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Spatial characteristics of development efficiency for urban tourism in eastern China:

A case study of six coastal urban agglomerations

LI Rui[1], GUO Qian[1], *WU Dianting[1], YIN Hongmei[2], ZHANG Hua[1], ZHU Taoxing[3,4]

1. School of Geography, Beijing Normal University, Beijing 100875, China;
2. School of Geography and Environment, Guizhou Normal University, Guiyang 550001, China;
3. School of Government, Peking University, Beijing 100871, China;
4. School of Economics and Management, Shijiazhuang Tiedao University, Shijiazhuang 050043, China

Abstract: The traditional data envelopment analysis (DEA), bootstrap-DEA and Malmquist models are employed to measure different tourism efficiencies and their spatial characteristics of 61 cities in six coastal urban agglomerations in eastern China. The following conclusions are drawn. (1) The comprehensive efficiency (CE) of urban tourism using the bootstrap-DEA model is lower than the CE level using the DEA-CRS model, which confirms the significant tendency of the DEA-CRS model to overestimate results. (2) The geometric CE averages of urban tourism in the Yangtze River Delta (YRD) and the Pearl River Delta (PRD) have changed from ineffective to effective since 2000, the averages in the Beijing-Tianjin-Hebei (BTH) and the Shandong Peninsula (SDP) have changed from ineffective to moderately effective since 2000, and those in the Central and Southern Liaoning (CSL) and the West Bank of Taiwan Strait (WBTS) have been ineffective since 2000. (3) The CE values of urban tourism in the PRD, the YRD, the BTH and the SDP have been slightly affected by the pure technical efficiency (PTE), whereas the CE values in the CSL and the WBTS have been slightly affected by the scale efficiency (SE) since 2000. (4) Spatially, the range of geometric averages of the total factor productivity (TFP) for the PRD, the YRD, the BTH, the SDP, the WBTS and the CSL has decreased sequentially, while the one for most cities in six urban agglomerations has exhibited a downward trend since 2000. (5) Collectively, the natural conditions, the economic policies and the tourism capital drive the SE change of urban tourism of the CSL and the WBTS. The tourism enterprises for increasing returns to scale and imitating innovative technology have an effect on the CE change of urban tourism in the BTH and the SDP. The tourism market competition drives the PTE change of urban tourism in the PRD and the YRD. Although the PTE and the SE of urban tourism in six coastal urban agglomerations suffer from uncertain events, the CE maintained overall sound momentum since 2000.

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Author: Li Rui (1984–), PhD, specialized in urban and regional tourism, ethnical village tourism.
E-mail: liruigznu2008@ 163.com
***Corresponding author:** Wu Dianting (1958–), Professor, E-mail: wudianting@bnu.edu.cn

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1 Introduction

The development concept of urban agglomeration, which was clearly proposed in the 11th Five-Year Plan of China (2006–2010), promotes rapid urbanisation and strategically provides development patterns for China's future economy (Fang *et al*., 2010; Li *et al*., 2012). The integrated development of urban tourism has been transformed into the development of urban agglomeration tourism, which has become a significant issue in domestic and international research on regional and urban tourism (Yu, 2012). This paper suggests that the development efficiency of urban tourism has become a critical point in the construction and improvement of different areas as there has been a transformation from scale and speed development to quality and efficiency development. It is the driving mechanism of the complete advancement of quality development of urban agglomeration tourism. Therefore, efficiency development of urban tourism in the regional context of urban agglomeration has immense practical significance.

Tourism efficiency is vital to domestic and international research on regional and urban tourism. A review of relevant studies indicates that development efficiency has become prevalent in the hotels, travel agencies, travel transportation industries and tourist destinations. Morey (1995) and Tsaur (2000) employed the traditional DEA model to measure the management performance of private hotel chains in 1993 and from 1996 to 1998 and concluded that the marketing of travel services had been effective in the United States. Barros (2006) used a stochastic frontier production function to analyse the operating performance of 25 largest travel agencies, which accounted for 68.6% of all travel agencies, and concluded that the majority of Portuguese travel agencies from 2000 to 2004 were effective. Sarkis (2004) evaluated the operating performance of 44 American airports from 1998 to 2004 and confirmed their collective effectiveness. Compared with these three tourism sectors, there is less available research on the development efficiency of tourist destinations. Lee (2002) evaluated the protective and existing value of five different national parks in Korea and demonstrated that location and resources have a positive impact on the existing value of national parks. Some Chinese scholars had also employed the traditional DEA model to study state-level scenic spots and common tourist destinations in China and concluded that these areas and cities in eastern China exhibited high levels of efficiency and that the scale efficiency had a prominent effect on the advancement of the comprehensive efficiency (Ma *et al*., 2009; Ma *et al*., 2010a; Cao *et al*., 2012a; 2012b).

However, by reviewing these studies, several problems are also identified. (1) Currently, the majority of the studies utilise the traditional DEA model to examine tourism efficiency. Although this model has been distinguished from empirical research due to its less-restrictive constraints and non-parametric behaviours, it has distinct drawbacks, which produce higher measured values (Simar, 2000). Therefore, this paper will rectify the deviation of measured values using the traditional DEA model, which is not involved in the efficiency research of domestic and international urban tourism. (2) Although the measurement of dynamic change and the development during a certain period had already been conducted in research on urban tourism efficiency (Ma *et al.*, 2010a; Liang *et al.*, 2012), the comprehensive measurement and dynamic change of development efficiencies and spatial patterns of urban tourism in the regional context of urban agglomerations remains insufficient. (3) The scale efficiency of urban tourism in eastern China is deemed critical to the comprehensive efficiency advancement of urban tourism. The efficiency measurement of urban tourism in the regional context of six urban agglomerations in eastern China has been neglected, and the decomposing efficiencies of urban tourism in different agglomerations remain uncertain. (4) The influencing factors and development stages of the comprehensive efficiency and the pure technical efficiency and the scale efficiency for different urban agglomerations have still not been clear. Therefore, this paper uses the traditional DEA, bootstrap-DEA and Malmquist models to measure different tourism development efficiencies for prefecture-level cities, vice-provincial cities and provincial capitals in six coastal urban agglomerations of eastern China, to analyse their spatial characteristics, to explain the decomposing efficiency of urban tourism in different agglomerations, to supply the theoretical support for the scientific development of urban tourism of different agglomerations in China.

2 Evaluation systems

2.1 Evaluation indices

Urban tourism efficiency refers to the quality of maximum input and output of unit factors and the total surplus of different stakeholders within a specified period (Ma, 2008). Accordingly, the measurement indices of input-output efficiency are constructed based on the concept of urban tourism efficiency, while the special requirements of index selection used the traditional DEA model[1] (Table 1).

Land, labour force and capital are the basic production factors in economics (Gregory, 1977). First, land area should not be considered as an input factor because the tourism production activities are not fully constrained by land areas (Cao *et al.*, 2012a). Second, this paper selects the number of employees in urban tourism to reflect labour inputs. This index approximately accounts for the number of direct and indirect urban tourism employees and fully reflects the urban tourism comprehensiveness (Ma *et al.*, 2010b). Third, capital inputs are critical tourism production factors. This paper selects the number of 3A, 4A and 5A

[1] The traditional DEA method states that the measurement indices have a certain particularity. Namely, the number of required input and output indicators is equal to or less than one-third of the number of production units (DMU).

[2] According to the detailed grading rules of the quality of tourism scenic spots from The Classification and Evaluation of Tourism Scenic Spots' Quality (GB/T17775-2003), the overall inputs of urban tourism resources are as follows: 3A (55 points), 4A (70 points) and 5A (90 points).

[3] According to the grade standards and star-level classification from The Assessment Standards of Star Hotels in the People's Republic of China, the total inputs of urban star hotels are included and adhere to the following criteria: 3-star (55 points), 4-star (70 points) and 5-star (90 points).

[4] According to the setting and management of international and domestic travel agencies from The Regulations of Travel Agencies (Order of the State Council of People's Republic of China [2009] No.550), the total inputs of urban travel agencies are included and adhere to the following criteria: domestic qualifications (70 points) and international qualifications (90 points).

Table 1 Measurement indices of input-output efficiency of urban tourism

Evaluation contents	Types	First grade indices	Second grade indices	Index sources
Development efficiency of urban tourism	Input indices	Labour inputs	Number of employees in urban tourism	Barros, Ma Xiaolong, Cao Fnagdong
		Capital inputs	Number of 3A, 4A and 5A scenic spots	Tsaur, Barros, Liang Mingshu, Cao Fangdong
			Number of 3-star, 4-star and 5-star hotels	
			Number of international travel agencies	
			Number of domestic travel agencies	
	Output indices	Efficiency outputs	Total number of tourists	Anderson, Ma Xiaolong, Cao Fnagdong
			Total quantity of tourism incomes	

scenic spots[2], the number of 3-star, 4-star and 5-star hotels[3], and the number of international and domestic travel agencies[4] to reflect the capital inputs of urban tourism resources, enterprises and infrastructures. Fourth, this paper selects the total number of international and domestic tourists and tourism incomes to reflect the urban tourism outputs, which comprise all tourist needs and services (Tsaur *et al*., 1999; Barros *et al*., 2006). The urban tourism outputs also include visitor satisfaction and institutional factors; however, the total number of international and domestic tourists and tourism incomes substitute for these two factors (Anderson *et al*., 1999; Anderson *et al*., 2000; Tsaur *et al*., 2000; Barros *et al*., 2005).

2.2 Measurement models

This paper employs a standardised method to address the original values of second grade indices of urban tourism. The formulae are expressed as

input factors:

$$x_{mk} = \frac{X_{mk} - \min X_{mk}}{\max X_{mk} - \min X_{mk}} \tag{1}$$

output factors:

$$y_{ml} = \frac{Y_{ml} - \min Y_{ml}}{\max Y_{ml} - \min Y_{ml}} \tag{2}$$

where x_{mk} (x_{mk}>0) and X_{mk} are the standardised values and original values, respectively, with units of k (factors) and m (cities). y_{ml} (y_{ml}>0) and Y_{ml} are the standardised values and original values, respectively, with the units of l (factors) and m (cities).

2.2.1 DEA-CRS and DEA-VRS models

The traditional DEA model evaluates the relative effective situation of inputs and outputs of one or more production units (cities) using mathematical planning methods. Namely, it determines whether the production units (cities) are located on the frontiers (Wei *et al*., 2000). This paper evaluates the efficiency of K inputs and L outputs of m urban tourism. x_{mk} (x_{mk}>0) and y_{ml} (y_{ml}>0) are the standardised values with the units of k or l (factors) and m (cities), respectively. θ ($0<\theta\leqslant 1$) is the comprehensive efficiency index of input and output factors of m (m = 1, 2, …, M) cities. ξ is the infinitesimal of non-Archimedean. λ_m ($\lambda_m \geqslant 0$) is the variable weight used to determine the profit scale of urban tourism. s^- ($s^- \geqslant 0$) is the slack variable that reflects the decreasing inputs of relatively effective demands of urban tourism. s^+($s^+ \geqslant 0$) is the surplus variable that reflects the increasing outputs of the relatively effective demands of urban tourism. Therefore, the traditional DEA model is expressed (Charnes *et al.*, 1978) as follows:

$$\begin{cases} \min(\theta - \varepsilon(\sum_{k=1}^{K} s^- + \sum_{l=1}^{L} s^+)) \\ s.t. \sum_{m=1}^{M} x_{mk}\lambda_m + s^- = \theta x_k^m \quad k = 1,2,\cdots,K \\ \sum_{m=1}^{M} y_{ml}\lambda_m - s^+ = y_l^m \quad l = 1,2,\cdots,L \\ \lambda_m \geqslant 0 \quad m = 1,2,\cdots,M \end{cases} \tag{3}$$

Formula (3) is a CRS (constant returns to scale) model based on a DEA model of constant returns to scale. When θ_m is equal to one, it indicates that m urban tourism locates on the optimal production frontier. When θ_m is less than 0.5, it signifies that m urban tourism is ineffective. When θ_m is between 0.5 and 0.7 or between 0.7 and 1, it indicates that m urban tourism is moderately effective and extremely effective. $\sum_{m=1}^{M} \lambda_m = 1$ is introduced in Formula (3). The CRS model can be converted into a VRS (variable returns to scale) model that is based on the DEA model of variable returns to scale. The comprehensive efficiency (CE) should be decomposed by the product of the pure technology efficiency (PTE) and the scale efficiency (SE) using the VRS model. Namely, $\theta_m = \theta_{PTE} \times \theta_{SE}$ (θ_{PTE} and θ_{SE} were greater than θ_m) where θ_{PTE} is the pure technology efficiency index of urban tourism and θ_{SE} is the scale efficiency index of urban tourism. According to previous research (Ma *et al.*, 2010), if θ_{PTE} (θ_{SE}) is equal to one, the efficiency will be optimal; if θ_{PTE} (θ_{SE}) is between 0.6 and 0.8 or if θ_{PTE} (θ_{SE}) is between 0.8 and 1, moderate efficiency will be achieved, thus indicating effectiveness; if θ_{PTE} (θ_{SE}) is less than 0.6, then efficiency will be ineffective.

2.2.2 Bootstrap-DEA model

This paper introduces the bootstrap rectification technology in consideration of non-parametric distance function. The basic principle of this model incorporates a data-generating process, which is simulated by sampling with repetition. The sample distribution of primitive estimate is obtained using the primitive estimate of samples (Kniep *et al.*, 2003). The specific algorithm is composed of the following five steps (Zeng *et al.*, 2009):

(1) The linear calculation of inputs and outputs of certain urban tourism $\hat{\theta}_h$ such that

$$\hat{\theta}_h = \min\left\{\theta \leqslant \sum_{i=1}^{n} \gamma_i y_l; \theta x_k \geqslant \gamma_i x_k; \quad \theta \geqslant 0; \sum_{i=1}^{n} \gamma_i = 1; \quad \gamma_i \geqslant 0\right\} \tag{4}$$

(2) The sets of random samples, which are generated from (4), such that

$$\theta_{kb}^* = \left\{\theta_{1b}^*, \theta_{2b}^*, \cdots, \theta_{kb}^*\right\} \tag{5}$$

(3) The solution to the following equation is

$$x_{kb}^{*}=(\hat{\theta}_h/\theta_{kb}^{*})x_k \tag{6}$$

(4) $\hat{\theta}_{kb}^{*}$ is obtained by solving equation (7) such that

$$\hat{\theta}_{kb}^{*}=\min\left\{\theta\middle|\, y_l\leqslant\sum_{i=1}^{n}\gamma_i y_l;\ \theta x_k\geqslant\gamma_i x_{kb}^{*};\theta\geqslant 0;\ \sum_{i=1}^{n}\gamma_i=1;\ \gamma_i\geqslant 0,\ i=1,2,\cdots,n\right\} \tag{7}$$

(5) The sets of estimated values were obtained by repeatedly calculating B such that

$$\left\{\hat{\theta}_{kb}^{*},\ b=1,2,\cdots B\right\} \tag{8}$$

For large sample sets, the B value is determined using a computerised configuration. The coverage of confidence intervals can be ensured if the *B* value is equal to 1000 (Hall, 1986).

2.2.3 Malmquist model

Suppose that x_{mk}^{t} and y_{ml}^{t} are the standardised values in the units of *k* or *l* (factors) and *m* (cities), respectively, when *t* is equal to *T*. The concept of the distance function $L^t(y^t\,|\,C,\,S)$ is introduced by Fare's reciprocal of technology efficiency (Fare, 1994), which is expressed as follows:

$$D_i^t(y_{ml}^t,x_{mk}^t)=1/F_i^t(y_{ml}^t,x_{mk}^t\,|\,C,S) \tag{9}$$

The distance function is a ratio in which a certain production set (y_{ml}^t,x_{mk}^t) is compressed to a perfect input value. Therefore, the total factor productivity (TFP) of urban tourism can be represented by the Malmquist index (Caves, 1982).

The measured values of the technical efficiency from *t* to *t*+1 are as follows:

$$M_i^t=D_i^t(x_{mk}^t,y_{ml}^t)/D_i^t(x_{mk}^{t+1},y_{ml}^{t+1}) \tag{10}$$

$$M_i^{t+1}=D_i^{t+1}(x_{mk}^t,y_{ml}^t)/D_i^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1}) \tag{11}$$

The Malmquist index of the TFP is measured by the geometric average of formulas (11) and (12) from *t* to *t*+1 as follows:

$$\theta'_{TFP}=M_0(x_{mk}^{t+1},y_{ml}^{t+1},x_{mk}^t,y_{ml}^t) \tag{12}$$

The Malmquist index of the TFP is expanded to formula (13) by the double variant based on constant returns to scale (Fare, 1997) as follows:

$$\theta'_{TFP}=\frac{D_c^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1})}{D_c^t(x_{mk}^t,y_{ml}^t)}\times\sqrt{\frac{D_c^t(x_{mk}^{t+1},y_{ml}^{t+1})}{D_c^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1})}\times\frac{D_c^t(x_{mk}^t,y_{ml}^t)}{D_v^{t+1}(x_{mk}^t,y_{ml}^t)}}=\frac{D_v^t(x_{mk}^{t+1},y_{ml}^{t+1})}{D_v^t(x_{mk}^t,y_{ml}^t)}$$

$$\times\left[\frac{D_v^t(x_{mk}^t,y_{ml}^t)}{D_c^t(x_{mk}^t,y_{ml}^t)}\times\frac{D_c^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1})}{D_v^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1})}\right]\times\sqrt{\frac{D_c^t(x_{mk}^{t+1},y_{ml}^{t+1})}{D_c^{t+1}(x_{mk}^{t+1},y_{ml}^{t+1})}\times\frac{D_c^t(x_{mk}^t,y_{ml}^t)}{D_v^{t+1}(x_{mk}^t,y_{ml}^t)}}$$

Namely,

$$\theta'_{TFP}=\theta'_{CE}\times\theta'_{TPE}=\theta'_{PTE}\times\theta'_{SE}\times\theta'_{TPE} \tag{13}$$

where θ'_{TFP} is the total factor productivity, θ'_{CE} is the comprehensive efficiency, θ'_{TPE} is the technical progress efficiency, θ'_{PTE} is the pure technical efficiency and θ'_{SE} is the scale efficiency from *t* to *t*+1. Generally, these efficiencies will increase if their indices exceed one. If the indices are equivalent to or less than one, these efficiencies will be unchanged or reduced.

2.3 Case study and data source

The 61 prefecture-level cities, vice-provincial cities and provincial capitals of coastal urban agglomerations in eastern China are included in the Yangtze River Delta (YRD), the Pearl River Delta (PRD), the Beijing-Tianjin-Hebei (BTH), the Shandong Peninsula (SDP), the Central and Southern Liaoning (CSL) and the West Bank of Taiwan Strait (WBTS). They are selected as cases according to the relative studies (Fang *et al*., 2010) (Figure 1). Currently, the development levels of six urban agglomerations are in the mature stage or peak stage (Fang *et al*., 2011). The excellent tourism cities account for 91.8% of all the 61 cities. Their scale efficiencies and technical advantages of input factors, such as tourism resources, infrastructures, and human capital have continually changed with regards to urban construction and development. These cities will become the most successful and promising nodes of China's future agglomerations. The original data are derived from *China City Statistical Yearbook 2002*, *2007*, *2012*; *The China Tourism Statistical Yearbook 2002*, *2007*, *2012*; and The Official Website of the China National Tourism Administration.

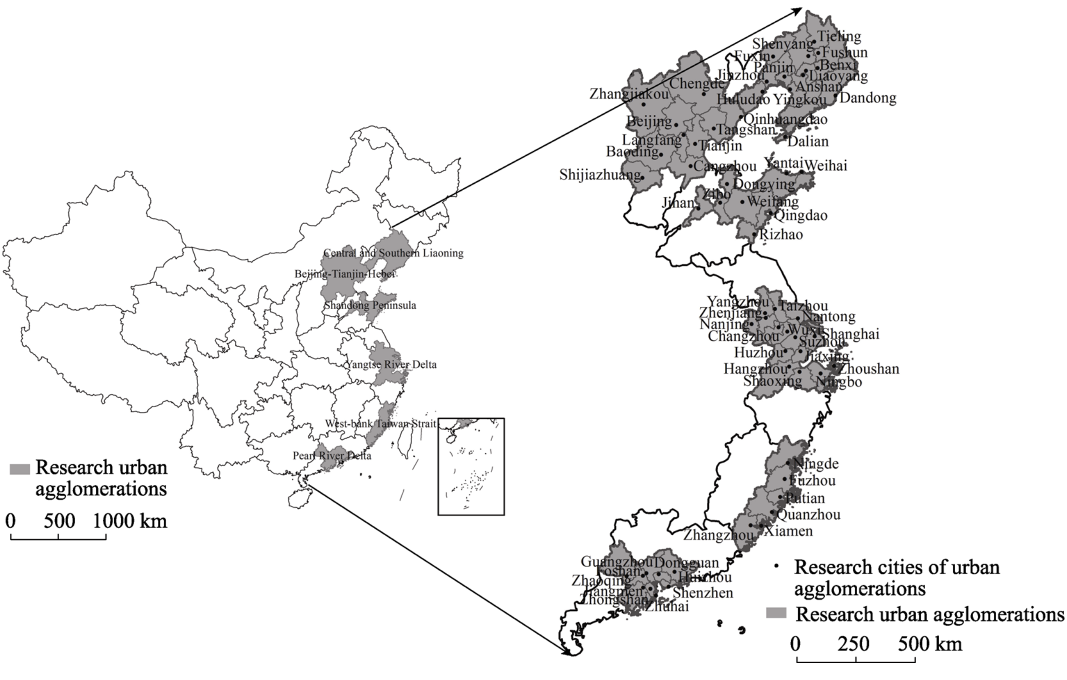


Figure 1 Spatial diagram of six coastal urban agglomerations in China, including their 61 cities

3 The measured values and spatial characteristics of the CE of urban tourism in six urban agglomerations

3.1 A comparison analysis of measured values of the CE before and after the rectification

This paper uses the bootstrap-DEA model to calculate the CE. The rectified efficiencies are compared with the measured results using the traditional DEA model, which shows that the CE obtained by the bootstrap-DEA model are lower than the CE obtained by the DEA-CRS model (Figure 2), thus confirming the significant tendency of the DEA-CRS model to over-

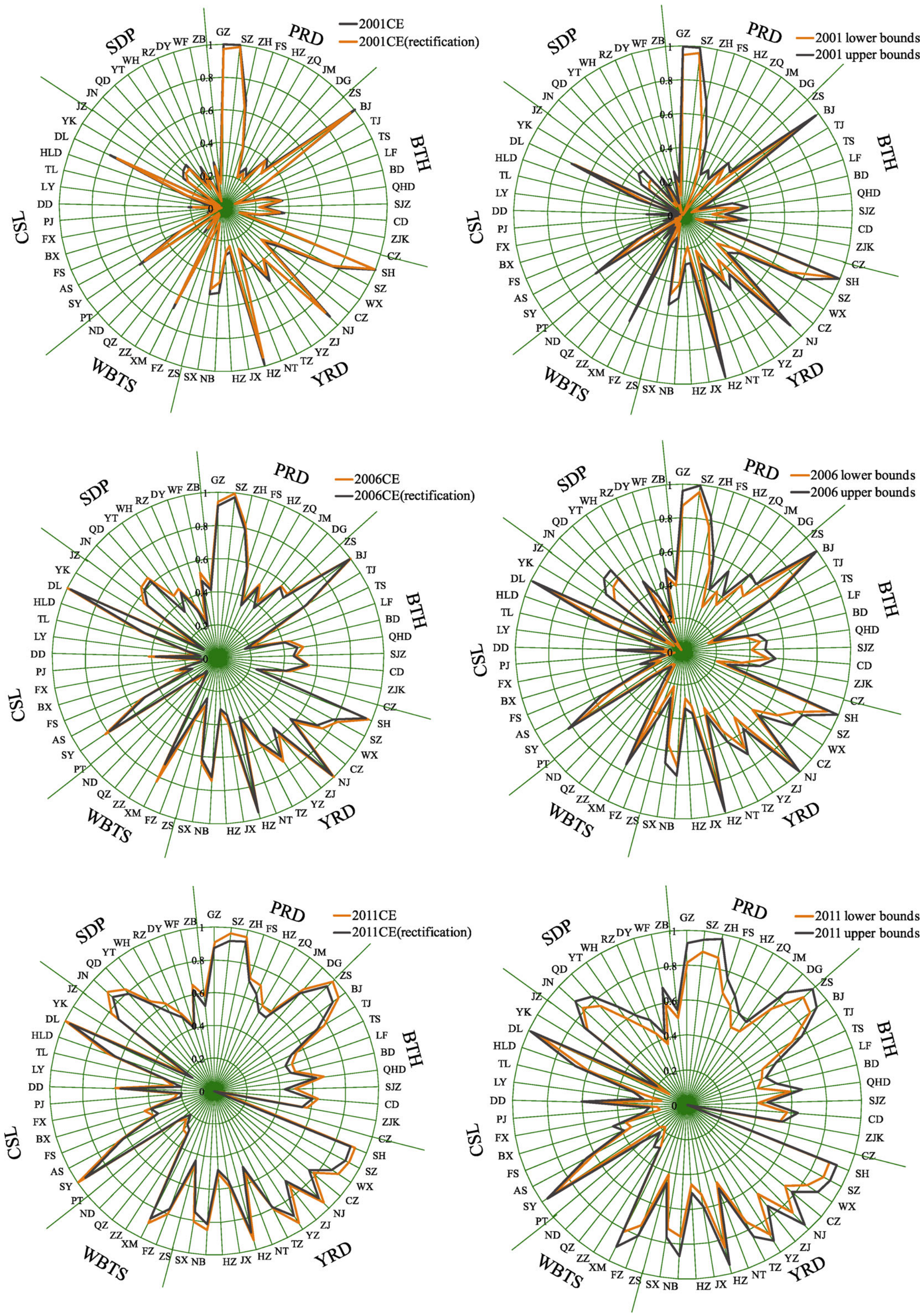


Figure 2 Radar charts of rectification values and the interval bound values of the CE of urban tourism in six urban agglomerations since 2000[1]

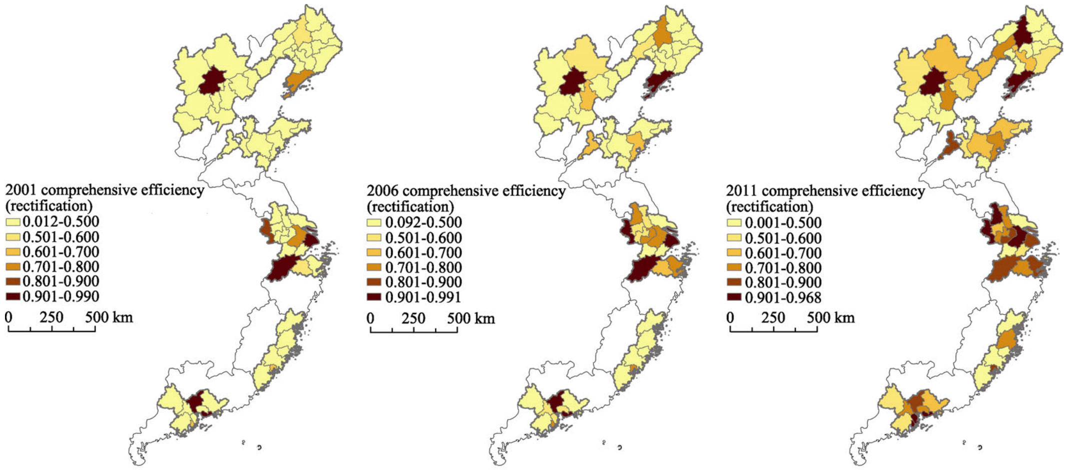
estimate. Although the confidence intervals have widened over time, the general tendency of the CE remains distinct, and the measured values from Figure 2 are unchanged. Therefore, this paper uses the CE obtained by the bootstrap-DEA model to analyse the different efficiencies described in the following section.

3.2 The spatial characteristics of the CE

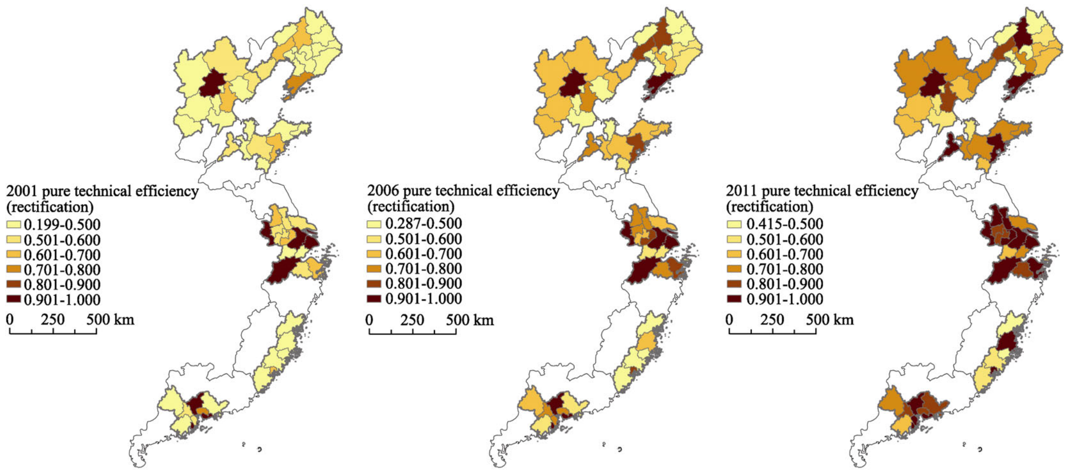
The CE highly reflects the comprehensive ability of resource utilisation of urban tourism in urban agglomerations. Table 2 indicates that the geometric means of the CE of urban tourism in the YRD and the PRD have changed from ineffective to extremely effective, while the means of the BTH and the SDP have changed from ineffective to moderately effective and those of the NDP and the WBST have been continually ineffective since 2000.The measured values of the CE of urban tourism in six urban agglomerations indicate that Guangzhou, Shenzhen, Shanghai, Nanjing, Hangzhou and Beijing have been extremely effective since 2000. In 2001, the CE of Suzhou, Shaoxing, Zhuhai, Shenyang and Xiamen were moderate to extremely effective. In 2006, the CE of these five cities was extremely effective. The CE of eight cities, including Dongguan, Changzhou, Tianjin, and Jinan, was moderately effective, while the CE of other cities was ineffective. In 2011, the CE of 17 cities, including Zhuhai, Nanjing, Tianjin, Shenyang, Jinan and Xiamen, was extremely effective. The CE of 16 cities, including Nantong, Langfang, Fushun, Rizhao and Zhangzhou, was ineffective. The CE of other cities was moderately effective. The following two characteristics can be formulated (Figure 3a). (1) The comprehensive utilised levels of urban tourism resources of municipalities, provincial capitals and important cities in six urban agglomerations have been continually effective since 2000. (2) The comprehensive utilised levels of urban tourism resources for most cities in the YRD, the PRD, the BTH and the SDP have changed from ineffective to moderately effective, while most cities in the CSL and the WBST have been continually ineffective since 2000. In all, the evolving spatial model of the CE of urban tourism in six urban agglomerations has transformed from single-core congestion into multi-core diffusion. The transformation of most cities in the YRD, the PRD, the BTH and the SDP has occurred more rapid than it has in the CSL and the WBTS.

Table 2 Geometric means of the CE and the PTE and the SE of urban tourism in six coastal urban agglomerations in eastern China

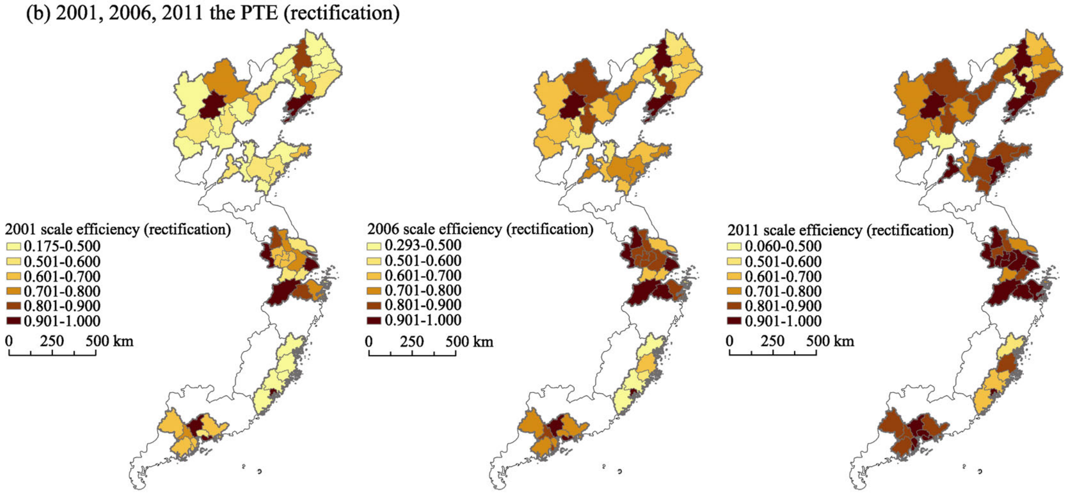
Name	2001CE	2006CE	2011CE	2001PTE	2006PTE	2011PTE	2001SE	2006SE	2011SE
YRD	0.485	0.627	0.743	0.659	0.777	0.878	0.740	0.821	0.879
BTH	0.295	0.463	0.530	0.514	0.646	0.725	0.561	0.722	0.745
PRD	0.478	0.619	0.766	0.657	0.767	0.864	0.737	0.820	0.923
SDP	0.202	0.428	0.606	0.461	0.645	0.750	0.478	0.721	0.848
WBTS	0.188	0.278	0.374	0.350	0.502	0.599	0.457	0.568	0.693
CSL	0.195	0.356	0.484	0.401	0.559	0.655	0.467	0.620	0.752



(a) 2001, 2006, 2011 the CE (rectification)



(b) 2001, 2006, 2011 the PTE (rectification)



(c) 2001, 2006, 2011 the SE (rectification)

Figure 3 Spatial patterns of the CE and the PTE and the SE of urban tourism in the coastal urban agglomerations

4 The measured values and spatial characteristics of the PTE and the SE of urban tourism in six urban agglomerations

4.1 The spatial characteristics of the PTE

The PTE reflects the allocation and utilisation levels of urban tourism resources in six urban agglomerations. Table 2 indicates that the geometric means of the PTE of urban tourism in the YRD and the PRD was moderately effective from 2001 to 2006. In 2011, the PTE was extremely effective. The geometric means of the PTE of urban tourism in the BTH and the SDP changed from ineffective to moderately from 2001 to 2006. In 2011, it was moderately effective. The geometric means of the PTE of urban tourism in the CSL and the WBTS were ineffective between 2001 and 2006; however, in 2011, subsequently had increased to moderately effective.

The PTE of urban tourism in six urban agglomerations indicates that the PTE of Shanghai, Nanjing, Hangzhou, Suzhou, Guangzhou, Shenzhen, Zhuhai and Beijing has been optimally effective since 2000. The PTE of nine cities, including Ningbo, Dongguan, Tianjin, Qingdao, Dalian, and Xiamen, was extremely effective in 2001, while the PTE of other cities had been ineffective. In 2011, the PTE of 16 cities, including Zhongshan, Yangzhou, Tianjin, Jinzhou, Jinan and Xiamen, was extremely effective. The PTE of 11 cities, including Langfang, Fushun, Dongying, and Quanzhou, was ineffective. The PTE of other cities was moderately effective. Accordingly, several characteristics can be extracted as follows (Figure 3b). (1) The allocation and utilisation levels of tourism resources in municipalities, provincial capitals and important cities in six urban agglomerations have been optimally effective since 2000. (2) The allocation and utilisation levels of urban tourism resources for most cities in the YRD and the PRD have changed from ineffective to extremely effective since 2000, while those in the BTH, the SDP and the CSL changed from ineffective to moderately effective and those in the WBTS have been continually ineffective. In all, the evolving spatial model of the PTE of urban tourism in six urban agglomerations transformed from single-core congestion into multi-core diffusion. The transformation of most cities in the YRD, the PRD, the BTH and the SDP occurred more rapidly than it did in the CSL and the WBTS.

4.2 The spatial characteristics of the SE

The SE reflects the cumulative scale level of urban tourism in six urban agglomerations. Table 2 shows that the geometric means of the SE of urban tourism in the YRD and the PRD changed from moderately effective to extremely effective between 2001 and 2006. In 2011, the means in the YRD and the PRD increased to 0.879 and 0.923, respectively, while the mean in the PRD was higher than that of the YRD. The geometric means in the BTH and the SDP changed from ineffective in 2001 to moderately effective in 2006. In 2011, the means in the BTH and the SDP had increased to 0.745 and 0.848, respectively. While the SE in the CSL and the WBTS was ineffective in 2001, those of the CSL increasing to 0.620, thus changing the CSL's SE status from ineffective to effective. The SE in the WBTS, however, remained ineffective. In 2011, the SE geometric means in the CSL and the WBTS were

0.655 and 0.599, respectively, thus improving their statuses to moderately effective.

The SE of urban tourism in six urban agglomerations shows that the SE of Guangzhou, Shenzhen, Shanghai, Nanjing, Hangzhou, Yangzhou, Shaoxing, Shenyang, Beijing, Dalian and Xiamen have been optimally effective since 2000. In 2001, the SE of 15 cities, including Foshan, Suzhou, Chengde, Anshan and Weihai, was moderately effective in 2001, while the SE of other cities was ineffective. In 2006, the SE of 11 cities, including Zhuhai, Changzhou, Tianjin and Anshan, was extremely effective, while the SE of 12 cities, including Zhoushan, Langfang, Benxi, Dongying and Putian, was ineffective. The SE of other cities was moderately effective. In 2011, the SE of Zhongshan and Dongguan increased to optimally effective, while the SE of 25 cities, including Zhuhai, Tianjin, Anshan, Jinan and Fuzhou, was extremely effective, and the SE of Cangzhou, Liaoyang and Ningde was ineffective. The SE of other cities was ineffective. Based on these results, the following two characteristics can be ascribed (Figure 3c). (1) The SE of the municipalities, provincial capitals and important cities in urban agglomerations has been optimally effective since 2000. (2) The cumulative scale levels of most cities in the YRD, the PRD and the SDP changed from moderately effective to extremely effective, while the cumulative scale levels of most cities in the BTH, the CSL and the WBST have improved from ineffective to moderately effective since 2000. In all, the spatial model of urban tourism in the YRD, the PRD, the SDP and the BTH demonstrates a trend toward balanced multi-core diffusion. Furthermore, the spatial model of the CSL and the WBST transformed from single-core congestion into multi-core diffusion, and the transformations occurred more rapidly in the YRD, the PRD, the BTH and the SDP than they did in the CSL and the WBST.

5 The influence of the PTE and the SE on the CE of urban tourism in six urban agglomerations

To ascertain and compare the extent of the influence of the PTE and the SE on the CE of urban tourism in different urban agglomerations, this paper uses correlational analysis method to construct the scatter plots based on the rectified results of the PTE, the SE and the CE of urban tourism. Figure 4 shows that the linear relation of the PTE and the CE is stronger than that of the SE and the CE, which affirms the variation in the CE caused by the PTE. The urban tourism of 42 cities in four urban agglomerations should accelerate the updated speed of the resources utilisation and environmental protection and actively strengthen the extent of the effective technical promotion based on the cumulative scale optimisation of tourism input factors in urban agglomerations.

Figure 4 also illustrates that the CE of urban tourism in the CSL and the WBTS was slightly stronger as it was influenced by the SE than by the PTE. Therefore, the 19 cities in two urban agglomerations should employ the tourism input factors to develop the tourism corporate potentials and to improve the brand effect of tourism marketing of urban agglomerations.

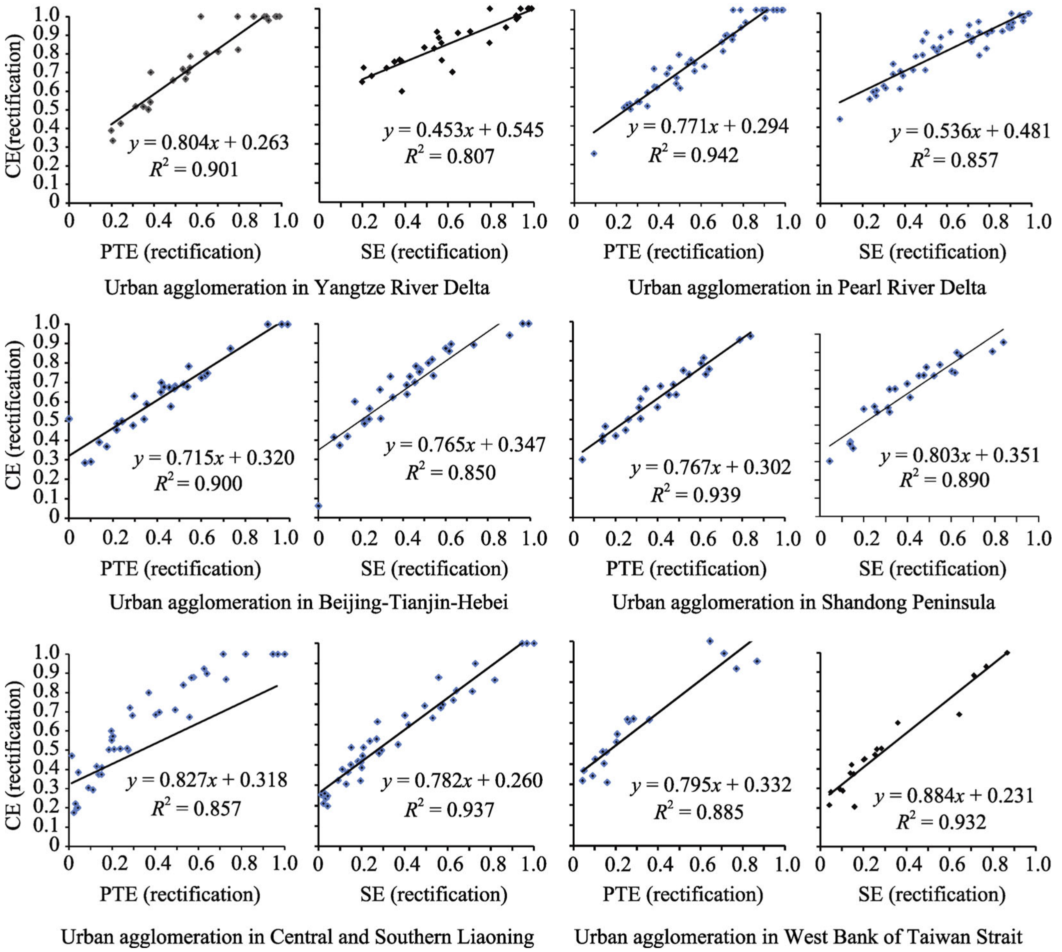


Figure 4 Scatter plots of the contribution of decomposing efficiencies to the CE of urban tourism in six coastal urban agglomerations in eastern China (2001–2011)

6 The spatial variations for different efficiencies of urban tourism in six urban agglomerations

6.1 The characteristics of the spatial variation in the PTE and the SE

The PTE variation index is used to measure the variation degree in production efficiency of pure technology. The SE variation index is used to assess whether urban tourism has an optimally effective production scale. The increasing returns to scale will expand the production scale and vice versa. Table 3 indicates that the geometric means of the PTE and the SE variation indices of urban tourism in six urban agglomerations exhibited an increasing trend, but the increasing ranges decreased from 2001 to 2006. Regarding the spatial patterns, the PTE of urban tourism in the YRD, the BTH, the PRD, the SDP, the WBST and the CSL decreased sequentially, and the SE of urban tourism in the YRD, the PRD, the SDP, the BTH, the WBST and the CSL increased sequentially. The geometric means of the PTE and the SE variation indices of urban tourism in six urban agglomerations subsequently decreased from

2006 to 2011. Regarding the spatial patterns, the PTE of urban tourism in the PRD, the YRD, the BTH, the SDP, the CSL and the WBST decreased sequentially, while the SE of urban tourism in the YRD, the BTH, the PRD, the SDP, the CSL and the WBST increased sequentially. Furthermore, the geometric ranges of the PTE variation indices of urban tourism in the YRD, the PRD and the BTH were slightly stronger than those in other urban agglomerations. The geometric ranges of the SE variation indices in the CSL and the WBST have been slightly stronger than those in other urban agglomerations since 2000. Accordingly, the PTE variation led to the CE variation of urban tourism in the YRD, the PRD and the BTH. The higher measured values and increasing ranges demonstrate that the allocation and utilisation levels of urban tourism resources in the YRD, the PRD and the BTH have been extremely effective. However, the production scales of urban tourism in the CSL and the WBST were near the optimal frontier, and the increasing returns to scale by inputting factors indicate that the sustainable scale expansion is the optimum approach to improve the CE of urban tourism in the CSL and the WBST.

Table 3 Geometric means of the variations of the PTE, the SE, the TE, the TP and the TFP of urban tourism in six coastal urban agglomerations in eastern China (2001–2011)

Name	2001–2006 PTE	2006–2011 PTE	2001–2006 SE	2006–2011 SE	2001–2006 TE	2006–2011 TE	2001–2006 TP	2006–2011 TP	2001–2006 TFP	2006–2011 TFP
YRD	1.184	1.105	1.078	1.004	1.226	1.277	1.174	1.134	1.441	1.333
BTH	1.158	1.096	1.108	1.059	1.309	1.164	1.104	1.109	1.440	1.313
PRD	1.150	1.138	1.083	1.096	1.274	1.244	1.114	1.157	1.456	1.380
SDP	1.135	1.092	1.105	1.099	1.333	1.238	1.082	1.061	1.327	1.281
WBTS	1.130	1.076	1.151	1.127	1.308	1.081	1.012	1.009	1.306	1.225
CSL	1.114	1.076	1.158	1.121	1.202	1.195	1.001	1.011	1.240	1.204

The spatial characteristics of the PTE and the SE variation of urban tourism in six urban agglomerations show (Figures 5a and 5b) that the variations in two efficiencies of most of the cities in six urban agglomerations exhibited a downtrend. Regarding the PTE, the measured values of urban tourism in six urban agglomerations exceeded one and increased to varying degrees, of which the increasing value of Huizhou was most distinct. The ranges of 16 cities, including Zhaoqing, Wuxi, Shijiazhuang, Dalian, Yantai and Fuzhou, ranged from 20% to 30%, and the ranges of the remaining cities were less than 20% from 2001 to 2006. From 2006 to 2011, while the measured values of urban tourism in six urban agglomerations also exceeded one, the ranges had noticeably decreased. The ranges for Huizhou, Zhongshan, Tangshan, Langfang, Rizhao and Fuzhou were between 20% and 30%, while the ranges of the remaining 47 cities were less than 20% from 2001 to 2006. Regarding the SE, the measured values of urban tourism exceeded one and increased to varying degrees, among which Tianjin was most distinct, in six urban agglomerations. The exceptions were Guangzhou, Shanghai, Hangzhou and Xiamen. The values for seven cities, including Changzhou, Tangshan, Fushun and Fuzhou, ranged from 20% to 30%, and the ranges of the remaining 49 cities were less than 20% from 2001 to 2006. The values for Dongguan, Zhongshan, Fuxing, Fuzhou, Rizhao and Fuzhou ranged from 20% to 30%, while the values for the remaining

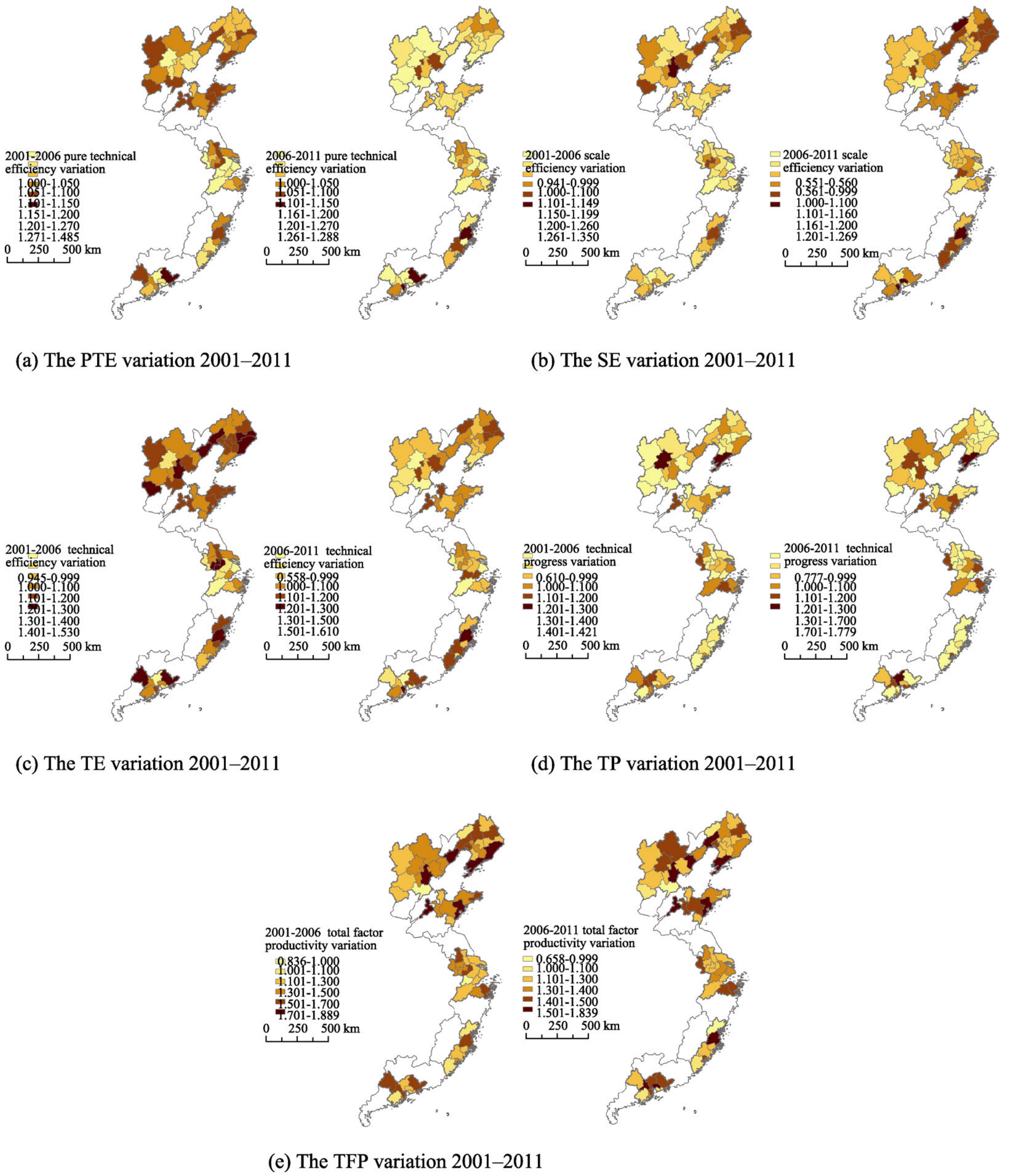


Figure 5 Spatial patterns of the variations in the PTE, the SE, the TE, the TP and the TFP of urban tourism in six coastal urban agglomerations in eastern China (2001–2011)

cities were less than 20% from 2006 to 2011. Accordingly, two characteristics can be formed. (1) The PTE ranges of the municipalities, provincial capitals and core cities in the PRD, the YRD and the BTH have been invariant since 2000, and the increasing ranges of most cities in the urban agglomerations have exhibited a downward trend. (2) Though the SE ranges of urban tourism in most cities in the urban agglomerations were slightly lower than the PTE ranges, they, too, have exhibited a downtrend since 2000.

6.2 The characteristics of the spatial variation in the TE and the TP

The TE variation index, which is used to measure the optimal degree of production input factors, is a highly comprehensive reflection of the PTE and the SE variations. The TP variation index reflects the degree of variation in production technology. Table 3 indicates that the TE of urban tourism in the CSL, the YRD, the PRD, the WBST, the BTH and the SDP decreased sequentially, while the TP of urban tourism in the YRD, the PRD, the SDP, the BTH, the WBST and the CSL decreased sequentially. The geometric means of the TE and the TP variations of urban tourism in six urban agglomerations decreased again from 2006 to 2011.

Specifically, the following characteristics can be concluded. (1) The geometric ranges of the TP and the TE variations of urban tourism in six urban agglomerations increased slightly but exhibited a downtrend since 2000, and the geometric ranges of the TE were higher than those of the TP. These conclusions further illustrate that the PTE variations led to the CE variations of urban tourism in the YRD, the PRD and the BTH. The higher measured values and increasing ranges demonstrate that the allocation and utilisation levels of urban tourism resources in the YRD, the PRD and the BTH were extremely effective. The technical innovation and progress of urban tourism in six urban agglomerations remained insufficient for the optimised and harmonious development of configuration, utilisation and scale agglomeration of input factors. (2) The TE and the TP ranges of urban tourism in the YRD, the PRD, the BTH and the SDP have been higher than the ranges in the CSL and the WBST since 2000. These conclusions also illustrate that the coordinated development of scale configuration and technology utilisation of input factors of urban tourism in the YRD, the PRD, the BTH and the SDP was relatively evident. However, due to the inconsistent PTE and SE variations and a certain distance to the optimal frontier of the TP, the optimised development of the CE of urban tourism in the CSL and the WBST decreased.

Figures 5c and 5d show the spatial characteristics of the TE and the TP variations of urban tourism in six urban agglomerations. The TE of core cities, including Guangzhou, Shenzhen, Shanghai, Hangzhou and Beijing, were invariant or slightly decreased from 2001 to 2006. The TE values of urban tourism in six urban agglomerations exceeded one and increased to varying degrees, of which the increasing value of Huizhou was most distinct. The values for ten cities, including Zhaoqing, Wuxi, Tianjin, Benxi and Fuzhou, ranged from 40% to 50%, and the values of the remaining cities were less than 20%, of which the values for Suzhou, Nanjing and Huzhou were less than 10% from 2001 to 2006. From 2006 to 2011, the measured values of seven cities, including Guangzhou, Shanghai and Beijing, were less than one and exhibited a downtrend; the remaining cities exceeded one and achieved increases to varying degrees, of which the increasing value of Fuzhou was most discernible. The values for Huizhou, Langfang, Fushun and Quanzhou ranged from 40% to 50%, and the ranges of five cities, including Zhaoqing, Baoding and Xiamen, were less than 10%. In addition, the TP variations for Jiangmen, Changzhou, Baoding, Liaoyang and Zhangzhou were less than one and exhibited a downtrend from 2001 to 2006. The TP variations for the remaining cities exceeded one, of which Dalian and Beijing were most distinct. The variation values for ten cities, including Guangzhou, Nanjing, Shaoxing and Jinan, ranged from 30% to 40%. From

2006 to 2011, the variation values of 20 cities, including Zhongshan, Zhenjiang, Shijiazhuang, Fushun, Rizhao and Fuzhou, were less than one and exhibited a downward trend. The variation values of the remaining 39 cities exceeded one, of which Dalian was most distinct. The TP values for the five cities of Guangzhou, Shanghai and Beijing ranged from 40% to 50%. The following two characteristics can be formed. (1) The TE of municipalities, provincial capitals and core cities of the PRD, the YRD and the BTH have been invariant and subsequently decreased since 2000, while the increasing ranges of most cities in six urban agglomerations were larger but exhibited a downward trend. (2) The TP ranges of municipalities, provincial capitals and core cities of the PRD, the YRD, the BTH and the SDP have been distinctly higher than the ranges in the NLD and the WBST since 2000.

6.3 The spatial characteristics of the TFP variation

The TFP variation reflects the degree of variation of the total factors productivity of urban tourism in six urban agglomerations. Table 3 indicates that the geometric increasing ranges of the TFP variation of urban tourism in six urban agglomerations have exhibited both an increasing trend and a downward trend since 2000. Spatially, the geometric increasing ranges of the TFP variations in the PRD, the YRD, the BTH, the SDP, the WBST and the CSL have increased sequentially since 2000.

The spatial characteristics of the TFP variations of urban tourism in six urban agglomerations (Figure 5e) show that the increasing ranges of 12 cities, including Guangzhou, Shanghai, Dalian, Qingdao and Xiamen, have gradually improved since 2000. From 2001 to 2006, the TFP ranges of Zhongshan, Tianjin and Jinan were most significant, ranging from 70% to 90%, while the TFP ranges of 11 cities, including Foshan, Wuxi, Dalian, Qingdao and Fuzhou, were significant and ranged from 50% to 70% and the TFP ranges of Jiangmen, Fuxing, Zhangzhou and Ningde were less than 10%. From 2006 to 2011, the TFP ranges of Tianjin, Dalian, Jinan and Qingdao were significant and ranged from 60% to 90%. On the other hand, the TFP ranges of Jiangmen, Shijiazhuang, Fuxing, and Zhangzhou were less than 10%. The above analysis showed that while the TFP ranges of most cities in six urban agglomerations were large, they have exhibited a downward trend since 2000. The TFP ranges of urban tourism of municipalities, provincial capitals and core cities of the PRD, the RD and the BTH have been slightly higher than the ranges in the WBST and the NDP since 2000. Therefore, the TFP of important tourism cities in the PRD, the YRD and the BTH were near the optimal frontier due to the optimised combination, collocation and technical utilisation of their tourism factors. The important tourism cities in the WBST and the CSL grew rapidly due to the growth of total tourism factors and the realisation of increasing returns to scale under the same technical level. However, the growth trend of the PTE and the SE exhibited a downward trend, and the urban tourism in six urban agglomerations were confronted with problems, such as the sustainable development of technical innovation and progress and the decrease in tourism input factors.

7 Driving mechanisms and development stages divisions

Combined with the measurement indices of input-output efficiency of urban tourism with the factual situation of urban tourism, this paper analyses different influencing factors of urban tourism efficiencies based on the urban attractions and tourism products and enterprise technology and tourism market, including the attractions number, the tourists number, the tourism documents number, the tourism input capital, the competitive tourism products number, and the star-level tourism enterprises number. The correlation analysis is used to fitting the correlation coefficient between different influencing factors and different development efficiencies. Table 4 indicates that: (1) The PTE and the CE for the PRD and the YRD have affected significantly by the tourism input capital and the competitive tourism products number and star-level tourism enterprises number. (2) The SE and the CSL and the WBST have affected significantly by the attractions number and the tourists number and the tourism documents number. (3) The CE for the BTH and the SDP have affected significantly by the tourism documents number and the star-level tourism enterprises number.

Table 4 Influencing factors of the PTE, the SE, and the CE for urban tourism in six coastal urban agglomerations in eastern China (2001–2011)

Influencing factors		Attractions number	Tourists number	Tourism documents number	Tourism input capital	Competitive tourism products number	Star-level tourism enterprises number
	PTE	0.458	0.522	0.542	0.855***	0.905*	0.876***
	SE	0.853*	0.916**	0.836***	0.692	0.587	0.491
CE	PRD and YRD	0.415	0.493	0.521	0.917*	0.816*	0.942**
CE	BTH and SDP	0.527	0.618	0.721***	0.623	0.583	0.893**
CE	CSL and WBST	0.819***	0.922**	0.932*	0.482	0.502	0.489

Note: the value (***) is significant at the 10% level; the value (**) is significant at the 5% level; the value (*) is significant at the 1% level.

Under the above different influencing factors, the development efficiencies for urban tourism in six urban agglomerations are divided into three stages.

7.1 The stage of scale dominance: the urban tourism in the CSL and the WBST

The effect of natural conditions: Although the economic development of most cities in the CSL and the WBST urban agglomerations has been relatively slow, the sightseeing marine attractions have been under the development since 2000 due to the important tourist cities that have unique advantages in terms of climate, geology, topography and location. Furthermore, they have the three-dimensional tourism traffic pattern. The unique attractions and the good transportation system provide a resource basis for increasing the returns to scale in the tourism market of most cities.

The support of economic policies: With the rapid development of urban tourism in two urban agglomerations, the development of attractions, the design of tourism products, the exploitation of tourism markets, the quality of the tourism facilities and the governance of the tourism environment require the support of economic policies. Economic policies are essential for the efficient development of urban tourism in two urban agglomerations. At the same time, the implementation of the policies is critical to the success of the tourism projects. The tourism projects require the overall promotion of the SE, the CE and the TFP variations in the urban agglomerations.

The drive of tourism capital: Tourism capital investment is a major factor affecting the development of urban tourism in two urban agglomerations. Because of the investment of a substantial amount of tourism capital, the number of sighting-seeing attractions have gradually increased, the construction of urban infrastructures and tourism facilities have gradually accelerated, the driving force of the tourism industry has significantly enhanced, and the SE and the CE of urban tourism have gradually increased.

Therefore, at this stage, due to the same technical level of urban tourism in two urban agglomerations, these tourism cities should further increase the total input to realise the increasing returns to scale and enhance the sustainable TFP by improving tourism development conditions, implementing tourism programs and increasing capital investments.

7.2 The stage of technical learning: the urban tourism in the BTH and the SDP

The drive of the productive value of tourism enterprises: Since 2000, the early stage of technological innovation, the municipalities, provincial capitals and core cities in two agglomerations have invested in numerous industrial factors to develop urban tourism based on the quality of the resources, economic conditions, market scales and policy systems. Between the early stage and the middle stage, most tourism cities entered a comprehensive development stage. The function of tourism products has transformed sightseeing into vacations. The competition among urban tourism enterprises appeared. Accordingly, the diversified investments, the various industrial factors and the enterprise competition in urban tourism were promoted by the open marketing policy and the configuration of reasonable tourism factors such as the urban tourism resources development, the tourism products design and the improvements in the marketing environment and management. While the scales of tourism production are moving toward the best frontier, the advanced technology of urban tourism in the YRD and the PRD have defused gradually in the BTH and the SDP, resulting in the study and imitation of aspects of production and marketing, which leads to the rapid increase of urban tourism efficiency. However, because advanced technology cannot attain a leading position in a short time, together with the overinvestment of urban tourism factors, to a certain degree, during the middle stage, the variation levels of the PTE, the SE and the TE are below average, and the TFP ranges of urban tourism in two urban agglomerations are slowed. Thus, it is important that the tourism cities in two urban agglomerations enhance their capability of innovative R&D in the background of optimising their SE and studying the advanced technology to reduce the redundancy caused by the overinvestment in tourism factors.

7.3 The stage of technological innovation: the urban tourism in the YRD and the PRD

The drive of tourism market competition: From 2000, which was the early stage of technological innovation, due to the comparative advantages in tourism location, attraction conditions, economic development and policy execution, the SE of most tourism cities in the

YRD and the PRD took the lead in moving towards the best frontier in short time, and their TFP reflects this the rapid increasing trend. Up until the middle stage, the increasing returns to scale of most of tourism cities in the YRD and the PRD demonstrated a relative steady situation due to the urban infrastructures and facilities that were gradually being improved and the diversification of urban tourism products. On the other hand, technological innovation and progress became the inherent driving force of efficiency development of urban tourism in two urban agglomerations due to the decreasing returns to scale of tourism funding, the minimal differences in tourism technology, and the rational and individualistic aspects of tourist requirements. From the middle stage to the late stage, Shanghai, Hangzhou, etc. maintained a continuous competitive advantage. Other cities in two urban agglomerations enhanced the market competitiveness through the independent innovation and the introduction of external innovation and promoted the innovative and reformative strategies in the design and marketing of tourism products, the consumption attitude of tourists and the competitive mode of tourism enterprises through the development of new technologies and ideas. The aim was to raise the PTE to a sustainable level. Notably, the TFP ranges of urban tourism in two urban agglomerations gradually slowed. As a result, it was determined that the key to increasing the TFP ranges is the continuous technological innovation and progress under market competition.

7.4 The impact by uncertain events on the above three stages

Generally speaking, uncertain events should reduce tourist consumption requirements, capital operation efficiency and tourist market competition as such events affect investors' investment ability and faith and significantly delay the realisation of the SE. At the same time, the affecting mechanisms of the above three stages are different. From 2000, there are two uncertain events that fully impact urban tourism in six urban agglomerations in eastern China – the *SARS event in 2003* and the *sub-prime crisis in the United States in 2008*. By estimating the SE, the PTE and the TFP of urban tourism in each unban agglomeration, it is determined that the decline of the SE is obviously higher than that of the PTE. Spatially, the decreases of the SE of urban tourism in the CSL and the WBST were obviously greater than the decreases of the other four urban agglomerations in 2003. Furthermore, the *SARS event* led to the relative stagnation of consumption activities of domestic tourists and the further decline of the invalid SE in two urban agglomerations. Even so, the SE rose to a moderate level in 2006. In 2008, the decline of the PTE was obviously greater than that of the SE. Spatially, the decline of the PTE in the YRD, the PRD, the BTH and the SDP was obviously greater than that of the other two urban agglomerations in 2008. It was also determined that the *sub-prime crisis in the United States* caused a significant decline in the domestic and foreign tourism market share and in tourism investment. Additionally, it also negatively impacted competition among the urban tourism enterprises and impeded the introduction of the advanced technology. Therefore, though the PTE of urban tourism in the YRD, the PRD, the BTH and the SDP fell sharply, it never dropped below the medium level and then rose to a good level in 2011. In summary, the trend line of the CE of urban tourism in six urban agglomerations indicates that the CE maintained, overall, sound momentum in spite of suffering from uncertain events (Figure 6).

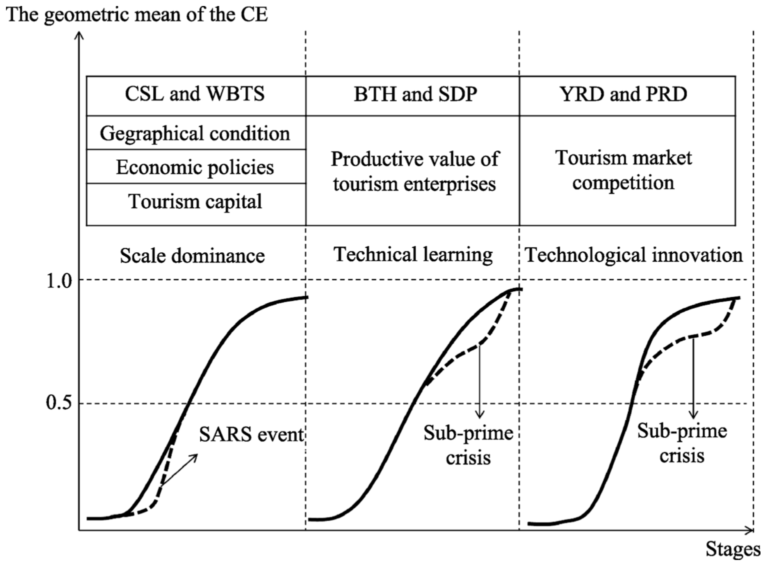


Figure 6 Trend lines of different stages of urban tourism in six urban agglomerations and driving mechanisms

8 Conclusions and discussion

(1) The CE of urban tourism obtained by the bootstrap-DEA model is lower than that obtained by the DEA-CRS model, which confirms the significant tendency of the DEA-CRS model to overestimate.

(2) Spatially, the average levels of the CE, the PTE and the SE of urban tourism in the PRD, the YRD, the BTH and the SDP changed from ineffective to moderately effective and transformed from single-core congestion into multi-core diffusion. The average levels of the CE and the PTE of urban tourism in the CSL and the WBST were ineffective, while the average levels of the SE of urban tourism in the CSL and the WBST were moderately effective and also transformed from single-core congestion into multi-core diffusion. The increasing ranges of the SE of urban tourism in the CSL and the WBST were most distinct, and the CE, the PTE and the SE in municipalities, provincial capitals and important cities of urban agglomerations have been optimally effective since 2000.

(3) The PTE influenced the CE of urban tourism in the PRD, the YRD, the BTH and the SDP slightly more than did the SE. The CE of urban tourism in the CSL and the WBTS was slightly more strongly influenced by the SE than by the PTE.

(4) The average PTE ranges of urban tourism in the YRD, the PRD and the BTH have been slightly higher than the ranges in the SDP, the CSL and the WBST since 2000, while the average SE ranges of urban tourism in the CSL and the WBST were nearer to the optimal frontier. The average TE and TP ranges of urban tourism in the YRD, the PRD, the BTH and the SDP have been higher than those in the CSL and the WBST since 2000. The TFP ranges of most cities in six urban agglomerations have been significant since 2000, though they have exhibited a downtrend, and the ranges of the municipalities, provincial capitals and core cities in the PRD, the YRD and the BTH have been slightly higher than those in the WBST and the NDP since 2000.

(5) Collectively, the natural conditions, economic policies and tourism capital drive the

SE changes of urban tourism in the CSL and the WBTS. The tourism enterprises for increasing returns to scale and imitating innovative technology have an effect on the CE change of urban tourism in the BTH and the SDP, while the tourism market competition drives the PTE change of urban tourism in the PRD and the YRD. Though the CE of urban tourism in six coastal urban agglomerations suffers from some uncertain events, overall, it has maintained sound momentum since 2000.

(6) The limitations of measurement indices and data make it difficult to obtain annual efficiency levels. Accordingly, the selection of more reasonable indices and valuable data as well as the development of long-term policies are important research directions for urban tourism efficiency of urban agglomerations.

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