.03496	0.03201	0.0455	0.02891	0.07460	0.06675	0.02909	0.02627
	W_9	W_{10}	W_{11}	W_{12}	W_{13}	W_{14}	W_{15}	W_{16}
	0.03214	0.03795	0.07064	0.03997	0.04100	0.04192	0.03451	0.06289
	W_{17}	W_{18}	W_{19}	W_{20}	W_{21}	W_{22}	W_{23}	W_{24}
	0.03604	0.04484	0.03731	0.03831	0.03560	0.03922	0.03314	0.03647

2.2.3 Determine Comprehensive the Weights

The weights are obtained by subjective method AHP and objective method CRITIC. Subjective and objective weighting method both have their own flaws. So the author defines comprehensive weighting method combining the advantages of the two methods.

$$W_j^* = \frac{w_{AHP_j}\, w_{CRITIC_j}}{\sum_{j=1}^{m} w_{AHP_j}\, w_{CRITIC_j}}$$

W_j: the comprehensive weight of j-th indicator integrated on the target;$w_{AHP_j}\, w_{CRITIC_j}$:the weights of j-th indicators of the target weight obtained using the AHP and CRITIC. Consolidated weight calculation results are in Table 4.

Table 4
Comprehensive Weight Method to Determine the Index Weight

Weight	W_1	W_2	W_4	W_4	W_5	W_6	W_7	W_8
	0.03093	0.00959	0.02231	0.01412	0.21981	0.04976	0.03860	0.05421
	W_9	W_{10}	W_{11}	W_{12}	W_{13}	W_{14}	W_{15}	W_{16}
	0.04862	0.01814	0.05728	0.06062	0.00882	0.00486	0.01759	0.02098
	W_{17}	W_{18}	W_{19}	W_{20}	W_{21}	W_{22}	W_{23}	W_{24}
	0.00862	0.03693	0.01992	0.01449	0.10117	0.05988	0.02718	0.05557

3. COMPREHENSIVE EVALUATION AND ANALYSIS METHODS OF URBAN SOFT POWER

The current study uses linear weighted sum function of the method to get comprehensive evaluation mathematical model. The linear weighted sum function is formed by weights of each indicator and dimensionless values.

$$f(x) = 100\sum_{i=1}^{n} w_i x_i' \text{ (i=1,2……n)}$$

$f(x)$: the comprehensive evaluation value of the object; w_i: the weight of i; x_i': the standard value of the i ; n: the number of evaluation.

The final evaluation results of urban soft power are presented by "urban soft power comprehensive Index (A)". Two indicators can be expressed as urban cultural force (B1), the quality of manpower force (B2), Public Administration force (B3), the city's image force (B4), urban communication and power (B5) and urban innovation (B6).

4. EMPIRICAL STUDY OF THE COMPREHENSIVE EVALUATION OF URBAN SOFT POWER

Based on evaluation index system and measure model, this study chose the data of the statistical yearbook of Shandong province (2010) and the cities of Shandong province 2010 Statistical Yearbook. Data from statistical bulletin or by simple calculating is also used as a supplementary.

The researchers first make the data being dimensionless, and then invest them into comprehensive evaluation model and processed the two-level index respectively. Finally, the current study obtained the index of Shandong province and 17 cities soft power and

comprehensive index evaluation results. SPSS18.0 was used to make cluster analysis.

According to the research results, the current study classified city's soft power into three sorts: strong, middle and weak. Those whose comprehensive index score is above 60 points are the first class cities, they are Jinan, Qingdao, Zibo, Weihai, Dongying, Yantai and Weifang respectively. Obviously, their city's soft power is strong. Those whose comprehensive index score is between 50-60 points is the second class city, Laiwu, Tai'an, Jining, Binzhou and Rizhao belong to this class. Their soft power is in middle level; those whose comprehensive index score is less than 50 points is the third level, respectively Linyi, Liaocheng, Zaozhuang, Dezhou and Heze, City's soft power is weak.

According to evaluation results, the construction of Shandong province city's soft power has the following characteristics: (a) There is a significant difference between regions. Soft power of Shandong province wears off from east to west. The development level of the soft power in the eastern coastal areas is significantly higher than that in the western areas showing ladder distribution. And Jinan City, the capital of Shandong Province, as a political, economic and cultural center in Shandong, definitely has a unique advantage and its comprehensive index of soft power is the highest. (b) Soft power is positively correlated with economic development. The development of economy in the coastal cities in Shandong province is significantly higher than that of the inland cities. It can be say that the soft power is stronger if economic development level is higher which fully demonstrates when the city's economic development reaches a certain level, the importance of soft power is highlighted. The soft power plays multiplier effect on the economic development of the city and push the whole city development to a higher level; (c) The development of city's soft power vary significantly in different regions. According to statistic analysis, the highest score and the lowest in the same area is nearly 10 percentage points. The mean score of the lowest cities is only e half of the highest city.

CONCLUSION

Different indicators and different weighting methods will have a significant impact on the final result. Therefore, this article refers to a lot of documents to guarantee that the evaluation index system we adopted comprehensively reflects the soft power construction. By using this comprehensive measure model of city's soft power, we analyzed the soft power of 17 cities in Shandong Province statistically. Findings indicated that the development of city's soft power vary significantly in different regions and soft power is positively correlated with economic development. The comprehensive evaluation results of Shandong Province are consistent with actual situation. Hence, this indicates that the evaluation method in the article is practical. It is the researchers hope that this measure model would provide reference for government's decision-making in the development of promoting urbanization. To investigate the applicability of this comprehensive evaluation method is the focus of the future study.

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