

Research Article

Patterns of Location and Other Determinants of Retail Stores in Urban Commercial Districts in Changchun, China

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Knowledge of the patterns of location of retail stores in urban areas supports the development of effective urban planning and the reasonable allocation of commercial facilities. Using point of interest data and consumer survey data in three main commercial districts in Changchun, China, this study investigates the spatial structures of commercial districts and the patterns of distribution of retail stores to assess the determinants of the development of retail stores in commercial districts. Kernel density estimation, nearest neighbor index, and Pearson's correlation analysis were used for this study. The following conclusions are drawn. (1) The spatial distribution of retail stores in Changchun commercial districts generates the coexistence of a concentration in the core area and diffusion in the peripheral area. The emergence of shopping malls has challenged the traditional single-center structure, resulting in the transformation of commercial districts from single-center to multicenter layouts, while also producing a hierarchical trend in development. (2) The Chongqing Road and Hongqi Street commercial districts have a relatively high spatial concentration of retail stores. Retail stores in Guilin Road exhibit distinct characteristics, namely, stores selling textiles, clothing, and daily necessities show the highest concentration, and food, beverage, and tobacco outlets as well as integrated stores show the lowest concentration. (3) The selected locations of the differing categories of stores on Chongqing Road strongly correlate, and textile, clothing, and daily necessity stores show a high correlation with other retail categories. (4) Four main factors affect the development and spatial layout of retail in the commercial districts. First, the interaction between consumer behavior and location choice in retail stores promotes the evolution of retail formats and trends in the development of comprehensive, specialized, and hierarchical retail commercial spaces. Second, the retail format determines the spatial layouts and the historical inheritance of the format. Third, governmental planning and policies lead to the agglomeration and diffusion of commercial activities in different areas. Fourth, such spatial clustering effects are an external driving factor for integration and aggregation among retail formats.

1. Introduction

The study of commercial activity and its spatial structure has always been an important research content in the study of urban geography and urban planning. The rational distribution of retail trade has an important role in developing the urban economy, reasonably allocating circulating resources, and satisfying consumption demand [1]. The results of studies of commercial geography in Western countries can be grouped into three main schools. The first focuses on explaining the impact of land rent on the choice of location for commercial facilities using traditional location theory.

The second pays closer attention to the spatial structure and hierarchical systems of commercial spaces [2]. The third discusses the impact of consumer behavior on commercial spaces using the behavioral geography theory, which centers on consumer behavior [3–5]. A commercial district is the most convenient and most frequently used space for urban commercial communication, accumulating different types, scales, and formats of commercial facilities, which reflect the interaction between commercial facilities and consumers by attracting customers from a certain range of locations [6]. The high concentration of retail stores in adjacent geographical areas, that is, urban commercial districts, is an

important manifestation of commercial agglomeration, whether it occurs in a natural commercial street or at a planned shopping mall [7]. The different types of retail formats in commercial agglomeration locations constitute commercial spatial structures within a city. As retail formats become continuously enriched, the agglomeration effects of commercial centers have become more prominent. As the economic benefits of retail activities grow, such centers can better respond to the multipurpose shopping demands of urban residents in new trends of consumption [8]. Research on factors that affect the location selection of commercial stores has mainly focused on population, policy environment of urban development, competition factors, traffic accessibility factors, and format combination factors [9–14]. Raon proposed six key elements in retail store site selection, including convenience of shopping for customers, population flow around the store, traffic flow, parking conditions, and store identification and visibility [15]. González-Benito showed how geodemographic consumer profiles and spatial convenience are determinants for store choice [16]. Beginning in the 1990s, commercial function area, location choice for retail department stores, commercial districts and the agglomeration economy, reconstruction of commercial spaces, and consumer choice behavior have become central topics at the urban microlevel [17–21].

Since the reform and opening up period began in China in 1978, with the attendant rapid development of its economy and the rapid progress of its urbanization, the Chinese retail industry has entered a period of rapid growth, as many cities have transformed from manufacturing to consumption cities. The retail industry has gradually become an important location for urban economic activities, and this has promoted an upsurge in retail theory and location research for commercial activities [17]. The study of the business geography of China has largely focused on commercial location and regional structures, consumer behavior and its impact on commercial layouts, central business district theory and the method of study of the commercial district, theory of retail and its layout, location choices for convenience stores, chain stores, and other retail formats, among others [22–27]. The scale of research has gradually been transferred from the macro- to the midrange and microlevel. The research is mostly empirical and focused on specific cities, and its methods and perspectives are constantly being enriched and innovated. Because the spatial pattern of retail stores results from interactions between the supply of commercial facilities and consumer demand, analyses of spatial structures and mechanisms of the evolution of urban commercial formats together with that of shopping behaviors of consumers are becoming more prominent in recent years [28]. At the same time, due to the rapid development and extensive application of internet mapping and location-service technologies, urban commercial space research based on point of interest (POI), mobile signal, GPS trajectory, and other geospatial data is also attracting more attention [29–31].

Overall, the achievements of research on commercial retail spaces in China are quite abundant, with research contents that cover the multiscale characteristics of retail commercial layouts, including chain supermarkets, online shopping, and other emerging retail formats. However, there has been relatively little discussion of specific retail industries and little attention paid to the actual location of the retail stores within micro commercial districts in recent work on commercial spaces. Meanwhile, by contrast with general industrial locations, different categories of retail stores have been found to interact with each other as a result of relationships among retail formats and spatial distances [32]. However, investigation of interdependences of retail stores at the microlevel is rare, and scholars tend to pay more attention to factors that influence the supply side of aspects of location choice for retail stores, with a lower degree of focus on demand-side influences on consumers' shopping behavior.

In recent years, Chinese consumption patterns have completed the development from a concentration on necessities to one on durable goods, and they are now seeing a beginning of a comprehensive consumption transformation from a relatively single shopping function to a combination of shopping, dining, leisure, recreation, and other activities. Shopping centers and commercial complexes are expanding rapidly in cities and broadening location from cities to the suburbs, becoming the main sites for residents' consumption and leisure activities [33]. The development of retail business is becoming an important force in cities and regions, driving economic growth, adjusting economic structures, and shaping internal urban spatial patterns. Therefore, to promote healthy development in the urban economy, meet residents' basic daily needs, and improve their quality of life, it is important, both theoretically and practically, to study the characteristics of the spatial distribution of retail stores and optimize structures in urban commercial spaces. This paper takes Changchun, a city in central northeast China, as a case of an urban commercial district to investigate the location patterns of retail stores within it using POI data from an internet map service and consumer survey data. The determinants of the location choice of retail stores in the commercial district are also explored. Kernel density estimation (KDE) and a nearest neighbor index (NNI) were used to identify patterns of location in retail stores, and the Pearson correlation coefficient was used to establish interrelated characteristics between spatial distributions of retail stores in different categories. The main objectives of this paper are as follows: exploring location choices for retail stores at a microlevel in an urban commercial district, identifying location patterns for retail stores in different categories and exploring their interrelated characteristics, and summarizing the determinants of retail stores in urban commercial districts. Together with the existing body of research on typical cases in China, it is hoped that this paper can shed light on urban commercial facility planning and sustainable development.

2. Study Area and Data

Changchun is the capital city of Jilin province and the political, economic, and cultural center of Jilin province in northeastern China, with a population of over 4.5 million people. Lying in the Songliao plain, Changchun is at the geometric center of northeast China. The city ranges within the coordinates 124°18′–127°05′E and 43°05′–45°15′N. Changchun is near Songyuan to the northwest, Siping to the southwest, the city of Jilin to the southeast, and Heilongjiang province to the northeast. The second national land survey indicated that the total area of the city was 20,604 km², with an urban area of 6,991 km². At the end of 2018, the built-up area of the central city was 633 km², consisting of five districts and four development zones. Changchun is an important industrial center, and its economy ranks the third in northeast China and the 34th among all Chinese cities in 2019, with 590.41 billion CNY produced per year. In recent years, thanks to the strategy of revitalizing the old industrial cities in northeast China and the strategy of development and opening up of Changjitu, Changchun has improved its consumption structure and the standard of living of its urban residents significantly, sustained a rapid development of its urban retail industry, and diversified the structure of its commercial formats. Well-known domestic and foreign retail enterprises, including Wal-Mart, Carrefour, Wanda, and Wangfujing, have been set down in Changchun, gradually developing and expanding market competition with local retail enterprises, forming important trends of development of scale, branding, and fusion.

Taking the distribution of the retail stores in the central city and the scope defined in the *Changchun Special Plan for Commercial Stores (2011–2020)* into account, we chose three relatively mature and typical commercial districts, those of Chongqing Road, Hongqi Street, and Guilin Road, as our study area (Figure 1). Chongqing Road commercial district, an old commercial center of Changchun, was formed in the early 1950s, with the Changbai building as its initial center. Later, after a continuous settlement of shopping centers and specialty stores, it gradually expanded along the Chongqing Road from west to east, forming the banded layout it features today. The Hongqi Street commercial district was formed in the late 1990s, and its retail stores are distributed radially along the Gongnong Road and Hongqi Street. Guilin Road commercial district formed later, in the early 21st century, and its retail format of Guilin Road is mainly aimed at younger consumers. There are many colleges and universities nearby.

All POI data were extracted from the open platform of Gaode Maps (<http://www.amap.com>) with the help of third-party web data crawler tools in May 2018. POI data are point data that represent real geographic entities, including spatial information, such as latitude and longitude, address, and attribute information such as name and category for each site. The original data were classified according to the system provided by the map service. After spatial matching, deduplication, and removal of stores with lower identification, 2815 effective retail stores were obtained, including 543 retail stores in Guilin Road, 1147 in Chongqing Road,

and 1125 in Hongqi Street. The retail classification in *China's Sectoral Classification System (GB/T 4754-2011)*, in use by the Chinese government since 2012, was used to reclassify retail stores into six specific categories, namely, integrated stores (IS); textile, clothing, and daily necessities stores (TCS); culture, sporting goods, and equipment stores (CSS); hardware, furniture, and interior decoration materials stores (HFS); household appliances and electronic products stores (HES); and food, beverage, and tobacco products stores (FBS) (Table 1).

3. Methodology

3.1. Kernel Density Estimation. To analyze the spatial clustering of point elements, KDE is often used to reflect the relative degree of concentration of a spatial distribution of elements, mainly estimated with a regular moving quadratic [34]. The equation is as follows:

$$f(s) = \sum_{i=1}^n \frac{1}{h^2} k\left(\frac{s - c_i}{h}\right), \quad (1)$$

where $f(s)$ is the kernel density value at spatial position s , k is a spatial weighting function, h is the distance-attenuation threshold, and n is the number of factors whose distance from the position s is less than or equal to h . Through a comprehensive consideration of the average influence range of retail stores in each commercial district and the degree of dispersion in their spatial distribution, a distance threshold of 50 m was selected for the analysis to better identify the overall distribution of stores and local distribution patterns of ones in different categories. Natural breakpoint classification is used to classify the results of the KDE, considering the differences in the number of retail outlets in each commercial district.

3.2. Nearest Neighbor Index. NNI analyses are often used to assess distribution patterns of spatial point elements and judge the patterns of the distribution of point elements with agglomeration or discrete distribution by comparing and calculating the average distance of the closest point pair with the expected average distance in random distribution [35]. The equation for the average nearest neighbor distance is as follows:

$$d(NN) = \sum_i^n \frac{\text{Min}(d_{ij})}{N}, \quad (2)$$

where $d(NN)$ is the average nearest neighbor distance, N is the number of sample points, d_{ij} is the distance from point i to point j , and $\text{Min}(d_{ij})$ is the distance from the point i to the nearest point. The expected average distance is defined by

$$d(\text{ran}) = 0.5 \sqrt{\frac{A}{N}}, \quad (3)$$

where N is the number of samples and A is the area of the study area. Thus, the NNI was calculated by comparing the average nearest neighbor distance with the expected average distance:

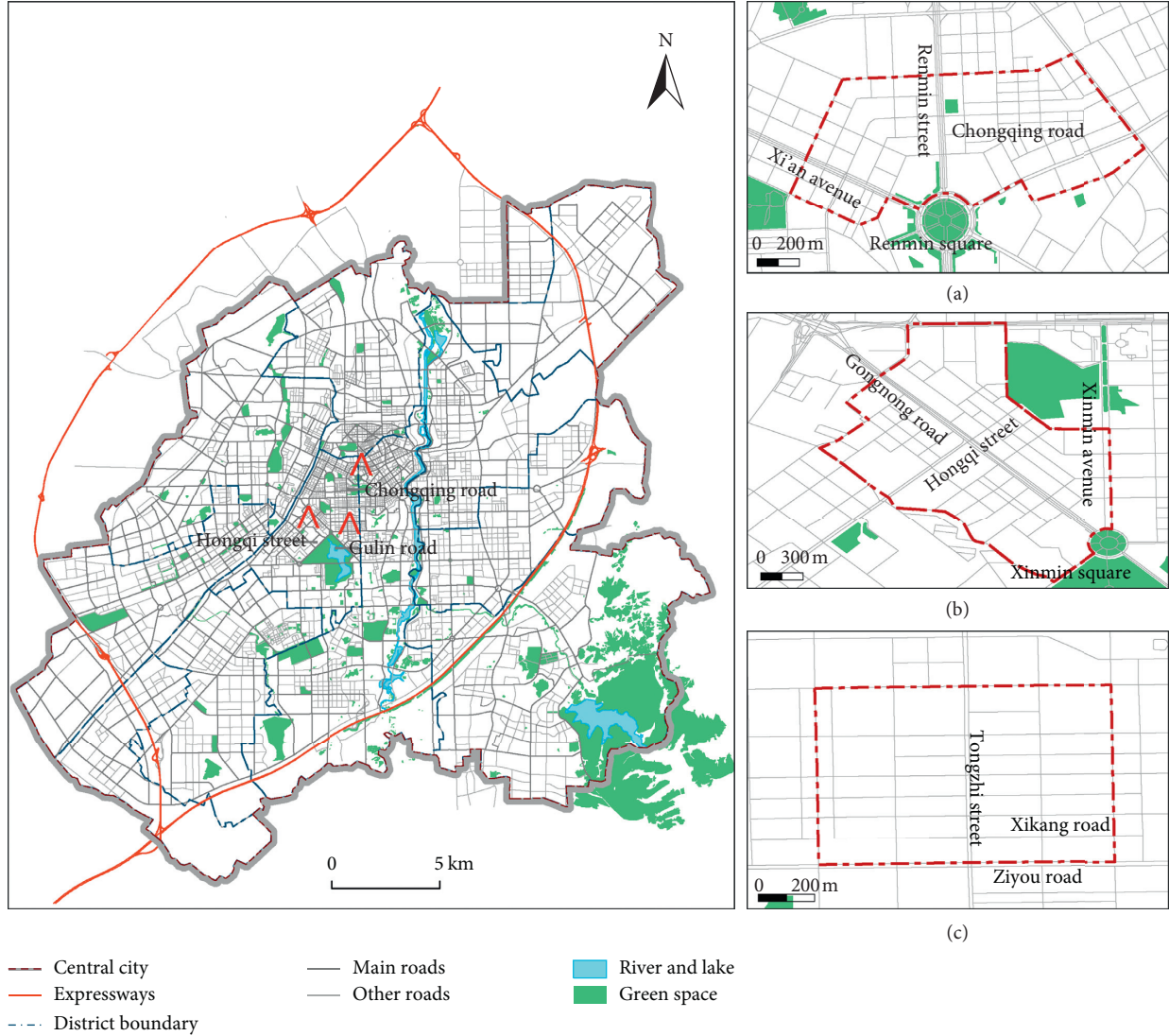


FIGURE 1: Study area and distribution of the commercial districts in Changchun: (a) Chongqing Road; (b) Hongqi Road; (c) Guilin Road.

$$NNI = \frac{d(NN)}{d(\text{ran})}. \quad (4)$$

When $NNI < 1$, the sample points are cluster-distributed, but when $NNI > 1$, the sample points feature a uniformly discrete distribution. Finally, when NNI is close to 1, the sample points are randomly distributed. Test Z is generally used to test the reliability of the results.

3.3. Spatial Correlation Analysis. The Pearson correlation coefficient is essentially a linearly dependent coefficient used in statistical methods to measure a linear relationship between distance variables. This method is used to measure the correlation between the spatial distribution of stores in different retail categories to explore the interrelated characteristics of different retail categories. First, the districts are divided into grids according to using the urban road network. Second, the number of

retail stores in each grid and its ratio to the total number are calculated. Finally, Pearson correlation analyses were performed for the six retail categories. In two samples, $X = (x_1, x_2, \dots, x_n)$ and $Y = (y_1, y_2, \dots, y_n)$, the Pearson correlation coefficient is defined by

$$r = \frac{1}{n} \sum_{i=1}^n \left(\frac{x_i - \bar{x}}{\sigma_x} \right) \left(\frac{y_i - \bar{y}}{\sigma_y} \right), \quad (5)$$

where x_i and y_i are the ratios of two categories in grid square n . \bar{x} and \bar{y} are the sample averages for x and y . Then, σ_x and σ_y are the sample standard deviations for x and y . The larger the absolute value of the Pearson correlation coefficient r is, the higher the degree of correlation between the dependent variable and the independent variable is. $|r| < 0.3$ indicates weak correlation; $0.3 < |r| < 0.5$ indicates low correlation; $0.5 < |r| < 0.8$ indicates a significant correlation; and $0.8 < |r| < 1$ indicates high correlation.

TABLE 1: Categories, quantities, and proportions of the retail stores in the commercial districts.

Retail store categories	POI subtype	POI quantities	Proportion (%)
Integrated stores (IS)	Supermarket, convenience store, department store	206	7.32
Textile, clothing, and daily necessities stores (TCS)	Clothing, shoes and hats, bags, cosmetics, gift store, watch store, glass store, daily necessity store, etc.	1811	64.33
Culture, sporting goods, and equipment stores (CSS)	Stationery store, sporting goods store, book store, audiovisual products and digital publication store, arts and crafts store, etc.	345	12.26
Hardware, furniture, and interior decoration materials stores (HFS)	Hardware store, lamps store, furniture store, decoration materials store, etc.	83	2.95
Household appliances and electronic products stores (HES)	Home appliances store, cell phone store, digital products store, etc.	226	8.03
Food, beverage, and tobacco products stores (FBS)	Fruits, vegetables, alcohol, tobacco, tea, bread, etc.	144	5.12

4. Location Pattern of Retail Stores in an Urban Commercial District

4.1. Descriptive Statistics and Overall Pattern of Spatial Distribution. The study area contained 2815 retail stores, including 1147 in Chongqing Road, 1125 in Hongqi Street, and 543 in Guilin Road. As city-level districts, the number and scale of retail stores in Chongqing Road and Hongqi Street are significantly greater than those in Guilin Road. There are also significant differences in the distribution of retail stores among the three major commercial districts (Figure 2). TCS has a significant scale advantage for each commercial district, and HFS accounts for a small proportion in each commercial district. The proportion of TCS and CSS in Chongqing Road is relatively high; that of TCS, HES, and FBS in Hongqi Street is relatively high. However, in Guilin Road, the proportion of all retail categories except TCS is relatively small.

The results of KDE are shown in Figure 3. The retail stores of the three main commercial districts in Changchun are characterized by the coexistence of single-center agglomeration and multicenter dispersion. The retail stores of Chongqing Road are mainly distributed along the west-east axis of Chongqing Road, following a chain-type layout. From west to east, there are two main agglomerating centers, the Zhuozhan and the Yatai Fuyuan shopping centers, as well as a secondary cluster core at the Changbai department store and the Dynamic City shopping center. The retail outlets of the Hongqi commercial district mainly radiate along Gongnong Road and Hongqi Street. The single-center clustering of this commercial district is relatively distinct, with the Eurasian shopping mall as the main core. The development of the Guilin Road commercial district is dominated by the commercial street, mainly relying on a first- and second-floor commercial front on both sides of the street, including exclusive shops, specialty stores, and apparel shops. The spatial distribution of the retail stores in Guilin Road is relatively uniform, and its hot spots show a large spatial range, forming a relatively concentrated center in the Guilin Road market, 7.8 shopping center, and the Xikang Road area. As a whole, the formation of the traditional commercial districts breaks the center-periphery radial structure, with a department store and a specialty store

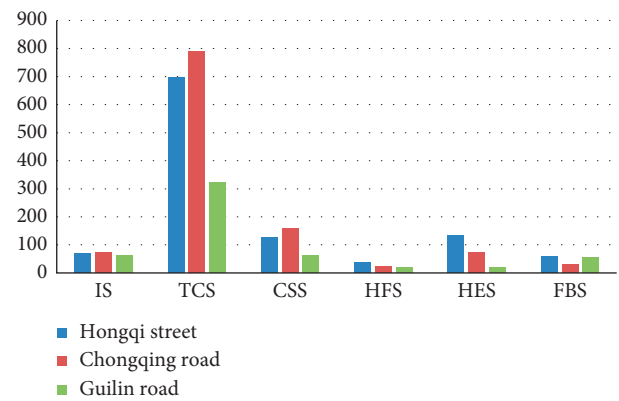


FIGURE 2: The quantities of retail stores in three main commercial districts.

as the center, promoting the transformation of a commercial district from a single-center to multicenter model and presenting a trend of hierarchical development.

4.2. Spatial Distribution of Retail Stores in Different Categories. The spatial distribution of IS, TCS, and CSS is shown in Figure 4. IS falls within the life service industry and is closely related to everyday life, having a variety of retail formats. These are mainly the convenience store, department store, and supermarket in the three districts. The convenience stores are mainly distributed in Guilin Road, and the department stores and supermarkets are mainly found in Hongqi Street and Chongqing Road. Convenience stores are scattered in Guilin Road at a wide spatial range, and competitive advantage is affirmed in their geographical proximity to residents. In Chongqing Road and Hongqi Street, the overall layout of convenience stores is similar to that of Guilin Road, and their distribution is more uniform. They are arranged along secondary trunk roads and branch roads, and their location selection is more flexible. Supermarkets mainly rely on the layout of the commercial center, which is generally arranged on the first floor of the main building or underground. The department stores are primarily in areas with large pedestrian flow and convenient transportation that are close to the business center.

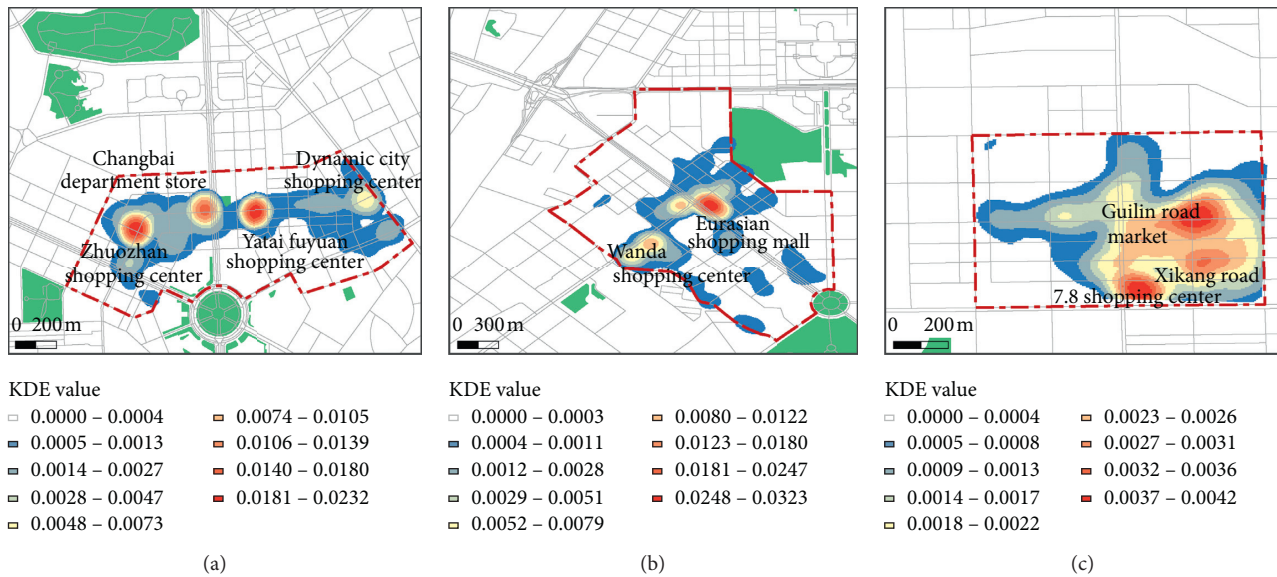


FIGURE 3: The results of KDE of retail stores in the three major commercial districts in Changchun: (a) Chongqing Road; (b) Hongqi Road; (c) Guilin Road.

TCS are among the middle and high-end consumer goods outlets by economic location. As part of a market-oriented industry with a high service level, TCS requires broad markets and large population flows. It must be distributed in areas with convenient transportation, large pedestrian flow, and large market potential. As the most important format of Guilin Road, TCS have gradually formed a significant cluster in the 7.8 shopping plaza and at the intersection of Guilin Road and Lixin Street. Chongqing Road has a cluster area at the Zhuozhan shopping center and Changbai department store from west to east, while the streets on both sides of Chongqing Road form a belt distribution, dominated by exclusive stores. The location selection range of TCS at Hongqi Street is small, mainly concentrated at Eurasian shopping mall and Wanda Square shopping center.

CSS are part of a sunrise industry with a rapid speed of development. They include stationery, sporting goods, books and audiovisual products, digital publications, and arts and crafts stores. CSS are within nonessential retail industry, featuring small demand but a wide range of services. With an advantageous format for Chongqing Road, CSS have developed mature and agglomeration features, with hot spots in Yatai Fuyuan, Changbai, Zhuozhan, and Dynamic City Center. CSS in Hongqi Street present a typical belt layout along Hongqi Street, the main road, but subcategories show different location choices. CSS are still at the point development stage in Guilin Road, and they have a scattered spatial distribution.

The spatial distribution of HFS, HES, and FBS is shown in Figure 5. The main formats for HFS include hardware, lamp, furniture, and decorative materials stores. HFS are less distributed in the urban commercial districts of Guilin Road, Chongqing Road, and Hongqi Street, with obvious grading. High-grade furniture and lamp stores tend to be in the core area of department stores and shopping centers. However, the less

competitive hardware and decorative materials stores are mostly distributed at the edges of the commercial district or areas adjacent to the main road, and most feature small-scale concentrated distributions. Most HFS in the commercial district are small-scale individual businesses, where specialized streets with different degrees of development are easy to form.

HES are durable goods. When consumers purchase these goods, they focus attention on product brand and after-sales services and make prudent decisions. Generally, HFS are distributed in areas featuring strong comprehensiveness and a good business environment and mostly set up operations in exclusive stores, commercial streets featuring digital products, and large shopping malls. HES in Guilin Road mainly focus on mobile phone sales and maintenance, accessory retail, communication business handling, and other services. They show a scattered spatial layout. In Chongqing Road, HES are mostly high-end retail of household appliances and computer equipment, mainly concentrated in the interior of shopping malls, including Suning, Gome, and Wanda Plaza. HES in Hongqi Street also have a strong clustering character, mostly in the urban commercial center layout.

The main formats for FBS include retail stores, selling fruits, vegetables, alcohol, and tobacco. Their location choice is different from that of similar stores. Due to their short preservation time, fruit and vegetable stores have higher requirements for prompt sales. They are mostly close to residential areas and position themselves toward family life consumption. Tobacco, alcohol, and tea as gifts are a large part of high-end consumption, taking the form of exclusive shop layout. In Guilin Road, fruits, vegetables, and tobacco stores have a cross-shaped spatial agglomeration along Lixin Street and East Guilin Hutong, the core area for the spatial development of FBS in Guilin Road. In Hongqi Street, FBS are mostly distributed in the shopping center and most sell tobacco and alcohol. Most stores along the street sell fruits

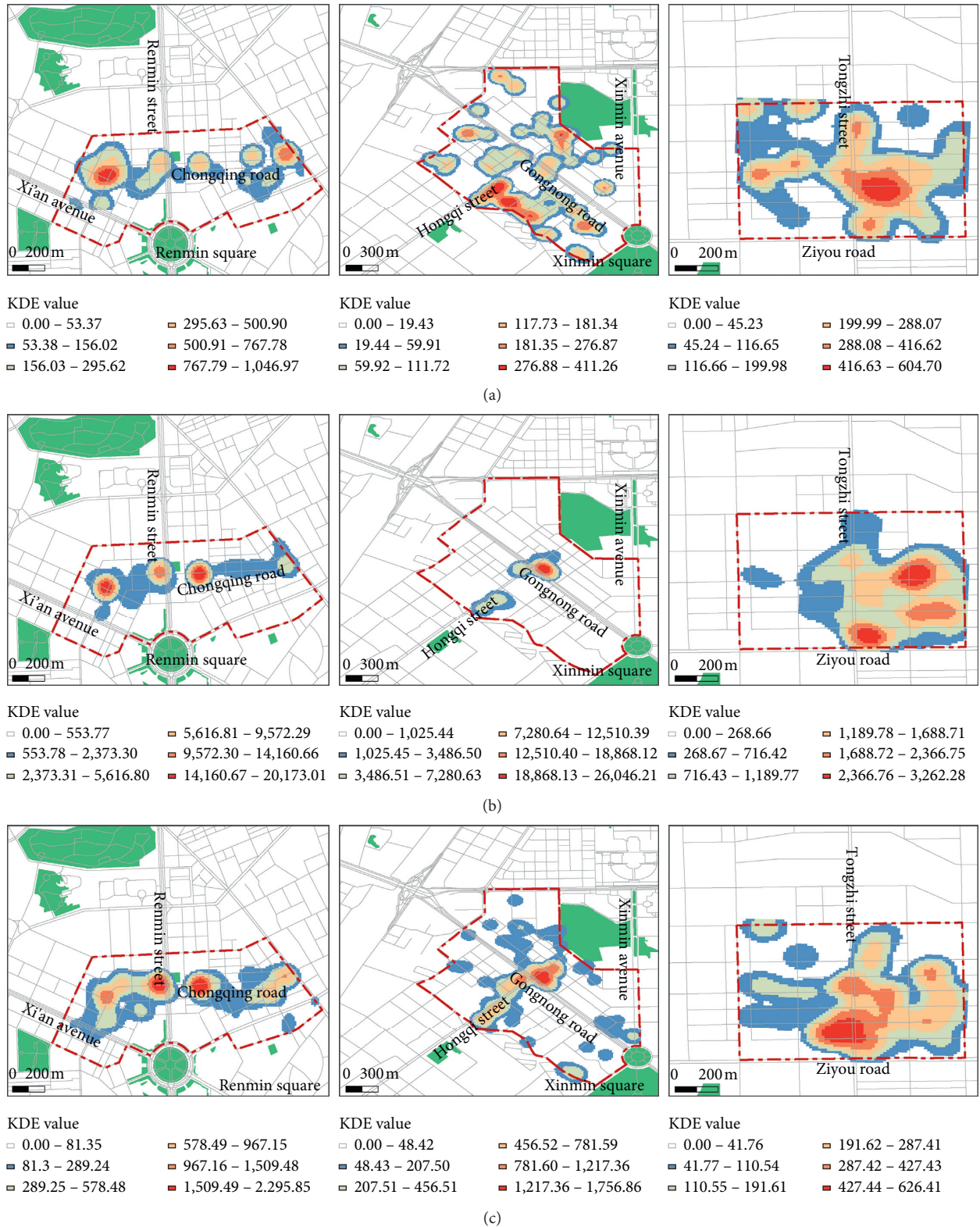


FIGURE 4: Spatial distribution of (a) IS, (b) TCS, and (c) CSS in the three commercial districts.

and vegetables. Chongqing Road has a relatively mature tobacco and wine specialty retail environment. High-grade FBS are also located inside shopping centers, while small-scale and low-grade shops are mostly along urban roads.

4.3. *Spatial Agglomeration Characteristics of Retail Stores.* The spatial distribution of retail stores in different categories can be judged by calculating the NNI for stores in different districts (Table 2). Chongqing Road and Hongqi

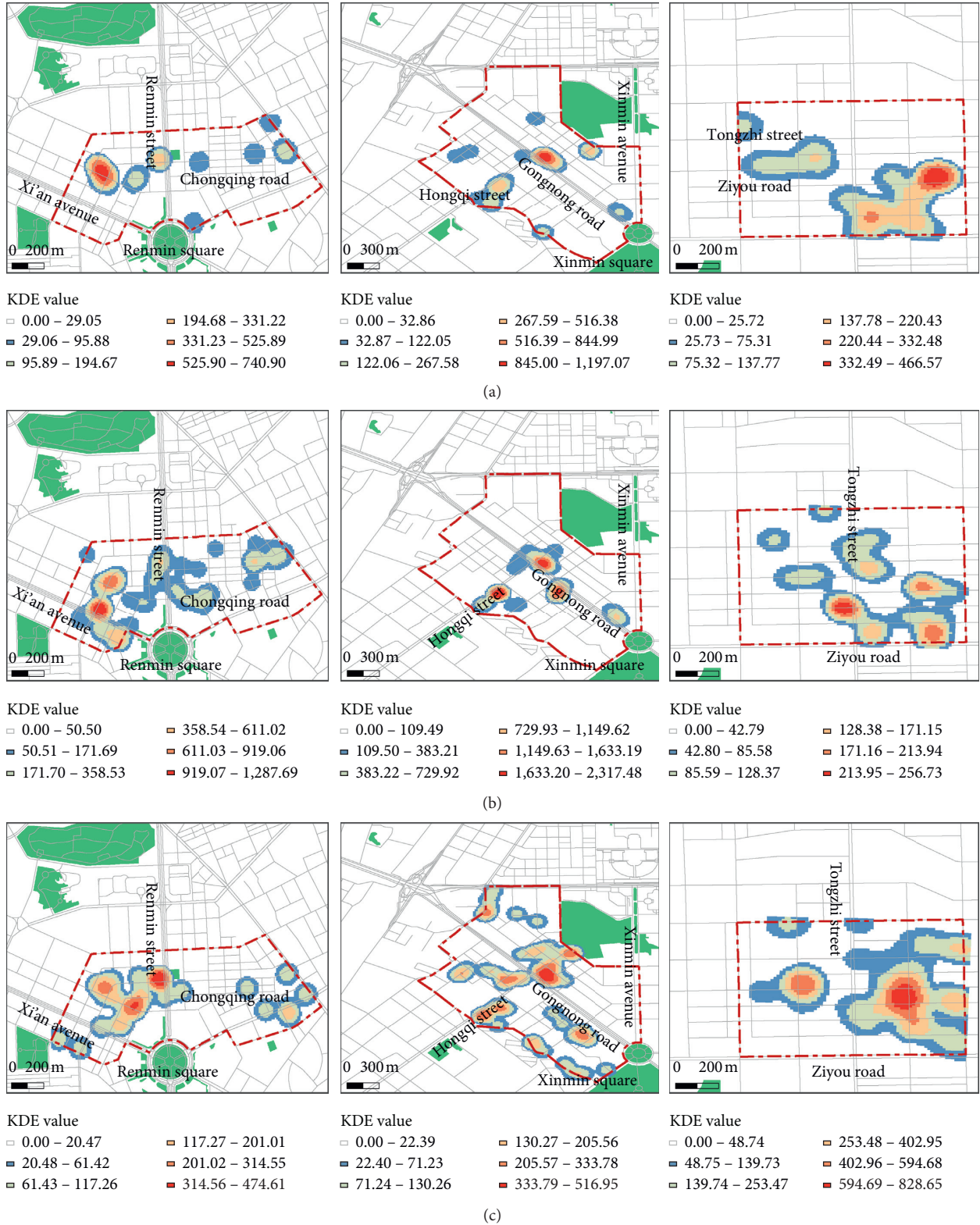


FIGURE 5: Spatial distribution of (a) HFS, (b) HES, and (c) FBS in the three commercial districts.

Street have a relatively high concentration of retail stores. The NNI of all retail categories in both is less than 1, passing the significance level. The discrete characteristics of Guilin Road retail stores are remarkable, but only TCS,

FBS, and HES present a significantly discrete distribution. The NNI for other retail categories is close to 1, which means that they have a spatial pattern of random distribution.

TABLE 2: NNI of retail categories in the three commercial districts in Changchun.

Retail categories	Chongqing Road			Hongqi Street			Guilin Road		
	NNI	Z value	P	NNI	Z value	P	NNI	Z value	P
IS	0.56	-7.03	0.01	0.83	-2.68	0.01	0.94	-0.89	—
TCS	0.34	-35.77	0.01	0.32	-34.50	0.01	0.61	-13.47	0.01
CSS	0.56	-10.59	0.01	0.56	-9.50	0.01	0.96	-0.66	—
HFS	0.73	-2.45	0.05	0.46	-6.49	0.01	0.96	-0.31	—
HES	0.56	-7.20	0.01	0.56	-9.72	0.01	1.27	2.27	0.05
FBS	0.81	-2.13	0.05	0.62	-5.70	0.01	0.83	-2.25	0.05

Note: “—” means not passing the significance level test.

Among specific retail categories, TCS have the highest agglomeration, followed by HES, CSS, HFS, and FBS, with IS having the lowest. For FBS and IS focusing on basic services, such as supermarket, fruits, vegetables, tobacco, and alcohol, spatial location has relatively little influence. To enable greater coverage, their locations are widely dispersed in the core and periphery of commercial districts, so their agglomeration is relatively low. When consumers shop at HES, HFS, and other retail goods stores, they are attentive to brands and after-sales services, and they are more inclined to consume in specialty stores and large professional shopping malls with better professional interiors and a better business environment. At the same time, as HES, TCS, and CSS are in the high-end consumer goods industry, their location requirements are also higher, so most are distributed in areas with convenient transportation, large pedestrian flow, and certain market potential, making it easier to form an agglomeration.

4.4. Spatial Correlation between Different Retail Categories. The correlation coefficients for location selection for different retail categories are shown in Figure 6. In Chongqing Road, TCS and CSS have the highest level of correlation, with r reaching 0.93, followed by those of IS, CSS, and TCS. The correlation between the other retail categories is relatively weak. In Hongqi Street, the correlation level for all six retail categories is significant, except for the relatively weak correlations among TCS, HFS, and IS. Commercial districts show a strong spatial correlation in types of retail industry in location choice. In Guilin Road, only CSS, HFS, and HES show a strong correlation with TCS, and the correlation among locations with other categories is not significant.

The overall correlation strength for retail categories in the three commercial districts in Hongqi Street and Chongqing Road is greater than that in Guilin Road. Hongqi Street and Chongqing Road are mostly concentrated in general department stores and shopping centers, which have high agglomeration. The retail formats in Guilin Road are mostly small shops, such as small specialty stores and exclusive shops, with a relatively scattered distribution. Moreover, the overall number of outlets is small, so the degree of correlation is low. TCS are highly correlated with other categories. As the most basic type in each commercial district, TCS exist in relatively large number, and they occupy advantageous locations, giving a certain driving effect to other retail types. On the other hand, as people's income

and living standards improve, improvisational purchases increase, and task-based shopping is gradually becoming recreational shopping. As an example, CSS have a strong tenant capacity by relying on the commercial space formed by TCS, and by forming an industry association with TCS, CSS can also enjoy the effects of agglomeration economies, promoting a coordinated development between the two industries. The dislocation layout and differential management of retail types can enhance the attraction of passenger flow in commercial centers and meet the diversified demand of urban residents for leisure shopping. Diversified retail formats are also a central trend in the development of the commercial district.

5. Determinants of Retail Stores in an Urban Commercial District

Previous studies have indicated that the development of retail stores is affected by spatial location, population density, urban planning, consumer behavior, traffic accessibility, and so on. Here, four main features or actors were identified, namely, the consumer, the vendors, the government, and the commercial activities. In line with this, four aspects were selected to analyze the determinants for retail stores in urban commercial districts. The first was the interaction between the consumer behavior and the location choice of retail stores. The second was the characteristics of the specific retail formats. These are the main determinants for retail stores in the commercial district. The third aspect was government planning and policies, which guide the special layouts of retail stores. Finally, the fourth is the spatial agglomeration effects of commercial activities. To more fully discern the mechanisms of formation of the retail stores in the commercial district, the project team conducted a random survey among consumers in the three main commercial districts from April 15 to May 10, 2018. More than 30 vendors were interviewed, and 180 consumers returned questionnaires that were distributed, resulting in 169 valid samples, for an effective rate of 93.89%. Among the consumers surveyed, 59.6% are women and 40.4% are men; in terms of age structure, the largest age group (63.6%) is between 18 and 25 years old, followed by those between 25 and 35 years old (20.0%), while other age groups are relatively small, with only 2.7% over 60 years old.

5.1. The Interaction of Consumer Behavior and Location Choice of Retail Stores. For consumers, consumption capacity, age, demand positioning, and other factors could

affect consumption behaviors, which have an important impact on spatial layout among commercial formats. As standards of living continue to improve, consumers are moving to express a higher level of demand, which not only means increasing the frequency of consumption but also paying closer attention to the quality of goods and the shopping experience. This implies that impromptu purchases would be more frequent. When purchasing desired goods, consumers may also notice trends in other goods, consciously or unconsciously. This requires a commercial district to be more comprehensive and specialized, which promotes the rise of the commercial complex, a dislocation between industries, and the increases in demand externality. The structure and spatial layout of the commercial district can also affect consumer behaviors, such as the duration and frequency of shopping activities. The results of the questionnaire indicate that consumers with shopping durations of less than 1 hour in Guilin Road were the largest group, 64.4%, while those with 1–3-hour shopping in Chongqing Road and Hongqi Street were the largest group, 53.3% and 44.1%, respectively. Interviews revealed that most of the consumers in the Guilin Road shopping area were task-oriented consumers with a clear purpose, so their shopping time was shorter, while shoppers in Chongqing Road and Hongqi Street were mostly leisure and entertainment shoppers who attached more importance to shopping as a leisure activity. The store owners in Guilin Road are mainly small-scale retailers, and although there are a variety of businesses and categories, there is an overall lack of large-scale shopping centers, which, as the vendors reported in interviews, leads to a lack of leisurely shopping experience for consumers. In addition, the lack of entertainment and leisure facilities also leads to a shortened stay for shoppers.

5.2. Characteristics of Specific Retail Formats. The location selection of various formats considers not only cost, earning cycle, and bearing capacity per land price but also its own nature, including product size, renewal speed, and level differentiation. Thus, the convergence of location selection and decision-making is a fundamental reason for clustering retail stores. Industry for the high-end consumer shows a higher service level, which is always located at sites with convenient transportation and strong comprehensive service capacity, requiring a broader market and a high-quality environment. Due to its short updating time, the industry for life service shows a high demand for timeliness of sales, which mainly relies on population density to obtain profits, tending to produce traffic nodes with fierce competition for commercial space. This results in a scattered spatial location. Thus, industries with larger scale and lower environmental dependence are mostly distributed across the marginal areas of the commercial district. The diversity and selectivity of commodity formats are a main factor affecting the economic benefits of stores. The questionnaire results show that 68.2% of consumers reported that they believed the variety of goods available in the shopping district effectively motivated them to spend; 47.6% and 49.0%, respectively, say that discounts and better quality products motivated them to spend. Conversely, only 10.9% of consumers

reported that they were concerned about the products and the professionalism of the shopping district.

5.3. Government Planning and Policies. Governmental urban planning constitutes regulation of urban space, which directly affects construction. The government is promoting the reconstruction of the old city in the central area by means of industrial policies to achieve a replacement of urban functions. Through an adjustment of administrative divisions, the commercial service industry is led to realize agglomeration and diffusion in different regions. Influenced by urban planning, the commercial district in Changchun has developed typical features of the core-periphery layout. Department stores and shopping centers with a strong tenant ability are distributed in the center of the district, and the small-scale, low-profit specialty stores have gradually moved to the edge of the commercial district and the adjacent secondary traffic area. Due to land reforms, development of the commercial district, and other government initiatives, most individual shops in the marginal areas of the commercial district have experienced migration from the center to the periphery due to increased rents in the center. As the core-periphery style developed, the intrusion of emerging commercial complexes was located on the edge of the district due to its low rents and general location conditions, but the rich and diverse retail forms and advantages of comprehensive entertainment experience split the core position of the original commercial center, gradually developing a new cluster center. From the emerging commercial formats, a commercial district with a single core is gradually transforming into a multicore pattern, which will enhance the strength of the commercial district.

5.4. Spatial Agglomeration Effects of Commercial Activities. In the early 1990s, the commercial districts in Changchun showed single-format space competition, mainly featuring department stores and traditional small-scale retail stores. Since the beginning of the 21st century, competition in urban retail commercial spaces has gradually shifted from single-format competition to multifunctional complex competition. The rapid development of emerging retail forms, such as chain supermarkets, exclusive stores, and shopping centers, has intensified competition for commercial space. The large-scale loss of traditional department stores has forced improvements of service quality and supporting facilities, and the single format has gradually integrated with chain supermarkets, exclusive stores, and other retail formats to achieve the effect of an agglomeration economy and to improve the comprehensive competitiveness of department stores. Different retail formats are both competitive and complementary, and the spatial agglomeration of multiple formats makes commercial spaces more comprehensive, improving competitiveness. It also alleviates horizontal competition to satisfy the diversifying consumer demand. Convenience, specialty, and department stores, as well as supermarkets and other commercial formats, are often clustered in and around shopping centers, and these locations are commercial districts in a city or region (Figure 7). The questionnaire results indicate that the Hongqi Street and Chongqing

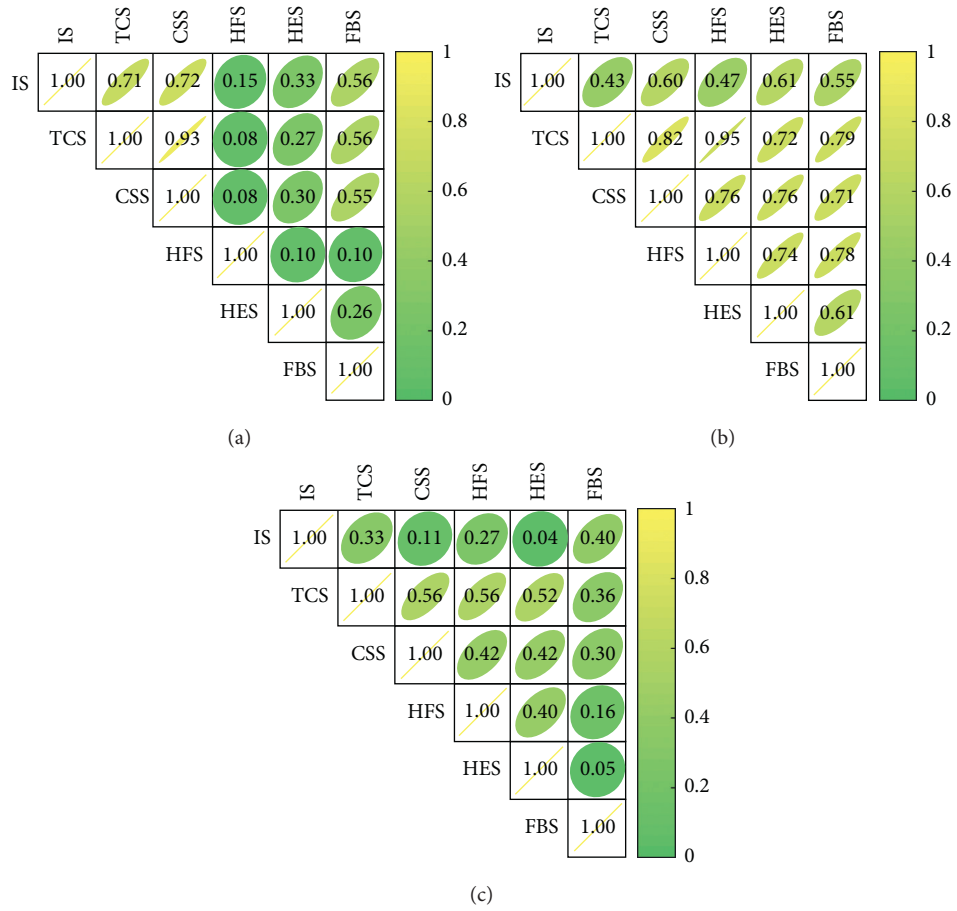


FIGURE 6: Pearson correlation coefficient of the retail categories in the three commercial districts: (a) Chongqing Road; (b) Hongqi Street; (c) Guilin Road.

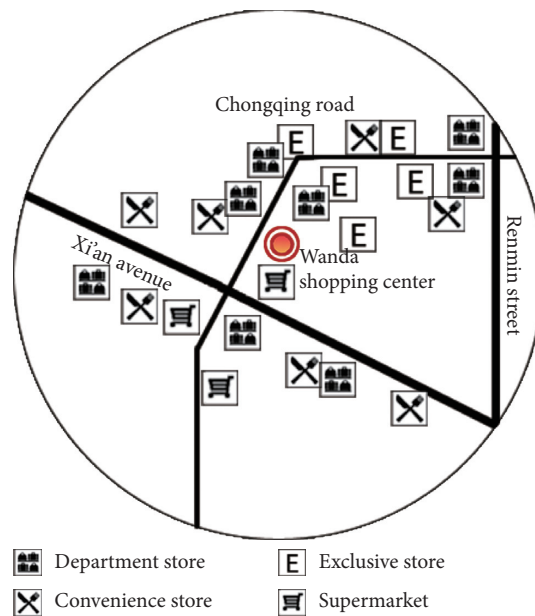


FIGURE 7: Spatial distribution of retail stores around Wanda shopping center in Chongqing Road.

Road districts, which are higher in the hierarchy, have a wider and more attractive radius. According to the survey, the majority of consumers chose public transport to shop on Hongqi Street (68%) and Chongqing Road (79%), and 49% reported that they were comfortable with a distance of 30 minutes or more. 69% of consumers walked to the Guilin Road shopping area, with 84% taking less than a half hour each way. The comparison shows that a high level shopping district presenting a wide range of options and products reduces the cost of searching, and a good shopping environment is favored by consumers, which indicates that accessibility is a lesser concern.

6. Conclusion and Discussion

POI data and field research in the commercial districts in Changchun were used to systematically analyze spatial structures of commercial districts, location patterns of retail stores, and interrelations of retail categories. The determinants of retail stores in the commercial district in relation to the consumer, the vendors, the government, and the commercial activities were assessed. The main conclusions are as follows:

- (1) The number and scale of retail stores in Chongqing Road and Hongqi Street are significantly higher than those in Guilin Road. There is a significant difference in the distribution of retail stores among the three, and TCS have a scale advantage in each.
- (2) Retail in the three main commercial districts in Changchun is characterized by both single-center agglomeration and multicenter dispersion. The traditional commercial districts break the center-periphery circular structure grouped around department stores and specialty stores with outward radii, which has promoted the transformation of the commercial districts from single-center to multicenter bodies, presenting a hierarchical development.
- (3) Retail industries show different characteristics in their location choice. In IS, convenience stores offer a wide spatial range of services, and their competitive advantage is affirmed in their geographical proximity to residents. Supermarkets mainly rely on the layout of the commercial center and are generally on the first floor or below the main building. TCS are middle and high-end consumer goods retailers that must be distributed in places with convenient transportation, large pedestrian flow, and large market potential. CSS are within the nonessential retail industry, featuring small demand but a wide range of services. Most HFS in the commercial district are small-scale individual businesses, which can easily form a

specialized street with different degrees of development. HES are distributed in areas with strong comprehensiveness and a good business environment and are mainly found in exclusive areas, commercial streets predominated by digital products, and large shopping malls. Due to the necessity of short preservation times, FBS have stronger requirements for the timeliness of sales, and they are mostly located near residential areas and take family consumption as their market positioning target.

- (4) Chongqing Road and Hongqi Street have a relatively high concentration of retail stores. The divergent characteristics of Guilin Road retail stores are remarkable. TCS have the highest agglomeration, followed by HES, CSS, HFS, and FBS, with IS stores having the lowest. In relation to industry correlation, the location selection for each retail industry in Hongqi Street and Chongqing Road is more relevant than that in Guilin Road, and TCS have a high correlation with other retail types.
- (5) Four main factors affect the development and spatial layout of retail in the commercial districts. First, the interaction between consumer behavior and location choice in retail stores is the main factor, and this promotes the evolution of retail formats and trends in the development of comprehensive, specialized, and hierarchical retail commercial spaces. Second, the retail format determines the spatial layouts and the historical inheritance of the format. Furthermore, governmental planning and policies lead to the agglomeration and diffusion of commercial activities in different areas. Finally, spatial agglomeration effects are an external driving factor for integration and aggregation among retail formats, which not only alleviates horizontal competition but also improves comprehensive competitiveness in commercial spaces.

Against the background of rapid urbanization, as an important carrier of the comprehensive, experiential, and multipurpose consumption of urban residents, large shopping centers, as represented by commercial complexes, are recreating the commercial structure of traditional urban shopping centers, driving development and renewal of urban areas. However, due to the difficulty of obtaining commercial data, traditional study of commercial districts has largely been carried out in relation to a few large commercial outlets and the census data, which reduces the precision of the understanding of these districts. Earlier work has largely ignored specific types of retail, and little attention has been paid to the locations of retail within a micro commercial district. Here, using POI and consumer survey data, we took meaningful steps to refine the

understanding of urban commercial districts. First, we reclassified the POI data into six categories, following China's Sectoral Classification System, which allowed us to identify the location pattern for retail stores in specific retail industries as distinct from the traditional perspective of retail formats. Second, we analyzed interrelated characteristics between the spatial distributions of retail stores in different categories, which can enrich the body of research on commercial districts in relation to locations of retail. We also investigated the determinants for retail in commercial district relative to the perspectives of the consumer, the vendors, the government, and the commercial activities, the results of which may guide sustainable development in commercial districts and urban planning.

This study had some limitations. Due to the lack of POI data from recent years, the discussion of the transformation of commercial formats and the evolution of commercial districts is inadequate. Moreover, obtaining data from a large number of consumers on in-depth shopping behavior proved to be difficult, which indicated that quantitative research on the patterns of urban commercial districts would be difficult. It is expected that further in-depth research can combine mobile signal data and other geographic big data. Additionally, the vigorous development of online shopping and other emerging formats will have a large impact on physical commercial shops. Its effects on the shopping behavior of consumers and the location choices for retail stores are worth further discussion.

Data Availability

All POI data are obtained from the open platform of Gaode Maps (<http://www.amap.com>). The consumer survey data are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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