

Analysis of heterogeneity and convergence of TFP in culture industry

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Abstract. Based on the panel data of China's culture and related industries, this paper constructs an evaluation index system of total factor productivity of culture industry, measures the TFP of culture industry by using the global Malmquist index method, The results show that the TFP index of China's culture industry decreases by 3.1% every year, which is mainly driven by technological progress, There is an obvious trend of σ convergence among China's culture industry as a whole, the western region and the subdivided industries. The convergence rate of TFP in the whole culture industry is 2.306%.

1 Introduction

It has been widely recognized that culture is the “soft power” for social economic development of regions and countries. The improvement of culture industry is the sole way to improve the comprehensive economic and social strength. We have taken labor productivity as an important indicator to measurement of the level, quality and sustainability of economic development since a long time ago. Such a practice provides a way for sustainable improvement of labor productivity. Based on literature, the research fruits on the efficiency of culture industry development mainly focus on the following aspects: (1) research on culture industry productivity: Zhao Yang *et al.*^[1] did deep research on changes of total factor productivity and regional heterogeneity of culture industry with different measurement methods; Guo Lanping *et al.*^[2] made a regional analysis of national cultural service industry and total factor productivity of culture industry in Jiangxi Province; Lv Hongqu *et al.*^[3] made deep analysis from different aspects of changes of total factor productivity of culture industry in terms of opening up and urbanization. (2) research on culture industry development efficiency convergence: Sun Zhijun *et al.*^[4] constructed a framework with the level of culture industry agglomeration as the explained variable and urbanization economy and local economy as the explanatory variables. They employed empirical model to explore the spatial spillover effect of culture industry and its mechanism, and convergence analysis was carried out as well.

According to literature review, it is noticed that scholars have carried out empirical research on the efficiency of culture industry during the past ten years from different aspects. However, the focus is put on a province or the country but in a certain year, and there is no clear distinction between total factor productivity and

efficiency. The measurement methods are also slightly different, and the conclusion is not consistent. What is the total factor productivity of China's culture industry at present? What are the differences between culture industry subdivisions and different regions? And what is the trend of difference development? Based on previous research and these problems aforementioned, the current paper constructs the index system of total factor productivity of culture industry. It adopts the global Malmquist index method to calculate and analyze the total factor productivity of China's culture industry and further analyzes the heterogeneity and convergence of the total factor productivity of culture industry. It aims to find out the core drive of growth by the decomposition of TFP, study and judge the type of driving forces. It discusses the TFP of culture industry and the power source by using σ convergence model and β convergence model, and it also puts forward corresponding suggestions.

2 Measurement and construction of TFP index system

2.1 Research method: Global Malmquist Index

The paper adopts Global Malmquist Index put forward by Pastor and Lovell^[5] to measure the TFP of national culture industry and its subdivisions. Considering the fact that the efficiency itself is a relative value, compared with the local index, the Global Malmquist Index owns the characteristic of transitivity. That is to say, the efficiency value takes the comparison results of each unit in all years. More specific information can be found in the research of Lu Tao *et al.* TFP index can be divided into technical efficiency and technological progress, and technical efficiency can be subdivided into pure technical efficiency and scale efficiency. If each TFP is more than 1, it

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indicates that TFP increases while TFP decreases, and vice versa.

2.2 Index System Construction and Data Sources

Based on the availability and representativeness of the indicators, the existing research results and the data availability, the number of employees in the culture industry and legal entities, the total amount of assets, and the amount of fixed assets investment are taken as input indicators. Since the continuous data of added value index of culture industry can not be found, business income of culture industry is taken as the output index in the construction of evaluation index system of TFP. All the data in this paper are selected from the 2012-2018 China Statistical Yearbook on Culture and Related Industries and the 2019 China Statistical Yearbook. The relevant data of the culture industry in 2018 are collected by the author in strict accordance with the statistic scale of 2012-2017.

3 Measurement and Analysis of TFP of Culture Industry

3.1 Results of Measurement of TFP

According to the results in Table 1, from 2012 to 2018, the average TFP of China's culture industry was 0.969, with an average annual decrease of 3.1%. From the division of TFP, the technical efficiency of culture industry decreased by 3%, of which the pure technical efficiency decreased by 1.7%, the scale efficiency decreased by 1.1%, and the technological change increased by 15.9%. From 2012 to 2014, the TFP of culture industry decreased from 1.037 to 0.973 due to the decline of technical efficiency. From 2013 to 2016, the technical efficiency showed a positive growth, and its rising effects exceeded the downward one of technological change. During this period, TFP increased slightly by 0.95%. From 2015 to 2017, the TFP of culture industry decreased significantly, with a decrease of 8.1%, mainly due to the obvious linear downward trend of technical efficiency and technological change in the same period, and there was also an obvious decline of technical efficiency. From 2016 to 2018, technological change increased by 10.1%, and TFP of culture industry increased by 3.9%.

Table1. 2012-2018 TFP of National Culture Industry and its Subdivision Changes

Year	Technical Efficiency Change	Pure Technical Efficiency Change	Scale Efficiency Change	Technological Progress Change	TFP
2012-2013	0.965	0.99	0.977	1.074	1.037
2013-2014	0.966	0.988	0.981	1.008	0.973
2014-2015	1.011	1.027	0.987	0.969	0.979
2015-2016	1.032	0.983	1.053	0.953	0.983
2016-2017	0.952	0.995	0.959	0.948	0.902
2017-2018	0.895	0.918	0.979	1.055	0.941

In conclusion, the TFP of China's cultural industry is not high in general, and it is mainly driven by technological progress. Technological progress plays an important role in supporting industry development in regions with strong scientific and technological innovation ability. At the same time, more attention should be paid to the improvement of technical efficiency. The development of culture industry should be driven by the improvement of management and the effective utilization ability of resources.

3.2 Spatial Dimension Analysis

In terms of regions, the average TFP of culture industry during the observation period was 0.969, and the overall TFP decreased. There is a big difference among regions. To order the regions from highest to lowest is the eastern region, the western region, the central region and the northeast region. During the observation period, TFP increased in different degrees in 8 provinces, including 5 provinces in the eastern region and 3 provinces. Hainan province has the highest TFP with an increase of 7.2%, followed by Beijing, Fujian, Zhejiang, Shaanxi, Shanghai, Qinghai, Chongqing, etc. The growth of TFP in Hainan and Beijing culture industries was driven by technical efficiency and technological progress, with the increase of technical efficiency of 5.7% and 6.9% respectively. The change of technical efficiency in Fujian gradually decreased and the change of technology gradually increased. Therefore, TFP showed an increasing trend. The technical efficiency and technical change showed a decreasing-rising trend. Shanghai's technical efficiency remained stable during the observation period, and the technological progress fluctuated slightly. Zhejiang maintained the overall development trend of technical efficiency higher than technological progress. To sum up, the TFP in the top 8 provinces above are all greater than 1, which means that they all showed an increasing trend. Except Chongqing, the growth of TFP of the other seven provinces comes from the power of both technical efficiency and technological progress.

4 Convergence Analysis of TFP of Culture Industry

4.1 σ Convergence

σ convergence can be used to judge whether the regional differences of TFP index of China's culture industry are narrowing or even eliminated with the passing of time. According to Chen Heng et al. [7], the coefficient of variation CV is often used to measure the σ convergence test. In this paper, the coefficient of variation of TFP of culture industry is calculated. The TFP of the i region or industry is represented by y_i , and the calculation formula of coefficient of variation is as follows:

$$CV = \frac{\sqrt{\frac{\sum (y_i - \bar{y})^2}{n}}}{\bar{y}} \quad (1)$$

If the coefficient of variation tends to decrease over

time, it indicates that there is σ convergence in TFP index of culture industry, and the regional differences will become smaller, or even disappear. On the contrary, if the coefficient of variation increases over time, it indicates that there is σ divergence, and the difference of TFP index will become larger. The results are shown in Figure 1.

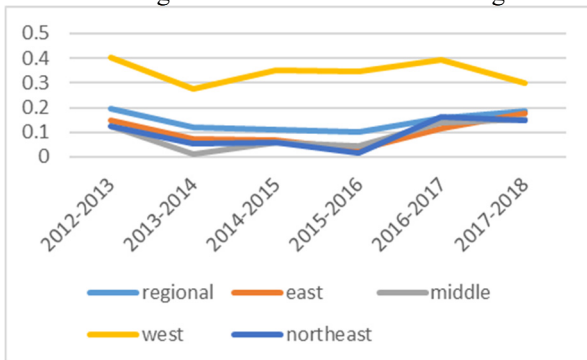


Fig1. Convergence Trend of TFP Index σ of Overall Cultural industry and Four Regions

As shown in Figure 1, during the observation period, the coefficient of variation of the overall TFP of the culture industry showed a downward trend, showing a relatively obvious trend of σ convergence. The coefficient of variation of TFP in the western region also shows an obvious trend of σ convergence after a short period of fluctuation; the central region shows a trend of σ convergence from 2012 to 2017, and it increases after 2017; the coefficient of variation of the eastern region gradually decreases from 2012 to 2016, showing a σ convergence trend. However, after 2016, the coefficient of variation gradually increases and shows a σ divergent trend; As for Northeast China, during the observation period, the coefficient of variation fluctuates and does not show a consistent trend of increase or decrease, and there is no significant trend of σ convergence.

4.2 Absolute β Convergence

$$\ln\left(\frac{y_{it}}{y_{it-1}}\right) = \alpha + \beta \ln y_{it-1} + e_{it} \quad (2)$$

Absolute β convergence analysis can reveal whether the regions with low TFP index have faster development speed than those with higher TFP index, that is, whether the former can "catch up" with the latter. Therefore, based on the research of Chen Heng et al. [7], this paper constructs the following β convergence model to further measure the development level and convergence speed of TFP of regional culture industry.

y_{it} and y_{it-1} represent the TFP of culture industry in i region during t period and $t-1$ period respectively. α is a constant term, e_{it} is a random error term and obeys $N(0, \sigma^2)$. If β coefficient is negative, it shows that the growth rate of TFP in backward regions is higher than that in developed regions, that is to say, there is β convergence; otherwise, if it is positive, the opposite is true. According to the estimated value of convergence coefficient β , the steady-state value r_0 and convergence speed θ can also be calculated, which represents the speed of culture industry development needed to catch up with developed areas.

$$r_0 = \frac{\alpha}{1-\beta} \quad (3)$$

$$\theta = -\frac{\ln(1+\beta)}{t} \quad (4)$$

Based on the TFP index of culture industry from 2012 to 2018, this paper uses the absolute β convergence model of dynamic panel fixed effect to regress TFP index of culture industry in China by using stata15 software. The results are shown in TABLE 2.

In Table 2, during the observation period, the convergence coefficient of TFP is negative, and it is significantly negative at the 1% confidence level, which indicates that the TFP of China's culture industry shows a significant absolute convergence trend during the observation period and it converges to the steady value at the convergence rate of 2.306%.

Table2. The Results of β Convergence Test of TFP of National Culture Industry

Variable	β	α	R2	F-stat	Steady Value r_0	Convergence Rate θ (%)
Total	-0.1292***	0.0606***	0.5997	213.58	0.0537	2.306%

5 Conclusion and Suggestion

This paper calculates the TFP of China's culture industry, and further analyzes the convergence of TFP index. The main conclusions are listed below: from 2012 to 2018, the overall efficiency of national culture industry is not high, with an average annual TFP decrease of 3.1%, mainly due to the decline of its technical efficiency, and there is a relatively obvious trend of σ convergence in China's culture industry as a whole. This is consistent with the viewpoints of Wang Xiaohong [8] and other scholars. The trend also appears that regions with low TFP are catching up with those with high TFP, and the convergence rate of TFP is 2.306%.

Suggestions are provided based on the conclusion above: First, Considering the current decline of TFP of China's culture industry, the characteristics and development rules of cultural industry which are different from other industries should be further explored in the process of turning the cultural industry to become a new economic growth point in the new period. Different economic development situation and cultural resources advantages of different regions are also needed to be noticed in the exploration of ways to promote development. The supply side structural reform of culture industry should be promoted, resources and elements should be integrated and optimized, management efficiency should be improved as well to promote the technological efficiency of the development of culture industry. We should learn from the experienced developed countries and regions, and promote the innovation of development mode of culture industry by means of big data and "Internet Plus" so as to improve the overall development efficiency of culture industry and enhance the core competitiveness of the culture industry. Second, based on the characteristics of convergence of TFP of culture industry, it shows a trend of narrowing the differences of culture industry development as a whole,

and also shows the trend of a slower development speed. Therefore, based on the analysis of the internal and external environment of the overall culture industry development, the advantages of finance in improving TFP should be given full play, market-oriented operation mechanism should also be introduced, multiplier effect be enlarged and the efficiency of resource allocation be improved.

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