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The Competitiveness of Tourism Industry along the Silk Road Based on the Entropy TOPSIS

YANG Jin, MENG Yan-mei

School of Humanities, Economics and Law, Northwestern Ploytechnical University, Xi´an 710072, P. R. China

Abstract: As a new growth point of the national economy, the tourism has increasingly become one of the most dynamic industries in the tertiary industry. The tourism industry cluster has attracted more and more attention, and promoting the competitiveness of the tourism industry is the key to the development of regional tourism. Northwest Silk Road area has made an important contribution to the development of local tourism through regional cooperation and joint development. Based on the brief review of the related literature at home and abroad, 16 indicators are used to establish the tourism industry competitiveness evaluation model. Then using FA and Entropy TOPSIS, this paper has carried on the empirical research of the tourism competitiveness in northwest five provinces. These analysis provide some theory reference and basis for the future development in the tourism market of the Silk Road economic belt.

Key words: silk road economic belt; entropy TOPSIS; tourism competitiveness

1 Introduction

As a connection between the way of peace friendship, the bridges of economic trade and the ties of cultural exchanges from long ago, the Silk Road is reputed to be the world channel that has an impact on the historical development. September 7, 2013, President Xi Jinping in Nazarbayev University further proposed the new strategic vision of economic belt along the Silk Road. Because of the initiative, the ancient Silk Road again became the focus of world attention. Along the Silk Road the tremendous tourism resources plays an increasingly important role in regional economic development. Thus, this paper will take an empirical analysis of the tourism industry competitiveness for the five northwestern provinces along the Silk Road and provide a theoretical basis for improving the competitiveness of the Silk Road tourism region.

With the development of society, the tourism has gradually become a new growth point of national economy and one of the most dynamic developments in the tertiary industry. The tourism industry has received more and more attention, so the competitiveness is the key to the development of regional tourism industry. It is in this context that

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many scholars have launched a study of the competitiveness of the tourism industry, and achieved certain results.

In abroad, Metin and Mike built an index system of competitiveness that includes soft and hard targets to quantitatively evaluate the competitiveness of tourism industry in several countries by questionnaires[1]. Based on the IPA (Importance Performance Analysis) method, Michael and James mainly analyzed the favorable and unfavorable factors on Hong Kong´s tourism competitiveness[2]. Fernando and Jessica explored the formation and development of tourism clusters and pointed a virtuous cycle of tourism and cultural heritage to enhance regional competitiveness[3].

In domestic, Liu baiping et al. collected the related statistical data in Anhui Statistical Yearbook from 2001 to 2011 to explore the regional differences of agglomeration level, time trends and economic relevance in Wan Jiang tourism industry, with the integrated location entropy and urban tourist economic strength indicators from basic conditions, the elements concentration degree and the economic effect of the tourism industry cluster[4]. Su Jianjun et al. built the multi-level evaluation system of the tourism strength, development potential and supportive[5]. Based on the AHP analysis and Yaahp software, using panel data for 11 cities in Shanxi Province, the comprehensive competitiveness of the tourism industry were analyzed. Luo Fenfen constructed the GEMS model after the comparative analysis of a certain model of industrial clusters competitive[6]. Using industry location entropy method combined with tourism industry chain and the specialization of method, analytic hierarchy process (AHP) and Matlab software for data processing, she evaluated the tourism industry cluster competitiveness on Kanas of Xinjiang quantitatively. With Porter´s diamond model, Guo Xuhong analyzed and discussed Qinghai tourism competitiveness from production factors, market demand, related and supporting industries, corporate strategy, structure and competition within the industry, development opportunities, and other government actions, and then put forward the measures to promote the competitiveness of the tourism industry in Qinghai Province[7].

The study of tourism competitiveness at home and abroad mainly has the following three inadequate aspects:

1) Quantitative research has made initial progress, but because of involving many different factors, the systemic of the tourism competitiveness index system remains to be strengthen;

2) Current research mainly focuses on the national and city level, quantitative study of tourism competitiveness on provincial level is still rare;

3) With the traditional methods and the subjective weighting method to determine the index attribute weights, the decisions or evaluation results are more subjective and arbitrary. At the same time, the method increases the burden of decision analysis and has great limitations in application.

Based on the above background, the paper will study the tourism industrial competitiveness of the Silk Road Economic Belt from the provincial level. Because of the objective weighting and the better systemic of the Entropy & Technique for Order Preference by

Similarity to an Ideal Solution (TOPSIS), the paper will apply the Factor Analysis (FA) and Entropy TOPSIS to an empirical analysis on tourism industrial competitiveness through five northwestern provinces along Silk Road with the statistical data from 2013. The results of the study will provide theoretical basis and decision-making guidance for the tourism development and competitiveness.

2 Entropy method

The Entropy TOPSIS is a combination of Entropy and TOPSIS method. The entropy method is a method to determine the weights of each index according to the amount of information reflected in the degree of variation values. That is, the greater the degree of variation of an index value, the amount of information contained in the index is the greater, the information entropy is smaller. Thus the index plays an important role in the comprehensive assessment, and the weight should be greater; vice versa counter. Using this objective weighting method, the influence of subjective factors can be effectively avoided.

Due to the different specific units of the indicators, a general method cannot score comprehensively. To exclude the interference of dimensionless and magnitude differences of each index, the dimensionless points of each index is calculated with the considerable Entropy method. This article uses the z-score normalization, and the matrix is $X' = (x'_{ij})_{m\times n}$ after standardization (m is the number of evaluation objects, n is the number of evaluation index, the observation of each evaluation index on each object is x_{ij}), the calculation formula of x'_{ij} is $x'_{ij} = \frac{|x_{ij} - \overline{x_i}|}{S_i}$. In the formula, $\overline{x_i}$ and S_i represent the mean and the standard deviation of index j respectively.

For the standardized matrix $X' = (x'_{ij})_{m\times n}$, the entropy method is used to determine the index weight and the specific steps are as follows[8]:

1) Determine the index weight. According to the matrix the $X' = (x'_{ij})_{m\times n}$, the information entropy is achieved:

$$H_j = -\frac{1}{\ln m}\left(\sum_{i=1}^{m} f_{ij}\ln f_{ij}\right), \quad H_j \in [0,1]$$

$$(i = 1,2,\cdots,m;\ j = 1,2,\cdots,n)$$

$$f_{ij} = \frac{x'_{ij}}{\sum_{i=1}^{m} x'_{ij}}$$

$$\frac{1}{\ln m} > 0$$

2) According to the degree of variation values, calculate the j different confident, namely the difference degree G_j is:

$$G_j = 1 - H_j \qquad (j = 1,2,\cdots,n)$$

3) Define the information entropy value of index j,

$$w_j = \frac{G_j}{\sum_{j=1}^{n} G_j} = \frac{1 - H_j}{n - \sum_{j=1}^{n} H_j}$$

The TOPSIS method is to determine the positive and negative ideal point as opposed to the collection of the uncertainty system, measuring the relative closeness, which better reflects the systematic analysis thought. Detailed steps to build single-level and comprehensive evaluation model are as follows:

Firstly, the establishment and standardization processing of evaluation matrix. Assuming m evaluation objects (where each province, autonomous region) constituted by n indicators, a standardized weighting matrix can be set up:

$$(V_{ij})_{m\times n} = \begin{bmatrix} w_1x'_{11} & w_2x'_{12} & \cdots & w_jx'_{1j} \\ w_1x'_{21} & w_2x'_{22} & \cdots & w_jx'_{2j} \\ \cdots & \cdots & \cdots & \cdots \\ w_1x'_{m1} & w_2x'_{m2} & \cdots & w_jx'_{mn} \end{bmatrix}$$

Secondly, using TOPSIS method for the single-level sorting of evaluation objects. The maximum and minimum values of each index in standardized matrix indicate a positive ideal solution V^+ and negative ideal solution V^-:

$$V^+ = (v_1^+, v_2^+, \cdots, v_j^+), v_j^+ = \max_{1\leqslant i\leqslant m} v_{ij}$$

$$V^- = (v_1^-, v_2^-, \cdots, v_j^-), v_j^- = \min_{1\leqslant i\leqslant m} v_{ij}$$

In the above formulary, $v_{ij} = w_j x'_{ij} (i = 1, 2, \cdots, m; j = 1, 2, \cdots, n)$.

Thirdly, considering the weight, the distance between each evaluated object and the ideal solution or the negative ideal solution by the weighted Euclidean distance is calculated in the following:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2} (i = 1, 2, \cdots, m; 0 \leqslant d_i^+ \leqslant 1)$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} (i = 1, 2, \cdots, m; 0 \leqslant d_i^- \leqslant 1)$$

The index d_i^+ and d_i^- express the condition of each evaluated object from different angles. The smaller of d_i^+ says the closer between the evaluation objects and ideal solution, and it is the more desired for people. The bigger the index d_i^-, the further from the negative ideal solution is the evaluated object, the better its condition.

In order to evaluate the state of the object reflected by the distance indicators comprehensively, the nearness degree C_i is used to describe in the following:

$$C_i = \frac{d_i^-}{d_i^- + d_i^+} (i = 1, 2, \cdots, m; 0 \leqslant C_i \leqslant 1)$$

The bigger the C_i value, the better is the state of the evaluated object. If all the evaluated indicators are in the optimal state, the value of indicator C_i is one, and on the contrary, the value is zero. Based on the order of nearness degree of all evaluated objects, we can evaluate them in the single – level and comprehensive level.

3 The empirical analysis

3.1 Determination of the common factors

Due to the availability and reliability of data, taking into account the lack of related data in tourism industry, this paper adopts the related indicators data of five northwestern provinces in 2012. Indicator data comes mainly from " China Statistical Yearbook in 2013" and " China Tourism Statistics Yearbook in 2013" (copy) and Northwestern Statistical Yearbook as well as the the original data of other index published by the national economic and social development bulletin. And then the relevant raw data were processed.

To study the tourism competitiveness in five northwestern provinces along the Silk Road, the paper adopts FA and entropy method comprehensively. Based on the results to the communalities analysis of 16 variables, it can be seen that the common values is most more than 90%. That is to say, the extracted factors already contain most of the information of the original variables, and the understanding of the variables is very full.

As can be seen from the eigenvalues and variance table, the initial eigenvalues of three variables in the main components is greater than 1, and their cumulative contribution rate has reached 94.03%. It shows that selecting 3 factors are more suitable. Then

the initial factor loading matrix is rotated, and the rotated component matrix is as shown in Table 1 (the load factor of the significant variable is represented by the dark color of the numbers).

Table 1 The Rotated component matrix

	Component		
	1	2	3
Total import and export (X_{10})	**0.957**	0.257	-0.041
The total number of scenic spots (X_{16})	**0.883**	0.200	-0.416
Star hotel business gross income (X_{15})	**0.879**	0.473	0.019
Star hotel average room occupancy rate (X_6)	**0.862**	0.265	0.171
Tourism entrepreneurs (X_2)	**0.791**	0.508	0.341
Star hotel in labor productivity (X_7)	**0.777**	-0.107	0.487
Tourism practitioners (X_3)	**0.736**	0.655	-0.072
The number of tourist reception (X_1)	-0.068	**0.948**	-0.011
The total amount of foreign direct investment (X_{11})	0.234	**0.896**	0.378
Total tourism revenue in GDP (X_8)	0.393	**0.887**	-0.240
International tourism receipts (X_5)	0.463	**0.822**	0.319
The added value of tertiary industry (X_{13})	0.584	**0.797**	0.072
Travel agency profits (X_{12})	0.477	**0.747**	-0.351
Per capita GDP (X_9)	0.098	-0.215	**0.906**
Tourism enterprises operating income (X_4)	0.033	0.033	**0.867**
The added value of tertiary industry index (X_{14})	0.537	0.279	**0.787**

According to the extracted factors, the 16 indicators can be divided into 3 categories, and each category contains different detailed indicators. Based on the specific economic meaning of the major categories indicators, three common factors are named as follows:

The first common factor (F_1) includes 7 variables of tourism entrepreneurs, tourism practitioners, star hotel average room occupancy rate, star hotel in labor productivity, the total import and export, star hotel business gross income and the total number of scenic spots. It can be defined as the tourism industry

environment of each province.

The second common factor (F_2) includes 6 variables that is the number of tourist reception, international tourism receipts, the total tourism revenue in GDP, travel agency profits, the total amount of foreign direct investment and the added value of tertiary industry. It can be understood as the degree of maturity and development of tourism in various provinces.

The third common factor (F_3) has a greater loading on the three variables including tourism enterprises operating income, per capita GDP and the added value of tertiary industry index. These indicators reflect the overall economic strength of each provincial tourism industry comprehensively, thus this factor can be defined as the macroeconomic environment in every province.

3.2 Tourism competitiveness evaluation of the five northwestern provinces

3.2.1 The single-level evaluation of each evaluated object

In this paper, the entropy TOPSIS method and MATLAB software is used to the single-level and comprehensive level evaluation of the tourism industry cluster. Accordance with the above first and second step, the difference coefficient and the entropy-weight value of each indicator are calculated in Table 2.

Table 2 The entropy, the difference coefficient and the entropy-weight value of index system

Extracted factor	Measured index	Entropy	Difference coefficient	Entropy-weight value
F_1	Total import and export (X_{10})	0.922 08	0.077 92	0.034 72
	The total number of scenic spots (X_{16})	0.924 86	0.075 14	0.033 48
	Star hotel business gross income (X_{15})	0.937 49	0.062 51	0.027 85
	Star hotel average room occupancy rate (X_6)	0.746 78	0.253 22	0.112 82
	Tourism entrepreneurs (X_2)	0.964 51	0.035 49	0.015 81
	Star hotel in labor productivity (X_7)	0.777 19	0.222 81	0.099 27
	Tourism practitioners (X_3)	0.909 49	0.090 51	0.040 32
F_2	The number of tourist reception (X_1)	0.888 43	0.111 57	0.049 71
	The total amount of foreign direct investment (X_{11})	0.853 02	0.146 98	0.065 49
	Total tourism revenue in GDP (X_8)	0.763 25	0.236 75	0.105 48
	International tourism receipts (X_5)	0.863 86	0.136 14	0.060 66
	The added value of tertiary industry (X_{13})	0.782 75	0.217 25	0.096 80
	Travel agency profits (X_{12})	0.869 73	0.130 27	0.058 04
F_3	Per capita GDP (X_9)	0.755 19	0.244 81	0.109 07
	Tourism enterprises operating income (X_4)	0.946 42	0.053 58	0.023 87
	The added value of tertiary industry index (X_{14})	0.850 50	0.149 50	0.066 61

In turn, we calculate the relative proximity of tourism industry cluster in tourism industry environment, the degree of maturity and development and macroeconomic environment and sort them. The ranking result is showed in Table 3.

Table 3 The single-level evaluation to tourism industry competitiveness in five northwestern provinces

Province	Tourism industry environment		The degree of maturity and development of tourism		The macroeconomic environment	
	The relative proximity	Rank	The relative proximity	Rank	The relative proximity	Rank
Shaanxi	0. 931 192	1	0. 406 809	3	0. 455 061	2
Gansu	0. 160 544	4	0. 220 032	5	0. 861 935	1
Qinghai	0. 403 362	3	0. 679 722	2	0. 278 184	5
Ningxia	0. 546 237	2	0. 370 810	4	0. 299 254	4
Xinjiang	0. 098 399	5	0. 691 087	1	0. 445 141	3

3. 2. 2 The comprehensive sequencing of the evaluation object

Repeat the above steps, and the result to the comprehensive evaluation of every evaluation object is shown as in Table 4. Then the comprehensive sequencing of all evaluation objects can be seen obviously.

Table 4 The comprehensive level evaluation in tourism industry competitiveness of five northwestern provinces

Province	Positive distance	Negative distance	The relative proximity	Rank
Shaanxi	0. 196 676	0. 301 183	0. 604 957	1
Gansu	0. 300 466	0. 228 687	0. 432 175	3
Qinghai	0. 274 947	0. 227 809	0. 453 120	2
Ningxia	0. 290 948	0. 209 280	0. 418 369	4
Xinjiang	0. 323 376	0. 183 589	0. 362 133	5

3. 3 The analysis of evaluation results

1) In terms of the industry environment, the relative proximity of Shaanxi is the first, and the optimal state, followed by Ningxia, Gansu finally. As seen from the relative proximity, the gap is very big between Shaanxi with other provinces. Qinghai is

relatively close to Ningxia, indicating that the maturity in these two regions is nearly equivalent, but far more than Gansu.

2) From the maturity and level of development, Xinjiang is the first, Qinghai followed, but the scoring is showed that their competitiveness is equivalent. It is easy to find the development of tourism industry is relatively slow in Gansu Province from the last rank.

3) As seen from the macroeconomic environment, Gansu Province ranks first, followed Shaanxi, and Qinghai worst. But from the scores, the gap between Gansu and Shaanxi provinces is still very large.

As can be seen from Table 4, we can obviously understand the tourism industry competitiveness of every province in comprehensive evaluation. From the comprehensive sequencing in the competitiveness of the tourism industry, Shaanxi is the first and Xinjiang is the last. It is seen that Shaanxi has an absolute advantage in the industry environment and macroeconomic environment. From the relative proximity, the competitiveness of tourism industry in Shaanxi Province is the strongest. Compared to Shaanxi Province, the competitiveness of other provinces remains to be improved to a great extent.

4 Countermeasures and suggestions

Through the above analysis, the tourism industry along Silk Road is the existence of absolute or comparative advantage in certain aspects, but there are also some problems. So this paper puts forward some suggestions in order to enhance the tourism industry competitiveness in the Silk Road economic zone.

1) Shaanxi tourism has an absolute advantage in the industry environment and the macroeconomic environment, but the growth is still slow and not mature. With universities everywhere, we should make full use of universities and research institutes in Xi′an, and provide information consultation, staff training, personnel transport for tourism businesses. At the same time, the capability of independent innovation of tourism enterprises should be improved, and we should improve the environment of scenic spots, further enrich the cultural connotation of tourism products, increase activities of tourism products, develop tourism replacement products and improve the attractiveness and value of tourism products.

2) In general, the comprehensive competitiveness of the tourism industry in Gansu Province is weaker. However, from the view of the single-level evaluation, the macroeconomic environment takes the larger advantage, and in the industrial environment and development maturity at a disadvantage. Therefore, Gansu Province should take full advantage of two major tourist cities which are Lanzhou and Dunhuang, Building the two tourism circle around them, we will accelerate research and development of tourism cultural products and develop local tourism products with profound cultural heritage.

3) From the point of comprehensive level evaluation, the tourism competitiveness in Qinghai is relatively strong, but in the single-level assessment, it is not dominant in all respects. To improve the competitiveness of the tourism industry in Qinghai

Province, it is necessary to strengthen the publicity and promotion, develop the plateau tourism and build brand scenic in order to highlight the characteristics of the plateau concept with the Qinghai Lake as a breakthrough, which fully reflects the natural, ecological advantages of Qinghai tourism. To achieve the optimization of economic and social benefits, it is important to create a great beautiful Qinghai and a Chinese Summer tourism circle around Xining.

4) As seen from the Table 3 and 4, the tourism competitiveness between Ningxia and Qinghai Province is equivalent. Therefore, Ningxia should use their own resources, location advantages and industry support policies to support the capital, brand, management, technology and talent of domestic and international tourism enterprises introduced by enterprises. As the basis along with the construction of the Yellow River, it can play the leading role of the regional center city in tourism.

5) Due to the unique environment, Xinjiang takes an absolute advantage in the maturity development along the Silk Road, the comprehensive competitiveness at a disadvantage because of special location. Xinjiang is rich in natural and cultural landscape resources, but the traffic is lagging behind, the relative lack of tourism professionals. As a leading role, the local government should increase investment and advocacy efforts to improve its advantages in transportation, professional talents. In addition, it should develop tourism advantage resources, build a multi-level, multi-functional three-dimensional pattern of tourism products with targeted manner, and clear a reasonable target layer and the implementation of classification development in tourist market, which will form a focused market diversification patterns in order to attract more tourists.

Currently, the tourism value of the Silk Road is obviously noticed, especially the strategic vision of the New Silk Road economy once again become the focus of foreign tourists. Therefore, the northwestern provinces must seize this golden opportunity to enhance the competitiveness of the tourism industry, and develop the tourism industry along the Silk Road region jointly. Only in this way, the northwestern provinces with the natural resources of quite complementary strengths will form a coalition fleet and a brand advantage, the desolate northwestern as China's emerging eco-tourism zone. However, with the tourism development, the tourism industry will be more complex and more research value. Tourism development competitiveness to different cities in horizontal comparison is as well as the essential content to study the relationship between urban and tourism development, and these are gradually perfected in future research.

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Brief Biographies

YANG Jin is now a professor in the School of Humanities, Economics and Law, Northwestern Ploytechnical University. His research interests include industrial cluster and supply chain management. jinyang@nwpu.edu.cn

MENG Yan-mei is a graduate student in the School of Humanities, Economics and Law, Northwestern Ploytechnical University. Her research interests include industrial cluster. mengyanmei1207@163.com