ISSN 1816-6075 (Print), 1818-0523 (Online)
Journal of System and Management Sciences
Vol. 1 (2011) No. 4, pp. 121-133

The evaluation and analysis of China's regional tourism industry efficiency

Huiping Dong, Dingtao Zhao
University of Science and Technology of China, Anhui, China
almee@mail.ustc.edu.cn, box@ustc.edu.cn

Abstract: The paper employs data envelopment analysis (DEA) method to measure the level of input-output efficiency of the tourism industry in China, included 30 provinces (municipalities). And it reflects the current development pattern of the domestic tourism industry and regional difference .Furthermore, the regression model was established based on the evaluation, and the factors which improve industrial efficiency are analyzed. Finally, some suggestion of policy and develop strategies are proposed.

Keywords: DEA Technical Efficiency, Tourism Industry, Principal Component Regression

1. Forward

With the social development, tourism has become one of the most powerful and biggest industries in global economy. The industrial status and economic role of tourism in the development of urban economy have been gradually increased. The role of tourism in boosting urban economy, driving social employment, as well as promoting culture and environment is becoming increasingly obvious. President Philip Benbeier of French Tourist Association suggests that 43% of the profits from hotels, coffee shops and restaurants are directly related to the tourism; 42% of the proceeds of air transportation are tourism-related, while that of railway transportation, motor vehicle, agriculture and building industry are 23%, 12%, 8%, and 6%, respectively.

Since reform and opening-up, China's tourism has developed rapidly to make outstanding achievements. "Opinions on Speeding up the Development of Tourism", promulgated at the end of 2009, points out in definite terms that

"tourism shall be developed into the strategic pillar industry of the national economy and the modern service industry that people are more satisfied with." It's an important development strategy positioning on the development of Chinese tourism, marking that the development of tourism has become a major national strategy. Based on the facts of gradually developed tourism in China, the analytical framework and measurement method of technical efficiency were used in this study to carry out empirical analysis on the technical efficiency of the tourism industry in 30 provinces (municipalities).

2. Method Introduction

2.1. Method Review

Data development analysis is a new system analysis method, and it refers to a method that conducts an evaluation on efficiency of multi-input and multi-output Decision Making Unit (DMU) without making clear the shape of the transformation function through the establishment of mathematical programming.

The advantage of DEA model is that it does not need establish production function, making parameter estimation, non-dimensional conversion of the indicators or indicators to determine the weight can avoid the subjective factors and simplify operations, and it can be used on a number of the same type with multi-input and multi-output Decision Making Unit to compare relative efficiency.

2.2. CCR and BCC DEA Model

Adopting the conventional nomenclature of DEA, assume that there are n DMUs that are to be evaluated in terms of m inputs and s outputs. We denote the ith input an rth output for DMU_j (j=1,…,n) as x_{ij} (i=1,…,m) and y_{rj} (r=1,…,s). The efficiency scores of each DMU_d (d=1,…,n), based on the traditional input-oriented DEA model proposed by Charnes, Cooper, and Rhodes (1984) can be obtained by the following linear programming model (1):

$$\max \sum_{r}^{s} m_r \, y_{rd}$$

$$\text{s.t.} \quad \sum_{i=1}^{m} u_i \, x_{id} = 1, i = 1, \dots, m.$$

$$\sum_{r=1}^{s} m_r\, y_{rj} - \sum_{i=1}^{m} u_i\, x_{ij} = 0, r = 1, \dots, s, j = 1, \dots, n.$$

$$m_r, u_i > 0$$

By duality, the model (1) is translated to the linear model (2):

$$\min q_d$$

$$\text{s.t.} \sum_{j=1}^{n} l_j\, x_{ij} = q_d x_{id}, i = 1, \dots, m.$$

$$\sum_{j=1}^{n} l_j\, y_{rj} = y_{rd}, r = 1, \dots, s.$$

$$l_j > 0, j = 1, \dots, n.$$

$$q_d > 0.$$

Model (2) is the optimal result of the above model, which shows the performance of DMU_d based on a traditional CCR model. A DMU_d is regarded as efficient if and only if $q_d^* = 1$. This model is take constant return to scale (CRS) into consideration. As a result, the efficiency obtained by this model is not good enough when the scales of DMUs are different, because it does take the present scale into consideration.

In order to measure the performance of DMU based on variable return to scale (VRS), Banker et al. (1984) composed a new DEA model. According to this DEA model, the overall efficiency score of a DMU consists of two factors: the pure technical efficiency and the scale efficiency, while the overall efficiency = technical efficiency * scale efficiency. So, one can analysis whether a DMU is efficient based on the present scale. Model (3):

$$\max \sum_{r}^{s} m_r\, y_{rd} - u_d$$

$$\text{s.t.} \quad \sum_{i=1}^{m} u_i\, x_{id} = 1, i = 1, \dots, m.$$

$$\sum_{r=1}^{s} m_r\, y_{rj} - \sum_{i=1}^{m} u_i\, x_{ij} = 0, r = 1, \dots, s, j = 1, \dots, n.$$

$$m_r, u_i > 0$$

And the dual problem is model (4):

$$\min q_d$$

$$\text{s.t.} \sum_{j=1}^{n} l_j \, x_{ij} = q_d x_{id}, i = 1, \ldots, m.$$

$$\sum_{j=1}^{n} l_j \, y_{rj} = y_{rd}, r = 1, \ldots, s.$$

$$\sum_{j=1}^{n} l_j = 1$$

$$l_j > 0, j = 1, \ldots, n.$$

$$q_d > 0.$$

The model above is called BCC model, which could be used to measure the performance of a DMU_d with considering VRS. Similar to the CCR model, a DMU_d is efficient if and only if the efficiency score $q_d^* = 1$.

3. Empirical Analysis

3.1. The Selection of Evaluation

With the reference to the former work and the tourism industry itself, I select input indicators mainly including industrial and agricultural travel demonstration centers, a class scenic spot, the star-rated hotels, the number of employees involved in the tourist industry and the travel agency. The output indicators include the income of foreign exchange from international tourism, the number of inbound tourist arrivals, income from domestic tourism and the number of domestic tourists. We choose our 30 provinces, cities and municipalities date (exclude the date from Tibet, Hong Kong, Macao, Taiwan area because of the date missing) as a decision making units (DMU) of regional tourism industry efficiency. We collected data from tourism statistic yearbook of 2009.

3.2. Interpretation of Result

The paper utilizes the CCR and BBC model to evaluate the technical efficiency of each decision making units. Table 1 show out three kind's efficiency of 30 regions. What we've found from the result is that the eight provinces that included.

Table1: efficiency value of the regional tourism industry based on DEA

	EFF	TE	SE		EFF	TE	SE
The west				**Central section**			
Chongqing	1	1	1	Shanxi	0.5097	0.5664	0.8999
Sichuan	0.8927	1	0.8927	Inner Mongolia	0.6987	0.7855	0.8895
Guizhou	1	1	1	Jilin	1	1	1
Yunnan	0.8485	0.8937	0.9494	Heilungkiang	1	1	1
Shanxi	0.6908	0.6951	0.9938	Anhui	0.6478	0.665	0.9741
Gansu	0.3292	0.4763	0.6912	Jiangxi	0.5891	0.5981	0.9850
Tsinghai	0.6573	1	0.6573	Henan	1	1	1
Ningxia	0.3905	1	0.3905	Hubei	0.7553	0.7605	0.9932
Sinkiang	0.1817	0.3397	0.5349	Hunan	0.999	1	0.9990
The east							
Beijing	0.8928	0.9799	0.9111	Fujian	0.9744	0.9753	0.9991
Tianjin	1	1	1	Shandong	0.5317	0.8387	0.6340
Hebei	0.4481	0.4586	0.9771	Guangdong	1	1	1
Shanghai	1	1	1	Guangxi	0.7374	0.7431	0.9923
Jiangsu	0.8482	1	0.8482	Hainan	0.6707	1	0.6707
Zhejiang	0.7197	0.8801	0.8177	Liaoning	0.6635	0.9374	0.7078

Remarks: EFF is the overall efficiency. TE is the pure technical efficiency. SE is the scale efficiency. EFF=TE*SE.

Tianjin, Shanghai, Guangdong, Jilin, Heilongjiang, Henan, Chongqing and Guizhou are all the efficiencies of technologies and scales can be effective. They make up the leading surface of China's regional tourism industry efficiency. That is to say, unless increasing some or all of inputs, or reducing the amount of certain outputs, or the level of existing technology cannot increase their output. Otherwise, the level of existing technology cannot increase their output. It is calculated that six provinces Jiangsu, Hainan, Hunan, Sichuan, Qinghai, Ningxia six provinces are pure technical efficiency rather than scale efficiency of effective. That is the inputs of these areas cannot be reduced in accordance with the existing output. The other 16 provinces and cities are neither technical efficient nor scale efficient. In other words, even if the parts of their investments are reduced, it is also possible to maintain the level of current outputs.

According to a Boston matrix diagram, the 30 region are divided into four types, combining the technical efficiency with scale efficiency, and considering the average as a boundary line (As Figure 1). It further compares the average technical efficiency of tourism industry in the eastern, central and western regions (As Table 2) Firstly, as shown in Figure 2, the average technical

efficiency present consistent trend of decreasing gradually in the sequence of central, east, west. Which should be pointed out is that this study stand on the view of tourism industry, so it's differ from the feature that central region is worse than the east region which presented in the overall national economy. We found that the efficiency level of central region is higher than the east and west region. The further analysis of original input and output data found that the tourism output of central region is low, but the number of spot and the number of employees are less than other region, whereas the transformation relationship between input and output is the DEA measuring, so the input increment of east region is bigger than its output increment when it is contrast with the central region, it should be the cause of higher technical efficiency of central region than east region.

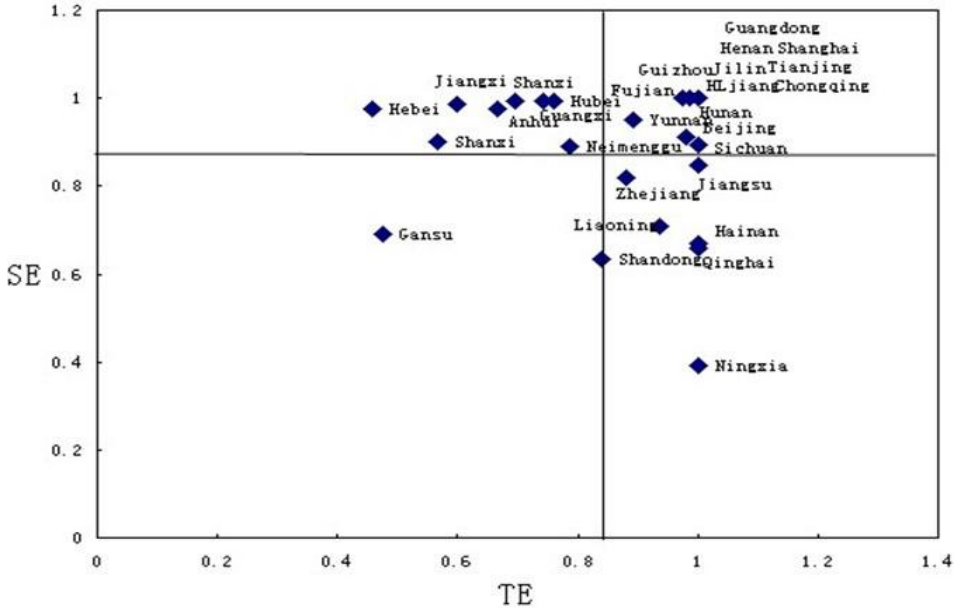

Figure 1: Boston matrix diagram and the areas in the quadrant

Secondly, they are the impacts of regional economy development level, regional environment, management system and so on, which cause the relative great input and output structure difference of China regional tourism industry. To the region has both technical valid and scale valid, although they are excellent in input and output efficiency, but there are still some differences. For example, Tianjin, Shanghai and Guangdong, they all developed in economy which saying by the abundant humane tourism resources, the great number of tourism enterprise and tourism employee, and the international tourism income which apparently higher than the other province/city in output aspects.

Table2: the average technical efficiency of the tourism industry in the east, west and central section

	EFF	TE	SE
The east	0.7905	0.9011	0.8773
Central section	0.8000	0.8228	0.9723
The west	0.6656	0.8195	0.8122

As well as the central and east region, although they have less input and still stay in starting stage, such as Jilin, Heilongjiang, Henan, Chongqing, and Guizhou province, the relative efficiency of input and output is good, therefore, included in the list of well-developed.

Table3: Total Variance Explained

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**
1	2.589	51.783	51.783	2.589	51.783	51.783
2	1.523	30.453	82.236	1.523	30.453	82.236
3	0.511	10.214	92.450			
4	0.198	3.957	96.406			
5	0.180	3.594	100.00			

Thirdly, the mainly cause of the relative low level of China tourism industry technical efficiency is non-effectively utilize of tourism resources such as the redundant scenic spot resource in most region from the input aspect. Moreover, the resource of tourism employee of Liaoning, Guangxi, and Shanxi province, the resource of star-rated hotel of Anhui, Hubei, Yunnan, Shanxi, Xinjiang province, and the resource of tourism agency of Neimenggu, Jiangxi are redundant. Both the star-rated hotel and tourism employee of Beijing are redundant, and the tourism agency and employee of Hebei and Shandong are underutilization. Excluded the DEA effective province/city from 29 provinces/cities, the rest provinces/cities that have inefficient DMU all need relative great adjusting to reach the frontier level. From the output aspect, the domestic and overseas tourism income and number of people of every province/city are not sufficient, all should be improved.

4. PCR Analysis

Based on the former work and the reality of China agriculture development, this paper have observed the tourism industry efficiency from five aspects (highway

mileage, GDP per capita, capital scale of tourism enterprises, number of firms, and number of media reports).

For the multiple correlations among factors, if the multiple linear regressions were carried on by Least Squares, the results maybe very poor sometimes, it was caused by the approximate linear relationship among independent variables that result in the disagreement between minus and value of regression coefficient and the theoretical value. In order to eliminate the unreasonable symbol in regression analysis, we will select the Principal component regression (PCR) to analysis. PCR was combined by the principal component analysis (PCA) and the regression analysis (RA), and the analysis issues about highly correlation among independent variables in regression will be solved under this method.

Firstly, we utilize the SPSS to conduct PCA on X1, X2, X3, X4, and X5.

Table 4: Component Matrix

	Component	
	1	2
X5	0.903	0.201
X3	0.871	0.020
X2	0.869	-0.014
X4	0.209	0.909
X1	-0.464	0.810

Extraction Method: Principal Component Analysis. a.2 components extracted.

ESSL is the result of factor extraction and the quadratic sum of factor loading without rotation. It shows that the percentage and cumulative percentage of the variance presented by each component's feature value account the total variance, extracted the first three factors which feature value is greater than 1 to be the principal components (PC), and the cumulative percentage is 82.236.

Table 5: Rotated Component Matrix

	Component	
	1	2
X5	0.918	0.118
X3	0.870	-0.059
X2	0.864	0.092
X4	0.290	0.886
X1	-0.389	0.849

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

The first PC has higher correlation with X2, X3, and X5, the second PC has higher correlation with X1, X4, and the third PC correlated with X5 (As Table 4). Rotated factor loading matrix was convergent after three times iteration (As Table 5).

Table 6: Component Score Coefficient Matrixes

	Component	
	1	2
X1	-0.131	0.546
X2	0.333	-0.039
X3	0.336	-0.017
X4	0.134	0.587
X5	-0.359	0.100

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization component Scores.

Table 6 shows the factor score. According to the factor score coefficients and standardized values of original variables, each factor scores of observation can be calculated, so the further analysis of observation should be carry on. Rotated factor (PC) can be expressed by:

Table 7: Coefficients

	Unstandardized Coefficients		Standardized Coefficients
	B	Std.Error	Beta
(Constant)	-1.578E-7	0.177	
Zscore: REGR factor Score 1 for analysis 1	0.334	0.180	0.334
Zscore: REGR factor Score 2 for analysis 1	0.108	0.180	0.108

$$F1=-0.131*ZX1+0.333*ZX2+0.336*ZX3+0.134*ZX4+0.359*ZX5 \quad (1)$$

$$F2=0.546*ZX1-0.039*ZX2-0.017*ZX3+0.587*ZX4+0.100*ZX5 \quad (2)$$

At the same time, we've got two principal factors independently: F1 (Power factor), F2 (Facilities factor), excluded the random disturbance. We consider every factor score as the independent variables, the total efficiency value of regional tourism industry Y as the dependent variables to conduct regression analysis, and find out the relationship between dependent variables and each factor. The result is shown in Table 7.

The results show: A. The regression equation has passed the F test; it means the significant linear relationship between independent variables and dependent variables, so the linear equation can be established. B. The equation has two independent variables, so the adjusted coefficient of determination (0.797) should be in view. C. From the goodness of fit data, we found that the equation has relatively high goodness of fit, so the model has a good performance in variable explaining. D. The DW test values are 1.787 and 2.084, both close to 2.000, which saying that residual series has little autocorrelation, the regression equation can interpret the change law of variables well. E. Variance inflation factors VIP all are 1.000, show the multicollinearity was eliminated, then the regression equation we've got was reasonable, as followed:

Y=-1.578E-7+0.334*F1+0.108*F2 (3)

We drag the PC equation in the regression equation, obtained the initial relationship between each variables and dependent variables, for the small differences among coefficients, we reserved three decimal. It can be expressed by:

Y=0.015ZX1+0.107ZX2+0.043ZX3+0.108ZX4+0.131ZX5-1.578E-7 (4)

Observed from the value of R^2, the fit goodness of regression equation is good. From the sign of regression coefficient, we found that the highway mileage, GDP per capita, capital scale of tourism enterprises, number of firms, and number of media reports all have positive impact to the efficiency of tourism industry, and the coefficients of impact intensity are 0.015, 0.107, 0.043, 0.108, 0.131 separately.

5. Conclusion

The paper suggests that China's regional tourism industry's overall development momentum is good, but the regions have significant differences in the efficiencies of the development among which some regions have developed inefficiently. There are barely few regions where both the efficiencies of the technologies and scales can be effective, which account for 31% of the samples. To realize the integration and sustainable development of the regional tourism, more efficient development and development paths still should be further studied and found according to the current specific situations of the provinces and regions.

Firstly, the seven provinces in the eastern region should take efforts in developing the potential and promote cultivating and optimizing the industry.

According to the current analysis of the efficiencies, the tourism industries of the seven provinces have the problems of the unreasonable input-output structure and less scale returns. As the provinces with rich tourism resources, superior of location and economic strength and well developed third industry, both have the fundamental conditions and environmental strength in vigorously developing the tourism industry. From now on, complementary advantages and dislocation development of the regions and cities should be focused to promote and the resources should be allocated optimized and reasonably used. And more efforts should be taken to guide potential demands and expand potential markets. Multiple inputs should be appropriately increased to improve the products and the input-output structure.

Secondly, in the middle region, the provinces of Shanxi, Inner Mongolia, Anhui and Hubei should take complementary strengths of each other to achieve win-win results. With the implement and deepening of the integrated cooperation of the regional tourism, the provinces in the middle region should interact to cluster regional industries and take complementary advances in both policies and practice. To solve the problems of the existing structure convergence of the industries, products and markets and the difficulty of deepening cooperation, generic "Tourism Industry Chain" should be constructed taking advantages of the radiation of the eastern developed provinces and regions, meantime, product system of differentiation should be set up with reconstruction and share of industrial elements driven by the market and capital to cooperatively achieve high yield of scale economy.

Thirdly, compared with the eastern and middle regions, the tourism industry of the western region has lower efficiency due to its disadvantages in geographic location and economic strength. Therefore, taking the opportunity that China has carried out the strategy of vigorously developing the west, resources should be promoted to share and more technologies and investments should be introduced. With the strength of the strong brand and market attraction of the developed regions, the potential of the industry should be developed to improve the scale efficiency.

The method of the paper—implementing evaluation to industries can guide the decision-makers to adjust the structure and activities with the frontier surfaces of the effective reflection of the input-output from the perspective of input-output efficiency to achieve strength performance and sustainable increasing capacity of the industry. The method also has limitation that it focuses on quantitative measurement and evaluation of the dominant data regardless invisible qualitative elements affecting the efficiency inside the

industry. So in the following study, more efforts will be made to combine industrial management, operation, environmental elements, and relative study methods to carry out more comprehensive and deeper investigation expecting to achieve more detailed conclusions and more practical suggestions to guide the development of the industry better.

References

Argenti, J. (1976). *Corporate collapse: the cause and symptoms*. Wiley, New York.

Charnes, A., Cooper, W. W. & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444.

Farrell, M. J. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*, 120(3), 253- 281.

Guo, L., Zhang, Y., & Li, Z. J. (2008). Evaluating the efficiency of listed tourism companies by data reduction factor and DEA model. *Journal of Management*, 2(5), 258-262.

Lin, Y. Y. & Ji, B. (2008). An evaluation and comparison of technical efficiency of urban tourism enterprises based on DEA. *Business Economic*, 4.

Yue, H. Z. & Zhu, C. L. (2010). Technical efficiency and the regional differences of tourism industry in China: 2001~ 2007. *Journal of Yunnan University of Finance*, 2, 36-43.

Tian, L. (2002). *The tourism economics*. China Higher Education Press, Beijing. 208.

Tian, X. Z. &Wang, B. (2003). The efficiency of the tourism market and game theory: To take the product of travel service for an example. *Tourism Tribune*, 6.

Wei, Q. L. (2000). Data Envelopment Analysis (DEA). *Science Bulletin*, 45(17), 32- 37.

Yu, Q. Y. & Feng, X. G. (2009). Evaluation of the efficiency of Yangtze river delta's tourism industry and strategy based on DEA. *Economic Forum*, 22.

Zhang, G. S. (2005). Evaluation of operational efficiency of tourism in Jiangxi province: Revelation comes from the comparison. *Statistics and Decision*, 3.

Zhang, G. S., Xiong, B. J., & Cheng, L. M. (2006). Efficiency of regional tourism based on DEA. *Business Research*, 1.