Evaluation on Competitiveness of Cultural Creative Industry Based on Catastrophe Progression Method

Ping Gu¹, Cheng Chen², *and Zili Chen³

^{1,2,3}School of Economics and Management, Jiangsu University of Science and Technology, Zhenjiang, P.R. China

*m18852890027@163.com

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ARTICLE DETAILS

Article History:

Received 02 october 2017
 Accepted 06 october 2017
 Available online 11 october 2017

Keywords:

Catastrophe progression method,
 Cultural creative industry,
 Competitiveness..

ABSTRACT

According to the characteristics of the connotation of cultural creative industry and the theory of competitiveness, competitiveness evaluation index system of regional cultural creative industry is established by catastrophe progression method, selecting 11 provinces and cities in east China, meanwhile, taking cultural creative industry as the research subject in these areas, the paper carries out quantitative study with evaluation on whole industrial competitiveness. Then, it gives a comprehensive analysis on the evaluation result and points out existing problems in cultural creative industry in different provinces and cities, as well as promotion strategies.

1. Introduction

Since the 21st century, with the aggravation of the economic globalization, and the transformation of economic growing mode, cultural creative industry has become a sunrise industry which has the most commercial value and cultural connotation in this era. At the same time, in the current context of supply-side structural reform in our country, the cultural creativity industry has absolute advantages in industry amalgamation, innovation, added value of high-tech, and low power consumption innovative when compared with other traditional industries. Therefore, the development of cultural creative industry, and the promotion of the competitiveness are the key to realize the optimization and upgrading of industrial structure.

Compared with other developed countries, cultural creative industry started relatively late in our country, and there are unbalanced development in different district. But overall, cultural creativity industry has been on some scale in east China. This paper through catastrophe progression method to construct competitiveness evaluation model of cultural creative industry, and selected 11 provinces and cities in east China, including Beijing, Tianjin, Hebei, Liaoning, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, and Hainan. Based on the cross section data of 2014, it utilized quantitative evaluation in these areas. Then, according to the result of competitiveness evaluation, this paper put forward some useful countermeasures to promote comparative advantages in different regions. Meanwhile it provide a reference for relevant government departments to make policy, so that fully enhance the competitiveness of cultural creative industry in our country.

2. Literature References

It is a new research direction when we use competitiveness theory in cultural creative industry. Many existing studies through the perspective of competitiveness definition to research cultural creative industry competitiveness[1]. Hua (2005) thought Competitiveness is divided into three levels, including microcosmic, middle and macrocosmic, and the competitiveness of cultural industry belongs to middle level[2]. Gu and Xia (2007) considered that the competitiveness of cultural industry includes realistic and potential competitiveness[3]. In the aspect of evaluation method, Ye and Li (2009) built a competitiveness evaluation index system which reflects reality and potential competitiveness, and they used factor analysis and cluster analysis in the evaluation[4]. In the view of empirical research[5-7], some scholars established evaluation

system on the basis of related research, then used the AHP to give weights and through relevant data to carry out empirical analysis in different provinces and cities(He,2011;Gao and Shao,2013;Kang and Chen,2014).And Zhao et al (2014) used Delphi method to confirm the weight of each index in the evaluation system[8].

In conclusion, there are many methods can be used in the competitiveness evaluation, such as factor analysis, AHP and Delphi, etc. Compared with these methods, catastrophe progression method does not need to determine the index weight, and it only consider the relative important degree among different indexes, so that reduce the subjective influence through the index weight is determined. Besides, it is simple and convenient in calculation, so, this paper use this method to evaluate cultural creative industry competitiveness.

3. Research Method & Model Building

3.1 Catastrophe Progression Method

Catastrophe progression method comes from Catastrophe theory, which was founded in 1972 by a French mathematician, Rene Thom[9]. Firstly, catastrophe progression method adopts multiple levels of contradiction decomposition on evaluation target, then using catastrophe theory and fuzzy mathematics to form a catastrophe fuzzy membership function. Next, through comprehensive quantitative computation to calculate the final total membership function by the normalization formula. Last, it will be the comprehensive evaluation results. In general, after determining the evaluation index, it need to be ranked by importance.

3.2 Model Building

3.2.1 Evaluation Index System

According to the characteristics of the connotation of cultural creative industry and the theory of competitiveness, this paper construct competitiveness evaluation index system from three aspects, including basic competitiveness, dominant competitiveness and potential competitiveness(table 1).

Table 1 Competitiveness Evaluation Index System of Cultural Creative Industry

Object Level	First Class Indicator	Second Class Indicator	Third Class Indicator
Competitiveness of Cultural Creative Industry A	Basic Competitiveness B ₁	Cultural Basis C ₁	Number of publications issuers D ₁
			Per 100,000 population average enrollment in colleges and universities D ₂
			Number of Internet users D ₃
		Cultural Resources C ₂	Population Coverage Rate of TV Programs D ₄
			Collections of Public Libraries Owned per Person D ₅
	Dominant Competitiveness B ₂	Industry Scale C ₃	Performances of Art Performance Troupes D ₆
			Number of Spectators in Museums(10000 person-times) D ₇
			Number of legal entities D ₈
		Economic Benefits C ₄	The proportion of industrial added value to GDP D ₉
			Investment in fixed assets D ₁₀
Competitiveness of Cultural Creative Industry A	Potential Competitiveness B ₃	Government Policy C ₅	Per capita business revenue D ₁₁
			Overall labor productivity D ₁₂
			Fixed asset investment rate of return D ₁₃
		Consumer Demand C ₆	Expenditure for culture, sport and media as percentage of government revenue D ₁₄
			Expenditure for education as percentage of government revenue D ₁₅
	Innovation Ability C ₇	Urban households per capital consumption expenditure on cultural and recreation D ₁₆	Urban households per capital consumption expenditure on cultural and recreation D ₁₆
			Expenditure on cultural and recreation as percentage of consumption expenditure D ₁₇
			Number of patents D ₁₈
		R&D expenses D ₁₉	R&D expenses D ₁₉
			Number of Registration of Copyright Contracts D ₂₀

3.2.2 Determine the Type of the Catastrophe System

There are three common types of the catastrophe system which are Cusp Catastrophe, Swallowtail Catastrophe and Butterfly Catastrophe. Their models and normalization formulas are in table 2^[10].

Table 2 Three Catastrophe Types and Normalization Formula

Type	Model	Control Variable	Normalization Formula
Cusp Catastrophe	$U(X) = X^4 + AX^2 + BX$	A, B	$X_A = \sqrt{A}, X_B = \sqrt{B}$
Swallowtail Catastrophe	$U(X) = \frac{1}{5}X^5 + \frac{1}{3}AX^3 + \frac{1}{2}BX^2 + CX$	A, B, C	$X_A = \sqrt{A}, X_B = \sqrt{B}, X_C = \sqrt{C}$
Butterfly Catastrophe	$U(X) = \frac{1}{6}X^6 + \frac{1}{4}AX^4 + \frac{1}{3}BX^3 + \frac{1}{2}CX^2 + DX$	A, B, C, D	$X_A = \sqrt{A}, X_B = \sqrt{B}, X_C = \sqrt{C}, X_D = \sqrt{D}$

3.2.3 Conduct Comprehensive Evaluation by Normalization formula

Using normalization formula to calculate the X of each indicator should follow minimax principle and average principle. If the indicators can't instead each other or totally independent, minimax principle should be used. It chooses the smallest one as the X from X_A, X_B, X_C, and X_D. And if the indicators can instead each other in some extent or have some relevance with others, average principle should be used. It calculates the average of X_A, X_B, X_C, and X_D to be the X.

4 Evaluation on Cultural creative industry Competitiveness

This paper selected 11 provinces and cities in east China, and made cultural creative industry as research object. The data source of *China Statistical Yearbook on Culture and Related Industries(2015)* and *China Statistical Yearbook(2015)*.

4.1 Data Standardization

Because each evaluation index is different on the content, dimensions and dimensional units, according to the requirements of mutation progression method, the raw data of the control variables must be converted to [0,1] based on the following formula (1).

$$Y_{ij} = \frac{X_{ij} - \min X_j}{\max X_j - \min X_j} \quad (1)$$

$i \in \{1, 2, L, \dots, 20\}$, $j \in \{1, 2, L, \dots, 11\}$, and the standard values of indicators in table 3.

Table 3 The Standard Values of Indicators

Region	Indicator									
	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇	D ₈	D ₉	D ₁₀
Beijing	0.5565	1.0000	0.1707	1.0000	0.2691	0.0873	0.0495	0.8789	1.0000	0.0325
Tianjin	0.1258	0.6560	0.0704	1.0000	0.2764	0.0075	0.1116	0.1760	0.6505	0.1191
Hebei	0.4868	0.0000	0.4635	0.8444	0.0000	0.3919	0.3393	0.2739	0.2080	0.5402
Liaoning	0.4006	0.2507	0.3145	0.7778	0.1891	0.0347	0.1445	0.2417	0.0000	0.3502
Shandong	0.5424	0.0970	0.6137	0.6667	0.0618	0.8977	0.6788	0.6319	0.1986	1.0000
Shanghai	0.5249	0.3753	0.1886	1.0000	1.0000	0.1058	0.2628	0.3705	0.3930	0.0434
jiangsu	1.0000	0.2282	0.5613	0.9778	0.1818	0.3069	1.0000	0.8762	0.2890	0.9176
Zhejiang	0.7975	0.0931	0.4424	0.9333	0.2655	1.0000	0.5756	0.8612	0.3478	0.3759
Fujian	0.2651	0.1246	0.2986	0.7111	0.1491	0.5705	0.3124	0.3056	0.2182	0.2804
Guangdong	0.7104	0.0775	1.0000	0.9778	0.1455	0.2156	0.5610	1.0000	0.3299	0.4403
Hainan	0.0000	0.0657	0.0000	0.0000	0.0618	0.0000	0.0000	0.0000	0.1168	0.0000

(continued table)

Region	Indicator									
	D ₁₁	D ₁₂	D ₁₃	D ₁₄	D ₁₅	D ₁₆	D ₁₇	D ₁₈	D ₁₉	D ₂₀
Beijing	0.5839	0.6142	1.0000	1.0000	0.5322	1.0000	0.6265	0.3682	0.0339	1.0000
Tianjin	0.4697	1.0000	0.1671	0.0000	0.7122	0.2086	0.1507	0.1247	0.2540	0.0587
Hebei	0.0515	0.8184	0.0000	0.0549	0.7895	0.0000	0.2434	0.0934	0.0376	0.0076
Liaoning	0.0027	0.0725	0.0038	0.0831	0.0000	0.3388	0.8011	0.0903	0.0719	0.0214
Shandong	0.4349	0.2808	0.0553	0.0614	1.0000	0.0881	0.0000	0.3589	0.8278	0.0395
Shanghai	1.0000	0.3114	0.7891	0.0484	0.2637	0.9971	0.5997	0.2464	0.1791	0.1467
jiangsu	0.1558	0.1396	0.1082	0.3022	0.6932	0.6176	1.0000	1.0000	0.8881	0.1789
Zhejiang	0.2034	0.3419	0.2648	0.2936	0.9557	0.5206	0.2203	0.9421	0.4317	0.0543
Fujian	0.0000	0.0851	0.0731	0.1434	0.8622	0.2863	0.4558	0.1827	0.2175	0.0000
Guangdong	0.0369	0.0000	0.2625	0.0906	0.9300	0.4341	0.7342	0.8988	1.0000	0.0185
Hainan	0.1283	0.4070	0.0272	0.2437	0.6525	0.1589	0.7947	0.0000	0.0000	0.0154

4.2 Comprehensive Evaluation

According to the basic principle of catastrophe progression method and catastrophe type, this paper carried out the evaluation on cultural creativity industry competitiveness for all regions. Take Beijing as an example, the process and result of the evaluation in table 4.

Table 4 The Process and Result of Comprehensive Evaluation (Beijing)

Type	Normalization Value				Principle	Result
Butterfly	X _{D1}	X _{D2}	X _{D3}	X _{D4}	Minimax	C1
Catastrophe	0.8102	1.0000	0.6428	1.0000		0.6428
Swallowtail	X _{D5}	X _{D6}	X _{D7}		Minimax	C2
Catastrophe	0.5187	0.4436	0.4717			0.4436
Swallowtail	X _{D8}	X _{D9}	X _{D10}		Average	C3
Catastrophe	0.9375	1.0000	0.4247			0.7874
Swallowtail	X _{D11}	X _{D12}	X _{D13}		Average	C4
Catastrophe	0.7641	0.8500	1.0000			0.8714
Cusp	X _{D14}	X _{D15}			Average	C5
Catastrophe	1.0000	0.8104				0.9052
Cusp	X _{D16}	X _{D17}			Average	C6
Catastrophe	1.0000	0.8557				0.9278
Swallowtail	X _{D18}	X _{D19}	X _{D20}		Average	C7
Catastrophe	0.6068	0.3238	1.0000			0.6435
Cusp	X _{C1}	X _{C2}			Average	B1
Catastrophe	0.8017	0.7627				0.7822
Cusp	X _{C3}	X _{C4}			Average	B2
Catastrophe	0.8873	0.9551				0.9212
Swallowtail	X _{C5}	X _{C6}	X _{C7}		Average	B3
Catastrophe	0.9514	0.9753	0.8957			0.9408
Swallowtail	X _{B1}	X _{B2}	X _{B3}		Average	A
Catastrophe	0.8884	0.9730	0.9849			0.9474

With the same method and calculation process can get the score of 7 second class indicators of other provinces and cities, and these regions are ranked by the score (table 5). Similarly, it also can get the score and rank of three competitiveness in first class indicator, until it is concluded that the total score and rank of regional cultural creative industry competitiveness(table 6).

Table 5 The Score of 7 Second Class Indicators

Region	C ₁		C ₂		C ₃		C ₄		C ₅		C ₆		C ₇	
	Score	Ra nk	Score	Ra nk	Score	Ra nk	Score	Ra nk	Score	Ra nk	Score	Ra nk	Score	Ra nk
Beijing	0.6428	2	0.4436	3	0.7874	5	0.8714	2	0.9052	1	0.9278	1	0.6435	5
Tianjin	0.3546	9	0.1959	9	0.6245	8	0.7749	9	0.4465	9	0.4944	9	0.4929	7
Hebei	0.0000	10	0.0000	10	0.6577	6	0.3874	8	0.5793	8	0.3122	10	0.3118	10
Liaoning	0.6305	3	0.3261	7	0.4203	10	0.2390	11	0.1442	11	0.7554	5	0.3663	8
Shandong	0.4594	6	0.2486	8	0.7928	4	0.5998	5	0.6239	7	0.1484	11	0.6613	4
Shanghai	0.6590	1	0.4729	2	0.5992	9	0.8734	1	0.4307	10	0.9209	2	0.5596	6
jiangsu	0.6111	4	0.4264	4	0.8586	1	0.4957	7	0.7174	3	0.8929	3	0.8705	1
Zhejiang	0.4532	7	0.5152	1	0.8048	3	0.6226	4	0.7635	2	0.6627	6	0.7364	3
Fujian	0.4994	5	0.3861	5	0.6275	7	0.3199	9	0.6652	5	0.6524	8	0.3430	9
Guangdong	0.4263	8	0.3814	6	0.8352	2	0.3026	10	0.6385	6	0.7805	4	0.7723	2
Hainan	0.0000	10	0.0000	10	0.1629	11	0.5018	6	0.6805	4	0.6625	7	0.1175	11

Table 6 The Score of 3 Competitiveness

Region	B ₁		B ₂		B ₃		A	
	Score	Ra nk	Score	Ra nk	Score	Ra nk	Score	Ra nk
Beijing	0.7822	2	0.9212	1	0.9408	1	0.9474	1
Tianjin	0.5881	9	0.8544	6	0.7656	7	0.8837	8
Hebei	0.0000	10	0.7700	8	0.7289	10	0.6135	10
Liaoning	0.7412	4	0.6344	10	0.6895	11	0.8771	9
Shandong	0.6533	8	0.8669	3	0.7404	9	0.8965	7
Shanghai	0.7955	1	0.8650	4	0.8314	5	0.9332	3
jiangsu	0.7672	3	0.8590	5	0.9253	2	0.9358	2
Zhejiang	0.7374	5	0.8755	2	0.8907	3	0.9289	4
Fujian	0.7175	6	0.7381	9	0.8161	6	0.9004	6
Guangdong	0.6890	7	0.7926	7	0.8858	4	0.9086	5
Hainan	0.0000	10	0.5991	11	0.7607	8	0.5923	11

4.3 Result and Suggestions

In order to more intuitively observe the competitiveness of cultural creative industry in 11 provinces and cities, on the basis of the above tables, this paper constructed a radar map about The level of regional cultural creative industry competitiveness in 2014 (figure 1). Meanwhile it used SPSS 22.0 to have on K-Means Cluster Analysis, the result is the classification of competitiveness level, as shown in table 7. With the result of this evaluation, the competitiveness level of cultural creative industry in east China is high, but it still has gap between different regions. The 11 provinces and cities were divided into 3 classes by cluster analysis, class I are Beijing, Shanghai, Jiangsu, and Zhejiang, these regions have a better competitiveness. Class II are Guangdong, Fujian, Shandong, Tianjin, and Liaoning, these regions also have a good competitiveness, and it do not have a large gap between class I. Class III are Hebei and Hainan, compared with class I and class II, there are still large gaps to fill.

Figure 1 The Level of Regional Cultural Creative Industry Competitiveness in 2014

Table 7 The Classification of Competitiveness Level

Class	Cluster center	Number	Region
I	0.9363	4	Beijing, Shanghai, Jiangsu, Zhejiang
II	0.8933	5	Guangdong, Fujian, Shandong, Tianjin, Liaoning
III	0.6029	2	Hebei, Hainan

Combined with table 5 and table 6, it analyzed the status quo further more. Jiangsu overcome Shanghai on the score, because Jiangsu has advantages in industry scale and innovation ability. Meanwhile Shanghai should enhance fiscal expenditure on cultural and educational entertainment. Guangdong is fifth, though its industry scale is huge, the economic benefits are not good. So, it should strengthen in industrial transformation and upgrading. As for regions after Guangdong, especially Hebei and Hainan, their most index score is not high, and there would be much to do. Firstly, government should increase investment to promote industrial scale. Secondly, it must pay more attention to talents, funds and innovation ability. Thirdly, government should play an important role in support and guide. Finally, it is vital to strengthen cooperation and communication in various areas, because it could promote mutual learning.

5. Conclusion

Based on the theory of competitiveness and the catastrophe progression method, this paper constructs the competitiveness evaluation index system of regional cultural creative industry, including basic competitiveness, dominant competitiveness and potential competitiveness. Based on the cross section data of 2014, it empirically evaluates the competitiveness of cultural creative industry of 11 provinces and cities in east China, and then ranks them by the score. The results show that the competitiveness level of cultural creative industry in these areas is high, but it still has a gap between different regions. Although the results are valuable, the paper is still inadequate due to some limits. For example, in the future, it should collect more data with a much longer period to show the trends.

References

- [1] W. Zhang, Y.H. Xie, A Study on the Cultural and Creative Industry Competitiveness of Guangzhou: Compared with Shanghai and Shenzhen, *Forward Position in Economics*. Vol.3(5)(2012) 62-72.
- [2] J. Hua, The connotation, structure and strategic focus of cultural industry competitiveness, *Journal of Peking University(Humanities and Social Sciences)*. Vol.42(2) (2005) 9-16.
- [3] N.H. Gu, J.C. Xia, A Comparison of Cultural Industry Competitiveness among Some Important Cities in China, *Journal of Business Economics*. Vol.19(12) (2007) 52-57.
- [4] L.J. Ye, L. Li, The evaluation and analysis of differences on regional cultural industry competitiveness in China, *Science and Technology Management Research*. Vol.29(3) (2009) 94-97.
- [5] J. He, Research on the Evaluation System of Cultural and Creative Industries Competition, *Jilin University*(2011).
- [6] B.L. Kang, Y.J. Chen, Study on Construction of Competitiveness Evaluation Index System of City Culture Creative Industries and its Application--taking Shanghai, Hangzhou and Nanjing as Examples, *Journal of Hubei Polytechnic University (Humanities and Social Sciences)*. Vol.1(2014) 37-41.
- [7] X.Y. Gao, C.X. Shao, Evaluation and Countermeasure Analysis on the Competitiveness of Regional Cultural and Creative Industry, *Enterprise Economy*(2013).