Chapter 12
Understanding Beijing's Urban Land Use Development from 2004–2013 Through Online Administrative Data Sources

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12.1 Introduction

The decade of 2004–2013 saw one of the most rapid urban expansion periods in Beijing. According to official statistical yearbooks, Beijing's resident population grew from 14.9 million in 2004 to 21.1 million in 2013, i.e. at an annual rate of 5.1 % and adding 886,000 people each year.[1] Urban land use has expanded at a similar speed to surrounding rural areas, accompanied by significant urban redevelopment and densification within existing built-up areas. Understanding the patterns of population and urban land use growth during this decade has an immediate relevance to urban planning in the coming decades, and hence to the pressing policy objectives to enhance citizens' quality of life, social inclusiveness, environmental sustainability and economic vitality in Beijing and its wider hinterland.

Rapid urban development tends to create a significant gap between what takes place on the ground and the statistical data for strategic policy analysis. Typically, the data sources lag behind for one or more years, and for urban land use the data has been really patchy, in spite of great efforts by statisticians and scholars in the field. Studies on the geographical pattern of Beijing's development usually rely on satellite photos (e.g. Liu et al. 2000; Kuang et al. 2009) and confidential official data (e.g. Yan and Feng 2009), which are not generally open for public use. Satellite

[1] Anecdotal evidence suggests that this may have understated the residential population growth; in addition, there are several million of transient population staying in the municipality at any given time.

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photos have limitations in categorising land use types. This hampers effective policy analysis in many areas of urban development where a rapid policy response is desirable.

However, the increasingly timely reporting of government administrative records for urban development permissions and urban land provisions, which arose from the Open Government initiative, has potentially opened up new opportunities to systematically monitor and analyse the emerging patterns of urban land use development in a timely fashion. Currently, these data sources are rarely used, in large part because the online data is crude and difficult to process. Yet, there has been research using similar data acquired from land bureaus mainly to examine city's land market through the land price and land intensity patterns (Ding 2004; Yan and Feng 2009; Wu et al. 2010; Gao et al. 2013; Dang et al. 2014).

This paper attempts to further fill the gap by examining the effectiveness and potential of using online administrative data sources to understand Beijing's urban expansion from 2004 when a number of such sources started to be released online. We focus on the pattern of land supply for housing and employment, which is one of the most essential factors affecting people's lives and the city's performance. This is also a weak spot in the field, as previous studies mainly approach this issue from the results of surveys (e.g. Chen and Meng 2011; Pan and Ge 2014) and census data (Feng and Zhou 2003), both of which are expensive to assemble and thus it is difficult to obtain frequent updates.

12.2 Data Assembly

This paper utilises urban land plot provision data collected from the Beijing Municipal Bureau of Land and Resources website, which provides land development and associated building floor space information. It covers the time after the reform of land provision.[2] Three datasets, respectively on land plot transaction,[3] land plot allocation[4] and land plot acquisition,[5] are published.

Land plot transaction and land plot allocation are the main types of urban land provision in transferring the right to use land. Land plot transaction deals with urban land plots which are to be used for profitable purposes, such as residential, industrial and commercial.[6] After the existing users or the primary land developers gain

[2] Most notably, the urban land development permission data published by the Beijing Municipal Commission of Urban Planning is not used because it does not include the land area and building floor space information in a manner required by this paper. We are separately studying the online data from that source for other purposes.

[3] http://www.bjgtj.gov.cn/publish/portal0/tab5422/

[4] http://www.bjgtj.gov.cn/publish/portal0/tab5163/

[5] http://www.bjgtj.gov.cn/publish/portal0/tab5164/

[6] Through this, the government grants 70-year leases for residential land use right, 50-year leases for industrial land use right and 40-year leases for retail land use right.

permission from the local government, the land plots go into open market for the potential recipients to bid on them. The bidding is conducted in three main ways: (1) invitation for tenders; (2) auction; and (3) notification (silent auction).[7] The recipients need to pay the government the market transaction price and the previous user/the primary land developer a specified fee (based on the construction cost of infrastructure on site).

Land plot allocation deals with urban land plots which are to be used for non-profitable, public purposes, such as infrastructure, government, affordable housing, etc.[8] The recipients do not need to pay a fee to the government, but in some cases they have to pay the previous user a small one-time fee for replacement cost and other expenses.

Land plot acquisition is a type of land provision specially adopted locally by Beijing municipality to allocate land through land acquisition. It deals with rural land which is collectively owned by villagers. Because the land use right of collectively-owned land is not transferable, the government usually has to first convert it into state-owned land through acquisition, and then provide it through transaction or allocation. However, in Beijing's case, the government directly allocates the rural land plots to the recipients, but the recipients have to pay compensation to the villages and to the primary developer of the land instead of the government which is usually responsible for these tasks in other Chinese cities.

In this paper, we choose to use the land plot transaction and allocation data because they provide a decade-long series since 2003 with reasonably consistent formats.[9] By contrast, the land plot acquisition data, which is separately collected and published by each city district, has little consistency in content and format, and

[7] The regulation 'Granting State-Owned Land Use Rights by Invitation for Tenders, Auction or Listing' was issued by the Chinese Ministry of Land and Resource on May 8, 2002, which became effective on July 2, 2003. Beijing issued a local regulation based on the national regulation on June 26, 2002, which became effective on Aug. 31, 2004. Prior to this, the land plot transaction for real estate was carried 'by way of agreement', in which the land was granted by the government when the developer and the previous land user reached an agreement on the payment. The payment included a nominal fee to the government, which was usually lower than the market value, and a one-time payment to the previous user, which was decided through negotiation.

[8] In this case, the recipients are given the allocated land-use right which has no time limit, but the land is not transferable to other uses or users.

[9] For land transaction data, we use the year the documents were signed for those transacted since 2008, and use the year they were published before 2008, to approximate the year of transaction. For land allocation data, the year is defined by the date of the document which approved the project; for the 173 projects without approval document dates, we use the year when they are published to approximate the year of allocation. There are three plots published before 2003 and without approval document number (one in 2001, and two in 2002). For land transaction data, the plots published in 2003 (1154 plots) are not included in the analysis because their location is only reported at the district level. The land data published in 2004 through 2013 is included in the analysis with one caveat: the data published online in 2004 is much larger than later years, which implies that the 2004 may have included transactions made in previous one or two years. For this reason, we have included all land allocation data available online (one record for 2001, two records for 2002, and all data from 2003 through 2014) in the analysis.

Table 12.1 Summary of the online administrative land plot data sources

	Transaction	Allocation	Acquisition
Year coverage	Published since 2003 to present	Published since 2003 to present (plus 1 site in 2001 and 2 sites in 2002)	Published in various years (earliest: Fangshan district, 2005; most recent: Miyun county, 2013)
Total number of plots until Feb 2014	7629	1324	891
Total number of plots that can be geo-coded below the district level since 2004–2013	6419	1313	/
Information	Recipient, location, land area, planned building floor space, planned land use, land transaction fee, boundary, signing time*, start time*, completion time*, FAR[a], number of page views (*: only available online since 2008)	Project name, user of land, location, land area, approval document number, approval authority, planned building floor space, planned land use, view times	Construction institution/company, project, planned land use, location, land area, land ownership, compensation, staff for resettlement, approval document
Included year	2004–2013 (Excluding 2003 data because of poor location information)	2003–2013 (including 1 in 2001 and 2 in 2002)	Not included in the analysis in this paper

[a]Floor-area ratio, i.e. the total building floor space area on site in square metre divided by the total land area in square metre

dates back to different years, typically 2009. The land plots in the acquisition data also include a substantial amount that will subsequently appear in the land transaction data (i.e. after primary land development) (Table 12.1). We will return later in the paper to the implications of leaving out this third source, and the prospects of using it in the future.

We first collected all the items published on the website.[10] After cleaning the addresses (mainly by confirming the integrity of the addresses and deleting unnecessary details), we used a VBA program[11] to geocode the address into longitude and latitude. By checking the longitude and latitude with the expected locations in the

[10] For this, we use a web-scraping software called LocoySpider (http://www.locoy.com/).

[11] http://www.masterable.com/1/post/2011/06/fusiontables-post.html. We tested geocoding using Esri Maps for Office (http://doc.arcgis.com/en/maps-for-office/) and the Google FusionTable VBA program, and based on the relative accuracy of the results preceded using the latter.

Table 12.2 Address misrecognition for geocoding before and after address cleaning

	Land transaction				Land allocation			
	Before cleaning		After cleaning		Before cleaning		After cleaning	
District level misrecognition	1339	22 %	0	0 %	205	15 %	0	0 %
Jiedao level and below misrecognition	1440	23 %	375	6 %	60	5 %	61	5 %
Total misrecognition	2779	45 %	375	6 %	265	20 %	61	5 %
Plots free from misrecognition	3433	55 %	5837	94 %	1059	80 %	1263	95 %
Total plots*	6212				1324			

*The comparison was done to the land transaction data up to August 2013 (excluding those from 2003 due to poor location information) and the land allocation data up to Feb 2014. That is why the totals are both different from the total number of plots we used for the final analysis as shown in Table 12.1

online maps, we further cleaned the addresses which were misrecognised by Google and controlled the level of accuracy in a semi-automatic way (Table 12.2).[12] The land use types were further categorised into 24 categories based on land use purposes,[13] and then combined into 7 main categories[14] (Table 12.3). Then the data were processed and analysed using Arc GIS.

Two main types of analysis were carried out – (1) the Rings of Growth which analyses the pattern of growth in different Ring Road areas to show any centralising/decentralising trends; (2) Growth Mapping which analyses the pattern of growth using a 3 km by 3 km grid overlaid on the Beijing map in addition to mapping all the projects by site to inspect growth trends with further spatial details.

[12] For one location (i.e. with same longitude and latitude) with more than 3 plots (exclusive of 3 for land transaction, and inclusive of 3 for land allocation), we check whether they have the same address, and if not whether they differ at the Jiedao level (sub-district) or district level. For those differ at the district level, we verify the district code and geocode again to make sure that they are geocoded into the correct address. For those differ at the Jiedao level, we carry out the same process for those with more than 10 (including 10) plots for one address. As the remaining misrecognitions are all at the Jiedao level and below and no more than 3 pots, and they are only 5–6 % of the total, we keep them as they are for the following analysis. Besides, we also correct the obviously wrong geocodes such as those suggesting locations outside Beijing. However, due to the large number of items, it is not possible to guarantee each and every address has been geocoded correctly.

[13] The most important land use purpose is chosen if there are more than one land use purposes.

[14] The main category of 'infrastructure' is not used in our analysis in the paper, as our focus is housing and employment land.

Table 12.3 Definition of land use categories

Main land use categories	Detailed land use categories
Housing	Housing
Offices and institutions	Office
	Institution
Manufacturing	Manufacturing
R&D	R&D (including higher education, and R&D)
Retail	Retail
Community services	Local education
	Hospital
	Public building
	Culture/Recreation
	Local commercial
	Hotel and restaurant
	Local facilities
	Mixed
Infrastructure	Facilities
	Parking
	Underground parking
	Transport
	Public transport
	Road/Railways
	Airport
	Storage
	Tourism
	Other

12.3 Trend Analysis

12.3.1 Overall Growth

From our data, we found that from 2004 to 2013, for housing and employment, 6719 projects acquired 21,342 ha of land through both land transaction and land allocation, which provide 337.6 million square metres of planned building floor space. Housing projects make up the largest proportion of land use at 32 %; the dominance of housing developments is further highlighted by its share in land area and planned building floor space, respectively 55 % and 68 % (Table 12.4). This is a trend shared by the majority of growing cities.

In order to show the trajectory of land transaction and allocation, we divided the decade into 4 periods, i.e. 2004 and before, 2005–2007, 2008–2010, and 2011–2013. In terms of the number of land plots, 2005–2007 is the highest (2108), whereas the other three periods are in the similar level of 1500 (Table 12.5). Land area has a similar pattern, with 2005–2007 ranking the highest (6129.0 ha). However, although the rest of the three periods have a similar number of projects,

Table 12.4 Summary of land area and planned building floor space by main type

	Number of projects		Land area (ha)		Planned building floor space (million m^2)	
Housing	2111	32 %	11704.9	55 %	229.1	68 %
Offices and institutions	757	11 %	724.9	3 %	21.2	6 %
Manufacturing	1079	16 %	5049.3	24 %	25.1	8 %
R&D	344	5 %	1514.2	7 %	18.1	5 %
Retail	1412	21 %	1285.3	6 %	30.1	9 %
Community services	1016	15 %	1063.8	5 %	14.0	4 %
Total	6719	100 %	21342.4	100 %	337.6	100 %

Table 12.5 Number of plots of different land use types throughout the period

	2004 and before		2005–2007		2008–2010		2011–2013		Total	
Housing	810	38 %	414	20 %	401	19 %	486	23 %	2111	100 %
Offices and institutions	221	29 %	270	36 %	173	23 %	93	12 %	757	100 %
Manufacturing	116	11 %	436	40 %	284	26 %	243	23 %	1079	100 %
R&D	20	6 %	68	20 %	95	27 %	161	47 %	344	100 %
Retail	192	14 %	580	41 %	426	30 %	214	15 %	1412	100 %
Community services	173	17 %	340	34 %	195	19 %	308	30 %	1016	100 %
Total	1532	23 %	2108	31 %	1574	24 %	1505	22 %	6719	100 %

2004 and before has a much higher land area (5747.7 ha) than the other two because of some preceding developments that may have been included (4555.6 ha for 2008–2010, and 4910.0 ha for 2011–2013) (Table 12.6). Planned building floor space shows a very different picture. 2004 and before was the largest (108.4 million m^2), followed by 2011–2013 (87.9 million m^2), 2005–2007 (75.4 million m^2) and 2008–2010 (65.8 million m^2). Apart from the issue arising from the crude data, this is due to the composition of different types of projects, suburbanisation and the associated evolution of the FARs throughout the decade (Table 12.7).

As we are mostly interested in the size of the development for different categories, we will focus on planned building floor space for the analysis below. Overall, both housing and employment are developing at a steady pace over the decade; housing construction fluctuates more with lower ebbs in 2008–2010 as expected. As for employment land, the pace varies substantially between different categories. The development of offices and institutions decreased significantly from 60 % in 2004 and before to 6 % in 2011–2013. R&D increased significantly from 4 % in 2004 and before to 41 % in 2011–2013, whereas retail increased steadily although in a slower pace from 21 to 30 %. Manufacturing and community services varied from period to period, with the lowest in 2004 and before, and the highest in 2005–2007 and 2011–2013, with a drop in 2008–2010 (Table 12.7).

Table 12.6 Land area of different land use types throughout the period

(Unit: ha)	2004 and before		2005–2007		2008–2010		2011–2013		Total	
Housing	4251.3	36 %	2717.2	23 %	2057.8	18 %	2678.6	23 %	11704.9	100 %
Offices and institutions	329.5	45 %	204.6	28 %	113.2	16 %	77.6	11 %	724.9	100 %
Manufacturing	707.4	14 %	2027.1	40 %	1227.5	24 %	1087.3	22 %	5049.3	100 %
R&D	45.6	3 %	451.7	30 %	507.5	33 %	509.3	34 %	1514.2	100 %
Retail	309.5	24 %	344.7	27 %	359.6	28 %	271.5	21 %	1285.3	100 %
Community services	104.4	10 %	383.8	36 %	290.0	27 %	285.6	27 %	1063.8	100 %
Total	5747.7	27 %	6129.0	29 %	4555.6	21 %	4910.0	23 %	21342.4	100 %

Table 12.7 Planned building floor space of different land use types throughout the period

(Unit: million m^2)	2004 and before		2005–2007		2008–2010		2011–2013		Total	
Housing	83.6	37 %	46.9	20 %	41.8	18 %	56.9	25 %	229.1	100 %
Offices and institutions	12.8	60 %	4.6	22 %	2.4	12 %	1.4	6 %	21.2	100 %
Manufacturing	3.0	12 %	7.9	31 %	5.7	23 %	8.5	34 %	25.1	100 %
R&D	0.8	4 %	5.0	28 %	4.8	27 %	7.4	41 %	18.1	100 %
Retail	6.2	21 %	6.7	22 %	8.1	27 %	9.1	30 %	30.1	100 %
Community services	2.1	15 %	4.3	31 %	2.9	20 %	4.7	34 %	14.0	100 %
Total	108.4	32 %	75.4	22 %	65.8	20 %	87.9	26 %	337.6	100 %

Table 12.8 Rings of growth

Rings of growth	Area
City Centre	Area inside the 2nd Ring Road
Ring 2–3	Area between the 2nd and the 3rd Ring Road
Ring 3–4	Area between the 3rd and the 4th Ring Road
Ring 4–5	Area between the 4th and the 5th Ring Road
Ring 5–6	Area between the 5th and the 6th Ring Road
Hinterland	Area outside the 6th Ring Road but within Beijing municipality

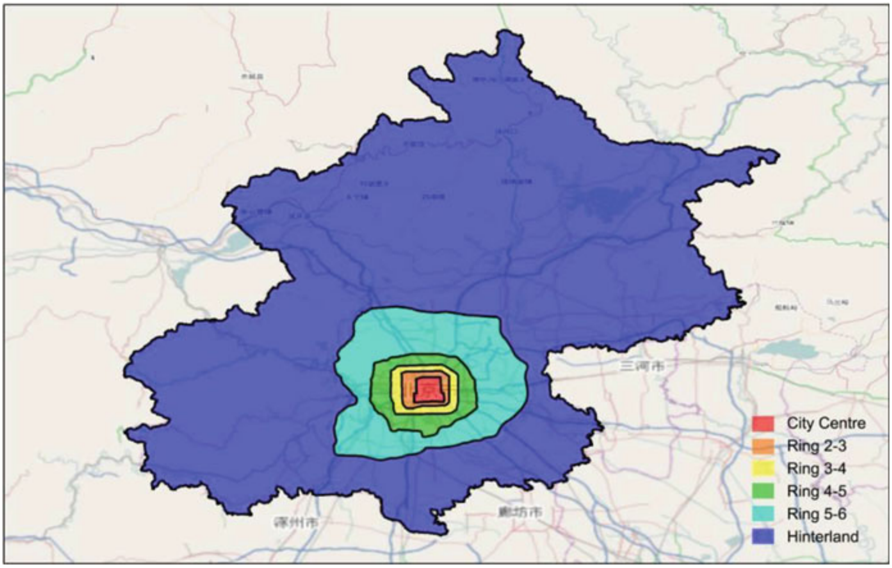

Fig. 12.1 Rings of growth

12.3.2 Rings of Growth

12.3.2.1 Ring Roads and Rings of Growth

In order to identify the trends of growth, we divide Beijing into 6 concentric rings in line with the wide ring roads which have been built out along with the outward urban expansion. The concentric rings for our analysis are: City Centre (i.e. inside Ring Road 2 which was built on the site of former city walls and moats), Ring 2–3, Ring 3–4, Ring 4–5, Ring 5–6, and the rest of Beijing municipality outside Ring Road 6 (Table 12.8, Fig. 12.1). The plan for the ring roads was first introduced by Soviet urban planning advisers to Beijing in the early 1950s following Moscow. The ring road pattern has remained in every version of Beijing's masterplan since then (Sit, 1996), and further extended. They not only serve as the physical boundaries of different patterns of land use development, but also embody psychological boundaries for business and residents, e.g. when discussing property prices.

12.3.2.2 Distribution of Planned Building Floor Space (BFS)

To analyse the geographical distribution as well as the rates of growth, we first compare the distribution of growth by land use type.

BFS of housing has shown a strong decentralising trend. There has been a steady build-up of the rates of growth starting from the centre, culminating to the area of Ring 5–6, which accounts for 38 % of the total growth. Beyond Ring Road 6 the share of BFS is 20 %, which is still higher than any area within Ring Road 5. In other words, 58 % of all planned new housing is located outside Ring Road 5.

BFS of employment, on the other hand, demonstrates a more mixed trend. Most types of employment are also decentralising. Manufacturing and R&D lead this decentralising trend, both with extremely low shares of total growth within Ring Road 4 (3 % and 5 % respectively). Most of the BFS for manufacturing is located in the hinterland (48 %), whereas R&D in Ring 5–6 (62 %). Retail and community services appear to decentralise at a slower rate, with relatively high growth in more central areas (8 % and 14 % respectively in the city centre), with the largest shares of growth concentrated in Ring 5–6 (31 % and 33 % respectively). The only exception are offices and institutions, which show a centralising trend. The city centre captures a share of 20 % of the BFS growth, and the areas within Ring Road 4 altogether have a 74 % share (Table 12.9, Fig. 12.2).

12.3.2.3 Changes in Growth Distribution Over Time

Building on the overall picture, we further investigate whether the decentralising or centralising trends are intensifying during the decade.

Figure 12.3, the stacked line diagram showing planned housing floor space development below, confirms a decentralising trend. It is clear that the rate of growth in Ring 5–6 and beyond started to accelerate around 2006.

For most employment land use types (Figs. 12.4, 12.5, 12.6, 12.7 and 12.8), the decentralising trend starts between 2005 and 2007, for example retail in 2005, community services in 2006 or 2007, R&D in 2007. Manufacturing stands out as the one land use type that has been decentralising throughout the decade. The land use types mentioned above have seen a build-out rate ramping up since 2008–2009, with the exception of community services for which the ramp-up started around 2010. It is worth noting that even for offices and institutions, areas outside Ring Road 4, especially Ring 5–6, have started to provide a larger proportion of BFS than areas within Ring Road 4 since 2009. However, the comparatively small amount of ramping up is not sufficient to change the overall centralising pattern.

Table 12.9 Spatial distribution of planned building floor space, 2004–2013

(Unit: million m^2)	City Centre		Ring 2–3		Ring 3–4		Ring 4–5		Ring 5–6		Hinterland		Total	
Housing	10.3	4.5 %	17.4	7.6 %	26.8	11.7 %	40.5	17.7 %	87.8	38.3 %	46.4	20.3 %	229.1	100.0 %
Offices and institutions	4.3	20.3 %	5.6	26.2 %	5.8	27.1 %	2.1	9.8 %	2.8	13.0 %	0.7	3.4 %	21.2	100.0 %
Manufacturing	0.2	0.6 %	0.2	1.0 %	0.4	1.7 %	5.0	20.1 %	7.1	28.2 %	12.2	48.4 %	25.1	100.0 %
R&D	0.1	0.5 %	0.1	0.6 %	0.7	3.9 %	2.7	14.8 %	11.1	61.5 %	3.4	18.7 %	18.1	100.0 %
Retail	2.5	8.3 %	2.3	7.7 %	5.5	18.3 %	7.0	23.1 %	9.2	30.6 %	3.6	12.0 %	30.1	100.0 %
Community services	2.0	14.2 %	1.1	7.7 %	1.7	12.4 %	2.7	19.2 %	4.5	32.5 %	2.0	14.0 %	14.0	100.0 %
Total	19.3	5.7 %	26.7	7.9 %	40.9	12.1 %	59.9	17.8 %	122.5	36.3 %	68.3	20.2 %	337.6	100.0 %

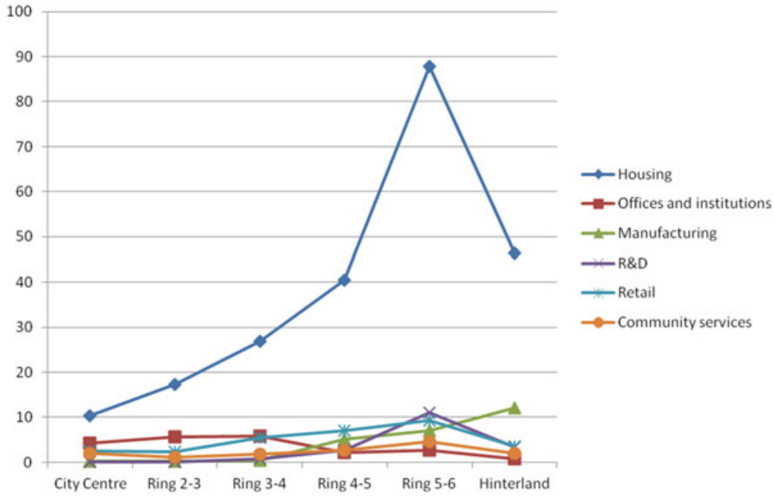

Fig. 12.2 Distribution of planned BFS for each land use type, 2004–2013 (Unit: million m^2)

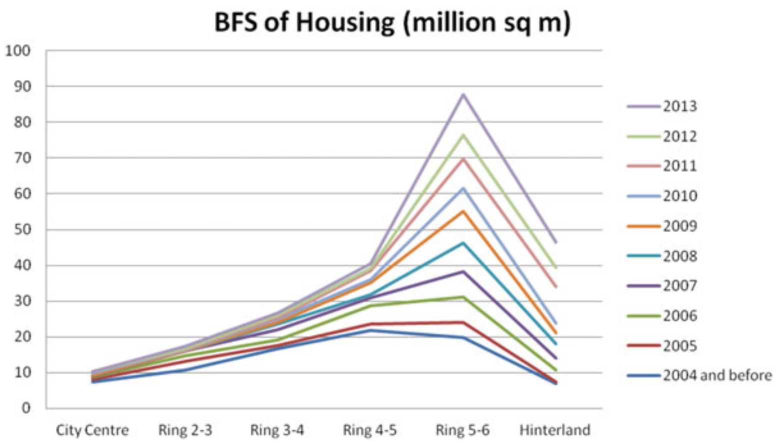

Fig. 12.3 Cumulative distribution of housing building floor space by year

12.3.3 Growth Patterns by Neighbourhood and Site

As the pattern of growth varies from land use type to land use type, we further map the growth for each land use type in progressively more detailed locations – first by neighbourhood and then by site (where feasible). For mapping the neighbourhood, we overlaid a 3 km by 3 km grid onto the municipal area and summed all the building floor space of each land use category in each grid cell. In addition, we also mapped the developments in their places using 5 dot sizes to demonstrate the

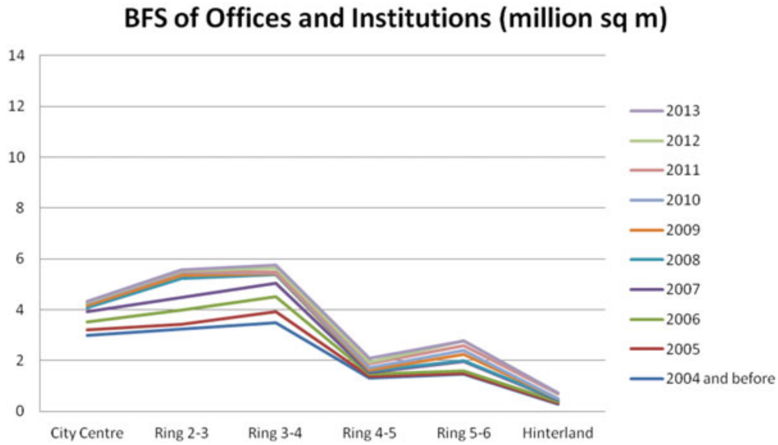

Fig. 12.4 Cumulative distribution of offices and institutions building floor space by year

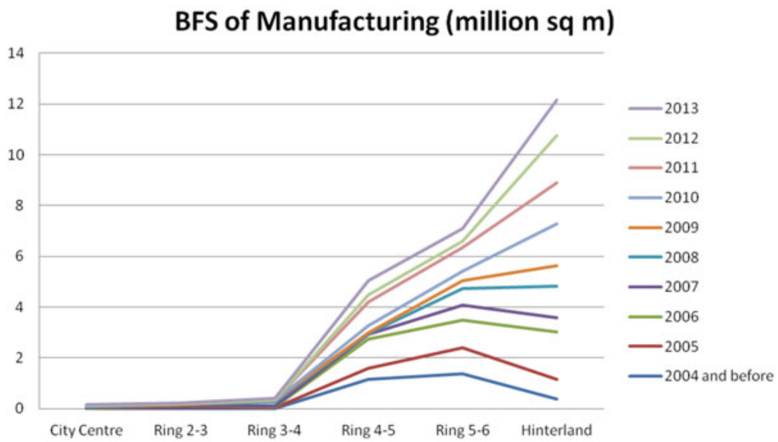

Fig. 12.5 Cumulative distribution of manufacturing building floor space by year

5 levels of planned project size where the sites are coloured from green if the planned project was before or in 2004 to red if in 2013.

For housing, the growth covers almost all the grids within Ring Road 5 and the majority of the grids between Ring Road 5 and 6 (Fig. 12.9). The locations of the projects suggest that the major housing project sites follow the main road arteries, such as the ring roads, the East-West axis extending from the Chang'an Boulevard, and the radial expressways outside Ring Road 5 and especially Ring Road 6 (Fig. 12.10). The majority of the recent projects are of increasingly larger scale and located further away from the city centre. Also worth noting are the numerous small central city rehabilitation projects in historic residential areas inside Ring Road 2.

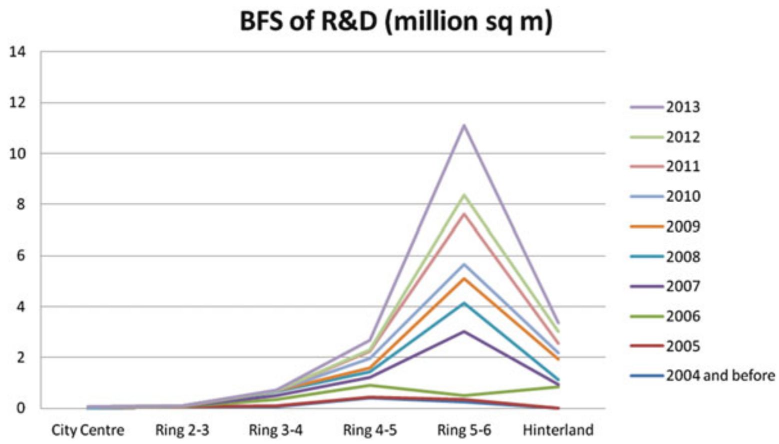

Fig. 12.6 Cumulative distribution of R&D building floor space by year

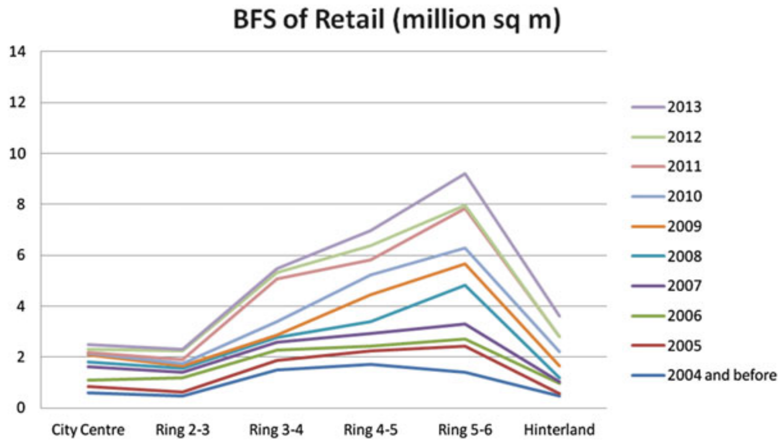

Fig. 12.7 Cumulative distribution of retail building floor space by year

Offices and institutions are mainly growing through densification in the northern part of the area encircled by Ring Road 5, particularly within Ring Road 4 (Fig. 12.11). This occurs in clusters along the Chang'an Boulevard and primarily to the north of it. Outside Ring Road 5, there are a few development clusters along the main transport corridors, although the sizes of the projects are smaller. The development cycle appears to have been affected by the world financial crisis of 2008: the majority of developments took place before 2008, and after 2008 the projects tend to be smaller and mainly located within the existing clusters (Fig. 12.12).

Manufacturing is expanding out in a dispersed way. Most of the growth is along and outside Ring Road 5 towards the south (Fig. 12.13). Within Ring Road 4, small

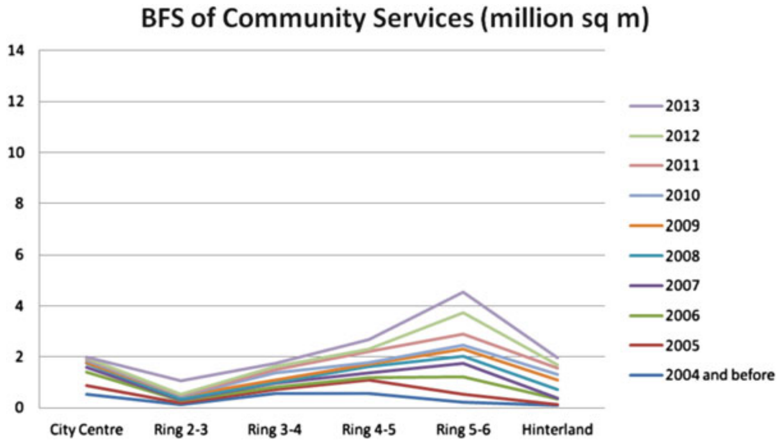

Fig. 12.8 Cumulative distribution of community services building floor space by year

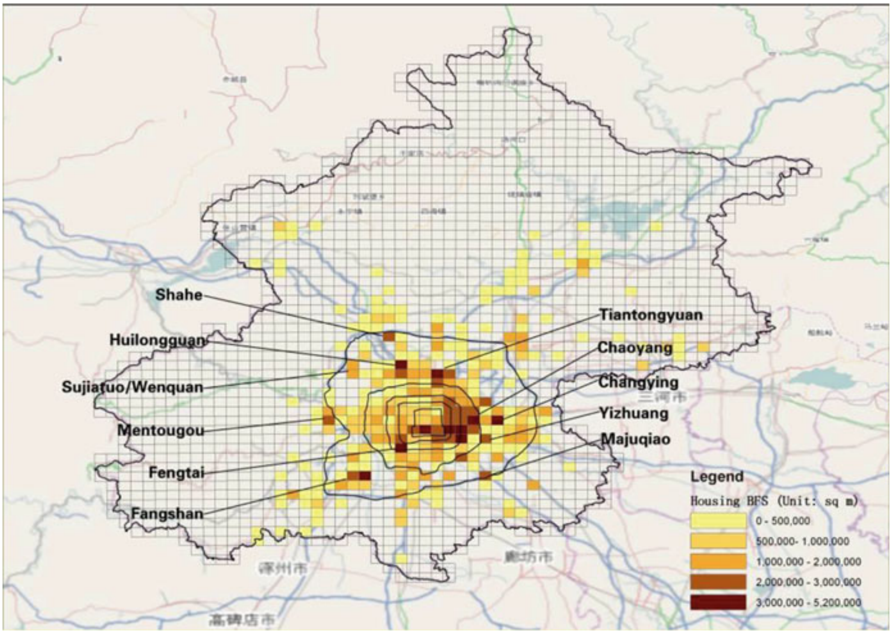

Fig. 12.9 Grid mapping of housing growth (BFS)

projects are located round Ring Road 2 and 3. In the Ring 4–5 area, large projects have started to emerge and grow along all the major road corridors. Among those, recent projects seem to have the potential to form the nuclei of future clusters (Fig. 12.14).

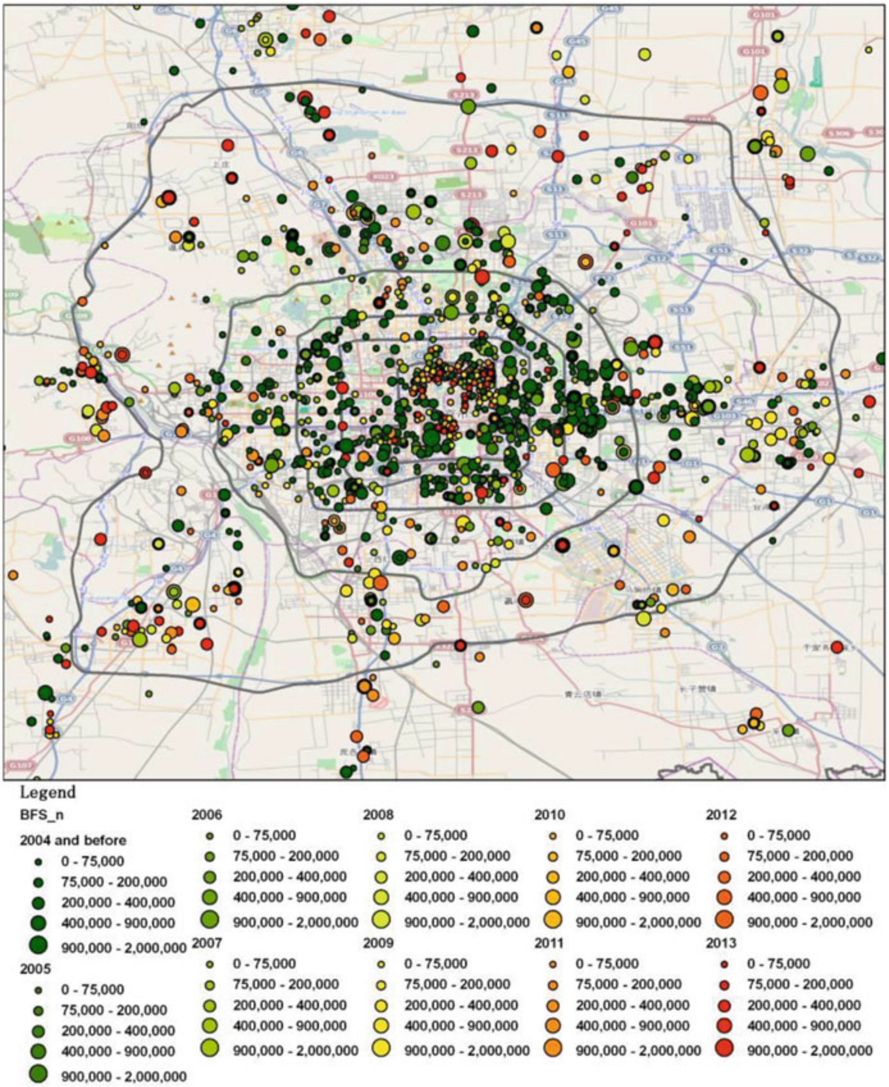

Fig. 12.10 Planned housing floor space by site

R&D, although large in the total volume of building floor space, actually consists of a very small number of projects, which are very dispersed (Fig. 12.15). Most large projects are outside Ring Road 4, occurring in clusters along the transport corridors. There are also the obvious cluster along the northwest axis of G6 Beijing-Lhasa Expressway, and the newly emerging clusters in Xiaotangshan, Wangjing, Wenquan, Yizhuang and Fangshan (Fig. 12.16).

Retail developments cover the areas within Ring Road 4 and extend further towards northeast as well as towards the west in Ring 4–5 and beyond (Fig. 12.17).

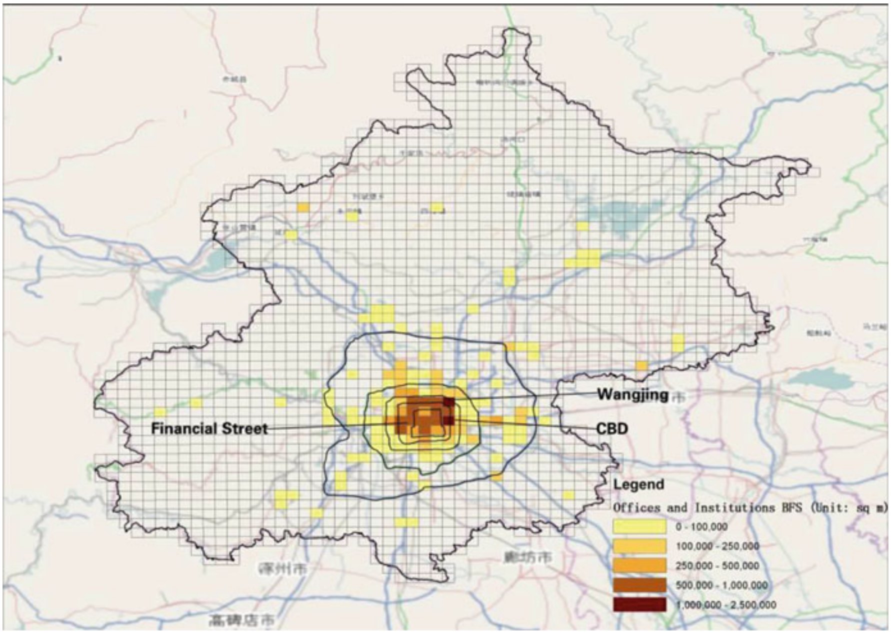

Fig. 12.11 Grid mapping of offices and institutions growth (BFS)

In the areas within Ring Road 4 and to the northeast of this, projects with relatively small sizes congregate. Further away from Ring Road 4, the size of projects begins to increase and the density begins to fall, although there are still clusters of smaller projects. There are several large recent projects expanding out along major transport corridors in all directions (Fig. 12.18).

Community services have a similar pattern as retail, as most developments take place within Ring Road 4. But rather than expanding northeast and west, community services expand mainly towards the north and west (Fig. 12.19). The projects are smaller and denser in the areas within Ring Road 4 than those in the areas outside. However, large projects are more evenly spread compared with retail. Outside Ring Road 4, projects follow the main transport corridors, more towards the west than east (Fig. 12.20).

12.3.4 Growth Clusters

For most land use types, specific clusters of growth can be observed. This can be compared with what is known about the main locations of housing and employment land growth in the municipality.

For housing, there is a large cluster in Chaoyang district between Ring Road 2 and 5, and another in the south of the Chang'an Boulevard axis towards the west

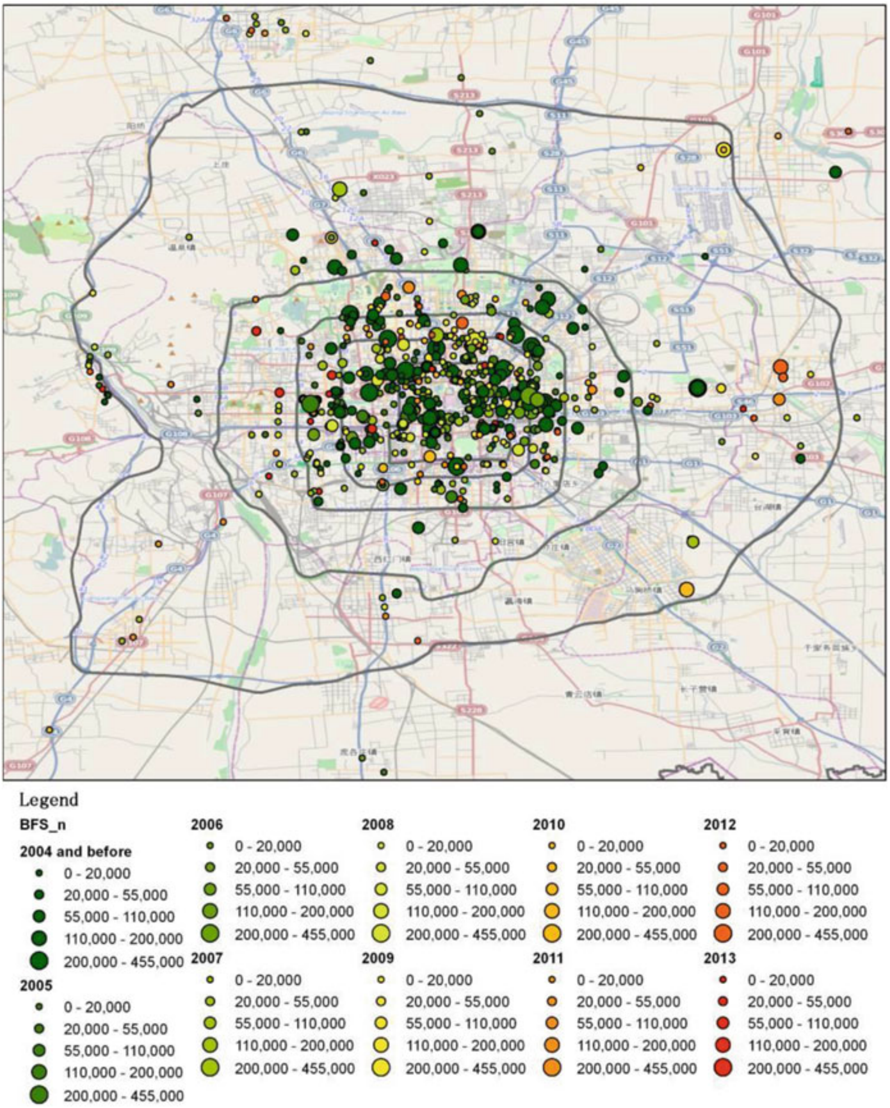

Fig. 12.12 Planned offices and institutions floor space by site

until the 2nd Ring Road. Further out, there are two further rings of clusters: the first ring is formed by comparatively smaller clusters which belong to the larger residential districts planned and developed in the early part of the decade, such as Changying, Tiantongyuan, Huilongguan and Fengtai; the second ring consists of newer clusters of even larger planned residential districts in the latter half of the decade – the developments are further away from the city centre, such as Yizhuang, Majuqiao, Shahe, Sujiatuo/Wenquan, Mentougou and Fangshan (Fig. 12.9).

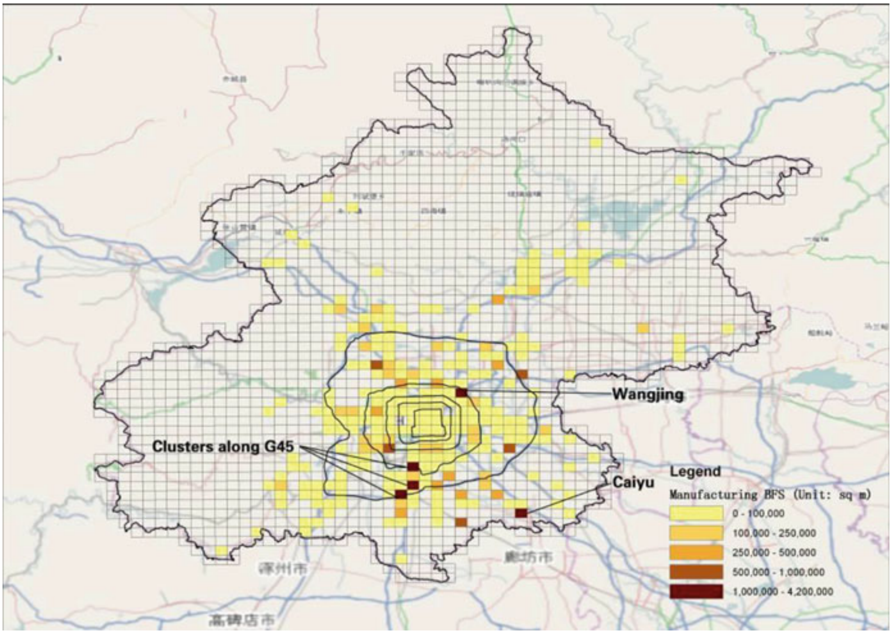

Fig. 12.13 Grid mapping of manufacturing growth (BFS)

For offices and institutions, the clusters are close to each other within Ring Road 4, remarkably concentrated to the north of the Chang'an Boulevard. They form a box-like belt bounded by the Ring 2–3 area in the west, north and east, and the Chang'an Boulevard to the south, with two major poles of growth centred upon the CBD in the east and the Financial Street in the west as well as a cluster in Wangjing (Fig. 12.11).

Manufacturing has very dispersed clusters which are located outside Ring Road 4. The most significant is the one in Daxing along the G45 expressway. And the rest are in Wangjing and Caiyu (Fig. 12.13).

R&D has a cluster in the northwest axis along the G6 expressway, starting from Zhongguancun town centre to the university campuses, Zhongguancun Software Park, Zhongguancun Life Science Park, and Changping. Apart from this, there are clusters emerging in Xiaotangshan (Weilai Science and Technology City), Wangjing, Wenquan, and Yizhuang, which are all part of the Zhongguancun Technology Park, as well as Fangshan, which is a planned new centre for higher education (Fig. 12.15).

For retail, the city centre and the northeast quarter of the Ring 2–3 area and the Ring 3–4 area are filled with small projects with the particular centres in CBD and the Financial Street. Outside this, there are a ring of clusters including Tiantongyuan, Huilongguan, Weigongcun, Shijingshan, Fengtai, Xihongmen, Wangjing and Pinggu. As expected, the larger clusters coincide with the clusters of housing or offices and institutions (Fig. 12.17).

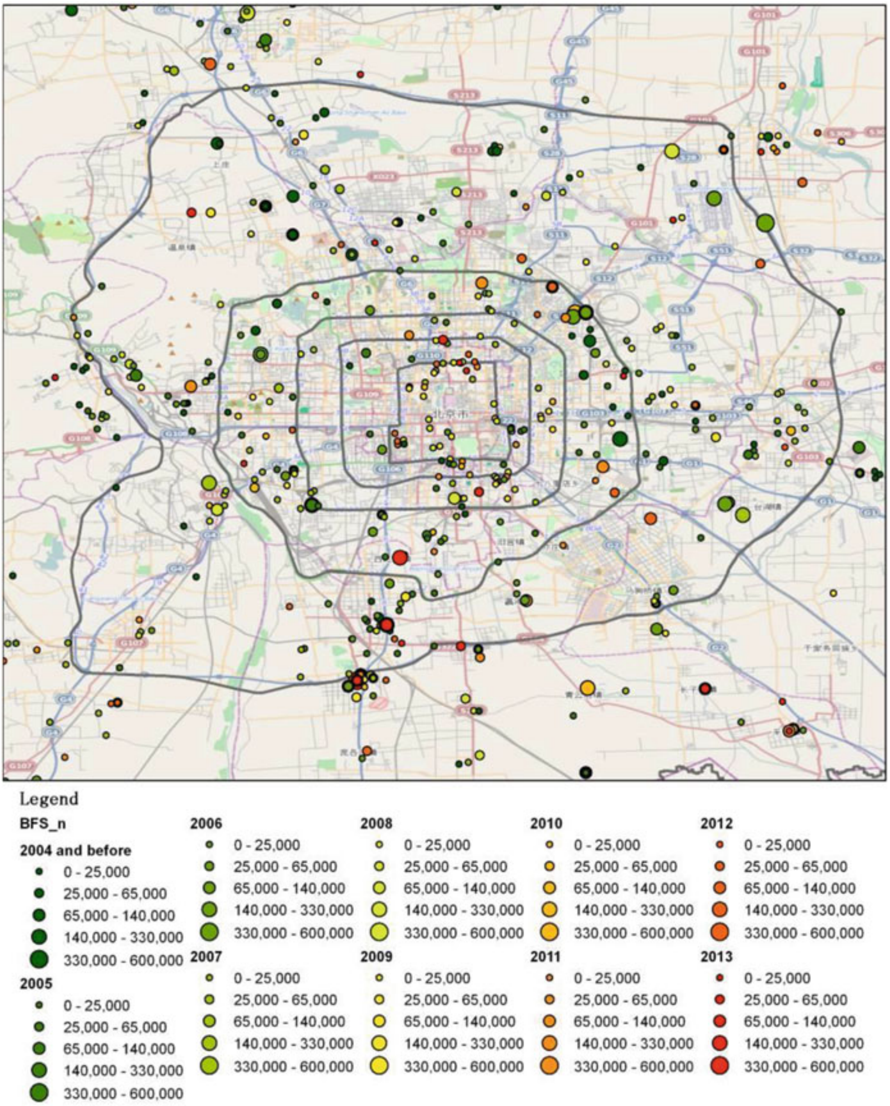

Fig. 12.14 Planned manufacturing floor space by site

The clusters of community services follow housing and retail to a certain extent. The city centre, the northeast half of the Ring 2–3 area and the Ring 3–4 area are filled with projects. Immediately outside this core, there is a ring of small clusters in Olympic Park, Changchunqiao, Fengtai and Xiaohongmen/Shibalidian. Further out in Ring 5–6, there is another ring of clusters, such as Huilongguan, Tiantongyuan, Houshayu, Tongzhou, Taihu and Fangshan (Fig. 12.19).

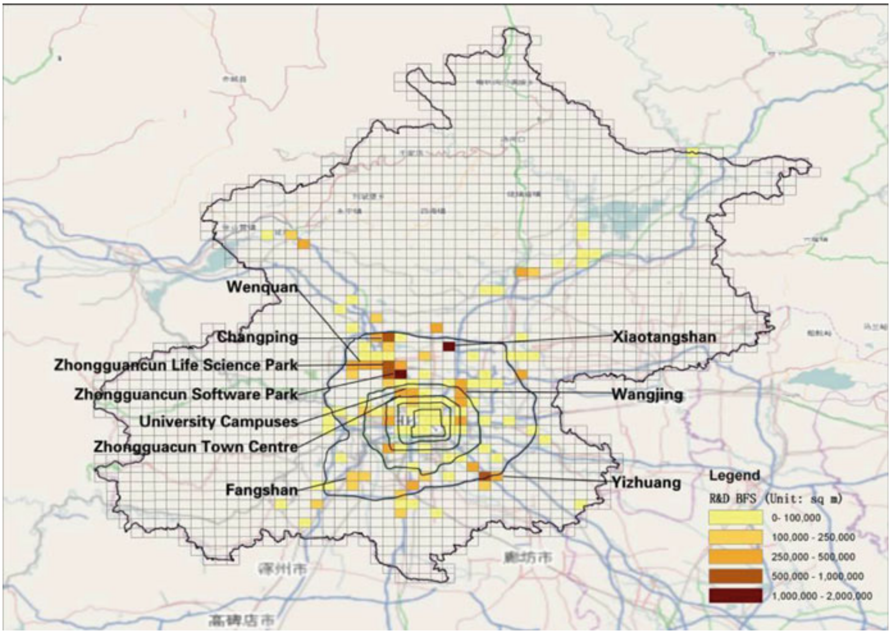

Fig. 12.15 Grid mapping of R&D growth (BFS)

12.3.5 Summary of the Growth Patterns

In summary, in the last decade, housing was growing faster in the outskirts, particularly outside Ring Road 5, leading to substantial decentralisation. Most employment types, such as manufacturing, R&D, retail and community services, are also decentralising but at different speeds. However, offices and institutions tend to grow more prominently in and around the city centre. For the decentralising land use types, the decentralising trend started in 2005–2007, and intensified in 2008–2009. Even manufacturing has seen more BFS planned outside Ring Road 4. The detailed spatial pattern of growth varies from land use type to land use type, in terms of overall locational distribution, project size, density, and clusters of growth. In particular, there appears to be a general spatial mismatch between the trend of housing development in the outskirts and that of offices and institutions, which tend to focus around the northern part of the Ring 2–3 area as well as the city centre.

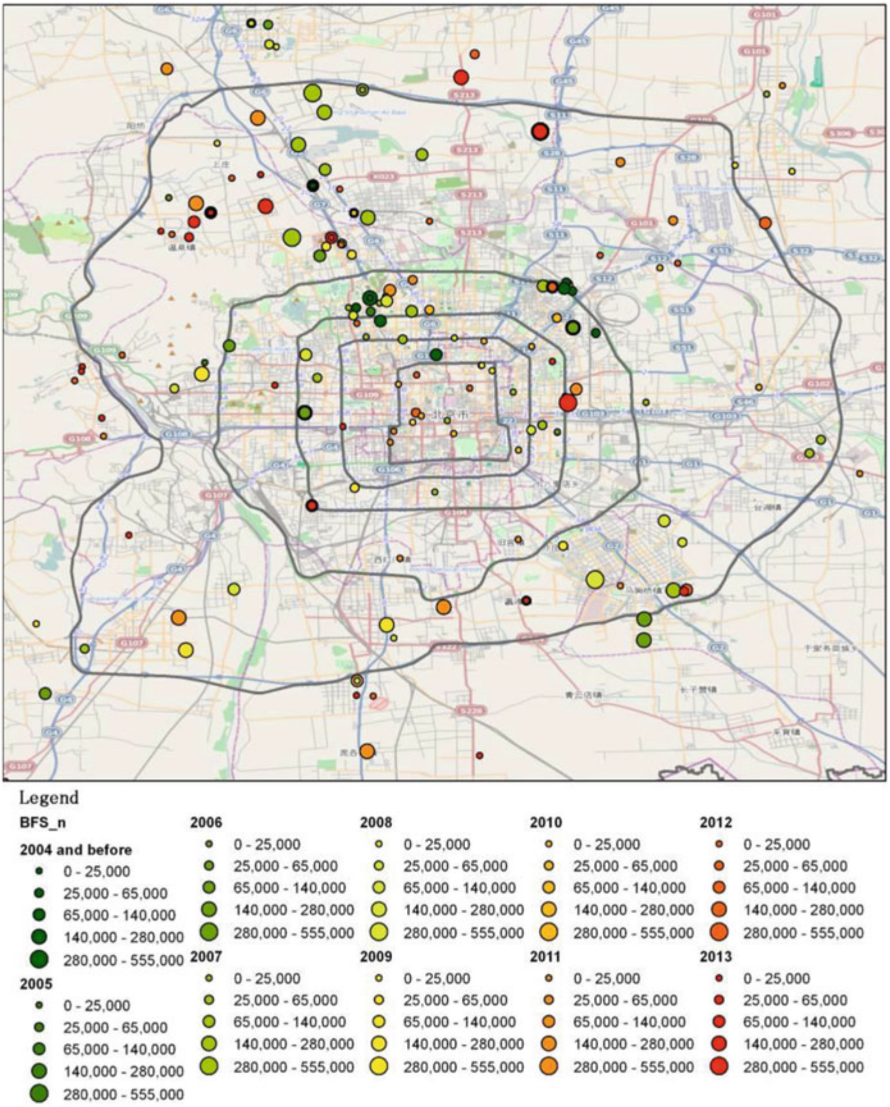

Fig. 12.16 Planned R&D floor space by site

12.4 Comparison With Published Data on Land Development

Although the data is corroborated by our knowledge of the implementation of the urban development plans as shown in Sect. 3.4, it would be necessary to examine how well the online data compares with the sources published in official statistics.

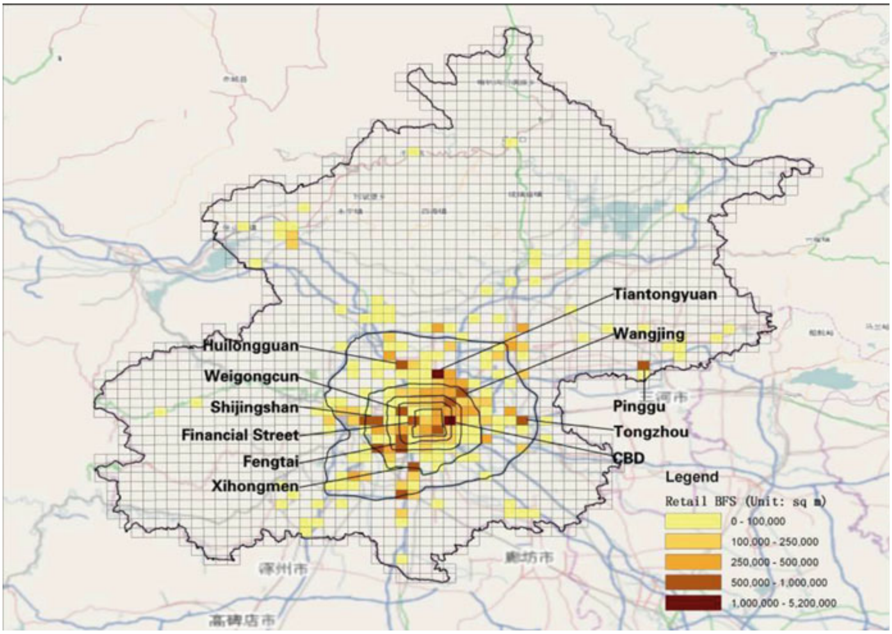

Fig. 12.17 Grid mapping of retail growth (BFS)

We therefore use the existing data sources from China Urban Construction Statistical Yearbooks, published reports of Beijing Municipal Bureau of Land and Resources and Beijing Statistical Yearbooks to compare with the online land and planned building floor space data.

The most relevant and, in theory, comparable statistics data is in the area of urban construction land in the table 'National Urban Population and Construction Land by City' from China Urban Construction Statistical Yearbook (CUCSY 2007, 2008, 2009, 2010, 2011, 2012). We compare the change of area for each type of urban construction land with those from the online data. Although there is usually a lag between the approval of land development (which is represented by the online data) and the registration for the actual use of the land (which is then recorded in CUCSY), the regulations ensure the approved land is used fairly swiftly in Beijing. Therefore we choose to compare the land change between 2005 and 2010 of online data with CUCSY data from 2006 to 2011, i.e. assuming there is a 1-year lag. In general, the online data reports lower total change than CUCSY, mainly because the former has more limited categories; but the changes in existing types of land use match well, e.g. for residential, public facilities and manufacturing (Table 12.10). More specifically, online data reports higher figures in residential, public facility, storage and municipal utility land development, similar figures in manufacturing, and lower figures in categories such as transport infrastructures.

There are several possible reasons for the mismatches for the existing land use types. The underestimation of the change for transport infrastructures is mainly

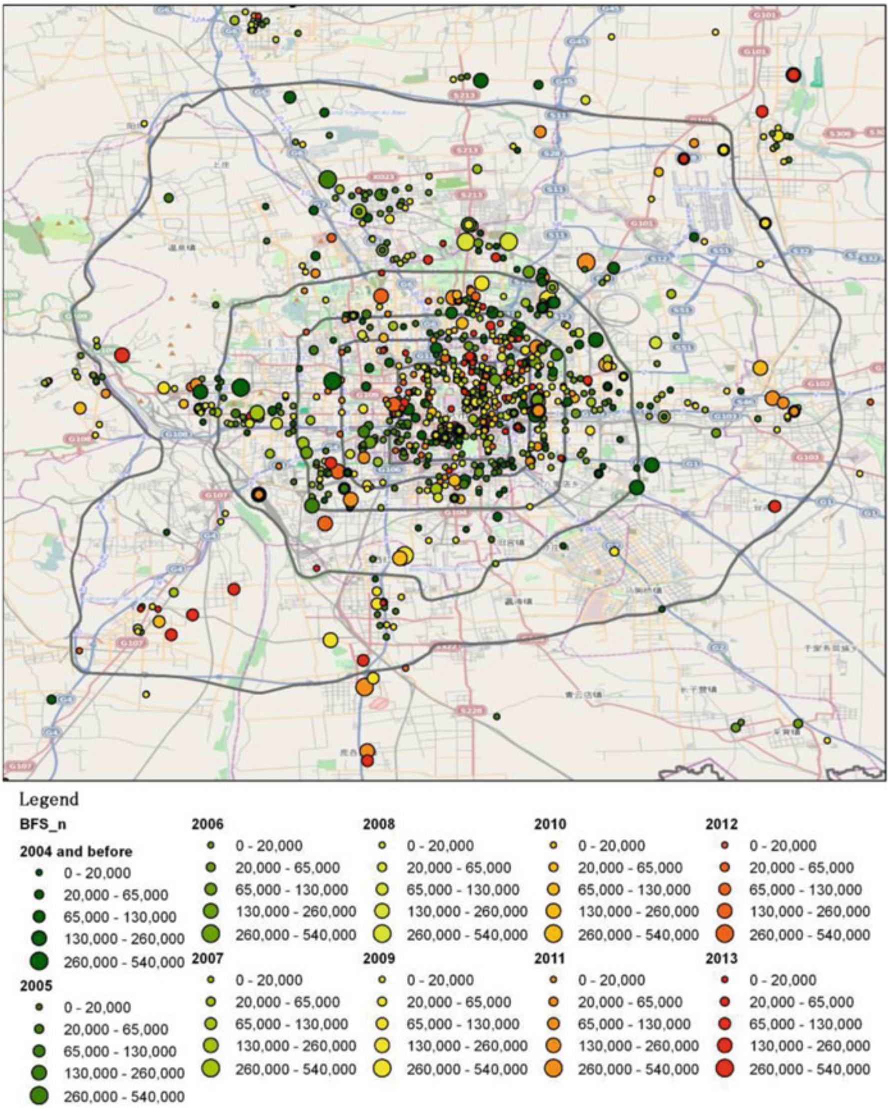

Fig. 12.18 Planned retail floor space by site

caused by the exclusion of land acquisition data, which tends to be used for non-profitable projects such as transport infrastructure taking place in rural areas. This also contributes to the underestimation of the total land area change. For the overestimation of housing land and public facility land, there are more complicated reasons behind this. First, this suggests that the online data may provide more comprehensive coverage than CUCSY. Secondly, the online data contains redeveloped housing land, whereas the CUCSY data only includes the land which

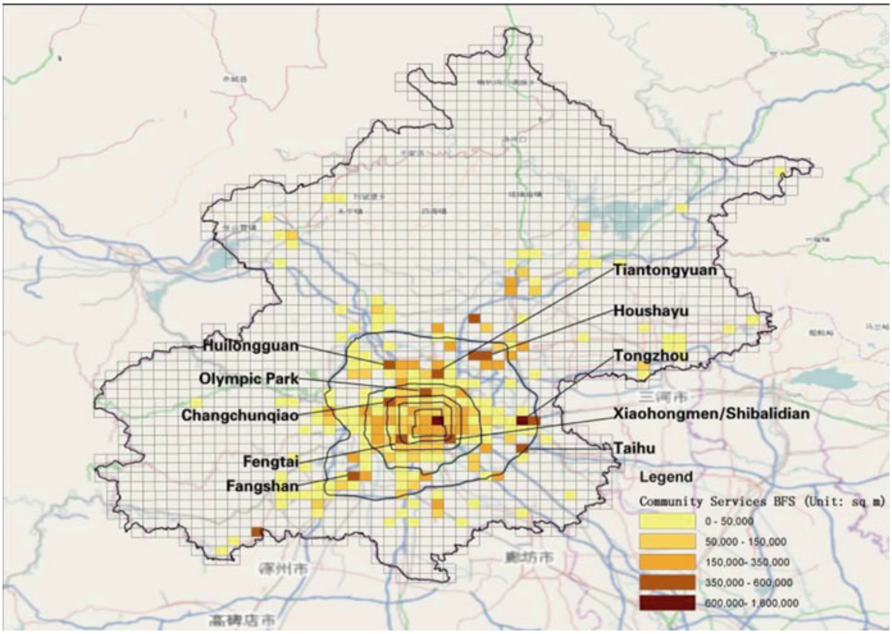

Fig. 12.19 Grid mapping of community services growth (BFS)

is newly converted to housing from rural land or other land uses. Thirdly, the online data may have missed some projects, as well as included some other projects missed by CUCSY. By comparing the total land area from the online data with the report from the Beijing Municipal Bureau of Land and Resources (2009, 2011, 2012),[15] we can see that the online data has missed some projects for land allocated, and included some extra projects for land transacted (Table 12.11). Moreover, changes in the amount of land use do occur in the development process, so the online and CUCSY sources are not expected to match exactly.

For housing, we further compare the online data on planned housing floor space with the Beijing Statistical Yearbooks (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013). The online data is almost always higher than the Yearbook data in land area developed for market housing, although lower for land purchasing cost (Table 12.12), even if we consider the time lag. This confirms the overestimation of housing land observed in the comparison between online data and CUCSY data, which suggests that online data may be more comprehensively, particularly in the outskirts where the published data may be weak. In addition, the Yearbook data is restricted to reported figures from the real estate companies, whereas the online data

[15] There are only reports which contain information of land provision through land transaction, land allocation and land allocation through land acquisition in 2009, 2011 and 2012. The report for 2013 only includes the first three quarters which is not comparable with our data.

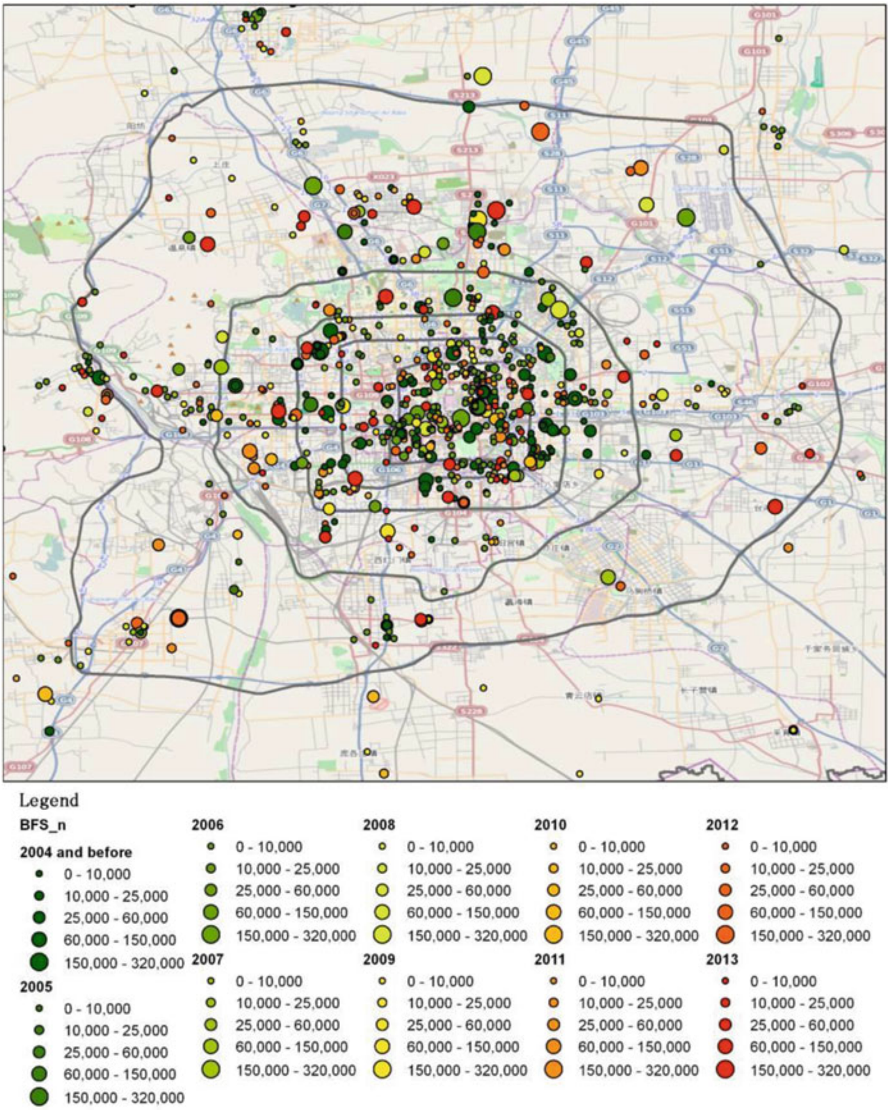

Fig. 12.20 Planned community services floor space by site

account for other types of developers such as non-real estate companies (especially state-owned enterprises controlled by central government) and institutions.

However, the online data is always lower in building floor space for housing (both market and non-market housing) than the Yearbook data (Table 12.13). This is contrary to the overestimation of land area for housing observed above. Our conjecture is that the online data on land has a better coverage, and the land recipients increase the building floor space (or FAR) after they have obtained the

Table 12.10 Comparison of online data and statistics on land area change (with 1 year lag)

(Unit: ha)	Online data Total of land area transacted and allocated from 2005 to 2010	Statistics Change between 2006 and 2011
Subtotal	12,990	17,164
Residential area	5288	4170
Area for public facilities	2868	2356
Area for industrial operation	3110	3142
Area for storage	186	−104
Area for traffic system	468	1459
Area for roads and plazas	0	3289
Area for municipal utilities	459	216
Green area	0	2662
Area for specific-purpose land	0	−26

Table 12.11 Comparison of online data and Bureau report on land provision (Beijing Municipal Bureau of Land and Resources 2009, 2011, 2012)

		Land transaction		Land allocation	
Plots	Area (ha)	Plots	Area (ha)		
2009	Online total	541	1271	87	475
	Official report	677	1854	133	722
	Percentage	80 %	69 %	65 %	66 %
2011	Online total	604	2156	68	215
	Official report	351	2086	121	586
	Percentage	172 %	103 %	56 %	37 %
2012	Online total	402	1118	139	345
	Official report	/	1077	/	450
	Percentage	/	104 %	/	77 %

land, as the planned building floor space suggested in land provision may not be legally binding and can be revised upwards in further planning permission applications.

In general, the verification results show that the online data does not fully represent what is taking place on the ground. This implies several issues with the data. Firstly, whilst the building floor space in the online data may be different from the actual practice on the ground, the land area in the online data for housing, public facilities, industrial operations and storage may be closer to reality than published statistics. Secondly, the exclusion of land acquisition data may underestimate the land provided, especially for transport infrastructure, and also for affordable housing and municipal utilities. Thirdly, for land allocation and land transaction, the

Table 12.12 Comparison of online data and statistics on real estate land development and land purchasing cost (2005–2012)

	Unit: ha	Unit: 100,000,000 Yuan			
	Land allocated and transacted	Land developed	Land purchasing cost		Land purchasing cost
	Online data (market housing)	Statistics (market housing)[a]	Online data (housing only)	Online data (including office, retail, community facilities and etc.)	Statistics
2005	565.5	314.2	43.9	75.3	239.8
2006	1181.2	840.5	116.3	165.7	477.9
2007	970.5	248.7	252.1	313.4	644.7
2008	779.7	351.5	466.1	539.0	639.0
2009	772.1	364.0	517.7	695.0	587.7
2010	506.1	/	640.5	840.7	1292.7
2011	1078.1	/	799.7	1267.5	1301.2
2012	697.8	/	424.7	656.9	1102.7

[a]For both statistics and online data, the land is for market housing projects, which also include a small number of office and commercial buildings as facilities

Table 12.13 Comparison of online data and statistics on housing building floor space (2008–2011)

Unit: ha	Total		Market housing		Non-market housing	
	Online data	Statistics	Online data	Statistics	Online data	Statistics
2008	1453.7	2177.4	1148.5	1565.3	305.2	612.1
2009	1599.9	2212.6	1174.0	1380.3	425.9	832.3
2010	1128.7	2999.3	851.3	2063.4	277.4	935.9
2011	2330.3	4047.4	1479.4	2596.4	850.9	1451.0

data has a small difference with the actual land allocation and land transaction. However, albeit that the difference is small, there is currently no way to identify which projects have been left out or need to be excluded. Fourthly, the land provision data by nature cannot fully reflect what is actually constructed on the ground in the particular year, because the developers and other recipients may stock the land or change the intensity of land use development.

This will particularly affect our understanding of the urban developments in the urban fringe. On the one hand, the exclusion of land acquisition data may underestimate the decentralising trend of housing, community services, etc. On the other hand, although the online data may better reflect the land development in land areas in outskirts compared to the official data, it may underestimate the land development in building floor space in the outskirts as the regulation of building floor space may be less strict in urban fringes than more central areas.

However, the land statistics has always been notoriously difficult. Despite the weaknesses, we are confident that we have captured the main land uses for housing and employment land, given the comparison above and the nature of the online data. In other words, the online data is starting to give us an insight into the patterns of growth for Beijing in the last decade.

It would seem that the pattern it captured is sensible, as some of it has been seen in many other historical precedents in developed countries. The finance and business centres in global cities such as New York, London, and Tokyo have been strengthening its concentration, followed by high-end hotels, retailers and cultural buildings. High technology sectors (i.e. R&D in our categories) tend to agglomerate in outlying clusters and corridors near major international airports, leading universities, etc., for example Silicon Valley in California and Heathrow-M4 Corridor (Cervero 1998). Other types of employment, relatively low-skilled services and human capital-intensive industry such as manufacturing, have been decentralising (Cervero 1998; Glaeser and Kahn 2001). On the other hand, in most European and US cities, housing has gone through almost a century of suburbanisation. Large-scale public housing projects were mainly built in the suburbs, for example new towns and council housing estates in London and grand-ensembles in Paris.

The trend also conforms to the dynamics of different industries. There are two counter-acting factors, which make decentralisation more common in manufacturing and less common in offices and institutions. One factor is the lower cost and higher abundance of land in the suburbs. The other factor is the nature of industries. Skill intensive industries, such as finance and business, prefer higher speed of the flow of ideas for instance through face-to-face contact, and easy access to specialised skills (Glaeser and Kahn 2001). In the mean time, decline in environmental quality of the densely built city centre, lifestyle changes, and the relative ease of developing suburban projects contribute to the decentralisation of housing (Camagni et al. 2002). On top of the market mechanisms, government policies also play an important role in Beijing. The manufacturing relocation policy, the new town policy, and the relocation policy for city centre residents, strengthen the decentralisation.

In summary, the land provision data has captured the main projects, and is able to demonstrate the growth pattern of Beijing's urban land use development. However, it has several weaknesses, including missing land acquisition data, and differences with the actual land development because of the nature of land provision data. More importantly, the online data reports more market housing land and less housing floor space. This would suggest that – on the one hand, more market housing land suggests that the online data may cover more comprehensively than reported in published statistics; on the other hand, less housing floor space suggests that the online data may have underestimated the actual size of housing on the ground. Given the data available, we are not able to solve this puzzle, because the planning permission data published online does not include land area or building floor space information. Therefore, it remains a critical issue to look at in the next step.

For future analysis and application, the data needs to be further compared with construction data/statistics, and adjusted and used accordingly. First of all, the puzzle for housing mentioned above needs to be solved, which then will allow us to estimate more precisely about building floor space. Secondly, the data needs to be compared in more detail with construction statistics for other land use type than housing, which still needs to be looked for. Thirdly, the development in the urban fringe, especially of affordable housing and community services, needs to be better estimated from the limited land acquisition data, either from the years which have complete data for each district, or from the districts which have the complete data for all the years. However, both the exclusion of land acquisition data and the underestimation of building floor space for housing suggest the contrast between centralisation and decentralisation trends may be even stronger.

12.5 Implications for Understanding the Growth Patterns

The increasing separation of housing and offices/institutions, which is demonstrated in Beijing's urban land provision, implies potential problems. The different pace and degree of decentralisation of housing and employment apart from offices and institutions, as well as the continuous development of offices and institutions in more central areas, are likely to add pressure on the city's transport, as the commuting travel demand will rise in the form of both more people travelling in cars and public transport and longer journeys. Given the city has already been suffering from traffic jams on the road and at-capacity flows on the main commuter metro lines, the continuing increasing travel demand would be a huge challenge. On the other hand, residents have already been suffering from long commuting time. According to the China Academy of Science (NIU 2012), Beijing's average travel time to work was 52 min in 2012, ranking it the first among all Chinese cities. In addition, Beijing is also considering increasing the metro fares to mitigate public spending in metro subsidy. The increase in either travel time or travel cost could result in significant impacts on the well-being of residents.

Yet, this is not yet a clear picture. Beijing is learning the lesson from historical precedents trying to solve the present and potential problems. The land plots allocated for affordable housing show a less decentralising trend compared with those for the market housing (Fig. 12.21). Also the city has been constructing public transport at rapid speed. Moreover, lower-end employment, especially manufacturing, is decentralising, which may provide jobs for people who live nearby.

Most importantly, people will change their location choice for working and living as well as adjust their daily activity pattern according to the price, travel time, comfort level, etc. For example, the estimated two million people who live in antiquated underground bomb shelters, and the expanding group-renting population, have found their own way to solve the contradiction of high housing costs, long commuting time and high commuting costs. Obviously, neither is a desirable choice in terms of living conditions which may also undermine the residents' well-being, and may cause potential problems which the city might not be able to estimate and solve because of its informality. Yet, there might be other adjustments which may mitigate the potential problem.

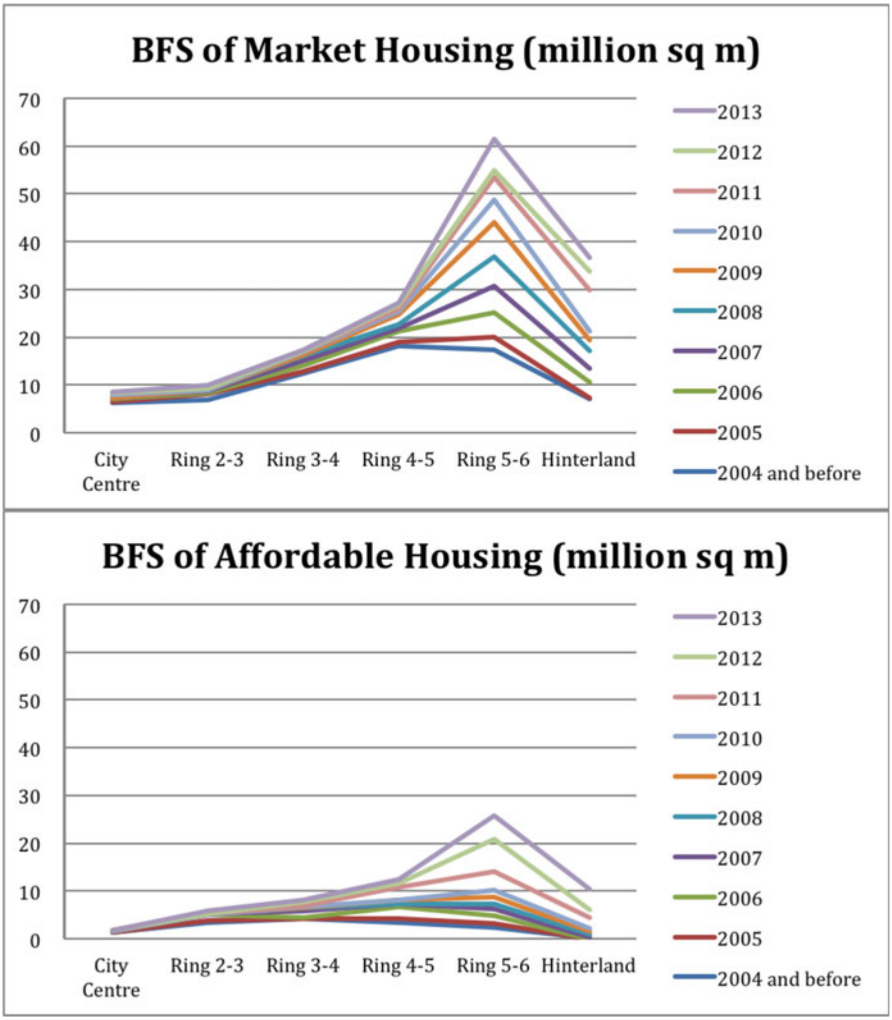

Fig. 12.21 Comparison of planned BFS distribution of market housing and affordable housing

Therefore, in order to better examine the impact of the current development trend, we propose to use a land use and transport simulation model that is based on robust economic and behavioural theories regarding individual, corporate and institutional behaviours, i.e. a recursive spatial equilibrium model (Jin et al 2013). Through this, we are able to simulate residents' adjustments, as well as to overcome the significant gaps and weaknesses of the online data through a new filtering and infilling method, and analyse the impact of the current development trend in comparison with other alternative strategies. With the aid of a theoretically robust simulation model, the online administrative data can make a significant and timely contribution to the understanding of growth patterns, and to core policy analysis.

12.6 Conclusions

This paper is a first attempt to use the novel online land plot provision data (land plot transaction and land plot allocation) to analyse the growth patterns of housing and employment land in Beijing in the last decade. In general, the online data demonstrate that housing is developing and decentralising at a faster rate than employment when measured in terms of both land area provided and square metres of floor space to be constructed. Land for manufacturing, retail and community, are also decentralising at a faster rate than average for employment land as a whole. For higher-end services, R&D is decentralising, but concentrated in very few projects in the outskirts of the city. The land for offices and institutions is clearly developing in a centralising way.

This analysis demonstrates that the online administrative data for land cannot precisely capture the on the ground construction taking place each year, and may underestimate the actual constructed building floor space as well as developments of housing and community services at the urban fringes. These weaknesses may be overcome by more detailed field work. However, when the data is fully corrected and validated we expect that the contrasts between the centralizing and decentralizing trends would be even stronger.

This trend together with the intensification of decentralisation since 2008–2009 means increasing separation of housing and office/institution sector employment, which may exert an even higher demand on the city's transport systems, both on the road and the metro. Next steps include use of a land use and transport simulation model to assess the impacts of alternative growth patterns and policies that will promote economic efficiency, social fairness and environmental sustainability of the city.

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