

## Methods for measuring urban cultural competitiveness in five northwestern provinces

Furan Bie <sup>a</sup>, Anmin Wang <sup>b</sup>

School of Economic & Management, Xidian University, Xi'an, 710071, China

<sup>a</sup>furanxdrj@163.com, <sup>b</sup>amwang@mail.xidian.edu.cn

### Abstract

There are many ways to measure the competitiveness of a city, and the role of city has become more and more important. It is essential to compare principal component analysis with equal weighting methods which are used frequently. The paper develops an indicator system to evaluate the cultural competitiveness of the cities in northwestern provinces with the different weighting methods PCA and EW. What we believe in is that the larger the urban cities, the stronger the cultural competitiveness. However, by checking the relationship of the city size and the ranking scores, a direction is obtained that to enhance the cultural competitiveness of entire region; the mid-size cities should be concerned for sustainable economic development in the northwestern provinces in China, especially under the background of the new Silk Road economic belt nowadays.

### Keywords

cities' cultural competitiveness; the Principal Component Analysis (PCA); Equal Weighting Method (EW); mid-size cities; sustainable economic development.

### 1. Introduction

With the accelerating process of urbanization, it becomes an important task to improve the competitiveness of the city for social and economic development [1], especially the development of the cities in the northwestern provinces to shorten the gap between the west and east in China. As one of the most important elements to compare the competitiveness of cities, the culture competitiveness of urban cities plays a more and more important role. Compared with the cultural competitiveness of the metropolis, the mid-size cities in the northwestern provinces contribute greatly to the strength the territorial comprehensive. For this reason, many scholars have used different methods to study and research city's cultural competitiveness with developed indicator system. A number of methods have been used to measure the urban cultural competitiveness in most studies [2], such as PCA, EW, DEA [3,4, 5], The Diamond Model of M. Porter [6,7, 8], AHP [9], TOPSIS [10], fuzzy TOPSIS [11] and so on. Otherwise, the crucial important stage of deterring the relative weights to each index stays confused in the indicator system. Two weighting methods of PCA and EW are widely used in evaluating the cities' competitiveness. Through the comparison of the essence between PCA and EW [12], we find the different results in the process of the comparison of urban cultural competitive. What's more, there are some delicate correlating between the size of cities and the cultural competitiveness.

At the same time, the cultural competitiveness of mid-size cities should be concerned. Large studies have found that it is essential to strengthen the creativity of cultural industry for the mid-size cities, because the mid-size cities play transition actors in the process of urbanization. The following section argues that the disparities are analyzed with PCA and EW through the results of cultural competitiveness ranking of cities in five northwestern provinces. Furthermore, it is surprising that the relationship is non-significant between the size and the cultural competitiveness in mid-size cities [13]. The results indicate that the government of five northwestern provinces should put the culture development of mid-size cities in the future agenda.

## 2. Methodology

Framing the cultural competitiveness disparities analysis of cities in the northwestern region was carried out by establishing the index system which draws lessons from in and outside countries [1, 7, 9, 12, 14]. For the purpose is to evaluate the cultural competitiveness of the mid-size cities included instead of the big metropolis, the index system established depending on the system of previous research results should be modified. A hierarchical system of indicators is constructed to grasp urban competitiveness which can be showed in *Table1*.

Table1. Criteria for Cities' Cultural Competitiveness

C1:The competitiveness of cultural resources	c <sub>11</sub> :The total investment in fixed assets (million)
	c <sub>12</sub> :Current actual use of foreign investment (US \$ million)
	c <sub>13</sub> :Number of mass culture institutions (unit)
	c <sub>14</sub> : Coverage rate of a forestation in developed area (%)
	c <sub>15</sub> :Number of Museums (unit)
C2:Public cultural services	c <sub>21</sub> :Theater, movie theaters number (unit)
	c <sub>22</sub> :Collections of Public LibranesPer100Persons(copy, piece)
	c <sub>23</sub> : Sports media investment accounted for the proportion of fiscal (%)
C3:Transforming power of cultural values	c <sub>31</sub> : The proportion of the tertiary industry to GDP (%)
	c <sub>32</sub> :Practitioners of cultural industry (million)
	c <sub>33</sub> :Special funds for cultural industry (100 million Yuan)
	c <sub>34</sub> : The ratio of residents' culture consumption (%)
C4:Culture radiation	c <sub>41</sub> :Foreign direct investment contract projects(unit)
	c <sub>42</sub> :The number of Internet users (million)
	c <sub>43</sub> :The number of mobile phone users (million)
C5:Cultural innovation	c <sub>51</sub> :Per million college students(unit)
	c <sub>52</sub> :International tourism foreign exchange earnings (US \$ million)
	c <sub>53</sub> :Ownership of colleges and universities(unit)
	c <sub>54</sub> : Science and technology expenditure of local fiscal budget proportion (%)
	c <sub>55</sub> : Education expenditure of local fiscal budget proportion (%)
	c <sub>56</sub> :Number of research institutions(unit)

By the means of certain approach, comparing the scores of different cities, we will obtain the ranking of cultural competitiveness. Then we can figure out the relationship between the city-size and the rank of cultural competitiveness with those data.

### 2.1 The Principal Component Analysis

PCA is a useful statistical technique for simplifying multidimensional data into several main components without much loss of information. The principle of the method is to transform the original variables into the liner combination of them. And the combination contains the most information of all the variables. The mathematical model [15, 16] can be given as follows:

$$F_i = \sum_{j=1}^n \frac{ZX_{ij}L_{ij}}{\sqrt{\lambda_i}} \quad (1)$$

Where  $F_i$  is the score of the  $i$ th principal component,  $ZX_{ij}$  is the standardized data of the index  $i$  for city  $j$ ,  $L_{ij}$  is the lode value of the index  $j$  in the principle component  $i$ ,  $\lambda_i$  is the Eigen values of the principle component  $i$ ,  $n$  is the number of the total indexes.

$$F = \sum_{i=1}^n \frac{F_i C_i}{C_n} \quad (2)$$

Where  $F$  indicates the component score of the evaluate system for each city,  $C_i$  is the rate of variance contribution for the  $i$ th principle component,  $C_n$  is the total variance contribution of all the principle components.

### 2.2 Equal Weighting Method

The difference between the PCA and EW [12] is the process to determine the relative weights with the hierarchical system of indicators. The results could be interpreted by the score of a composite index based on the analysis system. This method assigns the same weight to a component or an indicator on a given level of a hierarchical indicator system. The formula can be expressed as follows:

$$F_i = \sum_{j=1}^n W_j F_{ij} \quad (3)$$

Here,  $F_{ij}$  denotes indicator  $j$  for city  $i$ ,  $W_j$  is the weight for indicator  $j$ , the same weight is given to each element at the same level. The assumption underlying this approach is that each dimension is interrelated with and equally bounded by the other dimensions. The method is simple and transparent to interpret the results of any index.

### 3. Results

In this paper we choose thirty cities which are from the five northwestern provinces. Most data used in this study come from the Urban Statistical Yearbooks [18] published by the National Bureau of Statistics in China (a component score coefficient matrix produced by SPSS22.0). With the development of economic and society, the degree of unbalance among cities is becoming serious. To shorten the disparities, some measures should be taken in the future development about the mid-size cities' cultural competitiveness. According to the correlation coefficient matrix, eigen values and the variance contribution rate, the total variance explained is shown in *Table2*.

Table2. Total Variance Explained

Component	Total Variance Explained					
	Initial Eigen values			Extraction Sums of Squared Loadings	Rotation Sums of Squared Loadings	
	Total	% of Variance	Cumulative %	% of Variance	% of Variance	Cumulative %
1	7.789	37.091	37.091	37.091	30.256	30.256
2	3.769	17.950	55.041	17.950	18.640	48.895
3	2.387	11.364	66.405	11.364	12.678	61.574
4	1.698	8.088	74.493	8.088	11.935	73.508
5	1.346	6.411	80.904	6.411	7.395	80.904

Extraction Method: Principal Component Analysis.

The scores and rankings of the cities' cultural competitive are shown in *Table3*:

Table3.the rankings and scores of the part cities

	Ankang	Yan'an	Wuwei	Jiuquan	Qingyang	Dingxi	Longnan	Xining	Yulin
PCA	16	10	23	14	24	28	30	5	9
EW	21	10	15	11	9	17	16	13	2
score 1	-0.08	-0.04	-0.12	-0.07	-0.12	-0.15	-0.19	0.15	-0.02
score 2	0.08	0.21	0.11	0.19	0.21	0.09	0.1	0.15	0.36

The results indicate that there are large differences by using the methods above to determine the weights of factors. These discrepancies occurred because of the differences of principles of each method, warning the users to choose the proper method according to the type of the questions. To determine the relationship between the size and the competitiveness, a comparative is shown in Fig. 1 (which used the scores of PCA):

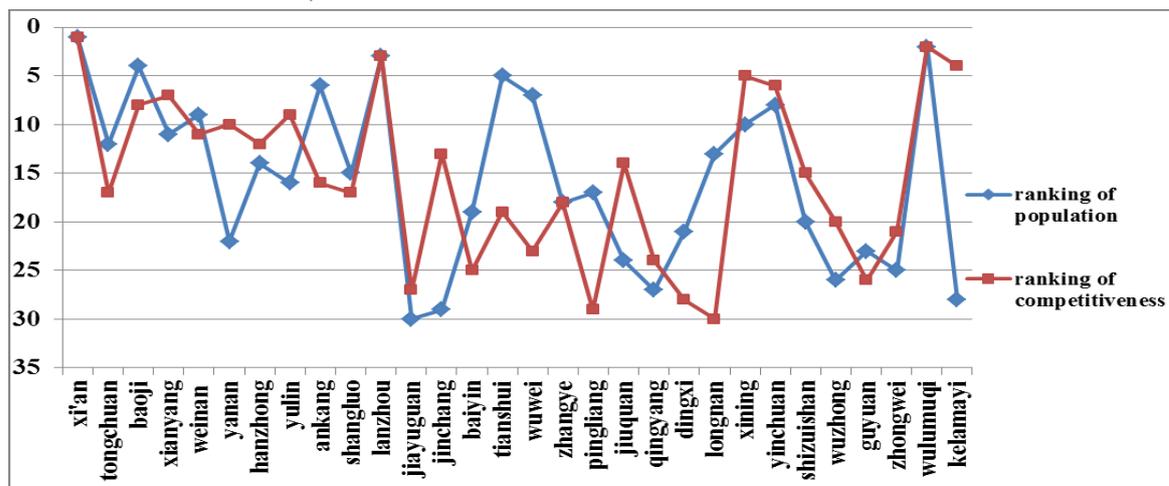


Fig. 1 The comparison of the rankings for size and the competitiveness

As the curve shows that ranking results are not convergent with the tendency line of the cities' sizes (here we use the population of the city to demonstrate the size), especially in Shaanxi Province, thus providing ways to strengthen the city competitiveness through improving the culture industry instead of the manufacture.

#### 4. Discussion and Conclusion

In this paper, a comparison is provided to measure the weight of factors to solve the problem of ranking the cultural competitiveness of different cities. Based on the hierarchical indicator system, the cities' cultural competitiveness ranking is obtained by using data from the cities of five northwestern provinces. The significant difference can be found by comparing the results of two methods which have highlighted the issue of weighting in the study of urban cultural competitiveness with the example of cities in northwestern provinces.

The study of cultural industries in each city of northwestern provinces within certain indicator system using different methods, the results indicates that to enhance the competitiveness of the entire region the mid-size cities should be concerned, especially the development of cultural industry. The new opportunity is provided for the development of cultural industry in medium-sized cities especially under the background of the new Silk Road economic belt nowadays.

#### Acknowledgements

The authors wish to acknowledge the Wang's support and guidance in the process of the writing of the article and the thanks to the anonymous referees for their valuable comments that have led to an improved version of this paper.

## References

- [1] Li Peng, Ma Zhanxin, The Evaluation of City Competitiveness in Shandong Province, *Energy Procedia*, vol.5(2011), pp. 472–476.
- [2] Booyesen. F, An overview and evaluation of composite indices of development, *Social Indicators Research*, vol.59 (2002), pp. 115–151.
- [3] Ramón, N., Ruiz, J. L., & Sirvent, I., Common sets of weights as summaries of DEA profiles of weights: with an application to the ranking of professional tennis players. *Expert Systems with Applications*, vol.39 (2012), pp. 4882–4889.
- [4] Khanjani, S. R., Charles, V., & Jalalzadeh, L. Fuzzy rough DEA model: a possibility and expected value approaches. *Expert Systems with Applications*, vol. 41(2014), pp. 434–444.
- [5] Vincent Charles, Luis Felipe Zegarra, Measuring regional competitiveness through Data Envelopment Analysis: A Peruvian case, *Expert Systems with Applications*, vol. 41(2014), pp. 5371–5381.
- [6] MOON H., RUGMAN M., A., VERBEKEE A. (1998), A Generalized Double Diamond Approach to The Global Competitiveness of Korea and Singapore, *International Business Review* 7, SS. 135–150.
- [7] Kazim Ozan Ozer, Hasan Latif, Mehmet Sariisik and Ozgur Ergun, International Competitive Advantage of Turkish Tourism Industry: A Comparative Analyse of Turkey and Spain By Using The Diamond Model of M. Porter, *Procedia–Social and Behavioral Sciences*, vol.58(2012), pp. 1064 –1076.
- [8] Mihaela Herciua, Measuring International Competitiveness of Romania by Using Porter's Diamond and Revealed Comparative Advantage, *Procedia Economics and Finance*, vol.6 (2013) , pp. 273– 279.
- [9] Shaleen Singhal , Stanley McGreal , Jim Berry , Application of a hierarchical model for city competitiveness in cities of India, *Cities* , vol.31(2013), pp. 114–122.
- [10] Rodolfo Lourenzutti , Renato A. Krohling, The Hellinger distance in Multicriteria Decision Making: An illustration to the TOPSIS and TODIM methods, *Expert Systems with Applications*, vol.41(2014) , pp. 4414–4421.
- [11] Jen-Hung Huang, Kua-Hsin Peng, Fuzzy Rasch model in TOPSIS: A new approach for generating fuzzy numbers to assess the competitiveness of the tourism industries in Asian countries, *Tourism Management*, vol.33 (2012), pp. 456–465.
- [12] Yihong Jiang, Jianfa Shen, Weighting for what? A comparison of two weighting methods for measuring urban competitiveness, *Habitat International*, vol.38 (2013), pp. 167–174.
- [13] Sylvette Puissant, Claude Lacour, Mid-sized French cities and their niche competitiveness, *Cities*, vol.28 (2011), pp. 433–443.
- [14] Trinidad Dominguez Vila, Simon Darcy b, Elisa Alen Gonzalez, Competing for the disability tourism market e a comparative exploration of the factors of accessible tourism competitiveness in Spain and Australia, *Tourism Management*, vol.47 (2015), pp. 261–272.
- [15] Cahill, M., & Sánchez, N. Using principal components to produce an economic and social development index: an application to Latin America and the U.S. *Atlantic Economic Journal*, vol.29 (2001), pp. 311–329.
- [16] Khatun, T. Measuring environmental degradation by using principal component analysis. *Environment Development and Sustainability*, vol.11 (2009), pp. 439–457.
- [17] So, M., & Shen, J. Measuring urban competitiveness in China. *Asian Geographer*, vol.23 (2004), pp. 71–91.
- [18] <http://bbs.pinggu.org/thread-3271109-1-1.html>.