Spatial pattern of urban functions in the Beijing metropolitan region

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A B S T R A C T

The morphology of a city affects its ecological and socioeconomic functions, and thus how a city is spatially structured has important bearings on urban sustainability. The paper analyzes the spatial pattern of Beijing in relation to its urban functions. Our results show that the 6 concentric ring-roads in Beijing provide a basic framework for the city's overall spatial pattern, and also give its apparent resemblance to the classic concentric zone theory. The paper identifies 5 concentric zones for Beijing based on a suite of urban functions. However, there are significant differences between the urban spatial pattern of Beijing and that depicted in the classic concentric zone theory. The study sheds new light on the urban morphology of one of the major Chinese cities, and provides needed information for developing plans to diffuse urban functions in Beijing.

Introduction

Advances in information technology, development of knowledge economy and various processes of globalization have profoundly influenced the world’s urban systems (Shen, 2000). Today, there are more than 300 metropolitan regions with more than one million people, and these metropolitan regions are still expanding rapidly (Wu, 2008a). As the world’s most populated nation, China has been experiencing an unprecedented urbanization in the past several decades. In 2004, more than 30 of the 661 cities in China had a population of one million or more (Beijing Statistics Bureau, 2005). The increase rate of urban population was 7.1% over a period of thirty years before 1978 (Chen, 1994; Zhang & Zhao, 1998), but rose to 20% in 1980 and to 41.8% in 2005 (China Statistics Bureau, 2006). China’s rapid urbanization is certainly influenced by and also influences the global urbanization process (Sassen, 2000; Sit & Yang, 1997). However, the primary impetus for the recent burst in urbanization in China has been related to a series of profound changes in policies and institutions as well as the rapid economic development since 1978 (Pannell, 1995; Sassen, 2000; Young & Deng, 1998).

Rapid urbanization often results in a number of problems, such as traffic jams, high-pricing houses, lack of green space, biodiversity loss, urban heat island effects and air pollution (Gordon, Kumar, & Richardson, 1989; Pickett et al., 2001; Wu 2008a, 2008b). In order to mitigate these problems, urban scientists and planners have put forward a number of theories and approaches to improve our understanding of the spatial pattern and functionality of cities (Luck & Wu, 2002; Wu, 2008a). Among them the most well-known are the concentric zone theory (Burgess, 1925), the sector theory (Burgess, 1925; Harris & Ullman, 1945; Hoyt, 1939), and the multiple nuclei theory (Harris & Ullman, 1945). According to Burgess’s concentric theory, the morphology of a city is characterized by several functionally distinct zones, together forming several concentric rings: the central business district (CBD), the zone of transition, the residential zone, and the commuter zone. The CBD is occupied by department stores, main offices, local government headquarters, banks, theatres and cinemas, and expensive shops; the transitional zone is characterized by poor social groups of recent immigrants; low cost family homes with limited amenities form the working class zone; the residential zone comprises middle-class and upper-class and more spacious dwellings; and upper-class and expensive housing in a suburbanized setting is found in the commuter zone that is beyond the built-up area of the city (Burgess, 1925; Schwab, 1982).

Based on the distinctive characteristics of different income groups, the concentric zone theory generalizes the urban land use pattern of American cities and has been frequently applied to fit all cities. However, the theory pays little attention to roads, railways and industries. In 1939 Hoyt put forward the sector theory which was valuable in drawing attention to the expansion of cities in wedge-like fashion. Harris and Ullman (1945) suggested that land use patterns in many cities do not focus on a single center, but have
multiple centers such as retail areas, warehousing districts, and manufacture, educational and financial centers. The multiple nuclei theory identifies several rules that are useful in predicting the location and future growth of the specialized districts (Harris & Ullman, 1945; Luck & Wu, 2002; Schwab, 1982). Multi-nuclei means different settlement sites such as major urban areas and edge or satellite cities. However, the multiple nuclei theory indicates that the metropolitan area is composed of several nuclei and each nucleus may have functional specialization such as CBD or high-technological garden. With the rapid urbanization, the metropolitan areas are becoming larger and the urban structure evolves from monocentric to multi-nuclei (Batty, 1995).

These classic theories seem to be able to describe and explain some of the general urban land use patterns found in many cities of developed countries. However, the urbanization process in developing countries, such as China, may be different from that in developed nations (Qi et al., 2004; Tian et al., 2005; Tian, Yang, & Xie, 2007; Tian, Yang, & Zhang, 2007; Zhou & Ma, 2000). However, although there is much literature on U.S. metropolitan spatial structure and polycentricity such as Los Angeles (Gordon, Richardson & Wong, 1986; Gordon et al., 1989; Gordon & Richardson, 1996; Giuliano & Small, 1991; Giuliano & Small, 1993), Atlanta (Gong & Wheeler, 2002), Randstad in Holland and Southern Californian urban region (Clark & Kuijpers-Linde, 1994), few have addressed the urban spatial functions of Chinese cities (Tian, Liu, & Zhang, 2002). In recent years, plans for multiple nuclei development and new edge cities have been proposed in some Chinese metropolitan regions (Zhao, 2004), but because most people are not willing to move outside due to long commute to work, such plans have not been implemented adequately. For example, Beijing as the political, cultural and economic center of China has highly concentrated and diversified functions and increasingly severe urban problems (e.g., exacerbated traffic congestion and environmental conditions). For purposes of both scientific understanding and policy making, therefore, there is an increasing need for studying urban spatial structure in relation to its functions.

The primary goal of this study was to investigate the spatial pattern of major urban functions of the Beijing metropolitan region, including those related directly to living, dwelling, traffic and working. To achieve this goal, it attempted to address the following research questions: (1) What is the spatial pattern of urban functions in Beijing metropolitan region? (2) Is the concentric zone theory adequate to describe the spatial pattern of the Beijing metropolitan region? The answers to these questions will not only shed new light on the urban morphology of one of the major Chinese cities, but also provide needed information for developing plans to diffuse urban functions and human populations and to alleviate environmental problems in Beijing.

Study area and data sources

Beijing, the capital of China, is located at 39°56′N and 116°20′E and covers an area of 16,808 km² (Fig. 1). Beijing’s history as a capital city dates as far back as Warring States Period (484–221 B.C.). After that, it was the capital of Yuan, Ming and Qing Dynasties. In 1949, it was again made the national capital of People’s Republic of China. Two-thirds of Beijing is mountainous areas, surrounding the city on the western, northern and eastern sides, and to its southeast lies the North China Plain. Taihang and Jundu mountains rise to heights of 2300 m, straddled by the Great Wall within 50 km north and west of the city. The main rivers include Yongding, Chaobai and North Canal.

The major road system, with ring-roads and radial arteries forming a complex network, is a primary determinant of the urban spatial structure of Beijing. The major road around the Forbidden City is named the first ring-road, and the concentric roads beyond the first ring-road are in turn called the second, third, fourth and fifth ring-roads in the order of the radial distance from the center of the city. The sixth ring-road is under construction and has been partly completed. The ring-roads and radial roads that have been developed over the past several decades constitute the underlying pattern of urban growth in the region. Beijing municipality encompasses
sixteen administrative districts and two counties. It is the second largest city in China with a total population of 14.93 million in 2004 (Beijing Statistics Bureau, 2005), accounting for 1.1% of the national population. Among them about 11.87 million people live in the urban areas and 3.06 million live in the rural areas.

The digital city datasets with the scale of 1:10,000 include vector polygon data such as administrative boundaries, water body, gardens, railways, roads and building blocks in 2004. The points of interest, such as public management and social organizations, supermarkets, hotels, and schools, are classified into twelve types (Table 1). The datasets were processed using ArcGIS 8.3 developed by the Environmental Systems Research Institute (ESRI).

### The spatial pattern of urban functions

Two different general approaches can be used to characterize the spatial structure and functions of Beijing metropolitan region. One is to divide the region into four urban regions according to the administrative boundaries and the underlying patterns (Fig. 1); the other is to divide it into 5 zones by the ring-roads distance from the central areas. The 4 metropolitan regions are as follows: (1) The inner center is delineated by the third ring-road, within which four districts—Xicheng, Dongcheng, Xuanwu and Chongwen—are found. Although they are all within the inner center, their per capita Gross Domestic Products (GDP) are dramatically different (Fig. 2). For example, the per capita GDP of Xicheng District was 3.83 times that of Chongwen District in 2004. (2) The outer center also includes four districts—Haidian, Chaoyang, Shijingshan and Fengtai. The economic development of the four districts is uneven, too (Fig. 2). The per capita GDP of Chaoyang District was 1.89 times that of Fengtai District which had the lowest of the four districts. (3) The inner periphery is composed of three districts (Mentougou, Fangshan and Daxing) and three edge cities (Tongzhou, Shunyi and Changping). The per capita GDP of the inner periphery is lower than that of the eight central districts (Fig. 2). (4) The outer periphery includes four counties: Huairou, Pinggu, Miyun and Yanqing, all of which have a lower per capita GDP than the eight central districts.

Beijing municipality can also be divided into 5 zones according to the 6 ring-roads in order to study the relationship between urban functions and the distance from the core area (Table 2, Fig. 3). Moreover, the paper also studied the concentric characteristics of urban functions using the distance statistics. The spatial pattern of urban functions in Beijing in greater detail primarily with reference to the ring-roads was described below.

### Public management and social organizations

The inner center occupies 32.5% of the total area of Beijing while the outer center, the inner and outer peripheries occupy 51.5%, 12.0% and 4.0%, respectively. Hence, most of the public management and social organizations are located in inner and outer centers. In 2004, 0.29 million people were involved in public management and social organizations in the central and local governments (Beijing Statistics Bureau, 2005). The occupancy of this sector decreased gradually from inside to outside (Fig. 3). The zone inside the third ring-road occupied 46.8%. Moreover, there were more institutions of the central government than those of local governments. National ministries accounted for 87.8% of the administrative institutions inside third ring-road. Only 12.2% were located outside the third ring-road (Fig. 3).

As the capital of China, Beijing municipality has the central government departments as its important components. After 1949 planners were concerned with defining the city as a political and cultural center. Of the 205 national ministries and commissions in the datasets, 148 departments are distributed in the inner center and only 57 departments in the outer center. The central government departments are mainly located in Xicheng and Dongcheng Districts while the municipal government branches are mainly located in Xuanwu District. National ministries concentrate more in the inner center. They usually have a great number of employees and produce a great job-home traffic flow. Although some planners and scientists suggest moving the central and municipal government to Tongzhou District, their proposal is still in debate (Zhao, 2004).

The spatial correlation coefficients between the urban function points of interest and population in every district and county were calculated (Fig. 4). The population of i district and county is variable x, urban function points of interest in i district and county is variable y. Then the correlation coefficient between population and public management was calculated and it was 0.83. But the spatial correlation coefficient between population and national ministries was 0.03. This indicates that public management and social organization concentrated in the central areas and was less correlated with population. The national ministries were even least correlated with population.

### Commerce

More than 0.42 million people were engaged in the wholesale and retail trade in 2004, of which there were 0.18 million people in the wholesale trade and 0.24 million in the retail trade. Only the supermarkets were calculated because there were a very large number of small shops. After 1979, the commercial activity of Beijing has increased dramatically. The three large commercial areas—Wangfujing, Xidan, and Qianmen—are undergoing massive renovation (Gautatz, 1995). Wangfujing caters to the foreign community; Xidan appeals to

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### Table 1

Classification of basic urban functional elements in the Beijing metropolitan region.

<table>
<thead>
<tr>
<th>Code</th>
<th>Classification and social organization</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Public management and social organization</td>
<td>National government, provincial government representatives, city, district, township, village, street government, residential district and village, fire control, police station, court, jurisdiction bureau, administration for industry and commerce, revenue, financial bureau, customs, embassy, association, foundation, welfare agency etc.</td>
</tr>
<tr>
<td>2</td>
<td>Commerce</td>
<td>Supermarket, plaza, shopping center, market, small shops, furniture, building material, shoe shop, glasses, computer, grocery.</td>
</tr>
<tr>
<td>3</td>
<td>School</td>
<td>University, college, middle school, vocational school, primary school, kindergarten, nursery school, training center, private school.</td>
</tr>
<tr>
<td>4</td>
<td>Hospital</td>
<td>Hospital, children hospital, clinic, emergency center, lunacy hospital, contagion hospital, tuberculosis, eye hospital, bone hospital, drug shop, drug company.</td>
</tr>
<tr>
<td>5</td>
<td>Official building</td>
<td>Commercial building.</td>
</tr>
<tr>
<td>7</td>
<td>Companies</td>
<td>Factory, oil station, building and decoration company, water supply, gas station.</td>
</tr>
<tr>
<td>8</td>
<td>Factories</td>
<td>Bank, insurance company, stock company.</td>
</tr>
<tr>
<td>9</td>
<td>Finance</td>
<td>Bank, insurance company, stock company.</td>
</tr>
<tr>
<td>10</td>
<td>Hotel</td>
<td>Hotel, cabaret, restaurant, rest house, snack, chafing dish, refecton.</td>
</tr>
<tr>
<td>11</td>
<td>Entertainment</td>
<td>Showplace, cinema, goggery, theater, club, tourism, holiday, temple.</td>
</tr>
<tr>
<td>12</td>
<td>Sports</td>
<td>Golf, swimming pool, hot spring, bowling.</td>
</tr>
<tr>
<td>13</td>
<td>Media, library and conference center</td>
<td>Library, museum, art gallery, conference center, auditorium, newspaper office, publishing house, news center, archives, church.</td>
</tr>
<tr>
<td>14</td>
<td>Communication</td>
<td>Post, telecom bureau, postal bank.</td>
</tr>
<tr>
<td>15</td>
<td>Everyday services</td>
<td>Hairdressing, taking pictures, marriage service, agency, electronic maintenance, residential living center.</td>
</tr>
</tbody>
</table>
residents of the municipality; and Qianmen serves local markets and other provincial tourists. There were 668 supermarkets in total, 45.8% of which were inside the third ring-road. They distributed more evenly outside the third ring-road (Fig. 3). Hence the area inside the third ring-road was still an important commercial center. The 3 large commercial areas are located inside the second ring-road. The business centers did not deteriorate as the CBDs in many developed countries. They evolved into complex commercial centers which were filled with food, entertainment, financial, and information industries. However, new complex commercial centers, such as Chaowai Street, Muxiyuan, Gongzhufen, Madiian and Shuangyushu, are located between the second and third ring-roads (Zhang & Li, 2005). The great commercial complexity made it difficult to diffuse the commercial function and resulted in large population flows.

The distribution of supermarkets was similar to that of public management (Fig. 3). Most supermarkets were distributed in the inner center (41.9%) and the outer center (39.8%). There were only 11.1% and 7.3% of the supermarkets that were located in the inner peripheral districts and the outer peripheral districts, respectively. The spatial correlation coefficient between the population and supermarkets was 0.67 (Fig. 4). Supermarkets were less correlated with the urban population distribution than small markets and shops.

Office buildings, residential districts, and manufacturing industries

The distribution of office buildings was similar to that of residential districts (Fig. 3). The numbers of both office buildings and residential districts increased inside the fourth ring-road and decreased gradually outside. However, the percentage of residential districts was higher than that of office buildings outside the fourth ring-road, while office buildings were mainly located inside the fourth ring-road. The 4r inner central districts and the four outer central districts had 19.7% and 73.6% of the office buildings, respectively. Hence, most of the office buildings were located in the eight central districts. In particular, the percentage of the office buildings was 41.4% for Chaoyang District and 22.7% for Haidian District. The inner periphery and the outer periphery had 4.3% and 2.3%, respectively. The distribution of office buildings and residential districts was highly correlated to population size (with a correlation coefficient of 0.85; Fig. 4).

A total of 3006 residential districts developed concentrically along the ring-roads, and there was little space for new residential buildings inside the second ring-road where most houses were historical or relict. Most of the houses between the second and third ring-road were built by the government branches, universities and hospitals before the 1990s. These houses were mainly allocated to the employees of the government. The inner center occupied 13.2% of the residential districts. After the 1990s, the zone between the third and fifth ring-road developed rapidly and the zone between the fourth and fifth ring-road had more and more commercial residential buildings (Zhang & Liu, 2002). The outer center, the inner periphery and the outer periphery occupied 15.8%, 67.7%, and 3.3%, respectively.

Table 2
Division of the five zones of Beijing and their spatial relations.

<table>
<thead>
<tr>
<th>Zone</th>
<th>Relation to the inner city</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone I</td>
<td>Area within the third ring-road</td>
</tr>
<tr>
<td>Zone II</td>
<td>Area between the third and fourth ring-road</td>
</tr>
<tr>
<td>Zone III</td>
<td>Area between the fourth and fifth ring-road</td>
</tr>
<tr>
<td>Zone IV</td>
<td>Area between the fifth and sixth ring-road</td>
</tr>
<tr>
<td>Zone V</td>
<td>Area outside the sixth ring-road</td>
</tr>
</tbody>
</table>

Fig. 2. Documented population ($\times 10^4$) and Gross National Product ($\times 10^9$) of the Beijing Municipality in 2004.

Fig. 3. Urban Functional characteristics in the five zones.
The professional companies included mainly service industries such as auditing, legal and accounting agencies and the headquarters of corporations. There were 8686 companies in total. In comparison with manufacture, the companies need small office spaces and can bear the high costs of amenities. The producer services can create new job opportunities, export the services to external regions and tie to the information technologies (Gong & Wheeler, 2002). The companies were distributed more evenly inside the sixth ring-road (Fig. 3). Most of the companies were located in outer center (68.1%) and the inner center (21.2%). They were also found in the inner periphery (8.6%) and the outer periphery (2.1%). Most of new companies were located in the Zhongguancun scientific and technological park and Beijing economic development zones, and foreign invested companies are mainly located in Chaoyang district.

Most manufacturing industries were located between the fourth and sixth ring-roads (Fig. 3), where 4026 factories were found. These industries need plenty of materials and spaces. The government had tried to move quite a few factories away from the city center to suburbs and counties outside Beijing. About 66.4% of the factories were located in the four new central districts. The inner periphery districts accommodated 20.1% of manufacturing industries. Although the workers’ houses were built close to the factories to allow speedy access to work (Schwab, 1982), they have not shaped the zone inside the city.

Educational, health, financing, and entertainment services

In 2004, more than 0.56 million people were employed in educational, health, and social welfare industries. Most universities and research institutes of the Chinese Academy of Sciences were located in Haidian District. However, elementary and high schools were more scattered across the region in response to needs of local populations. They decreased from the first to the fourth ring-road and then increased until the sixth ring-road was reached (Fig. 3). This indicates that the schools were mainly located inside the city. The four inner central districts encompassed 27.1% of the elementary and high schools while the four outer central districts had 65.4%. The inner periphery and the outer periphery had 11.3% and 1.8%, respectively.

The hospitals distributed evenly within the sixth ring-road (Fig. 3). The 4 inner central districts had 30.0% of the hospitals, and the 4 outer central districts had 52.9%. The inner periphery and the outer periphery possessed 12.5% and 4.7% of hotels, respectively. The hospitals were mainly located in Chaoyang and Haidian Districts. However, prestigious high-quality medical organizations still concentrated in the inner central districts.

The percentage of hotels and media agencies decreased from inside to outside and those of entertainment, communication and everyday services decreased gradually (Fig. 3). Many hotels, media agencies, news, entertainment and communication amenities and everyday services were located in the central city. The financial branches and sports facilities were distributed more evenly (Fig. 3).

39.3% of the 853 hotels were found in the 4 traditional central districts, and 49.7% of them were located in the 4 new central districts. Chaoyang District had the most hotels partly because of the great number of embassies and business districts. The inner and outer peripheries had only 6.3% and 5.1% of hotels, respectively. However, most of the high-class hotels were distributed in Xuanwu, Dongcheng, Xicheng and Chaoyang Districts. There were 2444 media facilities, libraries, conference centers, exhibition pavilions, publishing houses and newspaper offices. 42.7% of them were found in the 4 inner central districts and 49.9% in the 4 outer central districts. In addition, 5.6% and 1.8%, respectively, were found in the inner and outer peripheries. Nearly 77.7% of these facilities were distributed inside the fourth ring-road (Fig. 3). The everyday services include hairdressing, picture taking, marriage services, electronic maintenance, home media, dry cleaners, etc. (Fig. 3). The density of these facilities still was higher in zones that were closer to the old city center.

The number of entertainment services decreased from the third ring-road outward (Fig. 3). The distribution of sports facilities was not even inside the sixth ring-road (Fig. 3). The communication includes the post office, telecom branches and postal banks. There were 2270 post offices and postal service facilities. They were distributed evenly inside the sixth ring-road (Fig. 3). The 4 inner central districts possessed 29.0% of the entertainment service facilities, and the 4 outer central districts possessed 58.2%. The inner periphery and the outer periphery had 8.9% and 4.0%, respectively.

There were 6126 bank branches and insurance company agencies. 28.6% of them were distributed in the 4 inner central districts and 54.3% in the 4 outer central districts. Overall, the financial facilities were mainly located in Haidian and Chaoyang Districts. Xicheng District had 800 financial branches because of the construction of the “Financial Street”. The inner periphery and the outer periphery had 10.8% and 6.3% of the financial branches (Fig. 3). The urban functions of communication, finance, education, entertainment, sports, everyday services, hotels, and media facilities were all highly correlated with population size (spatial correlation coefficients being 0.93, 0.92, 0.91, 0.9, 0.89, 0.89, 0.82 and 0.79, respectively).
Discussion and conclusions

Beijing has been a major regional political center for as early as the Warring States period. The street network and all monumental architecture were aligned with the cardinal directions to conform with Chinese geomancy (Gaubatz, 1995). The imperial city is the center of the traditional center and was characterized by a high degree of neighborhood specialization. In 1949–1978, Mao Zedong's socialism reshaped the city and cities were planned to be production centers and the industrial development was encouraged. New development was structured around large walled work-unit compounds. The people rarely travel beyond their compounds because the compounds are accommodated with housing, housing, production facilities, health care, food distribution and even schools. This planning methods had virtually eliminated the need for specialized districts and neighborhoods and districts of the city were relatively undifferentiated by function (Gaubatz, 1999). Urban development has followed a strategy of spatial and functional specialization after 1979 (Chen, 1991; Quan, 1991). The eastern half of the central city is devoted to foreign embassies and international activities and the western half is devoted to domestic functions. Two master plans in 1982 and 1993 were influenced by analytical frameworks of central-place theory.

The results have shown that the spatial pattern of the Beijing metropolitan region has been influenced by the ring-road system, historical context and the planned activities. Because of the concentric ring-roads, the land use pattern and urban functions of Beijing has a general zonal structure that appears to conform to the concentric zone theory. However, this apparently concentric zonal pattern is not consistent with the differentiation of social and economic classes that underlines the classic theory.

Based on this analysis, 5 zones of urban functions can be identified in association with the 6 ring-roads in the Beijing metropolitan region (Fig. 3). The first zone is the area inside the third ring-road. It can be called the central business district (CBD), whose major function is characterized by public management, shopping malls, schools, hospitals, hotels, and media and high entertainment facilities. The area within the second ring-road is the heart of Beijing where the Forbidden City, Tiananmen Square, Changan Street and Xidan Mall are found. The second zone is the area between the third and forth ring-roads whose major function is represented by the dominance of office buildings, residential structures and commercial facilities. The third zone is between the forth and fifth ring-road, which is primarily for factories, company, sports, school, residential districts and hospitals. It can be called manufacture-residence zone. The forth zone is between the fifth and sixth ring-road, which is primarily for residential and manufacturing functions. It can be called residence-manufacture zone. The functions of the third and forth zone are similar. However, more companies are located in the third zone while more residential areas are in the forth zone. The fourth zone is outside the sixth ring-road, which includes the suburbs and the satellite cities.

However, there are significant differences between the urban spatial pattern of Beijing and that depicted in the classic concentric zone theory. Each of the 5 zones in Beijing is mixed with multiple urban functions. The functions of CBD in Beijing not only include business enterprises but also are dominated by the central and local government administrations. The second zone has middle-class homes and is not for groups lower on the socioeconomic scale, immigrants, and rural migrants. The third zone is not dominated by the workingmen's homes, and its major functions include both manufacturing industries and housing. In contrast with the classic theory, many wealthy people live in high-quality expensive houses in this zone. The forth zone is more similar to the classic theory with the residential area of the professionals. However, there are still many companies and factories. The fifth zone is most similar to the classical theory. Because of traffic congestion, the wealthy and middle-class people have not completely moved outward to suburbs. Many of them have 2 houses. They work and live in the central city and go to suburban villas on weekends and holidays. The spatial structure of ring-road meets with the concentric theory, but the theory can not explain fully the urban function patterns. The sector theory and multiple nuclei theory can be used to investigate urban functions more deeply. The sector theory will be beneficial to study the relationship between the radial ways and urban functions. The multiple nuclei theory will be beneficial to explain the multiple nuclei development models. Beijing has established 30 industrial development zones and 6 commercial development zones. New edge cities such as Yizhuang, Tongzhou, Shunyi, Daxing have been encouraged in the periphery areas. The construction is beneficial to move industry from central city to outlying areas.

The rapid expansion of the Beijing metropolitan region has led to numerous problems of traffic congestion, housing price hikes, and environmental hazards. The traffic congestion is worsening as the distance between housing, employment, and specialized districts expand (Gaubatz, 1995). However, the number of automobiles is increasing by 10% each year while the roads are extended by only 2%.

The study sheds new light on the urban morphology of one of the major Chinese cities, and provides needed information for developing plans to diffuse urban functions and to alleviate environmental problems in Beijing. Although the regional government wants to diffuse the population and functions of central city, the edge cities have not attracted too much population from the central city because the high-quality elementary and high schools, hospitals and hotels concentrate in the city center. In the developed countries, the third industry of cities has been moving to suburban areas (Nelson, 1986). But the finance and information consultancy services of Beijing are apt to assemble in the center city while the diffusion to suburbs is not obvious (Shao, 2008). Hence, the infrastructure of the edge cities should be complemented in order to attract more population from the central city. The immigration of population from the central city should be accompanied with the high-quality elementary and high schools, hospitals and hotels. The specialization and diversity of the zones need to consider the people's requirements. With the construction of edge cities, the traffic congestion will be improved. Compared with the classic concentric zone theory, high-income people have not moved to the suburbs because the time spending on the way. The concentric analysis can be beneficial to understand the spatial structure of Beijing and to improve the planning activity. The comparison of Beijing with Chicago will shed light on the understanding of their differences.

Acknowledgements

This work was funded by the key project of National Basic Research Program of China (973 Program) under grant 2005CB724204 and the project of Natural Scientific Foundation of China under grant 40571060. We thank Yun Ouyang for help with an earlier version of the manuscript.

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