International Journal of Hospitality Management 30 (2011) 1036–1043

Contents lists available at ScienceDirect

International Journal of Hospitality Management

journal homepage: www.elsevier.com/locate/ijhosman

Modeling hotel room price with geographically weighted regression

Honglei Zhang[a], Jie Zhang[a,*], Shaojing Lu[a], Shaowen Cheng[b], Jinhe Zhang[a]

[a] School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, 210093 Jiangsu, PR China
[b] School of Urban and Environmental Science, Huazhong Normal University, Wuhan, PR China

ARTICLE INFO

Keywords:
Hotel room price
Hedonic price model
Spatial autocorrelation
Geographically weighted regression
Beijing

ABSTRACT

Insufficient attention has been given to hotel-room-price attributions and its mechanism in the lodging research field till now. This article examines how site and situation factors differently affect lodging industry and room prices. Comparative analysis of four hedonic price models has been conducted to investigate how these attributions influence room price of Beijing's hotels above star three. Spatial autocorrelation in hotel prices and in hedonic room price equation residuals were analyzed in this research too. Some conclusions can be found and summarized: according to the estimated results, for specific locales, the results expressed in a global model might be inaccurate. The fitting coefficient of geographically weighted regression demonstrates the importance of going beyond the global modeling framework when incorporating geographically weighted regression into hedonic price model. At last, an innovative method for determining the influence of a hotel's attributes at market rates on its' values, or implicit prices was put forward by the authors.

1. Introduction

It is quite usual that hotel room prices vary enormously in the world even in the same city. But why hotel room prices are very different, and is there any relationship between room price of hotels and their location, quality and some other factors (the star-rated, the service of the hotel, etc.)? Many scholars have devoted themselves to answer these questions. Pricing decision-making is a well-researched area of the marketing literature (Nagle, 1987). This research area has also been of enduring interest to geographers (Dicken and Lloyd, 1990; Smith, 1966, 1981). The theoretical foundation for this research is the hedonic price model. The hedonic price model, which typically uses ordinary least squares (OLS) regression, is now routinely used to reveal how buyers establish implicit prices for expensive goods that are comprised of bundled attributes (Lancaster, 1966; Rosen, 1974). Lodging is one industry that is very appropriate for hedonic analysis (White and Mulligan, 2002). Taking Beijing, the capital city of China, as case study area, this paper examines how site factors (room stars, age, other room attributions, etc.) and situation factors (location, distance/accessibility, etc.) differentially influence room price of hotels with star rate of three or above there. Three types of hedonic price model (linear, semilog and loglinear) were used and compared by making full use of collected data about room price of 228 hotels in Beijing. Spatial autocorrelation in hotel prices and in hedonic room price equation residuals was then investigated. For the positive spatial autocorrelation of room prices and the residuals, geographically weighted regression analysis is exacted. Finally, innovative attempt of geographically weighted hedonic price model with local regression statistics analysis may further the research of room price.

It is crucial for hotel managers to know the determinant factors of room price, consumer choice and behaviors. Then they can take responsive measures to improve the quality of rooms and hospitality services. So this article developed a method for hotel or motel room pricing and for determining the influence of their room attributes at market rates.

2. Literature review

Marketing researchers demonstrats that pricing is a structured process, some other researchers and practitioners suggest that pricing in the hotel industry appears to be unscientific, self-defeating, myopic, and not customer-based (Lewis et al., 1989). Steed and Gu (2005) examined the hotel pricing approaches and categorized these approaches into four categories: (1) cost based; (2) market based; (3) a combination of cost and market based; and (4) best practice based. To make it more clear and easily understood, hotel pricing approaches in this paper were classified into three categories in terms of the techniques and methods, that is (1) consumer behavior; (2) conjoint analysis; and (3) hedonic analysis (see Table 1).

* Corresponding author. Tel.: +86 025 8359 7097; fax: +86 025 8359 7097.
E-mail addresses: lilymagician@gmail.com (H. Zhang), jiezhang@nju.edu.cn (J. Zhang), amagicgirlsy@163.com (S. Lu), Shaowen_cheng@163.com (S. Cheng), zhangjinhe818@263.net (J. Zhang).

0278-4319/$ – see front matter
doi:10.1016/j.ijhm.2011.03.010

Table 1
Empirical evidence of hotel room price with consumer behavior analysis, conjoint analysis and hedonic analysis.

Research approaches	Researchers	research area	Samples	Model	Dependent variables	Independent variables	
						Site factors	Situation factors
Consumer behavior	Arbel and Pizam (1977)	Tel Aviv, Israel		Interview	Room rate		Hotel location, distance
	Danziger et al. (2006)	Israel	114 participants	Behavioral process measure	Room price	Brand name, star rating, number of rooms, number of restaurants, pool size	Location
Conjoint analysis	Goldberg et al. (1984)	Nine standard metropolitan areas, U.S.	180 respondents, telephone screening	Hybrid conjoint model	Room price	Lounge, room, associated services, recreation/sports, security	Atmosphere/facilities
	Wind et al. (1989)	Atlanta, Dallas, San Francisco and Chicago	601 consumers	Conjoint model	Room price	Hotel size, pool location, pool type, building shape	Corridor/view, landscaping
	Bull and Alcock (1993)	Australia	Club members and visitors	Conjoint model	Room price	Food and beverage service, gambling and entertainment	
Hedonic analysis	Carvell and Herrin (1990)	San Francisco	20 hotels (1982–1986)	OLS	Actual room rate	Amenities that catered to business and pleasure travelers	Distance from the hotel to Fisherman's Wharf
	Sinclair et al. (1990)	Malaga, Spain		Linear hedonic analysis	Room price	Hotels in tour packages	In or out of central Malaga, Spain
	Bull (1994)	Ballina, Australia	20 hotels, 15 motels	Linear, quadratic, semilog and loglinear hedonic analysis	Room rate	Rating, age, restaurant	River side of the highway, distance from town center
	Wu (1999)	Arkansas and Kansas	155 motels	Linear hedonic analysis	Room price (low price and High price)	AAA rate, restaurant, pool, movies, chained	State, interstate
	Coenders et al. (2001)	Spanish continental Mediterranean coast	417 samples of price	Random-effect hedonic price model, SEM	Monthly room price	Size, category, room, parking, sport	Town
	Israeli (2002)	Israel	215 hotels	Linear hedonic analysis	Room price	Star rate, brand	Location
	White and Mulligan (2002)	Four corners region, southwestern US states	584 hotels	Linear hedonic analysis	Room rate	Pool, spa and complimentary breakfasts	Temperature, interstate location, and specialization of the local economy
	Monty and Skidmore (2003)	Southeast Wisconsin	15 bed and breakfast hotels	Linear hedonic analysis	Willingness to pay	Hot tub, private bath, larger room, fireplaces, themes, room service	Scenic views
	Coenders and Jm (2003)	Spanish continental Mediterranean coast	417 samples of price	Random-effect hedonic price model, SEM, latent growth curve models	Monthly room price	Size, category, room, parking, sport	Town, climate
	Thrane (2007)	Oslo, Norway	74 hotels	Semilog hedonic analysis	Room rate	Chain, mini-bar, parking, restaurant, hairdryer, room service, beds	Distance to Oslo Central Station
	Hung et al. (2010)	Taiwan	58 international hotels	Quantile regression analysis	Average room rate	Number of rooms, hotel age, number of housekeeping staff per room	Market condition

Consumer behavior research among potential and actual consumers could be used to explore their willingness to pay for specific attributes. Arbel and Pizam (1977) ever designed and completed some research by asking how different each consumer would be willing to pay when offered identical hotels/motels but for different attributes. Danziger et al. (2006) applied behavioral process into investigation on the contribution of strategic assets in determining customer perceptions of hotel room price at the aggregate level, which has also been proved by Israli and his colleagues via data analysis. Participants were asked to estimate the market price of a single occupancy hotel room after acquiring information on competing hotels. As to consumer behavior approach, its utility has been much limited owing to its reuirement of special and professional knowledge.

Conjoint analysis has also been used a number of times to estimate the values which consumers put on specific attributes of a hotel (Bull and Alcock, 1993; Goldberg et al., 1984; Wind et al., 1989). When careful consideration of available alternatives is involved, sensitive price change can be measured by conjoint analysis. But this approach is difficult for managers to understand.

One of the most fruitful lines of investigation in this field is the hedonic price model. Hedonic price model requires an analysis of market prices and objective attribute data rather than questionnaire data. Bull (1994) investigated the influence of star rating, hotel age, distance and transportation factors on price decision making. His research results revealed that the room rates decrease as the hotel's distance from the town center increases or star rate decreases. Israeli (2002) found that star rating was a better predictor of price than corporate affiliation. Espinet et al. (2003) also applied the hedonic price approach to investigate the determinants of hotel room rates and found that town, hotel size, distance to the beach and availability of parking spaces are the main determinants of hotel pricing. Monty and Skidmore (2003) used a "willing to pay" method to collect data on price and amenities from bed and breakfast accommodations in Southeast Wisconsin. The research results revealed that hotel amenities such as provision of hot tubs, private baths and a larger room were statistically significant determinants of price. Additionally, location characteristics, day of week, and time of year are also found to be important. Hung et al. (2010) used quantile regression approach to investigate the major determinants of hotel room pricing strategies. The results further demonstrated that room number and the number of housekeeping staff per guest room do not significantly influence hotel price at the low price quantile. Hotel age and market conditions were the only significant determinants in high-price category.

In one word, prior empirical studies employing different pricing approaches have indicated that star rating, location, age and the number of rooms are key predictors of hotel room price. However, traditional regression models only consider the global relationship between hotel price and several explanatory variables. Spatial relationships were missed in these global models. Geographically weighted regression allows an opportunity to increase the explanatory power of the model by incorporating important spatial relationships. Thus, it is desirable to apply the GWR technique to investigate the determinants of hotel pricing.

3. Specification and estimation

3.1. The hedonic room price specification

In economics, hedonic price model is a revealed preference method for demand or value estimation. It decomposes the item researched into its constituent characteristics, and obtains estimates of the contributory value of each characteristic. To use this model some composite goods evaluated should be divided into its constituent parts, and so be its value and price. Hedonic models are normally used with regression analysis.

For hotels, characteristics that can influence room prices can be grouped into (1) site attributes (the physical or structural characteristics of the hotel and selective features of the surrounding property) and (2) situation attributes (characteristics of the wider area surrounding the establishment) (White and Mulligan, 2002). According to Wooldridge (2009), it is better to use natural logs model analysis to make dependent variables satisfy the CLM assumption more closely, to mitigate or eliminate the heteroscedastic or skewed distributions, and to narrow the range of variables with better explanation power. Three types of global hedonic price models have been designed and analyzed in this research.

The general linear specification for a hedonic price equation is given as:

$$P = f(X_1, X_2) \tag{1}$$

The loglinear form for a hedonic price equation is given as:

$$\ln(P) = f(\ln(X_1), \ln(X_2)) \tag{2}$$

The semilog form for a hedonic price equation is given as:

$$\ln(P) = f(X_1, X_2) \tag{3}$$

where P is the room prices of hotels, X_1 denotes variables describing site attributes (such as star rate, size, service, and so on), and X_2 denotes situation attributes (such as interstate location, distance from the center of city, landscape, and so on).

All these three forms of hedonic price models are regarded as global OLS regression model.

3.2. Spatial autocorrelation in the room price and the residuals

The first Law of Geography asserts that "everything is related to everything else, but near things are more related to each other" (Tobler, 1970). Room prices of hotels are supposed to be spatially autocorrelated for three reasons. First, because of the same or similar location, neighboring hotels tend to share same development goals and requirements. Secondly, because of similar development history, neighboring hotels have similar structural characteristics such as dwelling size, interior and other service facilities. Thirdly, neighborhood hotels share location amenities, for example, the same restaurants, the same shopping mall, and the same security services and facilities.

Classic spatial autocorrelation statistics, such as Moran's I, are used to measure and analyze the degree of dependency among observations in geographic space. The Moran's I statistic index for spatial autocorrelation of room price is given as:

$$I = \frac{n}{S} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} z_i z_j}{\sum_{i=1}^{n} z_i^2} \tag{4}$$

where z_i is the deviation of room price for hotel i from its mean, $w_{i,j}$ is the spatial weight between hotel i and j, n means the total number of hotels, and S is the aggregate of all the spatial weights.

$$S = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{i,j} \tag{5}$$

Technically, Moran's Index value close to +1.0 indicates clustering while index value close to −1.0 indicates dispersion. The significance of Moran's I can be tested by Z score and p-value.

Eq. (1) can be stated as:

$$P = \beta_0 + \beta_1 X + \varepsilon \tag{6}$$

where P is the room price, X is a vector (possibly transformed) hotel characteristics, β_0 and β_1 refer to unknown hedonic coefficients to be estimated, and ε is the residual. The same transformation can be made to Eqs. (2) and (3). Using Eq. (4), the residuals ε can be tested for spatially autocorrelation.

3.3. The geographically weighted regression specification

Geographically weighted regression (GWR) is a recent modeling technique for spatial analysis proposed by Fotheringham and his colleagues in a series of papers (Brunsdon et al., 1998a,b, 1999; Fotheringham et al., 1997a,b, 2002). GWR provides a technique to deal with spatial nonstationarity in multivariate regression. Essentially, GWR estimates regression coefficients locally using spatially dependent weights. The weight of data points is determined by their distance from each of a given number of estimation locations. GWR analysis has become more and more popular in economic geography. It has also been applied for the hedonic modeling of house prices (Cho et al., 2006; Kestens et al., 2006), household income (Yrigoyen et al., 2008), regional industrialization (Huang and Leung, 2002), geographic diversity in urban and regional growth (Yu, 2006), commuting patterns (Lloyd and Shuttleworth, 2005), rural employment growth in the US (Partridge et al., 2008), rural poverty patterns (Partridge and Rickman, 2007), rural development patterns related to the creative class (Cho et al., 2007), the relationship between rural poverty and tourism development (Deller, 2010), and the migration patterns of older persons (Jensen and Deller, 2007). These studies come to the conclusion that economic phenomenon can be better analyzed by accounting for the spatial effects (local dependence and spatial heterogeneity) with GWR analysis.

GWR is a local multivariate regression method by which the data samples are weighted on their spatial proximity. It produces a separate set of regression parameters for every observation across the study area. It therefore relaxes the assumption in traditional OLS models that the relationships (regression coefficients) between dependent and independent variables being modeled are constant across a study area as seen in Eq. (6).

Here β_0 and β_1 are assumed to be constant in classical ordinary least squares regression. Where there is any geographical variation in the relationships between P and both β_0 and β_1, it will be captured in the error term.

As to ordinary least squares (OLS), the parameters can be estimated by solving:

$$\beta = (X^T X)^{-1} X^T Y \tag{7}$$

Comparatively, the specific GWR model for each observation point g is specified as:

$$P(g) = \beta_0(g) + \beta_1(g)X + \varepsilon \tag{8}$$

Here g represents the vector of co-ordinates of the location, which indicate that there is a separate set of parameters for each of the g observations.

When GWR was used, the parameters can be estimated by solving:

$$\beta(g) = (X^T W(g) X)^{-1} X^T W(g) Y \tag{9}$$

Here $W(g)$ is the weight matrix which denotes connectivity between observations.

The weight can be determined by several methods. Two common methods are the bi-square function and the Gaussian function. As for Gaussian function the weight for the observation i is shown as:

$$w_i(g) = \exp\left(-\frac{d}{h}\right)^2 \tag{10}$$

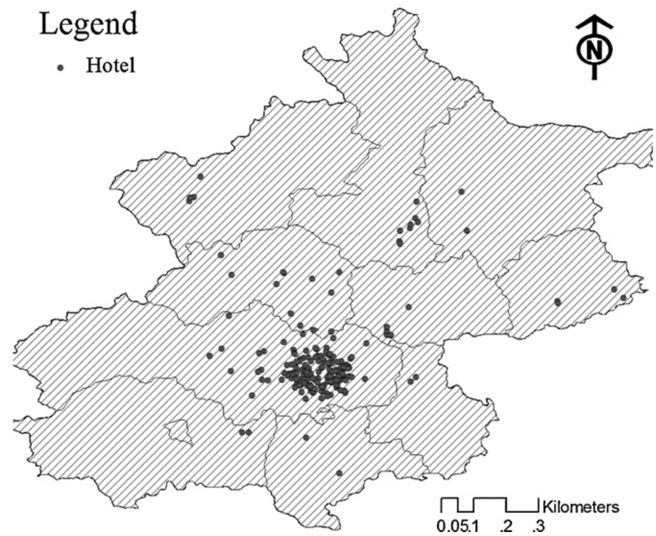

Fig. 1. Locations of sampled hotels in Beijing.

where d is the Euclidean distance between the location of observation i and location g; h is a quantity known as the bandwidth of sampled observations. The bandwidth may be either defined by a given distance, or a fixed number of nearest neighbors from the analysis location. The optimal number of nearest neighbors is determined by minimizing the cross validation statistics (CV) or through selecting the model with the lowest Akaike Information Criterion (AIC) score (Hurvich et al., 1998), given as:

$$\mathrm{AIC}_c = 2n\ \ln(\hat{\sigma}) + n\ln(2\pi) + n\left\{\frac{n + tr(S)}{n - 2 - tr(S)}\right\} \tag{11}$$

Here $tr(S)$ is the trace of the hat matrix. The AIC method is more appropriate and applicable than the CV statistics, and can be used to select between a number of competing models by taking into account differences in model complexity (Fotheringham et al., 2002).

4. Study area and data

Room prices data of 228 randomly selected hotels above three star rates in Beijing were collected and analyzed. Fig. 1 shows the spatial distribution of all the 228 researched hotels in the Beijing Municipality.

4.1. Study area

Beijing, also known as Peking, is a metropolis in northern China and the capital city of the People's Republic of China. Governed as a municipality under direct administration of the central government, Beijing is China's second largest city after Shanghai, with more than 17 million people in Beijing's area of jurisdiction. Located on the northern edge of the North China Plain, the administrative area of Beijing Municipality is composed of four inner city boroughs (Xuanwu, Xicheng, Chongwen, and Dongcheng), four suburban boroughs (Haidian, Shijingshan, Fengtai and Chaoyang), eight outer suburban boroughs (Mengtougou, Fangshan, Daxing, Tongxian, Shunyi, Changping, Pinggu, Huairou), as well as two rural counties (Yanqing, Miyun). Traditionally, the four inner city boroughs plus the four suburban boroughs are viewed as the central city with about 300 km^2 in area (He et al., 2006).

Beijing is quite monocentric, and TianAnMen Square and the surrounding traditional hub of commercial, cultural, and administrative activities can be regarded as the city center, Beijing is spreading out in every direction (Gu et al., 2005; Zheng and Kahn, 2008).

Beijing is a major transportation hub, with dozens of railways, roads and motorways passing through the city. It is also the destination of many international flights arriving in China. Beijing has developed itself into the political, educational, and cultural center of the People's Republic of China.

4.2. Data

Data in this research is mainly from the Beijing Hotel Report 2005 by Beijing Hotel Association. And yearly this report is all about business situation of hotels in Beijing.

Location is the only generally proved and accepted attribute of lodging product. Some researchers have investigated the role of location as a determinant of consumer choice. Numerous studies have also identified locations as one of the major determinants of hotel room price. Monty and Skidmore (2003) found bed and breakfast accommodations located near tourist areas charge significantly more as compared to those located in other areas. In previous studies, location can be represented as distance from the town center, highways or local attractions to case study hotels as global variables. However, Beijing is a huge city with 16,410 square kilometers acreage, the global variables cannot impose influences on hotel room prices within the whole city. That is why this study adopted S-distance and T-distance to investigate the effect of location on hotel room price. These two geographical variables are both local variables which may have significant effects to hotel room prices. S-distance is the straight linear distance between hotel and its nearest scenic spots. Here scenic spots researched were all the AAAA and AAA scenic spots in Beijing in 2005. Transport hubs referred to calculate the T-distance include Beijing Railway Station and Beijing West Railway Station, the Capital International Airport and Beijing coach stations.

Based on previous studies, age partly explains hotel pricing behavior (Bull, 1994). Older hotels charge higher room prices. So the variable Year which means the duration from the building or latest refurbishment of the researched property for hospitality use till now.

Compared to small hotels, larger hotels are typically more luxurious and therefore charge higher room prices (Chung and Kalnins, 2001). In this study, room number represents hotel size as one of the independent variables.

Star rating is considered as the most important factor in hotel room pricing process. The hotels with high star rating posted higher prices (Israeli, 2002). As most researchers did, star rate of hotels is regarded as one independent variable in this study.

The room prices used in this study is list prices. Although actual transaction prices are preferred, it varies depending on season, and occurrence of trade events, exhibitions or conferences. List price may be a perfect substitute if discounts from list price are minimal or identical across hotels. List price can reflect site factors and situation factors' impact more approximate essentially.

Table 2 lists variables and their brief descriptions in the context of this study.

Table 2
Variables and brief descriptions.

Attribution	Brief description	Code
Rprice	The average hotel prices	Price
Room	Number of rooms	Number of rooms
Star rate	The star rate of the hotel	Among 3, 4, 5
Year	Years since property was built or last refurbished	Number
S-distance	The straight line distance between hotel and its nearest Scenic spots	Distance
T-distance	The straight line distance between hotel and its nearest transport hub	Distance
LnRprice	The ln form of Rprice	Number
LnRoom	The ln form of Room	Number
LnS-distance	The ln form of S-distance	Number
Ln-T-distance	The ln form of T-distance	Number

5. Estimation results

5.1. Estimated hedonic parameters

Table 3 lists the linear, loglinear and semilog hedonic price model analytical results.

Table 3
Hedonic price model results.

Form	Number of obs	F	Prob > F	R^2	Adjust R^2	Root MSE
Linear	228	44.160	0.000	0.499	0.487	154.040
Loglinear	228	53.620	0.000	0.547	0.537	0.309
Semilog	228	51.340	0.000	0.536	0.526	0.313

As can be seen from Table 3, some significant findings can be got after the three models comparison with each other: (1) the variation—room price can be explained by all the five selected independent variables in all the global OLS regression models (F values respectively equal to 44.160, 53.620, and 51.340). (2) The loglinear hedonic price model is the optimal model with the best fitting coefficients (F = 53.620, Adjust R^2 = 0.537). That means the loglinear hedonic price model fits the data best. Table 4 was the result report of loglinear hedonic price model analysis.

Table 4
Loglinear hedonic price model estimates for room price.

	Coef.	Std. Err.	t	$P > t$	95% conf. interval	
LnRoom	−0.111	0.039	−2.840	0.005	−0.188	−0.034
LnT-distance	−0.049	0.018	−2.760	0.006	−0.084	−0.014
LnS-distance	−0.009	0.024	−0.380	0.703	−0.058	0.039
Year	0.004	0.002	2.120	0.035	0.000	0.008
Star rate	0.504	0.035	14.230	0.000	0.434	0.573
Constant	4.993	0.240	20.800	0.000	4.520	5.466

Among the five selected independent variables, LnS-distance is not significantly correlated with room price at 90% confidential level. On the contrary, LnRoom, LnT-distance, Year and Star rate all perform significantly at the samw confidential level. It may come to the conclusion that LnRoom as well as LnT-distance has a negative influence on hotels' room price. In other words, with the increase of room number and the straight linear distance between hotel and its nearest transport hub, hotel room prices turn to decrease gradually. While Year and Star rate have positive impact on room price, these results corroborate previous researches.

5.2. Spatial autocorrelation analysis results

Table 5 is the result report of spatial autocorrelation analysis of room price and residual by using the optimal loglinear hedonic price model.As seen from Table 5, the Moran's Index values of room price and residual respectively equal to 0.014 (Z score = 5.50)

Table 5
Result report of spatial autocorrelation analysis of room price and residual.

	Moran's Index	Expected Index	Variance	Z score	p-Value
Room price	0.014	−0.004	0.000	5.496	0.000
Residual	0.019	−0.004	0.000	7.212	0.000

Table 6
Geographically weighted regression analysis estimates for room price.

GWR	Minimum	Lower quartile	Median	OLS (global average)	Upper quartile	Maximum	Mean
R^2	0.277	0.287	0.620	0.547	0.870	0.922	0.602
LnT-distance	−0.672	−0.615	−0.031	−0.049	0.271	0.314	−0.061
LnS-distance	−0.757	−0.671	−0.032	−0.009	0.535	0.554	−0.042
Star rate	0.054	0.056	0.441	0.504	0.777	0.996	0.451
LnRoom	−0.144	−0.131	−0.016	−0.111	0.064	0.084	−0.018
Year	−0.048	−0.023	0.003	0.004	0.038	0.040	0.004

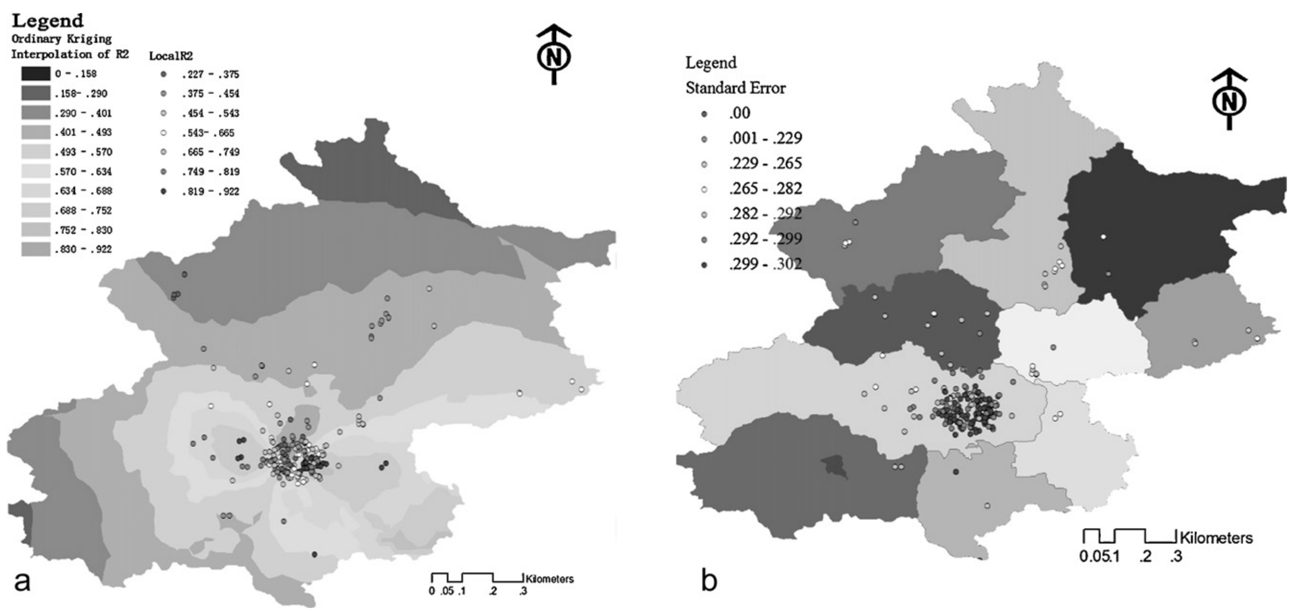

Fig. 2. (a) Spatial distribution of the *R*-square value and ordinary kriging interpolation of *R*-square value. (b) Spatial distribution of the standard error of GWR model.

and 0.019 (Z score = 7.212), which meant positively spatial autocorrelation (p = 0.000). In addition, this information provides some evidence to suggest the existence of spatial dependency *within the hotels*(?) and that geographically weighted regression analysis is intended to correct.

5.3. Estimated GWR parameters

Table 6 is the result report of GWR analysis. For comparison purpose the loglinear hedonic price model estimates are also listed.

The adjusted *R*-squared[1] of GWR model had increased to 0.842. This improvement reflects the importance of localized spatial influences on hotel room pricing in Beijing. The important spatial distribution obtained from the GWR analysis is the spatial variation in the goodness-of-fit statistic, *R*-square. The *R*-square value varies from 0.227 to 0.922. As previously analyzed, the global model explains 54.7% of the variance of room price, just between the minimum and the maximum *R*-square values. Fig. 2a shows spatial distribution of the *R*-square value and the map of *R*-square value's ordinary kriging interpolation. Fig. 2b shows the spatial distribution of the standard error of geographically weighted regression analysis.

As can be observed, *R*-square values in Xicheng Borough, Dongcheng Borough, Haidian Borough and Chaoyang Borough areas are higher than those in other boroughs of Beijing. It can suggest that the correlated relationship between the selected factors and the hotel room price are much better proved in these areas than in other areas according to the regression model. Room price in the periphery of Beijing may be affected by some other factors (such as breakfast, CPI and additional service properties) or areas outside Beijing.

All the five variables in the GWR model show evidence of spatial variation in parameter values. The range of the Star rate parameter goes from minimum value of 0.054 to a maximum value of 0.996. The other four variables, however, have a minimum to maximum range that includes zero. In other words, for other four variables, research results from OLS can be misleading for some hotels. For example, for most sampled hotels in Beijing, the OLS estimated parameter of age (? = 0.004) suggests that the older the age of hotel is, the higher the room price is. This pattern holds true for the majority of hotels but there is a handful unconformity, for there is a negative relationship for other hotels. Similar phenomena happens to the variables LnT-distance, LnS-distance and LnRoom.

Monte-Carlo tests for significant spatial variation provide evidence for the importance of exploring spatiality in statistical models. The result of Monte-Carlo test in this study revealed the significant variation of relationship between hotel room prices and all the independent variables at 0.005 level across the city of Beijing. Although the resulting set of parameter estimates for each variable can be mapped for visual inspection, patterns of *t*-values for the parameter estimates are more important to reveal which areas have statistically significant estimates. Fig. 3 shows spatial distribution of the significance of room and ordinary kriging interpolation of the significance of LnRoom.

[1] This is a "pseudo"-*R*-squared, calculated as the squared correlation coefficient between the observed and predicted values for all 228 regressions.

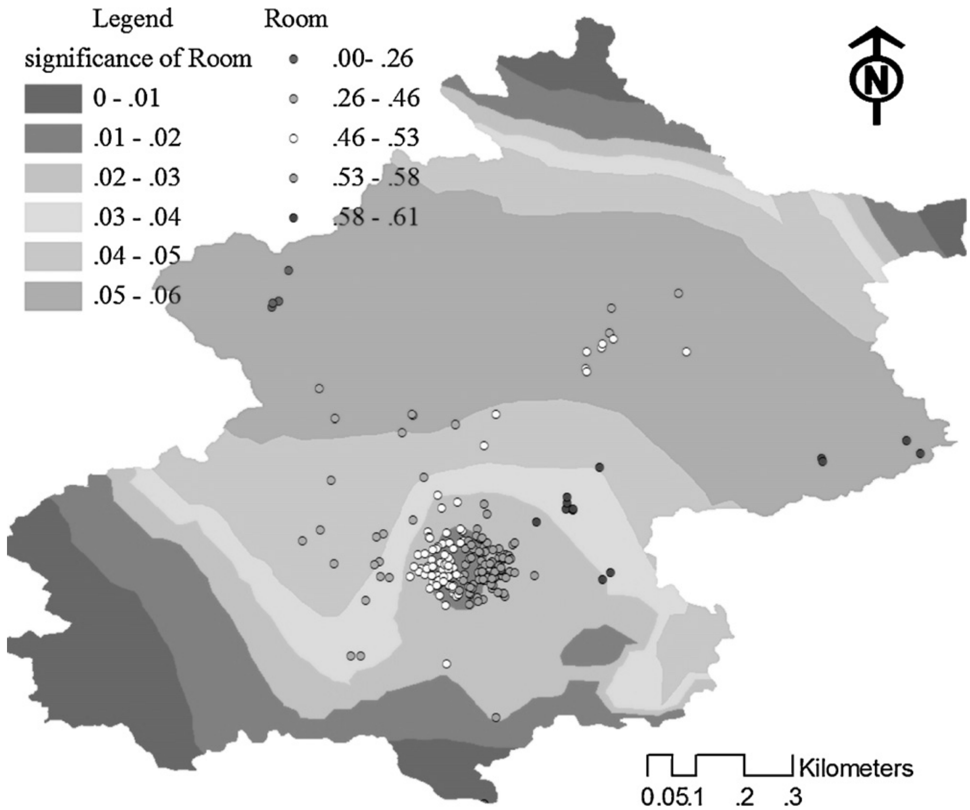

Fig. 3. Spatial distribution of the significance of room and ordinary kriging interpolation of the significance of LnRoom.

6. Conclusions

After reported comprehensive, comparative analysis and case study, some conclusions can be summarized as list:

(1) Among the three global hedonic price models (linear, semilog and loglinear), the loglinear model is the optimal one according to its fitting coefficient (0.5470).
(2) Star rate, size of hotels, age of hotels and location, etc. influence hotel room price significantly in Beijing. And this finding is consistent with previous research results.
(3) Among all the attributions, star rate and founding time have significant positive effects on hotel room prices, while room number and the straight line distance between hotel and its nearest transport hub have significant but negative impact on room prices in Beijing. The straight line distance between hotel and its nearest scenic spots is not significantly correlated with hotel room price in the loglinear hedonic price model.
(4) There does exist substantial spatial autocorrelation in the room price of hotels in Beijing. Room prices of hotels are proved spatially auto-correlated for three reasons. Analytical result of spatially autocorrelated residuals of loglinear hedonic price model illustrates that the global model could not explain the heterogeneity caused by the spatial proximity of the hotels. For specific locales, the results expressed in a global model might be inaccurate.

After all, this study suggests that global hedonic room price model can be used in combination with geographically weighted regression analysis. Geographically weighted hedonic price model has been proved to be more reasonable and explainable for room price in the Xicheng Borough, Dongcheng Borough, Haidian Borough and Chaoyang Borough with maximal value of R^2 there. For other regions with worse GWR model fit, there might be some other uncovered room rate determinants (such as breakfast, CPI and other additional service properties). The surrounding areas of Beijing are suburb and rural areas. Economic development in suburb is far behind that in centeral Beijing. Managers in hotels there should take hotel facilities, quality of food and beverage service, and other direct cost rather than geographic elements into their consideration during hotel room pricing process.

Geographically weighted hedonic price model helps to further related research by means of local regression analysis of room prices. Some inconsistencies about non-stationary parameters found in this study means further investigation is in great need. Managers would then not only be able to identify the current contribution of some site or situation attributions to room price, but know clearly how their hotels are in the spatial proximity of existed hotels.

Acknowledgments

This research was financially supported by National Natural Science Foundation of China (No. 40871072, No. 40371030)

References

Arbel, A., Pizam, A., 1977. Some determinants of urban hotel location: the tourists' inclinations. Journal of Travel Research 15 (3), 18–118.

Brunsdon, C., Fotheringham, A.S., Charlton, M., 1998a. Spatial nonstationarity and autoregressive models. Environment and Planning A 30, 957–974.

Brunsdon, C., Fotheringham, A.S., Charlton, M., 1999. Some notes on parametric significance tests for geographically weighted regression. Journal of Regional Science 39 (3), 497–524.

Brunsdon, C., Fotheringham, S., Charlton, M., 1998b. Geographically weighted regression-modelling spatial non-stationarity. Journal of the Royal Statistical Society Series D—The Statistician 47 (3), 431–443.

Bull, A.O., 1994. Pricing a motel's location. International Journal of Contemporary Hospitality Management 6 (6), 10–15.

Bull, A.O., Alcock, K.M., 1993. Patron preferences for features offered by licensed clubs. International Journal of Contemporary Hospitality Management 5 (1), 28–32.

Carvell, S.A., Herrin, W.E., 1990. Pricing in the hospitality industry: an implicit markets approach. FlU Hospitality Review 8 (2), 27–37.

Cho, S., Kim, S.G., Clark, C.D., Park, W.M., 2007. Spatial analysis of rural economic development using a locally weighted regression model. Agricultural and Resource Economics Review 36 (1), 24–124.

Cho, S.H., Bowker, J.M., Park, W.M., 2006. Measuring the contribution of water and green space amenities to housing values: an application and comparison of spatially weighted hedonic models. Journal of Agricultural and Resource Economics 31 (3), 485–507.

Chung, W., Kalnins, A., 2001. Agglomeration effects and performance: a test of the Texas lodging industry. Strategic Management Journal 22 (10), 969–988.

Coenders, G., Espinet, J.M., Saez, M., 2001. Predicting random level and seasonality of hotel prices. A structural equation growth curve approach. Unpublished Working paper. Department of Economics, University of Girona.

Coenders, G., Jm, E., 2003. Predicting random level and seasonality of hotel prices: a latent growth curve approach. Tourism Analysis 8 (1), 15–31.

Danziger, S., Israeli, A., Bekerman, M., 2006. The relative role of strategic assets in determining customer perceptions of hotel room price. International Journal of Hospitality Management 25 (1), 129–145.

Deller, S., 2010. Rural poverty, tourism and spatial heterogeneity. Annals of Tourism Research 37 (1), 180–205.

Dicken, P., Lloyd, P.E., 1990. Location in Space: Theoretical Perspectives in Economic Geography. Prentice Hall, Englewood Cliffs, NJ.

Espinet, J.M., Saez, M., Coenders, G., Fluvià, M., 2003. Effect on prices of the attributes of holiday hotels: a hedonic prices approach. Tourism Economics 9 (2), 165–177.

Fotheringham, A.S., Brunsdon, C., Charlton, M., 2002. Geographically Weighted Regression: The Analysis of Spatially Varying Relationships. Wiley, Chichester.

Fotheringham, A.S., Charlton, M., Brunsdon, C., 1997a. Measuring spatial variations in relationships with geographically weighted regression. In: Fischer, M.M., Getis, A. (Eds.), Recent Developments in Spatial Analysis. Springer, Berlin, pp. 60–82.

Fotheringham, A.S., Charlton, M., Brunsdon, C., 1997b. Two techniques for exploring non-stationarity in geographical data. Geographical Systems 4, 59–82.

Goldberg, S.M., Green, P.E., Wind, Y., 1984. Conjoint analysis of price premiums for hotel amenities. The Journal of Business 57 (1), 111–132.

Gu, C., Wang, F., Liu, G., 2005. The structure of social space in Beijing in 1998: a socialist city in transition. Urban Geography 26 (2), 167–192.

He, C., Okada, N., Zhang, Q., Shi, P., Zhang, J., 2006. Modeling urban expansion scenarios by coupling cellular automata model and system dynamic model in Beijing, China. Applied Geography 26 (3–4), 323–345.

Huang, Y., Leung, Y., 2002. Analysing regional industrialisation in Jiangsu province using geographically weighted regression. Journal of Geographical Systems 4 (2), 233–249.

Hung, W., Shang, J., Wang, F., 2010. Pricing determinants in the hotel industry: quantile regression analysis. International Journal of Hospitality Management 29 (3), 378–384.

Hurvich, C.M., Simonoff, J.S., Tsai, C.L., 1998. Smoothing parameter selection in nonparametric regression using an improved Akaike information criterion. Journal of the Royal Statistical Society Series B—Statistical Methodology 60 (2), 271–293.

Israeli, A.A., 2002. Star rating and corporate affiliation: their influence on room price and performance of hotels in Israel. International Journal of Hospitality Management 21 (4), 405–424.

Jensen, T., Deller, S., 2007. Spatial modeling of the migration of older people with a focus on amenities. Review of Regional Studies 37 (3), 303–343.

Kestens, Y., Thériault, M., Des Rosiers, F., 2006. Heterogeneity in hedonic modelling of house prices: looking at buyers' household profiles. Journal of Geographical Systems 8 (1), 61–96.

Lancaster, K.J., 1966. A new approach to consumer theory. The Journal of Political Economy 74 (2), 132–1132.

Lewis, R.C., Chambers, R.E., Chacko, H.E., 1989. Marketing Leadership in Hospitality: Foundations and Practices. Van Nostrand Reinhold, New York.

Lloyd, C., Shuttleworth, I., 2005. Analysing commuting using local regression techniques: scale, sensitivity, and geographical patterning. Environment and Planning A 37 (1), 81–103.

Monty, B., Skidmore, M., 2003. Hedonic pricing and willingness to pay for bed and breakfast amenities in southeast Wisconsin. Journal of Travel Research 42 (2), 195–199.

Nagle, T.T., 1987. The Strategy and Tactics of Pricing. Prentice Hall, Englewood Cliffs, NJ.

Partridge, M.D., Rickman, D.S., 2007. Persistent pockets of extreme american poverty and job growth: is there a place-based policy role? Journal of Agricultural and Resource Economics 32 (1), 210–224.

Partridge, M.D., Rickman, D.S., Ali, K., Olfert, M.R., 2008. The geographic diversity of US nonmetropolitan growth dynamics: a geographically weighted regression approach. Land Economics 84 (2), 241–266.

Rosen, S., 1974. Hedonic prices and implicit markets: product differentiation in pure competition. Journal of political economy 82 (1), 34–134.

Sinclair, M.T., Clewer, A., Pack, A., 1990. Hedonic prices and the marketing of package holidays: the case of tourism resorts in Malaga. In: Ashworth, G., Goodall, B. (Eds.), Marketing of Tourism Places. Routledge, London, pp. 85–103.

Smith, D.M., 1966. A theoretical framework for geographical studies of industrial location. Economic Geography 42 (2), 95–113.

Smith, D.M., 1981. Industrial Location: An Economic Geographical Analysis. John Wiley & Sons, New York.

Steed, E., Gu, Z., 2005. An examination of hotel room pricing methods: practised and proposed. Journal of Revenue Pricing Management 3 (4), 369–379.

Thrane, C., 2007. Examining the determinants of room rates for hotels in capital cities: the Oslo experience. Journal of Revenue and Pricing Management 5 (4), 315–323.

Tobler, W.R., 1970. A computer movie simulating urban growth in the Detroit region. Economic Geography, 234–240.

White, P.J., Mulligan, G.F., 2002. Hedonic estimates of lodging rates in the four corners region. The Professional Geographer 54 (4), 533–543.

Wind, J., Green, P.E., Shifflet, D., Scarbrough, M., 1989. "Courtyard by Marriott": designing a hotel facility with consumer-based marketing models. Interfaces 19 (1), 25–47.

Wooldridge, J.M., 2009. Introductory Econometrics: A Modern Approach. South Western Cengage Learning, Mason.

Wu, L., 1999. The pricing of a brand name product Franchising in the motel services industry. Journal of Business Venturing 14 (1), 87–102.

Yrigoyen, C.C., Otero, J.V., Rodríguez, I.G., 2008. Modeling spatial variations in household disposable income with geographically weighted regression. Estadística Españolal 50 (168), 321–360.

Yu, D.-L., 2006. Spatially varying development mechanisms in the Greater Beijing Area: a geographically weighted regression investigation. The Annals of Regional Science 40 (1), 173–190.

Zheng, S., Kahn, M.E., 2008. Land and residential property markets in a booming economy: new evidence from Beijing. Journal of Urban Economics 63 (2), 743–757.