Research on the Construction of Cultural Industry Competitiveness Index System Based on Index Loop Method

Wang Jiaming[1,a],Li Hong[1,b],Yang Fan[1,c]

[1]School of Chinese Law and Economics Management, Shengli College China University of Petroleum, Dongying Shandong, China

[a]upcjgyxwjm@163.com, [b]282725007@qq.com, [c]347337168@qq.com

[a]Corresponding author

Keywords: Index Loop Method, Cultural Industry Competitiveness, Factor Analysis Method.

Abstract. With the continuous deepening of the transformation of new and old kinetic energy, the promotion of cultural industry competitiveness has become the focus of regional development, and the evaluation of cultural industry competitiveness has become a research hotspot for experts and scholars. The traditional empirical evaluation focuses on the selection and innovation of the evaluation model, and often ignores the construction and improvement of the most important evaluation index system. The article takes the competitiveness of cultural industry as the object, and starts from the construction of the index system, innovatively introduces the "index loop method", and combines the factor analysis method to study the correlation, discriminative power and rationality of the cultural industry competitiveness evaluation index system. It has formed a set of perfect evaluation index system construction methods, which provides research reference and practical guidance for the development of experts, scholars and cultural industries in the same industry.

1. Introduction

As a new kinetic energy, the cultural industry is an important path for the transformation of old and new kinetic energy, and it is also the guarantee for the sustainable development of economic development in various regions. In recent years, with the policy orientation of cultural industries at all levels of government departments, research on the evaluation of their competitiveness has been increasing. At present, the research focuses on the selection of evaluation methods, combination innovation, etc. The focus is on the analysis of evaluation results. Model selection and result analysis are important, but the empirical evaluation should focus on the evaluation of the initial evaluation index system and the determination of the weight of each evaluation index. And the evaluation model does not pursue complexity, embarrassment, and scientific effectiveness. Based on this, the article innovatively proposes the "index loop method", combined with the factor analysis method to screen the indicators and determine the weights, providing ideas for scholars and scholars in the field of cultural industry and empirical evaluation, and developing new kinetic energy for the cultural industry. To provide guidance and advice, with certain theoretical reference and practical guiding significance.

2. Index Loop Method

The "Index Loop Method" proposed in this paper can be understood from the following three aspects:

(1) Loop means that the index from the evaluated subject to each final level can be decomposed from the forward layer, or from the final level indicators to the evaluated subject level. The construction of the indicator system is a closed-loop process, which needs to be improved from the forward and reverse directions.

(2) The index loop method emphasizes the independence and discriminative power of indicators, the correlation limit between each evaluation index and the ability to identify individual evaluation indicators. For the independence and discriminating power of indicators, quantitative analysis can be carried out in combination with factor analysis.

(3) After the indicator system is verified in the forward and reverse directions, the final rationality

verification is required.

3. Construction and Optimization of the Evaluation Index System of Cultural Industry Competitiveness

3.1 Principles and ideas for index selection

As the primary premise of effective empirical evaluation, the index system directly determines the validity of the empirical evaluation. The same series of indicators use different models to evaluate the evaluation results that may have the same result or little difference, but different indicators, the same model or the evaluation results of different models are completely different, so the scientific construction of the indicator system is the basis of the research. As a complex and large system, the regional cultural industry, in accordance with the index loop method, constructs the index system from both positive and negative perspectives. First of all, it must start from the unique development law of the cultural industry and have an impact on the competitiveness of the regional cultural industry. Effective screening and filtering of factors; secondly, it is to combine regional cultural industry realities, such as cultural resources, cultural heritage. On the basis of summarizing the research results of predecessors, the article starts from the basic connotation and characteristics of cultural industry competitiveness, and combines the characteristics of cultural industry to decompose the overall goal of cultural industry competitiveness evaluation, drawing on Zou Jiao[1], Zeng Tao[2], Wang Lan[3] and other experts and scholars to improve the research, preliminary cultural industry competitiveness comprehensive evaluation index system, as shown in Table 1.

Table 1. The preliminary evaluation index system of cultural industry competitiveness.

Target layer	First level indicator	Second level indicator	Third level indicator	Num-ber
The preliminary evaluation index system of cultural industry competitive-ness	Market expansion capability	Industrial strength	Total investment in the cultural industry	I1
			Annual growth rate of local cultural industry	I2
			Annual contribution of local cultural industry accounts for the national proportion	I3
			The annual contribution of local cultural industry to the proportion of GDP	I4
			The annual contribution of local cultural industry to the proportion of tertiary GDP	I5
			Total annual profit and tax of local cultural industry	I6
			Annual export volume of local cultural industry	I7
			Annual export volume of local cultural services	I8
	Cost control capability	Industrial efficiency	Local cultural industry full labor productivity	I9
			Local cultural industry million yuan asset tax rate	I10
			International market share of major local cultural products	I11
			The proportion of local cultural industry employees in the total number of local jobs	I12
			Local original screenings and performances of movies, large-scale performances	I13
			Total tourism revenue	I14
			The total retail sales of social consumer goods	I15
			Per capita cultural investment	I16
		Industrial association	The pull rate of local cultural industry on the growth of local related industries	I17
			Local per capita education, cultural and entertainment services investment	I18
			The ratio of overseas visitors to the total number of local permanent residents	I19
			The proportion of foreign students in the total number of local college students	I20
	Overall innovation capability	Industrial resources	Local human development index	I21
			Urban historical and cultural resources index	I22
			Urban natural cultural resources index	I23
			Number of local artists, scientists and engineers	I24
			Cultural industry R&D investment accounts for proportion of cultural industry GDP	I25
			Number of public libraries and museums	I26
			Art performance groups per million people	I27
			TV population coverage	I28

		Number of cultural relics	I29
	Industrial capability	Number of patents obtained in the local cultural industry	I30
		Number of international exhibitions held in the local year	I31
		The number of awards for scientific and technological achievements	I32
		The number of awards for artistic awards	I33
Sustainable development capacity	Industrial potential	Per capita GDP	I34
		Urban and rural per capita annual cultural entertainment investment	I35
		Per capita annual cultural and recreational investment in urban and rural areas	I36
		Per capita cultural industry fee	I37
		Cultural industry financial allocation	I38
		Cultural industry expenses account for the proportion of financial investment	I39
		The cultural industry actually completed the infrastructure investment	I40
		Cultural sector education funding	I41
		Investment in cultural (cultural relics) science and technology institutions	I42
		The increase in the value of education institutions in the cultural sector accounts for the national proportion	I43
	Industrial structure	Investment in cultural industry accounts for the proportion of the tertiary industry	I44
		The total market capitalization of listed companies in the local cultural industry accounts for the proportion of cultural industry GDP	I45
		Foreign trade dependence of local cultural industry	I46
		The proportion of high-tech cultural enterprises	I47
		The number of local headquarters of cultural industry multinationals	I48
	Industrial environment	Number of relevant cultural industry laws and regulations	I49
		Local per capita venture capital	I50
		Local people use Internet time every day	I51
		Local per capita public cultural service facilities use area	I52

3.2 The application of Index Loop Method

The correlation analysis, discriminative power analysis and rationality verification of the index loop method all require data support. The article is based on the basic data of the cultural industry competitiveness of Shandong Province in 2017.

3.2.1 Correlation analysis

Correlation analysis refers specifically to the evaluation of the contribution of the two indicators to the superior indicators and the evaluation subjects in the indicator loop method. If the correlation between the two indicators is high, screening optimization is needed. The paper uses *Pearson correlation coefficient*, *Spearman* and *Kendall correlation coefficient* to measure the correlation coefficient *r* of different properties [4]. See formula (1).

$$R = 1 - \frac{6\sum_{1}^{N} d_i^{\,2}}{N\left(N^2 - 1\right)} \tag{1}$$

In the formula, d_i is the difference of the variable values, that is x_i-y_i, i=1, 2, ..., N, N is the number of times. The absolute value of the correlation coefficient r is positively related to the correlation of the variables. The threshold value r=0.65 was set, and the article deleted 8 evaluation indexes of *I*1, *I*10, *I*18, *I*36, *I*37, *I*39, *I*41 and *I*42.

3.2.2 Discrimination analysis

In the index loop method, the discriminative power refers specifically to the contribution of each final index to the evaluation subject. If the evaluation contribution is low, the deletion optimization is needed. The article uses the difference coefficient to study each evaluation index, see formula (2).

$$CV = s / x \tag{2}$$

In the formula, *CV* is the coefficient of variation, *s* is the standard deviation, and *x* is the average. The coefficient of variation is positively correlated with the discriminating power. Based on the measurement of variation coefficient, the article deletes 7 indicators of *I*11, *I*28, *I*30, *I*45, *I*47, *I*48, *I*49 with relatively small variation coefficient and retains 37 evaluation indicators, which constitutes

the final evaluation index system.

3.2.3 Rationality verification

Rationality verification is an important part of the indicator loop method. It is the rationality verification of the entire indicator system after correlation and discriminative analysis. The article uses the factor analysis method to verify the rationality of the cultural industry competitiveness evaluation index system, how to use a few factors to represent many variables and to ensure the least information loss. The factor analysis uses the variance to represent the information content, and based on this, establishes the criteria for determining the rationality of the indicator system. Let S be the covariance matrix of the index data and measure the information contribution rate I_n of the screened index by the trace of the covariance matrix and the covariance, see formula (3).

$$I_n = \frac{trS_s}{trS_h} = 99.6\% \tag{3}$$

In this paper, the indicator system formed by the fact that 37 indicators can fully represent the original 52 indicators, 71% (37/52) of the indicators selected from the sea election indicators reflect 99.6% of the original information. It has been verified that this indicator system is reasonable.

3.3 Index weight determination

After the index system is constructed, the weights of each final level index need to be determined. However, the methods for determining the weights of different types of indicators are inconsistent. Subjective, objective, qualitative and quantitative need to be considered in all aspects. Therefore, the article will combine subjective analytic hierarchy process and objective. The entropy method performs combined weighting. The combined weight calculation is shown in equation (4).

$$W_{\text{Combination weight}} = \alpha W_{\text{subjectiveweight}} + (1-\alpha) W_{\text{objectiveweight}} \tag{4}$$

Among them, α is the weighting coefficients of two kinds of weighting methods, the analytic hierarchy process and the entropy method are subordinate to the subjective weighting method and the objective weighting method. Both methods of weighting are given a weight of 0.5, ie α=0.5. The weights of the combined weighting method are shown in Table 2.

Table 2. Cultural industry competitiveness final evaluation index system.

Target layer	First level indicator	Weight	Second level indicator	Weight	Third level indicator	Weight	Total Weight
Cultural industry competitive-ness final evaluation index system	Market expansion capability	0.25	Industrial strength	1	Annual growth rate of local cultural industry	0.2136	0.0534
					Annual contribution of local cultural industry accounts for the national proportion	0.1035	0.0259
					The annual contribution of local cultural industry to the proportion of GDP	0.1126	0.0282
					The annual contribution of local cultural industry to the proportion of tertiary GDP	0.1231	0.0308
					Total annual profit and tax of local cultural industry	0.1966	0.0492
					Annual export volume of local cultural industry	0.1222	0.0306
					Annual export volume of local cultural services	0.1284	0.0321
	Cost control capability	0.25	Industrial efficiency	0.5	Local cultural industry full labor productivity	0.2484	0.0311
					The proportion of local cultural industry employees in the total number of local jobs	0.1038	0.0130
					Local original screenings and performances of movies, large-scale performances	0.0611	0.0076
					Total tourism revenue	0.1988	0.0249
					The total retail sales of social consumer goods	0.1846	0.0231
					Per capita cultural investment	0.2033	0.0254
			Industrial association	0.5	The pull rate of local cultural industry on the growth of local related industries	0.5806	0.0726
					The ratio of overseas visitors to the total number of local permanent residents	0.2035	0.0254
					The proportion of foreign students in the total number of local college students	0.2159	0.0270
	Overall innovation capability	0.25	Industrial resources	0.5	Local human development index	0.1878	0.0235
					Urban historical and cultural resources index	0.1599	0.0200
					Urban natural cultural resources index	0.1566	0.0196

				Number of local artists, scientists and engineers	0.1355	0.0169
				Cultural industry R&D investment accounts for proportion of cultural industry GDP	0.1675	0.0209
				Number of public libraries and museums	0.0986	0.0123
				Art performance groups per million people	0.0415	0.0052
				Number of cultural relics	0.0526	0.0066
		Industrial capability	0.5	Number of international exhibitions held in the local year	0.3546	0.0443
				The number of awards for scientific and technological achievements	0.3321	0.0415
				The number of awards for artistic awards	0.3133	0.0392
Sustainable development capacity	0.25	Industrial potential	0.4	Per capita GDP	0.1867	0.0187
				Urban and rural per capita annual cultural entertainment investment	0.2224	0.0222
				Cultural industry financial allocation	0.1933	0.0193
				The cultural industry actually completed the infrastructure investment	0.2053	0.0205
				The increase in the value of education institutions in the cultural sector accounts for the national proportion	0.1923	0.0192
		Industrial structure	0.3	Investment in cultural industry accounts for the proportion of the tertiary industry	0.6331	0.0475
				Foreign trade dependence of local cultural industry	0.3669	0.0275
		Industrial environment	0.3	Local per capita venture capital	0.4108	0.0308
				Local people use Internet time every day	0.2867	0.0215
				Local per capita public cultural service facilities use area	0.3025	0.0227

3.4 Data Processing

Each data of the indicator system has different dimensions, different orders of magnitude, and different positive and negative directions. It needs to be standardized before use. The article uses the membership function to process, see equations (5), (6).

$$\overline{R_i} = \frac{R_i - R_{\min}}{R_{\max} - R_{\min}} \tag{5}$$

$$\overline{R_i} = \frac{R_{\max} - R_i}{R_{\max} - R_{\min}} \tag{6}$$

4. Summary

The article starts with the construction of the initial index system of empirical evaluation, proposes the “index loop method” innovatively, and takes the cultural industry as an example for research. The index system is constructed from the forward and reverse directions, and the correlation between the last two indicators and the discriminative power of each index are analyzed. Then the rationality of the constructed index system is verified to form a set. A perfect evaluation index system for cultural industry competitiveness. For the evaluation model, AHP, TOPSIS, and fuzzy comprehensive evaluation can evaluate the cooperation ability of the cultural industry. The article's innovation of the index system construction process provides reference for experts and scholars in the same industry, and provides suggestions for the improvement of cultural industry competitiveness. It has certain theoretical reference and practical guiding significance.

Acknowledgement

This research was financially supported by the Following Foundation.

1. Key project of art science of Shandong province: A study on the development index system and empirical evaluation of cultural industry in Shandong province based on correlative and discrimination (Grant NO.201806390);

2. Shandong Province Education Science Thirteenth Five-Year Plan: Research on the Evaluation Index System of Education Quality in Colleges and Universities in Shandong Province (Grant NO. YC2017044);

3. Shandong Provincial Higher Education Humanities and Social Science Program: Study on the

Economic Agglomeration and Diffusion Effect of Shandong Province under the "Two Circles and Four Zones" Pattern (Grant NO. J17RB068);

4. Chunhui major project of Shengli College of China University of petroleum: Study on efficiency measurement and development path of social science construction in Shandong province (Grant NO.KY2018005);

5. Social science planning research project of Shandong province: Study on evaluation index system of cultural industry innovation capacity of Shandong province (Grant NO.16CGLJ45);

6. Special project of social science planning research in Shandong province: Research on the improvement path of government credibility from the perspective of socialized government (Grant NO.18CQXJ40);

7. College students' innovation and entrepreneurship plan: Research on the development and innovation of the new travel network (Grant NO.2018033).

Reference

[1] Zou Wei, Xiao Shizhen, Design of Evaluation Index System of Cultural and Creative Industry Competitiveness Based on AHP, *Statistics and Decision*, vol.44, pp.58-60, 2017.

[2] Zeng Tao, Yang Wei, Zhan Shaowen, Simulation Research on the Formation Mechanism of Regional Cultural and Creative Industry Competitiveness, *Statistics and Decision*, vol.02, pp. 64-68, 2018.

[3]Wang Wei, Zhao Guojie. Evaluation Model and Index System of Regional Cultural Industry Competitiveness Based on ANP, *Science and Technology Management*, vol.07, pp.129-132+179, 2008.

[4] Wang Like, Construction of regional science and technology innovation capability evaluation index system based on correlation-discrimination analysis, *Productivity Research*, vol.01, pp. 65-68, 2013.