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Efficiency Evaluation of Tourism Industry With Data Envelopment Analysis (DEA): A Case Study in China

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YAN LUO
LIANG LIANG

Focusing on the efficiency evaluation of the Chinese tourism industry, this article aims to diagnose inefficiency and provide insight for improvement. A two-stage network data envelopment analysis model is formulated to compare the efficiencies of 31 provinces, municipalities, and autonomous regions in China. Assuming a two-stage process for the Chinese tourism industry, we evaluate the overall performance as well as the performance for each stage. The results indicate an obvious performance (or efficiency) imbalance in the tourism industry among different regions and a lot of room for improvement in some regions. Managerial implications of our findings may be of some benefit to local governments and related enterprises.

KEYWORDS. Tourism industry, data envelopment analysis (DEA), two-stage network DEA, efficiency evaluation

Introduction

During the past few decades, tourism has become one of the world’s major industries and has been playing an increasingly bigger role in economic growth. According to the World Tourism Organization, international travel and tourism provide 300 million direct and indirect jobs and create 13% of the world’s gross domestic product (GDP; Cortés-Jiménez, Pulina, Prunera, & Artis, 2009). Those figures will increase remarkably if domestic tourism is also taken into account.

Since the end of the 1970s, the tourism industry in China has been flourishing progressively and has an important place in the national economy and cultural life. In 2004, China attracted 109 million tourists from overseas and ranked fourth in the
Total outbound tourists reached 28.85 million (China International Travel Mart, 2005). Because of increasing investments, inbound, outbound, and domestic tourism is growing rapidly in China. However, the development of tourism demonstrates an obvious asymmetry largely due to the unbalanced distribution of tourism resources among different regions in China. In terms of economy, the areas along the eastern coast, such as Beijing and Shanghai, are much more developed than inland areas. Another problem faced by the local government is the low efficiency of investments, which leads to a severe waste of resources. Because the Chinese tourism market is expanding at a quick pace, a suitable environment is expected to be created to further accelerate its development. Therefore, it is worthwhile to study the problem of low investment efficiency and redundant construction in the China tourism industry. In this article we aim to address the above issues by developing a framework for regional tourism performance evaluation.

Performance evaluation is always a major concern of top management in the tourism industry. As an important industry in the national economy, tourism plays a leading role in the service sector. It requires cooperation between various organizations in the industry to provide final products and services to visitors. The performance of tourism industry is influenced by various factors, such as regional tourism resources, market development capabilities, industrial development potential, and government support (McKercher, 1993; Sharpley & Telfer, 2002). Hence, measuring tourism efficiency is important for investors, local government, and transprovincial business partners. A performance evaluation for each region can help managers to find the unfavorable factors that hinder further development of tourism and can provide insights into resource allocation and market competition. Most local governments have realized the importance of tourism in regional economy, and many cities have listed tourism industry as one of their pillar industries to drive the development of the whole economy (G. R. Zhang, 2003). In this article, we evaluate the efficiency of 31 provinces, municipalities, and autonomous regions in China in the field of tourism based on data from 2007 by using two-stage data envelopment analysis (DEA) network. Conclusions are drawn from the efficiency results.

**Literature Review**

Tourism development has been the focus of study recently. Some tourism topics, such as the development of the tourism industry, visitor patterns, and environmental, economic, and social impact of tourism have been studied (Huybers & Bennett, 2003; Lim & Pan, 2005; Su & Xiao, 2009; H. Q. Zhang, Yan, & Ye, 2008).

In China, there is a significant inequality in income distribution between eastern coastal regions and western or inland provinces. The uneven growth in tourism activity exacerbates such regional inequalities (Tisdell & Chai, 1997; Y. Zhang, 2001). On the other hand, regional tourism can make positive contributions to economic development, including increases in personal income, higher tax revenues, and additional employment opportunities. As Xu’s (1999) survey explained, many regions and cities in China have embarked on a tourism-oriented development course in pursuing regional development. Studies on China tourism have obtained substantial results that are significantly important and helpful in promotion of the tourism industry (Jackson, 2006; Lim & Pan, 2005; Pine & Phillips, 2005; Qu, Ennew, & Sinclair, 2005; Wu, Xu, & Ekiz, 2009).

Given the importance of tourism activity, it is interesting to investigate how efficient various units are. These units can be companies in different sectors, such as hotels,
tourism agencies, and airports. Efficiency evaluation in the tourism industry has received considerable attention in the literature (Assaf, 2010; Chen, 2007; Köksal & Aksu, 2007; Tyrrell & Johnston, 2001; Zhou, Huang, & Hsu, 2008). Yilmaz and Bititci (2006) studied the tourism industry as a value chain and developed a value chain model for performance management and measurement. Their model allows measuring the overall efficiency and effectiveness of tourism products and services from a value chain management perspective. Dwyer, Forsyth, and Spurr (2004) compared conventional techniques with an alternative one, computable general equilibrium (CGE), which is used to make estimates of the economic impact of changes in tourism expenditure and to present arguments in support of CGE modeling as the preferred technique. Beníteza, Martínb, and Román (2007) proposed a fuzzy multi-attribute decision-making approach to dynamically evaluate the service quality of three hotels of an important corporation in Gran Canaria Island. However, most of the above-mentioned research explored the performance of hotels or travel agencies, rather than the performance of regional tourism industries.

Among the techniques of assessing tourism performance, DEA may be the most popular because it is able to handle multiple inputs and outputs and does not require an assumption about functional form. As a main method to estimate the efficiency in terms of the frontier concept based on production theory, it has been adopted by most hotel efficiency studies (Botti, Briec, & Cliquet, 2009; Hwang & Chang, 2003; Sigala, 2004; Sun & Lu, 2005; C. Yang & Lu, 2006). Barros (2005) provided an extensive literature review on hotel sector efficiency up to 2004. Wang, Hung, and Shang (2006) complemented the DEA approach by means of a Tobit regression to analyze the cost efficiency of 49 tourist hotels in Taiwan. Tsai (2009) used the extended cross-efficiency approach based on a BCC DEA model (Banker, Charnes, & Cooper, 1984) to examine star-rated hotel productivity in China on a provincial basis.

Although previous studies attempted to measure performance, few studies have explored the internal process of tourism (but see Hsieh and Lin [2010] and Keh, Chu, and Xu [2006]) or discussed the performance of each subprocess along with its effect on overall performance. In fact, any inefficiency of subprocesses may lead to less efficient operations and hence to less desirable industry performance. Traditional DEA methods treat each process as a “black box,” with no consideration of the internal mechanism (Färe & Grosskopf, 1996). In that sense, they lack the ability to provide information concerning the source of inefficiency inside a unit. Nevertheless, the main purpose of the pioneers (Hsieh & Lin; Keh et al.) is to analyze the efficiency and effectiveness of tourist hotels from the micro aspects rather than the regional level.

Due to the drawbacks mentioned above, this article attempts to construct a DEA network model for regional tourism industry performance evaluation. Each regional tourism industry, viewed as an individual decision making unit (DMU), consists of two subprocesses (or two stages). The proposed model evaluates the efficiency of each stage, as well as the whole process, resulting in a comprehensive performance measurement. Results from the evaluation of regional tourism and subprocesses could provide detailed managerial insights that allow local government and decision makers in the tourism enterprise to make improvements.

Methodology

Performance evaluation is a critical aspect in management. It provides information necessary for decision making and helps managers in operational activities. Usually, there are two research approaches for tourism appraisal, namely, qualitative methods
and quantitative methods. Multiplier analysis (Frechtling & Horvath, 1998) and input–output analysis (Tyrrell & Johnston, 2001) are two common techniques used to evaluate performance. Developed by Charnes, Cooper, and Rhodes (1978), DEA is an excellent quantitative tool for assessing the relative efficiency of DMUs and has been widely applied in tourism. With carefully selected indicators, it is able to diagnose inefficiencies and provide information for improvements.

Traditional DEA models treat each DMU as a nonseparable entity in the sense that they usually do not probe into the internal mechanisms of how each DMU converts its inputs into outputs. Network DEA is an extended DEA model that focuses on the transformation process in the black box in order to exploit the information on the inner structure. It was firstly proposed by Färe and Grosskopf (1996), who aimed to correct the deficiencies of traditional DEA models. Earlier contributions in this field also include Sexton and Lewis (2003). They proposed a two-stage model that is a special form of network model and extended it to a multistage model in 2004 (Lewis & Sexton, 2004). In their models, DMU uses external inputs in the first stage and the outputs of this stage are consumed by the sequential stage. These outputs that become inputs to the latter stage are often referred to as intermediate products in the literature. Kao (2009) proposed a relational network DEA model to discuss the relationship between the two stages within a DMU. Y. S. Yang, Ma, and Koike (2000) provided another network model, called YMK, to measure the efficiency of the production system with k independent parallel subsystems. Most applications refer to the combination of series and parallel structure.

Under the framework of a DEA network, the two-stage model, also known as a series structure, is the basic type. Suppose there are n DMUs, each of which has two stages. Take DMU j as an example. In the first stage, DMU j uses m inputs Xj to produce t intermediate outputs Ij, where $X_j = (x_{1j}, x_{2j}, \ldots, x_{mj})$, $I_j = (i_{1j}, i_{2j}, \ldots, i_{tj})$. In the second stage, DMU j uses outputs from stage 1; that is, $I_j$, to produce the final outputs $Y_j$.

In this study, we build up a DEA network model to evaluate the performance of regional tourism development in China based upon the available data of 2007. Here, the regions are referred to as provincial-level administrative areas; that is, 31 provinces, municipalities, and autonomous regions in Mainland China. Each region is defined as a DMU. The data originated from the Yearbook of China Tourism Statistics 2007 and the Yearbook of China Tourism Statistics 2008 and its supplement.

Assessment of Chinese Tourism Industry

The suggested two-stage DEA is an appropriate approach to evaluate the efficiency of Chinese tourism. Unlike the traditional method, such a model divides the whole industry into two parts, production and service delivery, and makes it easy to explore the activities inside a network production structure. The performance of a regional tourism industry not only comprises the efforts from the two stages but relies on regional tourism as a whole. In the first stage, each province inputs manpower, materials, and financial resources into the tourism industry and acquires the ability to attract and serve tourists. The second stage is a transformation process in which tourist facilities and services are used to generate economic benefits and social benefits. Figure 1 shows this process.

An index system has been established to measure the performance of the tourism industry based on the tourism economic assessment model (TEAM; Rush, 2002, as cited in Sairosse & Mutula, 2003) and other researchers’ studies (Anderson, Fok, &
To ease notational burdens and facilitate the discussion that follows, we will employ the same notations used in the methodology section. Inputs for the tourism industry include employees, material resources, and capital. Tangible outputs and intangible services are then produced through operations. As Figure 1 shows, the model aims to measure the ability of every province to transform resources into capacity building in the first stage. Fixed assets and persons engaged in the tourism industry are used to produce three output variables: number of star-rated hotels, travel agencies, and other tourism corporations. These three outputs indicate the region’s service capacity. In the second phase, each region makes full use of nature tour resources and service capacity to generate benefits. When employment pressure is significant, people are generally optimistic about the tourism industry due to its characteristics of a large workforce, low threshold, and flexible working patterns of employment. From this point of view, we choose the rate of job growth as an output in order to evaluate the social effect created by the tourism industry. To summarize, input–output variables used for efficiency evaluation are as follows:

Stage 1: fixed assets ($X_1$) and persons engaged in the tourism industry ($X_2$) are inputs and the three intermediate outputs are number of star-rated hotels ($I_1$), number of travel agencies ($I_2$), and number of other tourism corporations ($I_3$).

Stage 2: number of excellent tourism cities ($X_3$), as well as three intermediate products $I_1$, $I_2$, and $I_3$, are chosen as inputs; the total number of visitors ($Y_1$), foreign exchange earnings ($Y_2$), tourism income ($Y_3$), tax delivery ($Y_4$), profits ($Y_5$), and rate of job growth ($Y_6$) are six final outputs.

Note that the input data in the first stage cover the star-rated hotels, travel agencies, and other tourism corporations. As an external input in the second phase, the number of excellent tourism cities reflects the region’s ability to attract tourists. To be exact, $X_1$ and $X_2$ are two standards of establishing an excellent tourism city but take only a very small proportion. The construction of an excellent tourism city depends on various factors, such as the policy support, management system, and security system, which are beyond the scope of this article. For this reason, $X_3$ is treated as an external input rather than an output from the first stage. $Y_2$ refers to foreign exchange earnings from international tourism and $Y_4$ refers to total tax derived from the tourism industry. $Y_6$ refers to the rate of increase in tourism employment. Table 1 exhibits the descriptive statistics of the data set.
According to the resource saving requirements and the rule that intermediate products will affect the efficiency of the second stage, we propose the following models to evaluate a DMU’s performance within two stages, under the assumption that the intermediate products remain unchanged.

- **Stage one**
  \[
  \min \theta_{1o} \quad \text{s.t.} \sum_{j=1}^{n} \lambda_j X_{ij} \leq \theta_{1o} X_{i0} \quad i = 1, 2 \\
  \sum_{j=1}^{n} \lambda_j I_{jt} = I_{t0} \quad t = 1, 2, 3 \\
  \lambda_j \geq 0 \quad j = 1, \ldots, 31
  \]  

- **Stage two**
  \[
  \max \theta_{2o} \quad \text{s.t.} \sum_{j=1}^{n} \lambda_j I_{jt} = I_{t0} \quad t = 1, 2, 3 \\
  \sum_{j=1}^{n} \lambda_j X_{3j} = X_{3o} \\
  \sum_{j=1}^{n} \lambda_j Y_{rj} \geq \theta_{2o} Y_{ro} \quad r = 1, \ldots, 6 \\
  \lambda_j \geq 0 \quad j = 1, \ldots, 31
  \]  

Model (1) is input oriented and model (2) is output oriented, and both are under the constant returns to scale hypothesis. The optimal solution \(\theta_{1o}^*\) and \(\theta_{2o}^*\) of the two models represents the efficiency of the two stages respectively for DMU\(_o\). The second
constraint in model (1) and the first constraint in model (2) are equations in order to agree with our assumption. Unlike inputs $X_1$ and $X_2$, $X_3$ is a nondiscretionary variable because the building of an excellent tourism city is a long-term task and its value is stable in the short run. As mentioned above, this input reflects the region’s attraction to visitors and may impact tourism income. Based on the above settings, we can calculate the overall efficiency for DMU$_o$ by model (3).

$$\min \theta_o$$

subject to:

$$\sum_{j=1}^{n} \lambda_j X_{ij}^* \leq \theta_o X_{io} \quad i = 1, 2$$

$$\sum_{j=1}^{n} \lambda_j X_{3j}^* = X_{3o}$$

$$\sum_{j=1}^{n} \lambda_j Y_{rj}^* \geq Y_{ro} \quad r = 1, \ldots, 6$$

$$\lambda_j \geq 0 \quad j = 1, \ldots, 31$$

where $X_{ij}^* = \theta_1 X_{ij}$ and $Y_{rj}^* = \theta_2 Y_{rj}$ are the projections for original inputs and final outputs.

By solving the three models above, the relative efficiency for the two stages of each province, as well as their overall performance, can be obtained. The calculated results are shown in Table 2.

The first stage is the production preparation phase to ensure a later profitability level. Thus, we call it a capacity building stage and define the latter as the benefit creating stage. From the results obtained, 19 out of 31 provinces are efficient in the first stage and 22 provinces are efficient in the second phase. All 31 DMUs have high efficiency scores (above 0.6) in the capacity building stage, which indicates that most of the regions are good at making use of various resources to create their handling capacity. The four municipalities, Beijing, Tianjin, Shanghai, and Chongqing, are all efficient in both stages but only two of them—Beijing and Shanghai—perform well in the whole process. In terms of resource utilization, Hubei, Zhejiang, Anhui, and Guangxi have low efficiency scores, which demonstrates that these provinces invest too much in the tourism industry. In other words, they can decrease the original inputs while keeping the intermediate outputs constant. This result reflects the phenomenon of low efficient investment and redundant construction in tourism.

In the second stage, the profitable phase, most of the regions, except Hebei, Shaanxi, Jilin, Heilongjiang, Jiangsu, Anhui, Hubei, Hunan, and Gansu, perform well. Table 3 lists the DEA results for these inefficient regions.

Comparing Table 3 with Table 1, we can easily find that most of these figures are below average. Four provinces, Shaanxi, Jilin, Heilongjiang, and Hunan, even create negative profits and employment growth. Jiangsu’s performance is somewhat better and only improves the efficiency by increasing its outputs by 7.17%. Hubei, the poorest region in the second stage, performs poorly in creating benefits. Despite high job growth, Hubei has room for improvement in terms of outputs. Theoretically, Hubei may attract more than 15 million visitors, who are estimated to bring in about 70 million dollars foreign exchange earnings and tax of more than 50 million RMB at its best.
Overall, Beijing, Inner Mongolia, Shanghai, Henan, Qinghai, and Ningxia are efficient and Hebei is the poorest performer, with an efficiency score of 0.3890. According to model (3), only 1,814 million fixed assets and 43,000 employees are sufficient for Hebei province (original inputs are 4,664 million and 110,000 respectively).

An interesting phenomenon indicated in Table 2 is that up to 17 DMUs are efficient in both of the two stages but only six of them are overall efficient. This is different from previous studies (Kao, 2009; Y. S. Yang et al., 2000) that determined that in two-stage DEA network, if a DMU is efficient in both stages, then it is efficient when compared with other DMUs as a whole. However, Tianjin, Liaoning, Jiangxi, Shandong, Hainan, Chongqing, Sichuan, Guizhou, Yunnan, Xizang, and Shanxi do not conform to this rule. They all have low scores, especially Yunnan province. As a
<table>
<thead>
<tr>
<th>DMU</th>
<th>Y1</th>
<th>Y2</th>
<th>Y3</th>
<th>Y4</th>
<th>Y5</th>
<th>Y6</th>
<th>Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hebei</td>
<td>10,111.26</td>
<td>30,911</td>
<td>1,132,234</td>
<td>38,574.52</td>
<td>11,736.06</td>
<td>95.4748</td>
<td>22.29</td>
</tr>
<tr>
<td>Shaanxi</td>
<td>8,603.09</td>
<td>22,171</td>
<td>694,243.4</td>
<td>26,768.81</td>
<td>−18,590.6</td>
<td>−38,433</td>
<td>25.66</td>
</tr>
<tr>
<td>Jilin</td>
<td>3,757.95</td>
<td>17,931</td>
<td>316,459.7</td>
<td>12,538.95</td>
<td>−10,780.2</td>
<td>−30,557</td>
<td>68.69</td>
</tr>
<tr>
<td>Heilongjiang</td>
<td>6,657.22</td>
<td>64,270</td>
<td>407,517.3</td>
<td>10,546.38</td>
<td>−5,963.52</td>
<td>−69,335</td>
<td>23.37</td>
</tr>
<tr>
<td>Jiangsu</td>
<td>23,711.15</td>
<td>346,900</td>
<td>3,143,059</td>
<td>91,485.51</td>
<td>14,944.42</td>
<td>209,3165</td>
<td>7.17</td>
</tr>
<tr>
<td>Anhui</td>
<td>7,955.43</td>
<td>34,400</td>
<td>1,641,582</td>
<td>36,028.01</td>
<td>59,872.4</td>
<td>26,418</td>
<td>47.12</td>
</tr>
<tr>
<td>Hubei</td>
<td>10,266.35</td>
<td>41,264</td>
<td>854,072.4</td>
<td>29,765</td>
<td>6,806.78</td>
<td>124,4738</td>
<td>69.32</td>
</tr>
<tr>
<td>Hunan</td>
<td>10,887.47</td>
<td>64,218</td>
<td>765,499.8</td>
<td>16,560.5</td>
<td>−15,503</td>
<td>−50,3776</td>
<td>29.63</td>
</tr>
<tr>
<td>Gansu</td>
<td>2,423.05</td>
<td>7,021</td>
<td>247,546.4</td>
<td>13,624.28</td>
<td>39,042.81</td>
<td>5,340383</td>
<td>20.47</td>
</tr>
</tbody>
</table>

Table 3. Data for the Inefficient Regions in the Second Stage.
tourism city, Yunnan has 6 state-level key scenic spots, 3 nationally famous historical and cultural cities, 17 state-level key heritage preservation units, and a number of tourism projects with ethnic characteristics. The abundant resources make tourism one of the four pillar industries in Yunnan. In addition, the province performs well in both building capacity and creating benefit.

The explanation for why DMUs are inefficient as assessed using model (3) possibly results from the external nondiscretionary input in the second stage, namely, the number of excellent tourism cities. Kao (2009) weighted the intermediate outputs equally at the two stages, and the overall efficiency is the product of the efficiencies of the subprocesses in series. As a result, a DMU is efficient if and only if all its processes are efficient. However, there is no such property in our models. \( x_3 \), one of the inputs at the second stage, comes from outside of the system and has no relation to the first stage, which is different from the intermediate outputs. After adding such input in the model, the quantity of inputs consumed at the later stage is not equal to the quantity of outputs produced by the first stage. Therefore, the sound property cannot be deduced in this case. One can easily prove the conclusions above by solving the dual problems of models (1) to (3).

From the perspective of geographic region, six efficient DMUs are distributed in northern China, eastern China, central China and northwestern China, respectively. Though the southwest is the richest in terms of tourism resources in China, no province in southwest China performs well. In the northeast, all three provinces are inefficient compared with other regions. This result is in accordance with the reality of slow development of tourism in the northeast relative to other regions. Three northeastern provinces are heavily concentrated industrial regions. The highly unbalanced scale and structure of their industry has led to slow development of tourism. In addition, their outputs are affected by seasonal factors. The 16th National Congress suggested the strategy of vitalizing the traditional northeast industrial base to create new opportunities and challenges for the development of tourism in northeast regions. Taking the long winter and low-temperature conditions of the northeast into consideration, making full use of natural resources and climate features may be appropriate. As an important part of tourism, ice/snow sports and ice sculpture exhibition may create more business opportunities and become a driving force of tourism in northeast China.

**Concluding Remarks and Future Research**

Compared with developed countries, the regional tourism industry in China is developing at a low level, and huge efficiency differences exist among 31 major regions. Performance evaluation may be the key to enhancing the overall strength of tourism in China by identifying the weakness of the tourism industry in each region and providing information for improvement. With appropriately selected indicators using DEA models, this article provides insights into resource allocation and determination of key works that may be useful to local governments and tourism corporations. Moreover, it may aid strategic decision making, especially for large tourism agencies.

This article applies a DEA network to construct two-stage evaluation models for regional tourism in China. The models assess regional tourism performance in two phases, as well as the overall process, resulting in a comprehensive measurement. By dividing the entire process into two stages, we can easily explore each region's resource utilization efficiency and their profitability.
Tourism evaluation is a complex systematic process, involving various perspectives such as nature conservation, environmental pollution, and local economic development. This research indicates that future studies should include more comprehensive variables, such as visitor satisfaction, service quality, and intensity of the government support to achieve a more complete analysis.

Taking social influence into consideration, we want to make the best use of tourism to alleviate employment pressure in China. Thus, a high rate of job growth should be one of our major targets. However, according to DEA, the fewer employees, the better. How to resolve such a conflict is another direction for our future study.

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