

# Research on the Input-output Efficiency of Tourism Industry in Anhui Province based on DEA Model

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**Abstract:** As a pillar industry in the tertiary industry, the efficiency of its input and output is crucial to social and economic development. This paper takes Anhui tourism industry as the object of model validation, selects the number of star-rated hotels, the number of travel agencies and the number of tourism employees as input indicators, and the domestic tourism revenue and international tourism foreign exchange revenue of Anhui Province as output indicators, and analyzes the evaluation results of tourism input-output efficiency of Anhui Province from 2005 to 2017 using DEA model. The results of the study show that the technical efficiency and scale efficiency of Anhui tourism industry both show a wave-like rise, and should continue to optimize the allocation of resources and give full play to the advantages of tourism.

**Keywords:** DEA model, Input-output efficiency, Tourism industry.

## 1. Introduction

Since the 21st century, people's living standard has been improving, and with the solution of the problem of food and clothing, people's demand for material culture and spiritual dimension has become more and more urgent. As the most intuitive reflection of the spiritual construction of tourism, its proportion of the national economy is increasing, and China has entered the era of mass tourism, the efficient use of tourism resources has become the core competition point of inter-provincial tourism[1]. How to maximize the efficiency of tourism and improve the economic efficiency of tourism are of great concern to scholars. Anhui Province is located in the hinterland of East China, the province's topography is high in the southwest and low in the northeast, and the topography is very different from north to south and complex and diverse. The Yangtze River and Huai River traverse the province, and tourism resources are abundant, with natural resources such as the world-class Huangshan Mountain, and profound humanistic heritage such as Buddhism, Taoism and Huizhou culture[2]. In this paper, DEA model will be used to study the input-output efficiency of tourism in Anhui Province, in order to make feasible suggestions for the rational allocation of input-output factors of tourism in Anhui Province.

## 2. Literature References

In the early 1990s, foreign research on topics related to tourism efficiency began, and the initial stage was to measure tourism hotel efficiency. Morey and Dittman (1995) used a DEA model to measure the efficiency of more than 50 privately owned U.S. hotel chains as the subject of their study and found that the U.S. hotel industry was more efficient[3]. Bishops P (2003) based on input-output perspective, the DEA method was used to analyze the efficiency of tourism in England's national parks, and found that the efficiency was higher overall[4]. Wen Yan et al. (2013) made the first innovative use of data envelopment analysis to analyze the cost control efficiency of listed tourism companies by establishing suitable indicators of corporate cost control efficiency[5]. Wang et al. (2018) combined spatial clustering,

SBM model and MI index to scientifically measure the efficiency of carbon emissions in China's tourism industry, and the results showed that the efficiency in the east, central and west showed a gradient shape, i.e., the spatial layout of "high in the east and low in the west"[6]. Based on the input-output perspective, Xu Dong et al. (2018) measured the efficiency of tourism in Zhejiang Province and found that the province has a high level of tourism efficiency, which develops in a "double-M" shape[7]. Wang Zhaofeng et al. (2019) measured the ecological efficiency of the Yangtze River Economic Belt with tourism ecology as the research object, and found that the efficient provinces were in the eastern region, and the inefficient provinces gradually shifted to the west[8]. Xie M (2019) used the DEA model and Malmquist model to study the tourism comprehensive efficiency and total factor productivity were measured and found that although its overall tourism efficiency from 2005-2015 was high, its internal development was uneven, and in addition, its total factor productivity growth was mainly due to the major role played by technological progress[9].

In this paper, based on the review of domestic and foreign literature on tourism industry efficiency, the DEA model is selected to measure the input-output efficiency of tourism industry in Anhui Province based on the theoretical guidance of tourism economics and operation research, and finally analyze the problems of input-output efficiency of tourism industry in Anhui Province based on the model calculation results and put forward corresponding countermeasure suggestions.

## 3. Research Methodology and Selection of Sample Indicators

### 3.1. Data Envelopment Analysis

DEA (Data Envelopment Analysis) was developed by Cooper, Charnes and Rhodes in 1978, and was initially used to evaluate the operations of non-profit organizations and government departments. Since then, numerous studies have shown that the model has the features of not considering the functional relationship between inputs and outputs, not estimating parameters in advance, and not giving weights in advance[10]. With the help of DEA, the overall technical

efficiency can be decomposed into technical efficiency and scale efficiency, so that the reasons affecting the overall technical efficiency of the decision unit can be more precisely analyzed and summarized, the inefficient input elements can be identified, and how to adjust the inputs to make them effective.

### 3.2. Selection of indicators

The selection of input and output indicators directly affects the accuracy of the efficiency assessment results. The inputs of production factors can be broadly divided into three categories: land and natural resources, labor, and capital. Labor and capital factors are generally used as input indicators in inter-provincial tourism efficiency studies using the DEA model. The number of employed persons in the tourism industry is the most reasonable indicator representing labor input, but the official published Statistical Yearbook of Anhui Province records this data only until 2017, so the data of this study is selected only from 2005-2017. The capital element includes fixed asset inputs such as infrastructure,

among which the construction of star-rated hotels and travel agencies is directly related to the tourism industry and is an important attraction of the tourism industry, which can best represent the capital element inputs. Based on this, this study takes the number of star-rated hotels, the number of travel agencies, and the number of tourism workers as input indicators to represent tourism inputs in Anhui, and the domestic tourism revenue and international tourism foreign exchange revenue as output indicators to represent the economic output of tourism in Anhui Province.

### 3.3. Source of data

In order to ensure the availability, accuracy and continuity of the data, the DEA model was constructed using relevant data on tourism in Anhui from 2005-2017 (Table 1), which was obtained from the Anhui Statistical Yearbook, the Statistical Bulletin of National Economic and Social Development of Anhui Province and other official information released by the Anhui Provincial Bureau of Statistics in previous years.

**Table 1.** Tourism Input and Output Data of Anhui Province

Year	Domestic tourism revenue (billion yuan)	Foreign exchange earnings from international tourism (USD million)	Total number of star hotels (pcs)	Total number of travel agencies (pcs)	Number of people employed in tourism (persons)
2005	288.96	24558.09	373	599	48013
2006	387.63	30053.42	392	662	82572
2007	543.68	42400.48	403	693	75475
2008	700.24	54245.41	433	792	50231
2009	863.78	56583.9	456	890	51898
2010	1094.81	82025.22	453	947	53200
2011	1814.99	117918.1	462	1057	55840
2012	2519.08	156266.8	480	1124	58973
2013	2903.2	173141.6	471	1098	55884
2014	3309.8	196025.8	466	1200	87249
2015	3980.5	226287.5	441	1465	84840
2016	4763.6	254235.8	314	1084	81320
2017	6002.4	288078.5	331	1104	110211

## 4. Results and Analysis

In accordance with the indicators in Table 1, the BCC model (input-oriented model) was selected for analysis, in which the payoffs to scale are variable and the efficiency of the model is assessed in terms of whether input minimisation is achieved with constant output. The DEAP 2.1 software was

used to measure and calculate the combined technical efficiency (CRS), pure technical efficiency (VRS) and scale efficiency (SCALE) of the tourism industry in Anhui Province during the period 2005-2017. The specific results are shown in Table 2.

**Table 2.** Overall efficiency of tourism in Anhui Province and its components, 2005-2017

Year	Integrated technical efficiency	Purely technical efficiency	Scale efficiency
2005	0.171	1.000	0.171
2006	0.174	0.944	0.184
2007	0.234	0.916	0.256
2008	0.345	0.987	0.350
2009	0.349	0.958	0.364
2010	0.493	0.960	0.514
2011	0.675	0.948	0.712
2012	0.848	0.944	0.898
2013	0.991	1.000	0.991
2014	0.719	0.818	0.879
2015	0.853	0.855	0.998
2016	1.000	1.000	1.000
2017	1.000	1.000	1.000
Average	0.604	0.949	0.640

As can be seen from Table 2, the average value of the comprehensive technical efficiency of the tourism industry in

Anhui from 2005 to 2017 was 0.604, i.e. a relatively optimal level, with 60.4% of the fraction reaching validity.

From the perspective of this time series change from 2005 to 2017, it can be observed that the overall efficiency of Anhui Province shows a continuous development and continuous improvement. Among them, the DEA efficiency optimum was reached in both 2016 and 2017. This is the result of a gradual increase in the various tourism resource elements until somehow the overall efficiency of the tourism industry in Anhui Province has increased under specific market conditions. From a purely technical efficiency perspective, the average value of its efficiency is 0.949, which is relatively high compared to the overall efficiency of Anhui, and in terms of time series, it has been showing a stable tendency to remain almost always optimal. Finally, the scale efficiency of the tourism industry in Anhui Province has an average efficiency of 0.640 over the 13-year period, which is higher than the average of the overall efficiency and shows a continuous increase in the time series. Therefore, it can be concluded that the main reason for the increase in the overall efficiency of the tourism industry in Anhui Province is the increase in scale efficiency.

In summary, the efficiency of the tourism industry in Anhui Province is improving and stabilising year on year due to the rich natural and humanistic tourism resources and the steady increase in the amount of industry factor inputs in recent years, coupled with the support of relevant national economic policies. The continued gradual increase and effective allocation of tourism market factor inputs, the rational use of technologies such as big data, the constant supply of talent to the market in the area of university tourism and the significant increase in the average education level, service quality and ability of practitioners will have a significant boost to the viability and competitiveness of Anhui's tourism industry.

## 5. Suggestions and Conclusion

### 5.1. Suggestions

#### 5.1.1. Integrating existing tourism resources and increasing technological investment

At present, the overall efficiency of Anhui's tourism industry is mainly influenced by technical efficiency, and strengthening the core competitiveness of the tourism industry is conducive to increasing its impact on Anhui's economic output. Although the well-connected transportation, the world-famous Huangshan Mountain and the strong atmosphere of ancient houses make Anhui Huangshan a popular tourist city, other cities still lack the high-profile attractions to create a comprehensive development situation. Therefore, Anhui should consider the current demand of tourists for spiritual tourism, invest resources in other cities, build large tourist attractions, introduce high-end technology to stimulate the development of tourism enterprises, constantly learn from the advanced experience of other provinces and cities, and gradually improve the tourism product system through the innovative excavation and development of existing tourism products.

#### 5.1.2. Develop tourism in a comprehensive manner and give full play to economies of scale

Insufficient or excessive investment will result in low overall efficiency. Optimise the investment environment and adjust the investment structure. Increase investment in tourism to create a clustering effect, enhance attractiveness and absorb visitors from neighbouring tourism cities such as

Shanghai, Nanjing and Hangzhou.

#### 5.1.3. Vigorously introduce and train high-end technical talents related to tourism

The competition and development of any industry from the root is reflected in the competition of talents, and in the tourism industry the number of tourism workers is the embodiment of a regional tourism reception capacity, the level of tourism workers is a scenic area humanistic sentiment and natural scenery extension, they can give tourism consumers a more profound and better sense of tourism experience, which in turn will enhance the effectiveness of tourism output in Anhui.

#### 5.1.4. Strengthen regional tourism collaboration and promote regional tourism integration

Anhui should continue to implement the goal of region-wide tourism development, combining the current situation of each city's resources, infrastructure construction and industrial development situation to promote the development of region-wide tourism in each city according to local conditions, breaking the situation that tourists are too concentrated in a few locations in the centre of Huangshan City. Continue to take advantage of the high coverage of the high-speed rail network to connect tourist attractions throughout the province and build a new pattern of tourism in Anhui as a means of promoting economic development. At the same time create a regional linkage and cooperation mechanism to further the process of regional integration.

## 5.2. Conclusion

Given that this article has not tapped into the statistics of tourism workers missing from the statistical yearbook in recent years, the author has only selected data from 2005-2017 as a sample, and the findings and recommendations of the study may be subject to some errors. Further data will be added and conclusions will be refined if further relevant studies are conducted in the future.

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