International Journal of Frontiers in Sociology
ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

Research on the Efficiency Measurement of Chinese Cultural manufacturing Industry Based on DEA Method

Hualei Ju*

College of Economics, Northwest University of Political Science and Law, Xi'an 710122,China

Corresponding author e-mail: chalele2008@163.com

ABSTRACT. *Using the DEA method, it empirically analyzes the cultural manufacturing efficiency of 21 decision making units in private, state and foreign countries about Guangdong Province, Heilongjiang Province, Hubei Province, Hunan Province, Zhejiang Province, Chongqing city and national average in China. This paper found Chinese to the cultural industry as the representative of the cultural industry has much room for improvement in the management system, management of technology, it is necessary to encourage, support and guide social capital to increase the contribution to the field of culture, promote the effective utilization of cultural resources and healthy development.*

KEYWORDS: *Cultural manufacturing industry, Efficiency measurement, DEA.*

1. Introduction

After twenty-first Century, China's cultural industry faces good opportunities for development, but there are also many challenges. The research literature in the academic circles has been carried out from the theoretical level of development, policy and suggestion, and most of them are qualitative research[1-4]. There are also some documents to evaluate the efficiency of cultural industry from a quantitative point of view, mostly from the overall level of cultural industry[5-7]. The concept of the culture industry was first put forward by the Frankfurt School of Horkheimer and Adorno and co-author of the "Dialectics of enlightenment" in a Book. But the development of the culture industry at that time is not mature, they focus on the spread of culture and the development of cultural industry. David Throsby thinks that cultural industry is "cultural products and services that contain creativity, condense certain degree of intellectual property and convey symbolic meanings" in production[8]. China National Bureau of statistics, culture and related industry classification (2012), divides the cultural industry of China into two categories: the production of cultural products and the production of cultural related products. Under these two categories, there are 10 middle classes. The classification of industrial links can be divided into cultural manufacturing, cultural wholesale and

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

retail, and cultural services. Generally speaking, the cultural industry mainly refers to the cultural service industry, but the cultural industry is an organic whole.It can better clarify the development context of the industry by measuring each industry link.

2. Analysis of the current situation of Chinese cultural industry

From the current development of China's cultural industry, 2013, 2014 and 2015 of culture and related industries accounted for the proportion of GDP reached 3.63%, 3.76% and 3.97%, has become worthy of the name is very important for the development of the national economy industry, has important significance to China's economic structure adjustment and industrial upgrading. The subdivision industry, which plays a basic role in China's cultural industry, has achieved a good development and laid a foundation for the healthy development of our cultural industry in the future. By the end of December 2014, the number of employees in culture and related industries reached 17 million people, of which 8 million 100 thousand people were employed in the above scale culture and related industries. The total assets accumulated were 69400 billion yuan, and realized 73800 yuan of business revenue.

3. Methods

3.1 Calculation method of efficiency

Data envelopment analysis (DEA) is a method for analyzing the relative efficiency of multiple input and multiple output decision units. The BCC model is more capable of reflecting the development of the cultural industry, so the BCC model is selected. The input oriented DEA model is chosen, because the input variable is relatively within the scope of enterprise control, and the efficiency of the enterprise is improved according to the adjustment of input. Pure technical efficiency mainly reflects the efficiency of decision making units in management system and management technology. When measuring pure technical efficiency, scale efficiency has been excluded. Scale efficiency is mainly reflected in the impact of production scale change on efficiency, and the calculation of scale efficiency also excludes pure technical efficiency. Integrated efficiency = pure technical efficiency * scale efficiency, comprehensive efficiency is the main index to measure the overall efficiency of decision making units.

3.2 Data source

From 2015 in Guangdong Province, Heilongjiang Province, Hubei Province, Hunan Province, Zhejiang Province, Chongqing city and the national average level in education, art, sports and entertainment products manufacturing, printing and reproduction of recording media industry, paper and paper products industry three

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

cultural manufacturing related industry data, according to the state-owned capital, private capital foreign capital, comprehensive efficiency, pure technical efficiency and scale efficiency evaluation.

Input variables: the division method of capital and labor input mainly follow the production function in the theory of the two elements, the cultural manufacturing industry in the capital to total assets (100 million yuan) (including fixed assets and current assets) measure, the average number of employees in labor (million) to measure.

Output variables: the main business income (billion yuan) reflects the management results of each decision unit, and it can measure the operation of each decision unit well. The total industrial output value of the cultural manufacturing industry (billion yuan) reflects that the decision-making unit is an effective indicator to reflect the scale of operation and the strength of operation.

Data source: Provincial Cultural Industry input-output data from the 2016 "statistical yearbook of Guangdong province", "statistical yearbook of Heilongjiang province", "statistical yearbook of Hubei province", "statistical yearbook of Hunan province", "statistical yearbook of Zhejiang province", "Chongqing Statistical Yearbook", the national cultural industry input-output data from 2016 "China statistical yearbook".

3.3 Data processing

According to the six provinces of state-owned and private enterprises, foreign enterprises and Hong Kong and Macao three types of culture, art, sports and entertainment products manufacturing, printing and reproduction of recording media industry, paper and paper products industry three cultural manufacturing related industries (6*3) data in total to 18 decision making unit culture manufacturing total data to evaluate. We add the national average level as a decision making unit to compare the efficiency of all types of departments in the six provinces with the national average. In DEA analysis, each analysis object is called a decision unit (DMU), and there are 21 decision-making units in the project group.

According to the application of the DEA method, the input variable and the output variable need to meet the positive correlation, that is, with the increase of input variables, the output variables should also increase. As shown in Table 1, through Pearson correlation coefficient test, two input variables, total assets and average number of employees have significant positive correlation with two output variables, main business income and total industrial output value. DEA analysis method is applicable. At the same time, the number of decision making units is more than two times more than the input and output variable (4).

Table 1: Pearson correlation coefficient

	Total Assets	Average number of employees
Main business income	0.942***	0.950***

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

Total industrial output value	0.944***	0.947***

Remark: * * * * indicated that the correlation coefficient was significant at the level of 1%.

3.4 Empirical analysis

3.4.1 Holistic analysis

Use Deap2.1 to analyze input-output data and conclude that the results are summarized in Table 2.

In terms of comprehensive efficiency, the total efficiency of the effective decision unit is low, and the average efficiency of the 21 decision-making units is only 0.639. Only Hunan's private and Chongqing private 2 decision making units have achieved DEA effectiveness (TE = 1), at the forefront of efficiency, namely, achieving pure technical efficiency and scale efficiency at the same time. The efficiency of the comprehensive efficiency decision making unit accounted for only 9.5%. The rest of the decision-making units are not comprehensive and effective, accounting for 90.5%.

The efficiency of comprehensive efficiency decision making units is low, which is mainly influenced by the low efficiency of scale. First, from the average, the average technical efficiency of the 21 decision making units is 0.8323, and the mean of scale efficiency is 0.79. Secondly, from the effective unit of pure technical efficiency and scale efficiency of the number of effective unit number comparison, 9 decision making unit (Guangdong, Guangdong, Heilongjiang private foreign private, Heilongjiang, Hubei, Hunan foreign private private, Zhejiang, Chongqing, Chongqing state owned state-owned private enterprises) to pure technical efficiency, pure technical efficiency of decision making units accounted for to 43%, pure technical efficient DMUs are close to half. Only 3 decision making units (private sector in Hunan, Chongqing private sector and private sector) reached scale efficiency and efficiency, and scale efficiency and effective decision making units accounted for only 14.3%. As comprehensive efficiency = pure technical efficiency * scale efficiency, the efficiency of comprehensive efficiency decision making units is relatively low.

In terms of scale compensation, most provinces can improve their output efficiency by adjusting input variables. Only 3 decision making units are in the stage of constant returns to scale. The 9 decision making units are in the stage of diminishing returns to scale. The 9 decision making units are in the stage of increasing returns to scale, and the proportion of decision making units needs to be adjusted to 86%. 3 DMU in Guangdong are in the stage of diminishing returns of scale. The investment and output of cultural manufacturing industry in private enterprises, state-owned enterprises and foreign-funded enterprises in Guangdong province are larger than those in other provinces, far higher than the national average level. This may be the main reason that the three sector of Guangdong province is in the stage of diminishing returns to scale. Because of its large

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

investment, it can't bring into full play the cost and competitive advantage brought by scale. The 3 DMU in Heilongjiang are in the stage of increasing returns to scale. The input and output of the three sector of Heilongjiang is below the national average level, and the scale advantage has not yet been fully utilized. There is no obvious characteristic of increasing, changing and decreasing distribution of the DMU scale in the other four provinces. In the stage of increasing returns to scale, it means that increasing output variables of the same proportion will bring greater proportion of output variable growth. Therefore, these decision making units should increase input and gain a larger proportion of output growth. In the stage of diminishing returns to scale, it means that the increase of input variables will bring a small proportion of output growth. Therefore, these decision making units will reduce input variables appropriately.

Table 2: a summary of the efficiency of each decision unit (according to the province)

Region	Type	TE	PTE	SE	Scale reward
Guangdong Province	state	0.439	0.476	0.922	drs
	private	0.82	1	0.82	drs
	foreign	0.408	1	0.408	drs
Heilongjiang Province	state	state	0.575	0.559	irs
	private	private	1	0.95	irs
	foreign	foreign	1	0.595	irs
Hubei province	state	state	0.796	0.828	irs
	private	private	1	0.936	drs
	foreign	foreign	0.775	0.951	drs
Hunan Province	state	state	0.893	0.86	drs
	private	private	1	1	-
	foreign	foreign	0.813	0.999	irs
Zhejiang Province	state	state	1	0.699	irs
	private	private	0.74	0.661	drs
	foreign	foreign	0.95	0.636	drs
Chongqing City	state	state	1	0.151	irs
	private	private	1	1	-
	foreign	foreign	0.349	0.974	irs
Whole country	state	state	0.703	0.746	irs
	private	private	0.73	1	-
	foreign	foreign	0.475	0.895	drs
Average		0.639	0.823	0.79	

Remark:(1) TE represents comprehensive efficiency, PTE represents pure technical efficiency, and SE represents scale efficiency. TE=PTE*SE

(2) irs indicates that the decision making unit is in the stage of increasing returns to scale. drs indicates that the decision making unit is in the stage of diminishing returns to scale, indicating that the decision making unit is in the stage of constant returns to scale.

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

(3) State owned and state holding enterprises are referred to as "state owned", private enterprises are referred to as private enterprises, and foreign invested enterprises and Hongkong, Macao and Taiwan investment enterprises are referred to as "foreign businessmen".

3.4.2 Input redundancy analysis

According to the BCC model, the model can calculate the number of multiple inputs and decrease in the case of no decrease in output, and at the same time, it can measure the number of input variables that can be reduced individually except for the same proportion. In Table 3, "Radial movement" reflects that the total number of assets and the average number of employees can be reduced at the same time. "S-" indicates that an input variable can be reduced separately.

In comparison with the two input variables, the total asset input has a greater improvement space than the average number of employees. 12 of the 9 units of pure technical efficiency of 1 do not reduce the total assets and employees' proportion. The total assets can also continue to reduce investment and maintain the existing output.

From the perspective of redundancy ratio, the redundancy ratio of Guangdong state owned enterprises, Chongqing foreign businessmen and foreign businessmen in China is over 50%, and the three decision making units have great improvement in input variables. The redundant proportion of Hunan state-owned, Zhejiang private and Zhejiang foreign investors in total assets investment is over 50%, and the proportion of redundancy is high.

Table 3: 12 decision units put into redundancy

Type	Input redundancy analysis					
	s-		Radial movement		Total redundancy ratio	
	Total assets ($100 million)	Average number of employees (tens of thousands)	Total assets ($100 million)	Average number of employees (tens of thousands)	Total assets ($100 million)	Average number of employees (tens of thousands)
State of Guangdong	53.051	0	132.929	1.382	73.27%	52.35%
State of Heilongjiang	0	0	20.942	0.276	42.47%	42.33%
State of Hubei	2.241	0	11.516	0.153	24.39%	20.40%
Foreign capital of Hubei	32.615	0	28.687	0.333	48.11%	22.50%
State of Hunan	212.561	0	35.262	0.191	75.53%	10.73%
Foreign capital of Hunan	0	0	14.277	0.226	18.68%	18.68%
Private of	406.584	0	334.786	6.088	57.62%	26.02%

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

Zhejiang						
Foreign capital of Zhejiang	528.156	0	41.879	0.502	67.71%	4.97%
Foreign capital of Chongqing	1.719	0	113.181	1.692	66.08%	65.08%
State of Nation	7.219	0	18.603	0.205	41.26%	29.61%
private Nation	0	0	32.884	0.976	26.96%	27.00%
Foreign capital of Nation	23.947	0	114.466	2.221	63.48%	52.47%

Remark: (1) according to the DEA model, the input redundancy analysis is used to analyze the decision making units with a pure technical efficiency of 1. For the 9 units with pure technical efficiency equal to 1, there is no list of the 9 units. (2) total redundancy ratio = (s-+Radial movement) / input

3.4.3 Type analysis

(1) Ranking analysis

As shown in Table 4, from the overall ranking of 21 decision making units, private enterprises occupy the top five, and the comprehensive efficiency of private culture manufacturing industry is very obvious. From the perspective of comprehensive efficiency, the efficiency of the top five is above 0.80, and the efficiency of the top four is above 0.93, and the comprehensive efficiency has a great advantage over the average value 0.639.

Table 4: Summary of the efficiency of each decision unit (ranked according to comprehensive efficiency)

Ranking	Type	TE
1	Private of Hunan	1
1	Private of Chongqing	1
3	Private of Heilongjiang	0.95
4	Private of Hubei	0.936
5	Private of Guangdong	0.82
6	Foreign capital of Hunan	0.812
7	State of Hunan	0.767
8	Foreign capital of Hubei	0.737
9	private of Nation	0.73
10	State of Zhejiang	0.699
11	State of Hubei	0.659
12	Foreign capital of Zhejiang	0.604

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

13	Foreign capital of Heilongjiang	0.595
14	State of Nation	0.524
15	Private of Zhejiang	0.489
16	State of Guangdong	0.439
17	Foreign capital of Nation	0.425
18	Foreign capital of Guangdong	0.408
19	Foreign capital of Chongqing	0.34
20	State of Heilongjiang	0.322
21	State of Chongqing	0.151

From the analysis framework of private, state-owned and foreign capital of the three sector, as shown in Table 5: private enterprises in the three indicators of the average pure technical efficiency, scale efficiency, comprehensive efficiency mean mean are leading in the foreign and Hong Kong and Macao enterprises and state-owned enterprises, in the first row. Among them, the average efficiency of the private enterprise has reached 0.846, which is significantly ahead of the other two departments, and the gap between the second and the private sector is 0.28.

The overall efficiency of foreign capital and Hong Kong, Macao and Taiwan enterprises is second, which is 0.051 higher than that of state owned and state owned enterprises, and the gap is not large. In the composition of comprehensive efficiency, the pure technical efficiency of foreign capital and Hong Kong, Macao and Taiwan enterprises is 0.012 lower than that of state-owned and state holding enterprises, and the scale efficiency is 0.099 higher than that of state-owned and state holding enterprises. Therefore, foreign capital and Hong Kong, Macao and Taiwan enterprises mainly use the advantage of the mean of scale efficiency, which has laid the position of comprehensive efficiency ahead of state-owned and state-owned holding enterprises.

Table 5 division of efficiency by enterprise type

Type	Mean value of comprehensive efficiency	Pure technical efficiency mean	Scale efficiency mean
Private	0.846	0.924	0.910
Foreign capital	0.560	0.766	0.780
State-owned	0.509	0.778	0.681

(2) intra regional analysis

As shown in Table 6, from the ranking of 7 regions, private enterprises ranked first, and state-owned and state-controlled enterprises ranked the top. Foreign businessmen and Hong Kong, Macao and Taiwan enterprises ranked second. Among them, the comprehensive efficiency of private enterprises is ranked first in 6 regions (Guangdong, Heilongjiang, Hubei, Hunan, Chongqing, and the national average).

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

The state-owned and state holding enterprises ranked last in the 4 area (Heilongjiang Province, Hubei Province, Hunan province and Chongqing city). Foreign companies and Hong Kong, Macao and Taiwan enterprises are ranked second in 5 regions (Heilongjiang, Hubei, Hunan, Zhejiang, Chongqing). In the same province, private sector, state owned and foreign investment three sectors have the same environment in cultural industry demand, overall economic development and industrial environment. Therefore, according to the above analysis, in general, the efficiency of the private culture manufacturing sector is relatively high.

Table 6 statistical tables of frequency number of private, state-owned and foreign capital in 7 regions

	Frist	Second	Third
Private	6	0	1
State-owned	1	2	4
Foreign capital	0	5	2

4. Conclusion

Based on the data of cultural manufacturing in Guangdong, Heilongjiang, Hubei, Hunan, Zhejiang, Chongqing and the national average level in 2012, the paper analyzes the efficiency of cultural manufacturing industry in a total of 21 decision-making units of private, state-owned and foreign businesses, and draws the following conclusions.

(1) 90.5% of the decision making units failed to achieve DEA effectiveness. On the whole, most of the decision making units in Guangdong, Heilongjiang, Hubei, Hunan, Zhejiang and Chongqing had room for improvement. 86% of the decision making units are inefficient in scale, which is the main reason that most of the decision making units fail to reach DEA. 57% of the decision making units do not achieve pure technical efficiency, which shows that there is a large space for improvement in management system and management technology.

(2) the overall efficiency of the private sector is higher than that of foreign investors and Hong Kong, Macao and Taiwan investment enterprises, state owned and state owned holding enterprises. State owned and state holding enterprises, foreign businessmen and Hong Kong, Macao and Taiwan investment enterprises all need to focus on improving pure technology efficiency and scale efficiency, and optimize input output structure by adjusting the amount of assets investment and staffing. In particular, there is a large gap between state-owned and state-owned holding enterprises and private enterprises, and the state-owned and state-owned holding enterprises have a lot of space for improvement.

The excellent performance of private enterprises in cultural manufacturing industry shows that cultural manufacturing is also an option for private capital to intervene in the cultural industry, except for private industries such as film and television, theatrical performances, animation, games and other cultural industries.

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

Private capital can combine itself with the cultural manufacturing industry and promote the development of cultural manufacturing industry and enhance the added value of cultural industry at the same time of its own advantages.

(3) the total assets are more space relative to the personnel. From the perspective of two elements of assets and labor, the cultural manufacturing industry is quite different from the "light assets" characteristics of traditional cultural industries such as TV, film, culture and art. The cultural industry is the technology intensive industry, a variety of fixed assets and intangible assets is more important for the development of cultural industry, has very important significance to grasp the advanced manufacturing technology, advanced production equipment, equipped with professional personnel to improve the efficiency of the cultural industry. The data of the research group show that most of the total assets of the cultural manufacturing decision making units are not fully utilized, and there is a phenomenon of low utilization efficiency and large investment redundancy. In the further development, we should increase the utilization of the existing assets.

(4) we should give full play to the support of cultural industry to the cultural industry, promote the integration of cultural industry and manufacturing industry, and create a high value-added cultural industry. In addition, cultural manufacturing is conducive to the extension of cultural industry chain. Taking movie and TV industry as an example, handicrafts and entertainment products designed according to the image of film and television industry have gradually become an important support point for the vitality of the film and television industry. Cultural manufacturing is an important industry that provides technical support and hardware guarantee for the development of cultural industry. It is necessary to adjust the allocation of resources and improve the efficiency of cultural manufacturing industry, so as to give full play to the support and auxiliary role of the cultural industry.

Acknowledgements

This work is supported by the Special scientific research plan project of Shaanxi Provincial Department: "Research on the coupling mechanism and collaborative evolution of science and technology finance ecology and science and technology innovation efficienc"(19JK0874)

References

[1] Gao X.W., Li S.M.(2014): “The development track, stage characteristics and efficiency evaluation of China's cultural industry,”.Research on Financial and Economic Issues, No.6, p.36-43.

[2] Han L.J.(2017): “Study on International Disputes Caused by Cultural Industry Policies and Corresponding Strategies,” Journal of Liaoning University(Philosophy and Social Sciences), Vol.45, No.3, p.73-79.

ISSN 2706-6827 Vol. 1, Issue 1: 32-42, DOI: 10.25236/IJFS.2019.010104

[3] Jiang S.Z., Zong Z.P.(2017): "The evolution of the research paradigm of cultural industry and Its Enlightenment," Fujian Tribune(The Humanities & Social Sciences), No.4,p.5-13.
[4] Le X.H., Chen X.H. (2013): "Research on the measurement of technical efficiency of Chinese cultural industry: 2000-2011," China Soft Science, No.1, p.143-148.
[5] Ma X., Zheng S.L. (2010): "A review and Prospect of the research on the efficiency of regional cultural industry in China," Economic Perspectives,Vol.30, No.3, p.83-86.
[6] Ou Yang Y.Q., Jiang X.J. (2018): "Highlights Problems and Policy Arguments:Analysis on China's Cultural Industry Policy Evolution," Journal of China National School of Administration, No.1, p.132-137.
[7] Throsby D. (2001): "Economics and culture," Cambridge University Press.
[8] Zhang Z.F., Zhang L.P.(2002): "The Culture Industry and Its Modes of Operation," Social Science in China, No.2,pp.98-106.