A GIS-based Analysis of the Hotel Locations Choice in Manhattan, New York, 1820-2012

By

Ting Du

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Approved by

Yingru Li , Chair, Assistant Professor of Geosciences
Luke Marzen, Professor of Geosciences
Chandana Mitra, Assistant professor of Geosciences

Abstract

Location is one of the most important elements of hotel development. This study aims to investigate the locations of hotels in Manhattan, New York. This research was conducted for the following purposes: (1) to analyze spatial-temporal variations of hotel development in Manhattan, New York from 1822 to 2012; (2) to provide feasible measurements to assess and quantify the relevant location factors influencing hotel performance; (3) to examine and identify the potential location factors which are significant to location decision making and hotel performance. GIS-based spatial statistical methods were applied to detect spatial-temporal patterns of hotel location distribution over different time periods. In addition, multiple regressions were used to examine the relationships between location factors as well as the star levels, sizes and performances of hotels. The results illustrate the sensitivity of location factors which impact hotel location decision making and operation, and provide valuable references for retailers and planners.

Key words: Hotel location, GIS, Spatial statistics, New York City

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1. Introduction

Spatial location is one of the most important factors for investment (Cheng, 2004). Newell and Seabrook (2006) defined hotel location as one of the most influential factors in hotel investment decision making. The location choice for a hotel facility may have a significant impact on the hotel's strategies for competitive advantage in terms of financing, marketing, human resources, and customer satisfaction (Mount, 1990; Adam, 2012). An appropriate location is of paramount importance because it is difficult and extremely costly for hotels to relocate and reconfigure their product offerings (Yang, 2012). This research aims to analyze the spatial-temporal variations of hotel development in Manhattan, New York from 1822 to 2012, and it examines the significance of relevant location factors on hotel performance, size, and star level.

Manhattan, which has the densest population and highest income level on average among the five boroughs (Manhattan, Brooklyn, Queens, The Bronx, and Staten Island) in New York City, has been described as the economic and cultural center of the United States.. It is surrounded by the East, Hudson and Harlem Rivers, which provide many busy and beneficial ports for cruises. Manhattan can be broadly divided into three general parts: Downtown, Midtown, and Uptown. Many landmarks and attractions are located in these three sections. Lower Manhattan, called the Financial District, includes Wall Street, the World Trade Center site, a departure point

for ferries to the Statue of Liberty, and New York University; Midtown, which has the Empire State Building, Broadway, and Times Square, and Upper Manhattan, which contains Central Park and Columbia University. . These areas are well known to the world and attract millions of tourists, investors, and businesspersons every year, creating a good scenario for hotels' prosperity from both economic and geographic aspects. Last year, tourists increased by 3.5 percent to a record of 50.5 million visitors, and data illustrates that supply of the hotel industry is currently lower than demand. This huge market potential has encouraged investors to build new hotels in virtually every Manhattan neighborhood and to compete for customers through hotel design, marketing and location.

Previous studies on hotel location have analyzed their spatial distributions. For example, Shoval (2001) analyzed the spatial distribution pattern of hotels in Jerusalem in terms of distances from churches and consulates. Yang (2012) used an ordered logit model, including location attributes and hotel characteristics, to present the hotel distribution in Beijing. Other research has examined the determinants for hotel location choice. They categorize hotel location selection factors according to laws and regulations, economic factors, neighborhood characteristics, socio-cultural factors, geographical characteristics, fine visual perception, and transport convenience (Adam and Francis, 2013; Chou, 2008; Newell and Seabrook, 2006; Ghita, 2013; Qiu Zhang, 2012; Ariffin, 2012; Danziger, 2006; Dye, 2007; Coutinho-Rodrigues, 2011).

Nevertheless, these studies provide snapshot investigations limited to the current characteristics and performance of hotels (Adam, 2013; Chou, 2008; Newell and Seabrook, 2006). Therefore, hotel location decision making should not just benefit from contemporary environments. It should be temporally adaptable to changing environmental characteristics and evolutions of market trends in order to be profitable for the hotel's lifetime. Spatial analysis is limited in the literature as well. If the results are shown in a visible way, it makes understanding and accepting the results much easier for readers. In addition, limited literature has clearly defined and quantified the influences of location factors, such as agglomeration and competition factors, on hotel performance. This study aims to fill in these gaps and investigate spatial-temporal variations of hotel locations by employing a combination of visible and statistical methods to appropriately define and assess the relevant location factors.

Based on the facts above, the following research questions are raised. (1) Is hotel development closely related to spatial-temporal variation? (2) Which factors influence hotel performance and location decision-making? Corresponding to the research questions, the hypotheses are 1) Hotel development is sensitive to spatial-temporal variation; 2) Hotel performance and characteristics are influenced by social, alternative, and transportation factors.

With assistance from a Geographic Information System (GIS) and statistical tools and techniques, the spatial patterns of hotel distributions in Manhattan were

mapped and analyzed. Four multiple regression models were constructed to examine and identify the influential location factors in hotel location decision making and performance. The dependent variables are time periods when hotels were built, star levels, and the number of rooms respectively. The independent variables can be categorized into three aspects, including social factors, alternative location factors, and transportation factors.

This paper is organized into five sections. As section 1, introduction outlines the research background and problems. The literature review follows in section 2, which summarizes findings of previous research. Section 3 explains the data and methods used to examine the relationship between hotel development and spatial temporal variation, calibrate the agglomeration and competition factors, and then estimate the influential factors on hotel performance. The results are discussed in section 4. Finally, some major findings and conclusions are highlighted in section 5.

2. Literature Review

This section briefly introduces basic theories of retail location, previous studies concerning hotel location, and GIS applications in location analysis.

2.1 Retail location theories

Extensive research about retail location is well documented. Brown (1993) summarized four virtual concepts in retail location: central place theory (CPT), spatial interaction theory, bid rent theory, and the principle of minimum differentiation.

The CPT was proposed by Christaller (1933) and Losch (1940), which describes the number, size, spacing, and functional composition of service centers in a micro-economic world. The precondition for this theory is that the world has a uniform distribution of identical, equal quantity, and fully informed consumers, and all the sellers have equivalent costs and free entry and behavior in a rational, perfect competitive, and profit maximizing manner. Since then, the CPT has been employed and elaborated on by other scholars. Berry and Garrison (1958) applied the model to a non-uniform environment, where people's purchasing power affected the distribution of markets in the area. If an area has a higher population and purchasing power, the market areas will be formulated to be compact and centrally located. Conversely, in areas where the population and purchasing power is less, market areas are found to be more widely dispersed and expanded.

Spatial interaction theory is regarded as one of the most valuable

generalizations in retailing location. The appearance of spatial interaction theory is rather remote and not easy traceable, however, the pioneering studies of applications in retail-related aspects are derived from Reilly (1929, 1931). Reilly proposed his famous law of retail gravitation which argued that consumer behavior was related to "gravitational" forces and expressed law-like regularities just as the laws of Newtonian physics. In the following years, a number of more fundamental conceptual refinements of the gravity models were proposed; perhaps most important was Huff's modification. Huff (1962, 1963) formulated a model for capturing market share, which is widely considered the single most significant post-war contribution to the spatial interaction theory. It assumes that consumers will patronize the most appealing shopping areas which have enough optional selections, regardless of the resistant effect of distance.

Haig (1926a, 1926b, 1927) proposed the land use theory based on his comprehensive study of land use in New York. He argued that all economic activities prefer access to resources and that the profit from these activities differ in degrees based on central location. Futhermore,competition for an inelastic supply of land makes it obvious that all urban sites are controlled by the affordable ability of paying the most for the best land. Therefore, land is put to its "highest and best" use in the long run.

The conceptual touchstone of "spatial" accessibility is Hotelling's (1929)

principle of minimum differentiation. He suggested that each customer patronizes the facility closest to him/her and that one seller can maximize profit by setting up shop adjacent to a competitor. This concept is often applied to micro-scale (intra-center) retail location. This aspect of Hotelling's agglomerative hypothesis received considerable empirical support, and large quantities of statistical analysis in different approaches were conducted to verify his theory. TResults showed that sellers with the same or similar categories of merchandise tend to cluster closely together. In addition, the clustering degree is inversely related to the order of goods (Kivell and Shaw, 1980). For instance, higher order retailers benefit more and much prefer to distribute close to each other, such as the ladies outfitters. On the contrary, low order retailers exhibit more dispersed distribution and are less agglomerated, like convenience stores and personal services. However, Hotelling's hypothesis strengthened the consumers demand and transportation costs, rarely encountered in real world situations (Freeman and Dungey, 1981). Consequently, many other scenarios were tested based on Hotelling's theory (Brown, 1993). These scenarios consisted of variations in population density (Ali and Greenbaum, 1977; Braid, 1988), pricing (Anderson and Neven, 1990; Fik, 1991), market shape and size (Relelle, 1986; Hanjoul and Thill, 1987), number of competitors (Eaton and Lipsey, 1975; Okabe and Suzuki, 1987), and customer loyalty (Anderson, 1986; Ohsawa, 1990).

Nelson's (1958) theory of cumulative attraction later further improved the

principle of minimum differentiation from his extensive empirical surveys of customer behavior. This theory states that customers prefer to compare the properties of offerings in several stores before purchase, including price, pattern, quality and fashion, especially. (Brown, 1993). Nelson (1958) explained in his theory of cumulative attraction that retailers with different categories prefer to locate near each other in order to take advantage of merchants themselves. Retail agglomerations attract more consumers because of the decrease in traffic time and search uncertainty (Ghosh, 1986; Brown, 1989). Therefore, "a given number of stores dealing in the same merchandise will do more business if they are located adjacent, or in proximity to each other than if they are widely scattered". (Nelson, 1958)

2.2 Previous research about hotel location analysis

Hotel industries face important decisions when developing a new establishment (Urtasun, 2005; Yang, 2012). Compared to other businesses, the hotel industry is unique because it relies heavily on location, although production and consumption occur simultaneously (Lee, 2010).

Many studies and models have been utilized to examine the potential determinant factors in hotel location decision making. Yang (2014) summarized hotel location models and divided them into three categories: theoretical models, empirical models, and operational models. Theoretical models, including tourist-historic city models (THC model) (Rogerson, 2012a), mono-centric models (Egan and Nield,

2000), agglomeration models (Canina et al., 2005) and multi-dimensional models (Ustrasun and Gutierrez, 2006), established the theoretical foundation for the spatial location choice of hotels. . Empirical models, including spatial statistical models (Sund, 2006), zoning regression models (Holl, 2004), discrete choice models (Yang et al., 2012), simultaneous equation models (Usrtasun and Gutierrez), individual evaluation models (Lee et al., 2010), and hotel success models (Shoval, 2006) were derived from substantial research efforts which aimed to better understand the driving forces behind hotel location.

Finally, operational models, such as the checklist method (Lin and Juan, 2010), statistical prediction (Smith, 1995) and a Geographic Information System (Yang, 2012) combine both theoretical models and empirical models to create new ways which are more suitable for real world.. Regression analysis is a common choice among those models. It allows researchers to determine how much variance a study needs and while at the same time, obtaining the weight for each criterion. For example, Chung (2001) used regression analysis to examine which factors were the most influential on industry performance in Texas among the number of retail, service establishment, per capita income, the count of same size and chain affiliation.

Investigation of previous literature identified a number of previous studies on hotel location site analysis. For example, Dolnicar (2003) organized attributes that influence hotel location decision making into 11 categories. These included location,

image, price, competence, access, security, additional services, bedrooms, and leisure facilitates. Qiu Zhang et al. (2012) also listed land, labor, raw materials, location, culture, human capital, and institutional framework, as examined attributes. Furthermore, Chou et al (2008) found geographic conditions, traffic conditions, hotel characteristics and operation management to be influential hotel site decision making factors.. Yang (2012) employed the number of subway entrances around hotels to examine the traffic convenience. All factors cannot be ignored, but location always shows to be the highest priority.

Most literature focuses on analyzing contemporary data. Newell and Seabrook (2013) used AHP multi-criteria decision-making methodology to assess the weights attached to each of the 30 factors influencing hotel investment decision-making. His findings showed that the main factors influencing hotel- investment decision-making were financial (37.0 percent) and location (29.9 percent) factors. Chu (2000) also concluded through conjoined analysis that hotel location appeared to be more important than marketing managers expected. Chung and Kalnins (2001) focused more on influences of agglomeration and competition effects on the hotel location, which are also significant. Qiu Zhang et al (2012) also analyzed the factors that determine the location strategies of MHGs (multinational hotel groups) and the effects of institutional factors on the location trends of MHGs by regression model. The results show that political factors, market demand and market size, business

environment, and mega events play a dominant role in determining the choice of location of MHG hotels in China. Wei et al (2001) used the Internet and its association with organizational characteristics and geographical locations to indicate that hotel size, star rating, hotel type and geographic location are significant useful factors when booking hotels online. Adam and Amuquandoh (2013) found unnecessary factors in special circumstances, including land price,, which is less important in cities with a good transportation network. In such cities, the cost and time of movement between the peripheries and the CBD (Central Business District) are insignificant; hence hotels may choose to locate in other locations for other reasons.

Ustasun and Gutierrez (2006)'s research is unique in that it pays special attention to both historical and contemporary data by empirically testing a simultaneous equations model. The results suggest that Madrid founders predicted greater benefits than costs by creating geographic agglomerations by locating near competitors of similar size and services. However, they predicted greater costs than benefits for geographic competition with similarly priced hotels (Ustasun and Gutierrez, 2006). Both the geographic agglomeration and competition show influence on pricing decisions.

Besides location factors, other factors also influence hotel performances, such as value, service quality, security, room price, business facilities, and food and

recreation (Chu and Choi, 2000; Danziger et al. 2006).

2.3 GIS methods applied in location systems

GIS is defined as a computerized system used for the storage, retrieval, mapping, and analysis of geographic data (Peuquet, 2003). GIS provides a more efficient decision-making support system for selecting suitable sites of new hotels by incorporating spatial considerations.

As Cheng et al (2007) says, in order to take advantage of information technology, GIS enables handling of both spatial and non-spatial data. This allows for itsspecific roles in data management, data query, data analysis, and data visualization. Although GIS has been used extensively for retail location analysis,there are few studies which have used GIS for hotel location analysis.

Oppermann and Brewer (1996) presented a conceptual framework of hotel location decision making by GIS, including data acquisition and data analysis stages. Joerger et al. (1990) provided a detailed example of utilizing GIS to improve hotel location selection. Their research used a stepwise diagnostic GIS approach to select suitable sites for new hotels based on soil type, land use type, conservation status, road accessibility and coast accessibility.. Beedasy and Whyatt (1999) used GIS to construct a spatial decision-support system to conduct a weighted linear combination technique to obtain the suitability score of each possible hotel location. In addition, the analytical ability of GIS has enhanced the possibilities of solving the semi-

structured problems and judging the subjective factors in hotel location. The way they used GIS gives the user or decision-maker a flexible approach to change the criterion based on different purposes or problems. Crecente et al. (2012) utilized GIS to manage evaluation data and visualize the results. The two approaches together supported the location selection of thalassotherapy resorts.

GIS is a tremendously useful tool in dealing with spatial problems. Dye (2007), Suarez-Vega (2011), and Benoit (1997), all used GIS to solve spatial location problems. However, GIS has rarely been used to analyze spatial- temporal patterns of hotel locations.

2.4 Research objectives

Based on the above review, these areas deserve further research efforts. First, most studies ignore the influence of history, focusing namely on the current circumstances. Second, although there has been extensive research discussing the factors related to hotel performance, there are fewer studies which provide guides on what should considered when establishing a hotel. Third, previous research only analyzes findings based on statistical results while not applying visual methods to clearly demonstrate the spatial patterns.

To fill-in these gaps, this research addresses these three research objectives: 1) to explore the spatial- temporal variations on hotel locations in Manhattan, New York

City from 1820 to 2012; 2) to examine the significance of location factors in hotel location decision making and illustrate the relevant importance of these factors in hotel performance, during different time periods and; 3) to develop a new approach to assess and quantify hotel location factors through using a combination of visible methods (GIS) and statistical methods (regression analysis).

3. Methodology

3.1 Study area

The Manhattan area, one of the five boroughs of New York City, is selected as the study area (Figure 1). Manhattan is considered one of the most famous tourist destinations in the world. Attractions and landmarks are factors that cannot be ignored for hospitality. The apparent attractions selected in this study are Times Square, the Statue of Liberty, Central Park, and Wall Street. Also, shopping centers can be appealing to customers all over the world as well as business centers. Therefore, Manhattan Mall, International Council-Shopping Center, Rockefeller Center, Limelight Shops, Canal Shopping Center, Bobby Berk Home and Plaza at Deptford LP are all counted as famous and influential shopping centers in this study area. The transportation in Manhattan is quite convenient. Buses, subways, and highways are located throughout the island. Meanwhile, three of the busiest international airports in the world, LaGuardia Airport, Newark Liberty International Airport, and Kennedy International Airport, are close to the study area. Also, there are many ports designated for cruise ships. Therefore, these three types of transportation are considered as basic traffic criterion in the study area, which offers a thoroughly solid and beneficial condition for hotels. A number of hotels are located in the study area which already provide a substantial database. Therefore, Manhattan is a meaningful and typical place for hotel location research.

Figure 1 Study area (Sketch map)

3.2 Analytical Framework

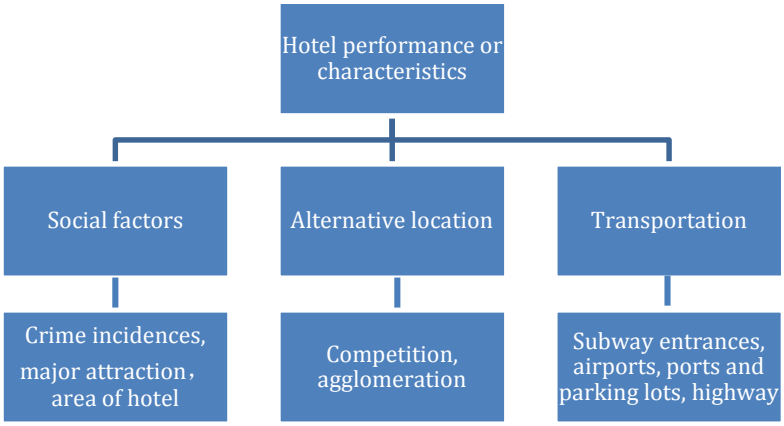

Figure 2 Analytical framework

In this research, hotel performance and characteristics will be described from three aspects: social, alternative location, and transportation characteristics.

Social factors are indicated by crime incidences and major attractions. Smith (2004) believes that terrain and nature of the landscapes around the hotel can attract more consumers. Access to attractions also affects hotel attractiveness for guests. (Bull, 1994). Additionally, Lee et al (2010) emphasized that low crime rates in neighborhoods (ranked just below tourism attraction influences) also contribute considerably to hotel performance. The importance of the land use area was also examined by Li and Liu (2012) and Adam (2013), which revealed that retailers can benefit more from larger store areas.

Alternative location factors include competition and agglomeration effects. As

Tsang (2009) argued, retailers should locate far away from each other in order to avoid the intense spatial competition and to obtain maximum local benefits. He further mentioned that the competition effect could be strengthened if retailers served similar merchants. In contrast, geographic proximity also generates agglomeration effects as well (Tsang, 2009). Furthermore, Chuang & Kalnins (2001) identified spatial agglomeration effects as an important factor in hotel location decision making since retailers can reduce the search costs of consumers by geographically concentrating (Pandit and Cook, 2003). As a consequence, it is meaningful to examine the influences of agglomeration and competition effects on the performance of Manhattan hotels.

Transportation factors are described by the accessibility to subway entrances, airports, ports, parking lots and highways (Newell and Seabrook, 2005). A good road network can enhance visitor experience and provide more possibilities and convenience to meet customer needs, since guests may not prefer to go through thick and thin to get to a hotel (Adam, 2013). Additionally, Lee and Hsu (2000) indicated that investors prefer to select a good hotel location which can easily achieve the commercial areas, conventional centers and airports. As a result, transportations are notable characteristics to account for hotel performance.

3.3 Data and Data Sources

Data required for this study include information of hotels, attractions,

transportation, retailers, parking areas, and security.

The hotel information data, which contains the number of rooms, star level, year built, and address, were purchased from STR Global (https://www.strglobal.com/). The GIS layers of highways, parking areas, crime incidence, and retailers were downloaded from NYC Open Data website (https://nycopendata.socrata.com). The basic data used in GIS, including streets data and boundary data in Manhattan, were downloaded from the U.S. Census Bureau website (https://www.census.gov). Locations of hotels, agglomeration stores, attractions, ports, airports, and subway entrances were obtained from the Internet and Google earth, before being geocoded with GIS.

Four regression models were constructed to examine the relationship between hotel development and spatial-temporal variation to calibrate suitable agglomeration and competition areas, and to explore the influential factors on hotel performance. The dependent variables are time period, star level, the number of rooms, and hotel performance, respectively. The years between 1822 and 2012 were divided into six periods based on the significant events. The six periods were replaced from 1 to 6 in sequence to indicate the changing of time. Star level indicates the level of each hotel, including economy, middle level, upper middle level, up level, upper up level and luxury, which are quantified using the numbers 1 to 6. Room number is defined by the number of rooms in each hotel, used to illustrate the size of hotels. It is divided into 4

categories, small (less than 150), middle (Between 151 to 400), large (between 401 to 1500) and mega (lager than 1501) sizes. Hotel performance is a variable, which is used to portray the operation status, Hotels which are currently open are illustrated by 1; all others are illustrated as 0. The independent variables include indicators of social, alternative location, and transportation factors. Social factors are reflected by the accessibility of hotels to attractions, explained by the distance from hotel to each attraction and the degree of hotel safety, explained by the number of previous crime incidences within 300 meters. Alternative location factors are demonstrated by competition and agglomeration effects, defined by the number of hotels with the same star level within Manhattan, in addition to the number of hotels and retailers within the area around each hotel. Transportation factors are composed of subway entrances, airports, ports, parking lots and highways, indicated by the number of subway entrances, airports, and parking lots within a radius of 500 meters around a hotel. Highways are quantified as 1 if adjacent to a hotel or 0 if not. Variables are summarized in Table 1.

The 500 meter radius was chosen based on previous studies of Shoval et al (2011) and McKercher and Lau (2008), which found that tourists preferred hotels within a 500 meter walking distance of attractions and/or transportation. Considering crime incidences consistently happened to people walking relatively long distances, such as on their way home or to other destinations, the relatively short walking

distance of 500 meters was chosen.

Table 1. Data and variables

Class	Type	Variables
Dependent variables	Time period	6 periods were divided based on big events between 1822 to 2012
	Star level	The classification of hotels
	Room number	The number of rooms in a hotel, indicating the size of the hotel
	Hotel performance	Hotel still open is 1; others, 0
Independent variables	Attractions	The distance between each hotel and each attraction
	Crime incidences	The number of crime incidence within the area around each hotel (radius=300 meter)
	Area of hotel	The areas of land occupied by the hotels are measured, with a unit of square meters
	Competition	The number of hotels with same star level in Manhattan
	Agglomeration	The number of hotels and retailers within the areas around each hotel (300 meters, 500 meters, 800 meters and 1000 meters)
	Subway entrances	The number of subway entrances within the area around each hotel (radius=500 meter)
	Airport	The distance between each hotel and each airport
	Port	The distance between each hotel and the nearest port
	Parking area	The number of parking areas within the area around each hotel (radius=500 meter)
	Highway	The adjacency to highway; adjacent highways =1, otherwise, 0

3.4 Methods and approach

GIS and statistical analysis were applied to explore the spatial pattern of hotel locations during 1822 to 2012 and identify the influential factors in hotel- location decision-making.

3.4.1 Spatial-temporal variations of hotel location distribution

The spatial distributions of hotels across six different time periods will be presented. The six time periods are divided by influential events. From1822 to 1869 was the Civil War era. The U.S. economy was primarily agricultural in the early 19th century (Habakkuk, 1962) and an increasing number of families in the South became wealthy by taking advantages of growing cotton. This led to a large South to North migration which stimulated the development of transportation, including the building of railroads and canals (Thomson, 2009). A consequence of this migration was the eruption of the Civil War. During this time, the priority was to satisfy the requirements for military battle, leaving no more extra resources for hotel construction (Fite, 1910). As a result, neither the demand for hotels nor the service level was strong. The years between 1870 and 1929 were known as the Progressive Era, known for the rapid development of the US economy. This was achieved through railroad construction and development of iron industries and manufacturing after the end of the Civil War. These projects in part established the foundation of modern American industry.

Following this great economic success, the stock market crashed in 1929, and the world economy plunged into the Great Depression, which lasted into 1941. Therefore, this historical time between 1930 and 1941 is known as the Great Depression era. The rise of income tax rates aggravated this serious crisis and giving rise to millions of unemployed workers. This resulted from a large number of farmers

being forced give up arable lands, the closing of factories and retailers, and the failure of banks (Fite, 1910). Hotels also suffered. By 1932, the unemployment rate increased to 25percent (Mitchell, 1947).

World War Ⅱ was the most influential event between 1942 and 1973. . America's involvement in the war required the expansion of arms and equipment, which offered job opportunities and decreased the high unemployment rate (Cantor and Land, 1985). Despite the Great Depression and World War II, the middle decades of the 20th century were a golden era of economic growth (Bjork, 1999). That is to say, even though World War II had some negative influences on some hotels, it also helped to stimulate their development. From 1974 to 2000, they experienced the rise of globalization, considered the new economic period. It was a period of transition from heavy industry to a new technology based economy, including the initial public offering of high-tech and "dot-com" companies (Charles, 1983) in which the economy is stable and increases gradually. From 2001 to 2012, the Great Recession occurred. In the early 21st century, the Internet bubble and the "9/11" terrorist attacks contributed to and exposed the weak economy of the United States. The housing bubbles accelerated the collapse of the world economy (Mauro, 2009). Although the great recession struck the US, it offers a good opportunity to reform its economic framework (Davis, Jonathan and Duncan 2012). The distribution of hotel establishment in Manhattan during these different periods of time are mapped and

analyzed with GIS.

3.4.2 Calibration of the agglomeration and competition factors

Agglomeration is one of the most intriguing features in service industries. Hotels that locate close to one another will mutually benefit from the agglomeration effects. Through spatial concentration, sellers can reduce consumers' search costs and attract more consumers as a whole relative to individual attraction (Gan and Hemandez, 2013). Therefore, agglomeration may imply higher retail profits. In contrast, competition effects lead to greater price competition and lower profits and rents.

Agglomeration and Competition effects have inverse influences on consumers' decision making. On one hand, the consumers' choice is flexible. The more alternatives, the less probability they will patronize a certain hotel. On the other hand, in order to have more choices, consumers may prefer to go to areas where hotels and retailers are clustered (Eric, 2009; Gan and Hernandez, 2013). This study proposes ways of explicitly measuring these two factors and examines the interplay between them in influencing consumers' choices, thereby potentially altering the management of individual hotels. Considering the purposes of this study, two market areas should be set up to examine the two effects within the agglomeration market area, i.e. within the area that the agglomeration effect occupies, and within the competition market area i.e. where the competition effect takes over. The competition area is larger than

or equal to the agglomeration market area (Li and Liu, 2012). The influence of agglomeration and competition effects will be slight and can be ignored when the area is out of the competition area.

Very little previous literature accurately defines the market area for agglomeration and competition effects in hospitality in a general way. Suarez-Vega (2011) set up 1500 m as the radius of the market area of agglomeration for retailers. Satani et al (1998) assumed four radii of market areas: the influence of the central commercial district is the entire metropolitan area; the influence of sub-central commercial district is about 5000 m; the influence for the local commercial district is about 2000 m; the influence of a neighborhood commercial district is limited to particular districts. However, none of these settings are suitable for Manhattan. The width of Manhattan is about 3450 m, making it too narrow and unscientific to fit the standard in previous literature. Therefore, a suitable market area is needed and calibrated based on the real conditions of Manhattan.

According to Li and Liu (2012), the distance they assumed for competition area 6,434 meter (4 mile) radius, and the study area was about 402,510,800 square meters. The area of Manhattan is about 74,441,500 square meters. With this in mind, the initial radius for the competition area in Manhattan was obtained through proportional calculation with Li and Liu's research, resulting in estimated radius of 1839 meters. In order to properly consider the various possibilities, the most suitable

radius of competition area in Manhattan was verified and selected from 1000 meters, 2000 meters, 3000 meters, 4000 meters, and 5000 meters, since the agglomeration area should be smaller or equal to the competition area. Hence, different agglomeration radiuses are set up to examine which area reflects the agglomeration effect the most. The different distances are 1000 meters, 800 meters, 500 meters and 300 meters.

The total number of hotels and neighboring retailers (restaurants, shopping malls), counted as agglomeration factors, strengthen the competition ability of hotels within market area (Tsang and Yip, 2009) Since there are plenty of retailers in Manhattan, it is difficult to get information on all of them. For the restaurants, "100 best New York restaurants" were chosen in this research according to published news from the website "Timeout New York" (http://www.timeout.com/newyork /restaurants/100-best-new-york-restaurants). Shopping malls are selected based on "best shopping mall in Manhattan area," from the website "trip advisor" and NYC.com.

According to Baum and Mezias (1992), the competition effect was more intense between hotels with similar size, level, and location in Manhattan. As a result, the competition effect is indicated by the number of hotels in the competition area with the same star level.

The agglomeration and competition factors counted in different areas will be

calibrated with the four regression models. The best agglomeration and competition market area distances will be filtrated based on the regression results analysis.

3.4.3 Statistical analysis

Statistical analysis was applied to examine the potential factors determining spatial-temporal variations in hotel distribution and contributors influencing hotel location decision making. Four multiple regression models were constructed.

Time period =

$$a+b*Air+c*Port+d*Att+e*Sub+f*Park+g*Crime+h*Agg+i*Com+j*High +h*Area$$

(Equation 1)

Room

$$=a_2+b_2*Air+c_2*Port+d_2*Att+e_2*Sub+f_2*Park+g_2*Crime+h_2*Agg+i_2*Com+j_2*High +h_2*Area$$

(Equation 2)

Level

$$=a_3+b_3*Air+c_3*Port+d_3*Att+e_3*Sub+f_3*Park+g_3*Crime+h_3*Agg+i_3*Com+j_3*High +h_3*Area$$

(Equation 3)

Perform

$$=a_4+b_4*Air+c_4*Port+d_4*Att+e_4*Sub+f_4*Park+g_4*Crime+h_4*Agg+i_4*Com+j_4*High$$

$+ h_4$*Area

(Equation 4)

Transportation factors include “air”, “port”, “sub”, “high”, and “park”. “Air” refers to the distance from each hotel to each airport around the Manhattan, considered the accessibility of airport. “Port” indicates the distance from each hotel to each port, considered the accessibility of port. “Sub” explains the number of subway entrances around each hotel within a radius of 500 meters, considered the accessibility of subway entrance. “High” indicates the probability of highway accessibility. “Park” means the number of parking areas included within a 500-meter radius of each hotel, considered the accessibility of parking area. All of these six factors belong to transportation factors, and a strong transportation network will have positive effects on hotel performance. Yang (2004) observed transport’s substantial influence on hotel location decision making, stating that it serves as a catalyst to attract and encourage visitors to patronize specific hotels, considering accessibilities to transportation are defined by distance. These results indicate that it is reasonable to have negative coefficients and significant results for these 5 factors.

Social determinants contain “crime”, “att” and “area”. “Crime” indicates the incidence of crime around each hotel within a radius of 300 meters, considered the safety degree of each hotel. “Att” represents the distance from each hotel to each major attraction, considered the accessibility of attractions. “Area” reflects the area of

each hotel. All of them are momentous socio-cultural issues, which need to be considered. Hotels exist in large extent to accommodate travelers who aim to visit these attractions. Also, hotels in low crime incidence areas attract customers who consider the issue of safety a priority. Larger area hotels can enhance the overall image to customers and raise the competition ability.

Alternative locations are reflected by “agg” and “com”. “Agg” indicates the agglomeration effects on hotel location choice. “Com” refers to the competition effect considered when building a hotel. They are alternative, non-ignorable location factors for retailers’ existence and performance.

The dependent variables in the four equations are time period, number of rooms, star level, and hotel performance. The 6 time periods will be replaced by 1 (1822-1869), 2 (1870-1929), 3 (1930-1941), 4 (1942-1973), 5 (1974-2000), 6 (2001-2012), separately. The star level will be represented according to: economy=1, middle level =2, upper middle level =3, up level=4, upper up level =5, luxury=6. The number of rooms in each hotel reflects the size of a hotel divided into four according to the classification of hotels on the website, “Hotel Mule,” which stipulates hotel sizes in the following way: small (less than 150), middle (between 151 to 400), large (between 401 to 1500) and mega (lager than 1501). For performance, hotels which are still in operation, were given a value of1, which also indicates better performance. All others were given a value of 0, indicating hotels with worse performance and as a result, are

now closed or are no longer operational.

The optimal agglomeration and competition indicators, which are calibrated in all four regression models with different distances, will be put into each model in this step with all the other independent variables.

5. Results

5.1. Spatial temporal variations of hotel location distribution

Notably, the establishments of hotels are mainly dominated by capital, land resources, labor pool, market size, and policy (Qiu Zhang, Guillet and Gao, 2012; Dolnicar, 2003; Lee, 2010). All of these parameters are highly affected by the diverse economic status and events which occurred during different time periodss. The spatial temporal variations of hotel distributions are presented in Figs 3-20, which illustrate the changes of hotel locations in 6 different periods of time from the perspectives of hotel performance, level, and size.

During the 1st period of time, from 1822 to 1869, two hotels were established. Both of them were economy level and small sized. They were located in southern Manhattan and are still operational. More hotels were built during the 2nd period of time, from 1870 to 1929. All seventy-four hotels preferred to locate in lower central Manhattan; more than half of which were luxury level. The eleven closed hotels were further examined. Most of them were middle-to-small-sized luxury level hotels. The number of hotels built during the 3rd period of time, from 1930 to 1941, decreased to nineteen. They were mainly clustered in lower central Manhattan. Only one mid-sized luxury-level hotel closed during this period. Among the rest of the still operational hotels, the number of mid-sized luxury level units slightly exceeded the others. During the 4th period of time, from 1942 to 1973, only one closed among the

total twenty-two hotels, which was again a small-sized luxury hotel established in lower central part. However, the number of luxury level hotels were still dominant among the open hotels, although the number of smaller-sized hotels were considerably exceeded the number of larger size hotels. The quantity of hotels built during the 5th period of time, from 1974 to 2000, grew to seventy-seven. The majority of them were built in the lower central area with fewer in the south, and only a handful of hotels built in the upper-central and northern parts. More than half of the hotels were chosen to be luxury-level and smaller-sized. Among those built, seven did are no longer in existence. Half of them were large- sized, with almost all of them being luxury level. The small and mid-sized luxury level hotels dominated the 6th period of time, from 2000 to 2012. All hotels were clustered in the lower central part and southern parts, with very few in the north. No hotels closed during this period.

Hotel performance (closed or still currently open) is interpreted in Figs3 thorugh8. Twenty-two of the 333 hotels are closed now. Most of which were built during the 2nd and 5th periods of time. Of the closed hotels, twenty of them were located in the lower central part, around Central Park and Times Square; the remaining two were in the southern corner near Wall Street. Examinations at the star level showed eighteen (82%) were to be luxury level, three (14%) to be affordable levels, and two (4%) to be economy level. From a hotel-size perspective, twenty (91%) of hotels were small and mid-sized, and the other two (9%) were large sized.

One clear conclusion is that smaller-sized luxury hotels established during the 2nd and 5th periods located in lower central Manhattan had a high risk of failure. The economy, technologies, and industries improved a lot during the 2nd and 5th periods of time. The 2nd period of time was known as the progressive era, and World War 1 also occurred during this time. The 5th period of time was known as the Globalization duration. (Soule, 1947; Surowiecki, 2002). During this time, government did not interfere in private enterprise; inversely, they set up rules and regulations to protect rising economy, technologies and industries, which led to a progress in people's living standards (Gordon, 2013). In these two periods, more hotels were established around the Times Square and Wall Street areas in order to satisfy consumers' desires for shopping, travelling, and relaxing. Nevertheless, with the increasing number of luxury hotels established and clustered together in the lower central part of Manhattan, the competition effects became more and more significant because they shared the same market area and targeted similar consumers (Shaver and Flyer, 2000). As a consequence, part of the hotels with same luxury levels had to secede from the fierce competition. The economy hotels targeted the consumer groups, which preferred lower prices, while the luxury hotels focused on the wealthier consumers, attracted by upper market circumstances, and facilities (Danziger, Israeli and Bekerman, 2006). Therefore, affordable level hotels were in an embarrassing place, mainly because their target marketing was not clear, which led to the close of most affordable level hotels.

Fig 3 Hotel Distribution from1822 -1869 related to hotel performance

Fig 4 Hotel distribution from1870 -1929 related to hotel performance

Fig 5 Hotel distribution from1930 -1941 related to hotel performance

Fig 6 Hotel distribution from1942 -1973 related to hotel performance

Fig 7 Hotel distribution from1974 -2000 related to hotel performance

Fig 8 Hotel distribution from 2001 -2012 related to hotel performance

The spatial distribution of hotel level is illustrated in Figs 9 through 14. In order to show a clearer pattern, middle level, upper middle level were combined and labeled as affordable level; up level, upper up level, and luxury are labeled as luxury level. During the whole time period, 60% of hotels were built as luxury level units. Meanwhile, 87% of luxury hotels were built during the 2nd, 5th and 6th period of time. Even though the total number of affordable level hotels was not marked, the trend of affordable hotels established in each period increased. Conversely, with the evolution of time, the number of economy level hotels decreased, with just three (2%) built in the 6th period of time. Regardless of hotel level, all tended to cluster in the lower central and southern parts, around Times Square and Wall Street. However, rather than locating in the lower central and southern parts, a few economy hotels chose to build in the intermediate field between them, while fewer still were established in the northern part of Manhattan. As the economic center of the United States, the standard of living in Manhattan is higher, resulting in more than half of the total number of hotels being luxury level ones, in order to fit the market requirement. During the 2nd period of time, America stepped into the progressive era, the economic development sped up. Many hotels established in the central part were deemed luxury level. During the 5th period of time, the rise of globalization offered tremendous opportunities for the hospitalities industries. A large number of hotels opened, and luxury hotels were still majorly in place. Even though the Great Recession swept the world economy

during the 6th period of time, economic foundation had been already established, even more, according to the NYC Statistics, the number of visitors to NYC from 2000 to 2012 grew from 36.2 million to 52.7 million. This caused the number of hotels built in this time to increase, and among them, luxury hotels still dominated in order to meet the preferences of modern tourists. However, investors expanded to the northern part and intermediate field between lower central and southern parts to explore new market areas and to avoid the increasing competition in the central and southern parts.

Fig 9 Hotel distribution from1822 -1869 related to hotel star level

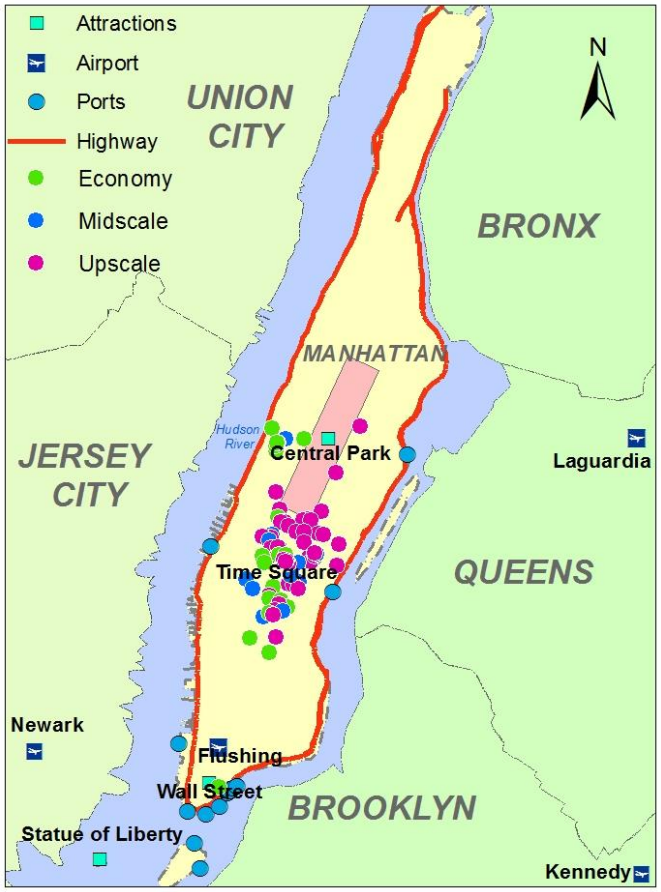

Fig 10 Hotel distribution from1870 -1929 related to hotel star level

Fig 11 Hotel distribution from1930 -1941 related to hotel star level

Fig 12 Hotel distribution from1942 -1973 related to hotel star level

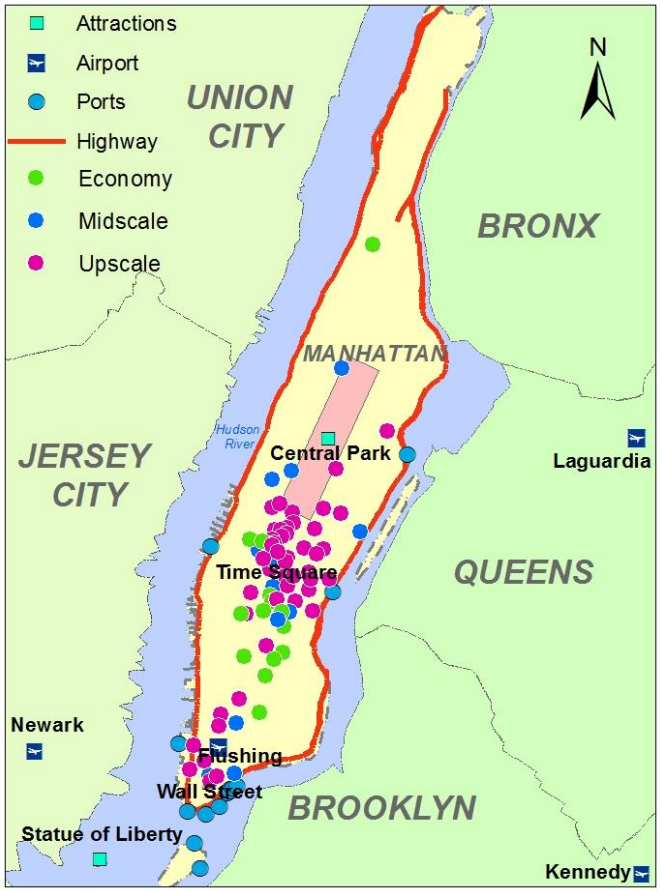

Fig 13 Hotel distribution from1974 -2000 related to hotel star level

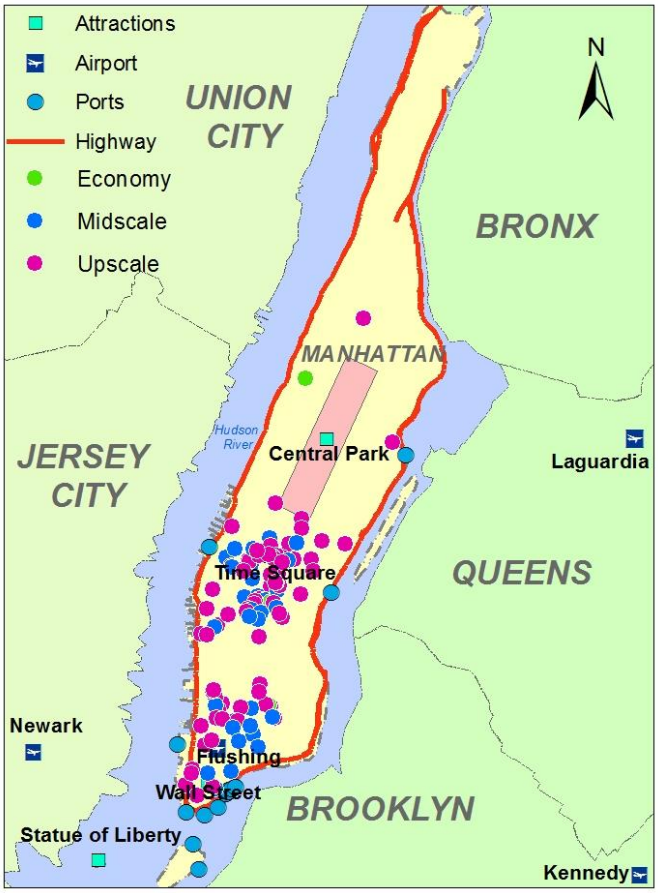

Fig 14 Hotel distribution from 2001 - 2012 related to hotel star level

The spatial distribution of hotel size is displayed in Figs15 through 20. The sizes of hotels are divided by the number of rooms, previously defined as small (less than 150), Middle (Between 151 to 400), large (between 401 to 1500) and mega (lager than 1501) in the methods section. Map show that an increasing number of small and middle size hotels were built when the time passed. As a result, almost 95% of hotels

were built in small and middle sizes during the whole time period. All of them preferred locations in the lower central part and southern part. Essentially, Manhattan is the smallest borough in terms of land area, but it is considered a borough which has the densest population and is treated as an economic and cultural center in the US (Barren, 2001). Therefore, less available land for retailers in Manhattan should be the major reason to account for almost all the small and middle-sized hotels. Meanwhile, as the core city, Manhattan attracts approximately 50 million visitors and business people recent year. The establishments of few large and mega hotels also help to meet the more elaborate and sophisticated requirements of customers.

Fig 15 Hotel distribution from1822 -1869 related to hotel size

Fig 16 Hotel distribution from1870 -1929 related to hotel size

Fig 17 Hotel distribution from1930 -1941 related to hotel size

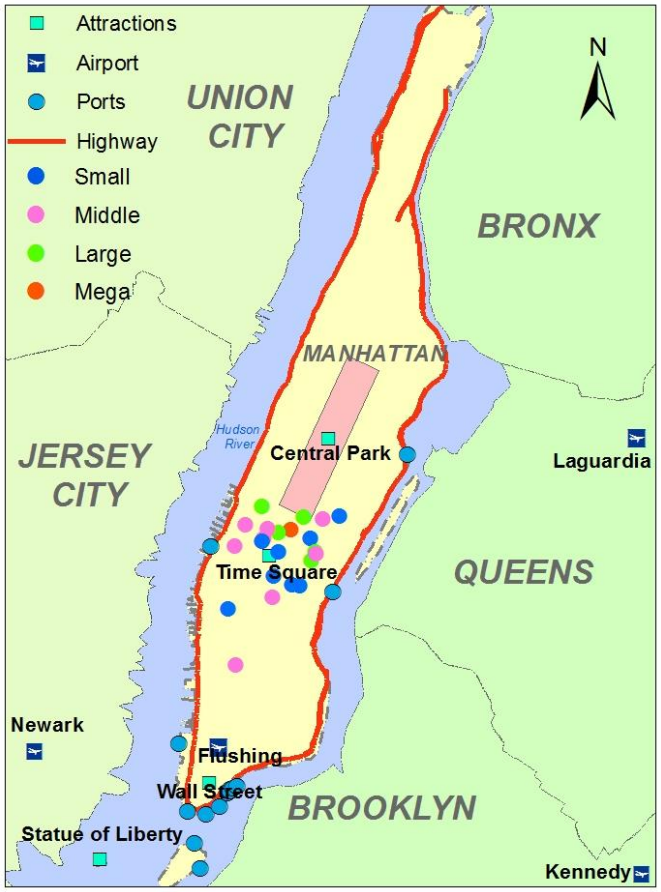

Fig 18 Hotel distribution from1942 -1973 related to hotel size

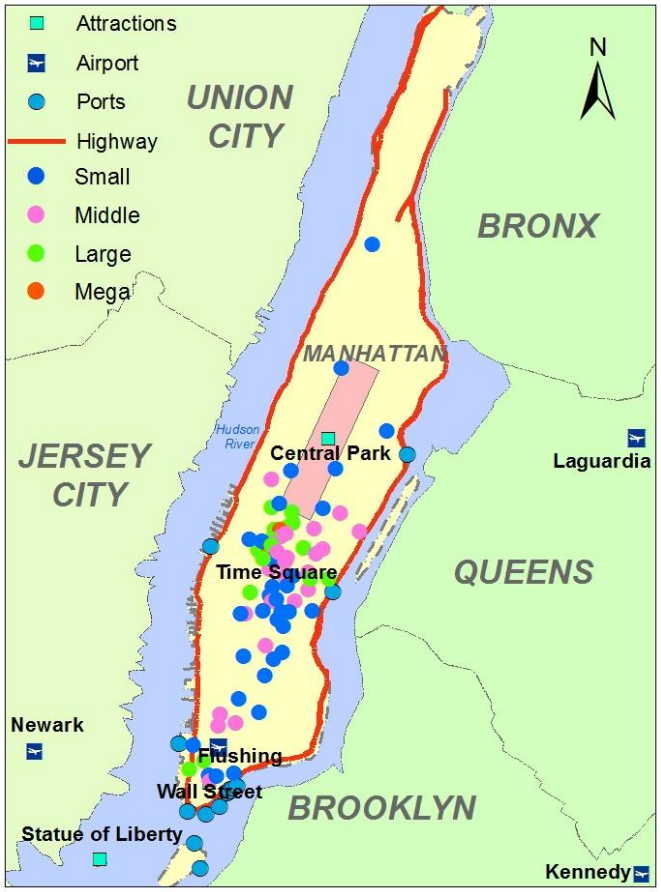

Fig 19 Hotel distribution from1974 -2000 related to hotel size

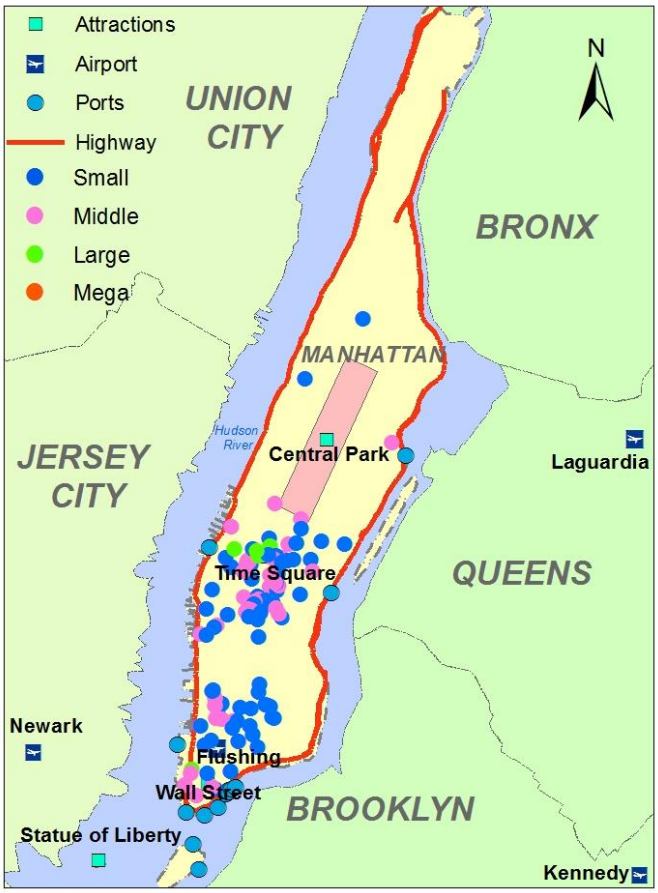

Fig 20 Hotel distribution from 2001 -2012 related to hotel size

Based on these results, relationships between spatial-temporal variation and hotel properties are apparent. More luxury hotels were built recent times in order to satisfy the increased standard of living. Most of them were smaller sized because of land resources limitations. The substantial increase in number of hotels in Manhattan also caused fiercer competition among them, forcing most of the older hotels to close, since they could not meet the standard and requirements of modern customers. In

order to decrease the negative effects of competition, managers preferred to cluster hotel locations in the central and southern parts to take advantage of famous attractions there.

In summary, the spatial-temporal variation of hotel distribution can be influenced and managed by the current socio-economic level, the agglomeration and competition effects among retailers, the market demand for hotels, government policies, and land resources. These factors all impact each other.

5.2. Calibrating agglomeration area and competition area

Agglomeration effect is derived from retailers' incentives to locate near their competitors in an attempt to benefit from each other (Hotelling, 1929). Counteracting the agglomeration effect is the competition effect (Netz and Taylor, 2002). Retailers compete with (rather than take advantage of) each other within the competition area (Brown, 1993). Increasing the agglomeration radius reduces the agglomeration effect while increasing the competition factor effects. Considering that the agglomeration factor is defined as the number of hotels and retailers within the agglomeration area around each hotel, and the competition factor is indicated by the number of hotels which have the same star level within the competition area, the distinction between agglomeration and competition factors decreases as the agglomeration area becomes larger.. There is actually no apparent boundary to divide the market area affected by

agglomeration or competition effects (McCann and Folta, 2008). The effect which occupies one market place means this effect dominates this area and is more influential than the opposite one. It does not mean this market area is only influenced by one effect (Pasidis, 2014). This research shows obvious differences between competition and agglomeration factors when agglomeration areas are smaller. . However, agglomeration and competition factors will likely be the same and have no difference between them with a large agglomeration area, especially in extreme cases when this area is as large as or larger than the competition area. The competition factor is redundant (i.e. had no influence) with respect to the dependent variable. As a result, the optimal agglomeration area should be found and examined.

The suitable agglomeration and competition areas are shown in the results. These areas were identified through employment of four regression models (Equation 1 to Equation 4), which used time period (equation 1), size (equation 2), level equation 3), and performance (equation 4) as the dependent variables. The agglomeration factor, used previously as an independent variable, was replaced by the four different agglomeration radiuses: 300 meters, 500 meters, 800 meters, and 1000 meters in each equation. Competition factors, defined by five different radiuses (1000 meters, 2000 meters, 3000 meters, 4000 meters, and 5000 meters), were examined together with the agglomeration radiuses, in four models.

The results are summarized in Table2. Four indicators, which are Significant-

F, R-Square, coefficients and P-value, were combined to highlight the suitable agglomeration and competition factors. A higher R-square value indicates better relationship between dependent variable and independent variables, since it illustrates the number of dependent variable which can be explained by the independent variables. Lower Significant-F indicates higher regression model efficiency. In this research, there are three significant levels, 0.1 (0.05<Significant F<0.1), 0.05 (0.01<Significant F<0.05) and 0.01(Significant F<0.01). The p-value of each independent variable shows whether or not this variable has a significant relationship with the dependent variable. The three significant levels are the same with Significant-F. The coefficient indicates a positive or negative relationship between each independent variable and dependent variable. .

These results found between smaller R-square or p-values to be associated with competition areas larger than 3000 meters. This was especially true in the time period model and performance models. Because of the low R-square and p-values at the 3,000 meter area, only the 1,000 and 2,000 meter completion areas were deemed suitable.

Results from the time period model with a competition area of 2000 meters showed the competition factor to be less significant with a larger agglomeration area.., The agglomeration factor was not significant within any agglomeration area. Moreover, the agglomeration and competition factors were not significant in the

performance model with a 2000 meter competition area. Although the agglomeration factor is significant in the size model, the competition factor is not. Since the goal was to identify the most suitable, significant agglomeration and competition factors in all the four models, it was decided that the 2000 meter competition area was not the optimal one.

After comparing the results of four different models with a 1,000 meter competition area, the most suitable agglomeration area was decided to be 800 meters. This conclusion was drawn since agglomeration and competition factors were significant most of time in this circumstance.. However, all the models were significant as a whole.

In the end, the optimal agglomeration factor was indicated by the number of retailers measured in the 800-meter agglomeration area around each hotel. The competition factor is explained by the number of hotels, which have the same star level, in a 1000-meter competition area.

Table 2 The results about agglomeration and competition factors from four regression models

	Time period				Performance				Size				Level			
	Agglomeration areas				Agglomeration areas				Agglomeration areas				Agglomeration areas			
	300 meter	500 meter	800 meter	1000 meter	300 meter	500 meter	800 meter	1000 meter	300 meter	500 meter	800 meter	1000 meter	300 meter	500 meter	800 meter	1000 meter
Competition (1000 meter)	0.00	0.00	0.00**	0.00**	-0.00**	-0.00**	-0.00*	-0.00	1.25***	1.22***	1.43***	1.55***	-0.00***	-0.00***	-0.03***	-0.01***
Agglomeration	-0.00	-0.00**	-0.00***	-0.00***	-0.00	-0.00	-0.00	-0.00	-2.53	-0.36	-1.67**	-1.47***	0.01**	0.01***	0.03***	0.03***
Significance F	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
R Square	0.53	0.53	0.54	0.54	0.7	0.7	0.7	0.7	0.66	0.66	0.67	0.67	0.81	0.81	0.54	0.4
Competition (2000 meter)	0.00***	0.00***	-0.21	0.01	0.00	0.00	0.00	0.00	-0.38	-0.36	-0.39	-0.37	-0.01**	-0.08**	-0.01**	-0.01**
Agglomeration	0.01	0.01	0.36	0.01	-0.00	-0.00	-0.00	-0.00	-5.04***	-2.68**	-1.31**	-1.12**	0.08***	0.04***	0.03***	0.02***
Significance F	0.00***	0.00***	0.00***	0.00***	0.01***	0.01***	0.04**	0.01***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
R Square	0.2	0.2	0.12	0.18	0.07	0.08	0.07	0.08	0.59	0.59	0.59	0.59	0.37	0.35	0.39	0.4
Competition (3000 meter)	-0.03	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-1.08**	-1.05**	-1.11**	-1.13**	0.00	0.00	0.00	0.00
Agglomeration	0.02	0.01	0.01	0.01	-0.00	-0.00	-0.00	-0.00	-4.85**	-2.51**	-1.29**	-1.12**	0.08***	0.04***	0.03***	0.02***
Significance F	0.00***	0.00***	0.00***	0.00***	0.01***	0.00***	0.01***	0.01***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
R Square	0.18	0.18	0.19	0.19	0.08	0.08	0.08	0.08	0.59	0.59	0.59	0.59	0.36	0.34	0.38	0.39
Competition (4000 meter)	-0.00	-0.03	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.85	-0.79	-0.79	-0.78	0.01**	0.01**	-0.02***	0.01*
Agglomeration	0.02	0.01	0.01	0.01	-0.00	-0.00	-0.00	-0.00	-5.06***	-2.63**	-1.27**	-1.08**	0.08***	0.04***	0.01***	0.02***
Significance F	0.00***	0.00***	0.00***	0.00***	0.01***	0.01***	0.01***	0.01***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
R Square	0.18	0.18	0.19	0.19	0.07	0.07	0.07	0.08	0.59	0.59	0.59	0.59	0.34	0.35	0.62	0.4
Competition (5000 meter)	-0.00	-0.00	-0.00	-0.00	0.00	0.00	0.00	0.00*	0.19	0.33	0.47	0.51	0.00	0.00	0.00	-0.00
Agglomeration	0.02	0.01	0.01	0.01	-0.00	-0.00	-0.00	-0.00	-5.12***	-2.83**	-1.45**	-1.24**	0.08***	0.03***	0.03***	0.02***
Significance F	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***	0.00***
R Square	0.18	0.18	0.19	0.19	0.08	0.08	0.08	0.08	0.59	0.59	0.59	0.59	0.36	0.34	0.36	0.39

Note: * means P-value is significant at 10% level;

** means P-value is significant at 5% level;

*** means P-value is significant at 1% level.

5.3. Statistical analysis

The four regression models were employed to examine the relationship between the transportation, social, and alternative location factors and the time change, hotel performance, hotel size, and hotel level.

At first, there were seventeen independent variables put into each model. However, the results showed that the VIF of six variables were over 7.5, indicating redundancy. Therefore, eleven of the seventeen independent variables were used for analysis in the same models. The results are summarized in Table 3.

The null hypotheses for four models are that there are no relationships between dependent variables and independent variables. And the alternative hypotheses are that there are some correlations between dependent variables and independent variables. Since the significance-F of four regression models are 0.00***, this indicate that the null hypotheses are rejected and alternative hypotheses are accepted, meanwhile, all models are effective as a whole at the 0.01 significance level. The R-square of each regression model shows the percentage of each dependent variable can be explained by the independent variables. Although not very high, it is important to remember that all dependent variables were also influenced by management, financial situation, technology, service attitude, in addition to other factors (Newell, 2005). Despite the relatively low values, the R-Squares of the four regression models are acceptable and reasonable.

The results of first model can be analyzed form three aspects. First, from transportation factors, especially in more modern times, hotels were located farther from convenient transportation and had larger parking areas. Second, from alternative factors, more intensive agglomeration and competition effects appeared as time progressed. Third, from a social factors standpoint, compared with earlier times, more hotels were built farther form attractions, and the land area used by hotels decreased. More hotels were equipped with inside restaurants, and the crime incidences around hotels decreased.

Hotels near the port are great attractions for visitors due to the good ocean view and access to cruise activities. Good scenery of the surrounding land is also identified as an important factor, which is included as a physical site characteristic in Adam (2013)'s research. With the evolution of time, Manhattan is becoming a tourist resort, more investors are willing to establish hotels near ports to obtain stable customers. This led to no more extra space around ports for hotels to build later. Similarly, convenience is an indicator of each hotel nowadays, therefore the accessibility to transportation, including highways, is also a big influential factor in hotel performance which cannot be ignored (Lee, Lee and Hsu, 2000). An increased number of hotels occupied the space near highways, resulting in longer distances between highways and hotels built later. At the same time, by avoiding the crowded hotel areas, there was more space for parking amenities.

With the evolution of time, an accumulated number of hotels were built and clustered in the lower central and southern part of Manhattan, around Central Park and the port to the Statue of Liberty. As a consequence, the agglomeration and competition effects became more significant around these areas.

Since hotels already occupied the land resources near the attractions in early times, hotels built later were forced to develop new market areas, which should be away from the earlier built hotels to avoid fierce competition effects. As a consequence, a farther distance from hotels to attractions later existed. Also because of the urgent land resources, hotels built later obtained smaller land areas. As a result, more later-built hotels are tall buildings in Manhattan, especially the famous Empire State Building. Hotels equipped with inside restaurants are becoming a criterion for customers to consider (Chu and Tat, 2000). To satisfy the needs of customers, more modern hotels established restaurants. Meanwhile, because of the perfection of legal system and protection policy, the total property crime rates decreased (Bureau of Justice Statistics), so crime incidents have gone down in modern times.

The results of the second regression model (Equation 3) indicate that hotel performance is quite sensitive to transportation, social factors, and alternative location factors. More specifically, hotels with better performance are closer to airports and highways with good access to subway entrances and parking lots. Conversely, hotels with better performance are farther from attractions and influenced less by

competition factors.

It should be noted that independent variables relating to Newark, subway entrances, highway, parking, Times Square and competition factors have significant relationships on hotel Performance. The positive coefficients of Newark, subway entrances, highway, parking lots and Times Square illustrate the positive relationship between these five factors and hotel performance. It is also important to note hotels which have better accessibilities to highways and subway entrances lead to better performance. At the same time, the results also show that greater distance from Times Square result in better hotel performance. Because hotels surrounded by more subway entrances and better access to highways help them to achieve the convenient and advantages of transportation and repair the shortage of further attractions (Adam, 2013). The negative coefficient of airports suggests that hotels can benefit more from transportation. The negative coefficient for the competition factor shows the negative relationship between competition effects and hotel performance, meaning that higher competition effects between hotels can worsen their performance.

The results of third regression model can be summarized into three parts. First, hotels with larger room numbers have bigger parking areas. Second, hotels with more rooms have larger land areas. Third, larger-sized hotels suffer higher competition effects and benefit less from agglomeration effects.

The independent variables of parking, hotel area, competition and

agglomeration factors have a highly positive relationship with the dependent variable, hotel size (room number). Four independent variables were found to be quite sensitive to hotel size. The positive coefficient of parking hotel area and competition factors mean that hotels with larger sizes tend to manage more parking areas, occupy more land area, while suffering higher competition effects. Since larger hotels need more capital to manage and operate, most of them are higher level hotels, as seen in the maps above. Higher level hotels suffer more from competition effects (Kim and Kim, 2005). Larger parking areas and access to subway entrances reflect the impacts of convenient transportation on hotels. More parking lots and higher numbers of rooms are also satisfied by the larger land use.

The results of the fourth regression model demonstrate that higher-level hotels with tend to benefit more from transportation and attractions. They are also equipped with inside restaurants to raise the competitive power. Simultaneously, higher level hotels are also influenced by bitter competition and more profitable agglomeration effects.

According to the regression result, the closer to the port, the higher the hotel level is. It reflects that to establish a luxury hotel, investors expend more capital than lower level hotels. In order to receive matched benefits, they obtain more profit from good scenery of surrounding land (Adam, 2013). In Manhattan, good scenery is concentrated on the ocean. The expenses of restaurants in hotels are incidental

consumption for customers who choose an up-market hotel to enjoy (Bojanic, 1996). Meanwhile, hotels with high levels strive to meet the needs of customers maximally, so the restaurants within high-level hotels can realize the objective from alimentary part. Meanwhile, the more hotels there are within the same level, the more competition and agglomeration effects they suffer (Kim and Kim, 2005). It has already been observed that eighty-seven percent of hotels in Manhattan are luxury level. Notably, high-level hotels are not for ordinary consumers, which lead to the limitation of the passenger source (Baum and Ingram, 1998). As a result, the competition effects are fierce between them. The agglomeration effect is also remarkable, because the clustered high-level hotels receive more benefits from each other (Tsang and Yip, 2009) to attract more customers.

Table 3 The results of four regression models

	Time Period	Performance	Room Num	Level
Intercept	−0. 64	0. 48	27. 06	−6. 43***
Newark	0. 00**	−0. 00***	−0. 01	0. 00***
Nearest port	0. 00***	0. 00*	0. 00	−0. 00***
Subway entrances	−0. 01	0. 01***	−4. 01	0. 04***
Highway	0. 07**	0. 42***	75. 63	0. 17
Parking	0. 02***	0. 04***	12. 64***	0. 01*
Times square	0. 00***	0. 00***	−0. 02	−0. 00***
Hotel area	−0. 00***	−0. 00	0. 13***	0. 00**
Restaurants	0. 78***	0. 05	60. 02	0. 03***
Crime	−0. 16***	−0. 15***	−2. 67	0. 02
Competition (1000m)	0. 00**	−0. 00*	1. 44***	0. 03***
Agglomeration(800m)	0. 02***	0. 02	−1. 67**	0. 03***
F-significance	0.00***	0.00***	0.01**	0.00***
R-square	0.54	0.70	0.67	0.54

Note: * means P-value is significant at 10% level;
** means P-value is significant at 5% level;
*** means P-value is significant at 1% level.

6. Conclusion

This research explored the influential reasons for spatial - temporal variance in hotel distribution in Manhattan from 1822 to 2012 in a GIS environment. It provides a combination of historical and contemporary views for hotel decision-making while providing a new comprehensive set of factors used in examining hotel performance. It is also a synthesis of both a visible spatial analysis approach and statistical analysis approach to offer a more understandable and reliable way to analyze hotel location problems. Through model calibration, a new approach to measure the optimal market area for agglomeration and competition effects is also raised.

From the results of spatial-temporal variation of hotel distribution, it was found that hotel development is highly influenced by the big events which occurred during each time period. As a result, the economic characteristics are different and varied over time, which impacted a lot on investors' decisions. Governments also regulated and controlled the economy through promulgating policies, which were an important field needed to be considered by investors. More hotels, especially luxury hotels, were built when the economy developed or was stimulated in different time periods. They both preferred to locate in the lower central part or southern Manhattan, to take advantage of the financial benefits provided by attractions, beautiful sceneries, transportation, and agglomeration effects. Some new market areas were found in the mid-lower central part and southern part of Manhattan to avoid the increasing

competition effects. Because Manhattan is the smallest of the five boroughs, most of the hotels were smaller in size. To summarize, hotel-development can be influenced and managed by the current socio-economic level, the agglomeration and competition effects among retailers, the market demand for hotels, government policies, and land resources in Manhattan.

Additionally, in order to calibrate the optimal agglomeration and competition area in Manhattan, four different agglomeration areas and five competition areas were examined in four models. After analyzing the results, the optimal agglomeration effect indicator is the number of retailers within an 800 meter area of around each hotel. The indicator for competition effects, which is quantified by the number of hotels with the same star level within 1000 meters, meets the significant level of all the results as well.

Finally, the influential factors for hotel location were analyzed in this research. Based on the results of four models, the transportation, social, and alternative location factors do have significant relationships on hotel performance and characteristics.

The numbers of subway entrances around each hotel, the distance from airports to each hotel, the distance from nearest ports to each hotel, the number of parking lots near each hotel, and the accessibility to highway were all selected to represent the transportation factor. All the transportation factors in this research show a positive relationship with hotel performance and characteristics. These results are

supported by Bull (1998) and Yang (2004), who observed that the influence of transportation acted as a catalyst in attracting and enhancing visitors' experience. It demonstrates the accessibility of transportation accounts for the convenience of hotels, which cannot be ignored. (Newell and Seabrook, 2005).

Crime incidences, hotel area, and major attractions were selected as indicators of the social factors; also significantly associated with hotel performance and characteristics. It has been examined that better performance hotels had less crime incidences in a 300 meter area around each hotel. The finding of Adam (2013) revealed that crime rates as socio-cultural issues are significant in determining the choice of hotel location. The same result was reported by Donicar (2003) to show the importance of safety for a hotel. Major attractions were also found to be an important factor for hotel performance and characteristics. However, the hotels with better performances and larger sizes tend to have farther distance between other hotels and attractions. This result is converse to what Lee (2010) and Yang (2004) and other previous research reported about tourist resources being beneficial and important for adjacent hotels. At the same time, more advantages can be taken from the attractions by hotels around. It is because of the specialty of Manhattan. It is a small island borough, and the land resources are very limited. Moreover, the land around attractions has already been occupied by hotels built at earlier times, and there is no more space for new hotels. As a result, hotels established later tried to locate away

from the clustered area, which also helped to avoid the competition effect there.

Competition and agglomeration effects were chosen to illustrate the influence of alternative location. They showed a good relationship with hotel performance and characteristics. The competition effect was found to be more dominant than agglomeration effect in this research. For the four regression results, competition effects were significant with respect to all four dependent variables at different significance levels (p-value). However, the agglomeration effect is sensitive to changing times (time period), hotel size (room number), and star level (level) of the hotels. Investors want to get maximum benefits from agglomeration effects and minimum disadvantages from competition effects, which is not simple (Pasidis, 2014). Although it is said that retail stores built within the agglomeration area will gain more benefit from each other, the competition effect still occupies a striking place. Baum and Mezia (1992) also examined the operation pattern of hotels in Manhattan, and indicated that the size, room price and location of hotels are quite similar which caused intense competition.

The hotel distribution implies the practical pattern of tourism and culture in Manhattan. This study can be used as a reference for administrators to make policy and economic planning adjustments. By observing the distribution pattern of hotels and other retailers, it is obvious which zone is over exploited, so that managers of the city can promulgate certain policy to limit redundancy. In addition, it was found that

hotels in central and south Manhattan tended to be saturated. Investors should be encouraged to develop the northern part of Manhattan with some policies. Vice versa, if the tourism or economic construction in a region needed to be advanced, after confirming the economic level of this region, suitable level hotels may need to be encouraged to establish. Restaurants, banks, shopping malls can also agglomerate. In addition, agglomeration and competition areas were analyzed in this research. Results showed that it is better to build hotels within the agglomeration area and avoid the competition area.

However, there are still a lot of spaces to make improvement. In this research, hotel performance and location decision are determined by many factors. This study only includes variables reflecting social factors, alternative locations, and transportation factors, which caused relatively low R-Squares. For example, the hotel performance is also influenced by many factors not considered in the research, including service quality, business facilities, front-desk efficiency, salary of employees, regulations, etc. More factors should be included in further studies.

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