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REAL ESTATE ECONOMICS

Does Government Investment in Local Public Goods Spur Gentrification? Evidence from Beijing

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In Beijing, the metropolitan government has made enormous place-based investments to increase green space and to improve public transit. We examine the gentrification consequences of such public investments. Using unique geocoded real estate, new restaurant count data and demographic data by neighborhood, we document that the construction of the Olympic Village and two recent major subway systems have led to increased new housing supply in the vicinity of these areas, higher local prices and an increased quantity of nearby private chain restaurants. Recent time trends in local resident income and human capital attainment support the claim that these investments have caused local gentrification.

In Beijing, the city's government is investing to improve local infrastructure. Over the last ten years, the government has constructed new subways and built the Olympic Park, which played a pivotal role in the successful 2008 Summer Olympics. These investments have cost billions of dollars. Four new subway lines were built during 2000 to 2009, with the total investment of 50.3 billion RMB. Between 2003 and 2008, 20.5 billion RMB was spent to construct the 2008 Olympic Park.[1] These place-based investments have been concentrated in some of the previously underdeveloped areas of Beijing.

Using several new data sets, we document evidence that this place-based public investment has triggered gentrification in areas close to the public investment. We define gentrification as taking place when a geographical area experiences

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[1]The official exchange rate is 6.5 RMB per dollar.

an increase in the quality of private-sector economic activity as reflected by rising local home prices, new housing construction and new restaurants opening. Gentrification encompasses the two distinct processes of upper-income resettlement and housing renovation (Helmes 2003).

In areas experiencing these trends, richer people are more likely to migrate in; this will further accelerate the gentrification process. Our major findings can be briefly summarized. First, homes near the new government infrastructure sell for a price premium, and developers are increasing the number of housing units produced in the vicinity of this infrastructure. Second, new restaurant openings have also increased in the neighborhoods close to the Olympic Village and the new subways. Third, we report evidence that those neighborhoods that are physically close to the new infrastructure are experiencing some growth in income and educational attainment.

Our investigation of the real estate market consequences from place-based investments in a fast-growing developing city contribute to recent empirical research on urban gentrification. Schwartz, Susin and Voicu (2003) estimate how crime reduction differences within New York City have contributed to local real estate price appreciation. Kahn, Vaughn and Zasloff (2010) report evidence of gentrification in Los Angeles communities that lie just inside the California coastal boundary zone. Sieg *et al.* (2004) show that an unintended consequence of successful Clean Air Act regulation in Los Angeles has been to trigger migration and gentrification in previously poor areas of the city whose air pollution has sharply decreased.

In each of these cases, a government financed or regulated place-based amenity improvement triggers a social multiplier effect in specific parts of a city. The government's investment has a direct effect of improving the local area's quality of life. This is capitalized into higher rents. As gentrification takes place, the local area will self-select people who can afford to pay this rent premium. A type of snowball effect ensues as the gentrification of the neighborhood attracts better stores and restaurants and this, in turn, attracts more high-skilled people to live nearby (Waldfogel 2008).

We simultaneously study the effects of new public transit investments and new investments in green space (73% of the 2008 Olympic Parkland is green space). Our findings contribute to international real estate research that has examined how property prices are affected by improvements in public transit. Gibbons and Machin (2005) find that a 1-km reduction in distances to train stations increases prices by around 1.5%. Kahn (2007) documents the increase in local home prices in major U.S. cities such as Boston and Washington D.C. that have opened "walk and ride" subway stops for fast new subways. That study concludes that

public transit has its largest impact on local home prices and gentrification when the new transit connects an area to a vibrant downtown. Based on data from Santiago *et al.* (2008) find that the news of announced new subway stations is capitalized into local property prices. Other research has investigated the effects of new green space. Tajima (2003) documents the localized real estate effects of green space in the Boston downtown. Kang and Cervero (2009) find that real estate prices in Seoul, South Korea, increased when a highway was torn down and was replaced with a water way and park. Our study builds on this earlier research by studying both of these land improvements within one integrated approach.

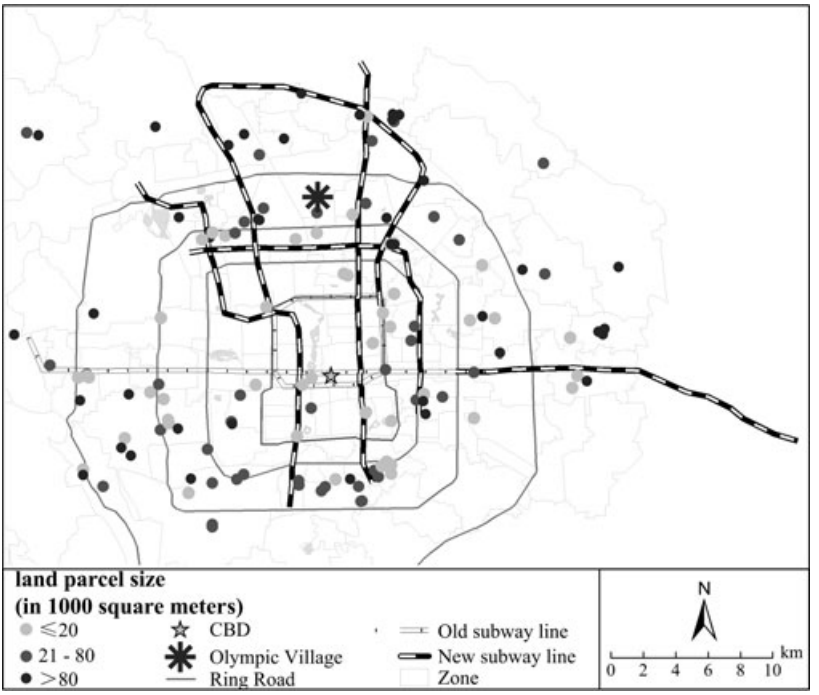
Spatial Locations of Recent Major Infrastructure Investments in Beijing

While the Beijing Administrative Area consists of 18 districts, both the municipal government and the public regard the inner eight districts (*Dongcheng, Xicheng, Chongwen, Xuanwu, Chaoyang, Haidian, Fengtai, Shijingshan*) as the urbanized area or "Beijing Metropolitan Area" (BMA). In this article, we focus on the BMA region. The administrative system has three levels: municipality, district and *Jiedao* (*Jiedao* is referred to as zone thereafter). Within the BMA there are 135 *Jiedao*s (zones). This is the fundamental administrative organization. The average size of each *Jiedao* is about 10 km^2. Unlike the United States, which has a highly decentralized public goods provision system, most of the public infrastructure and services, such as transportation, education and healthcare, are provided by the Beijing municipal government. The *Jiedao* (zone) is only responsible for some minor services such as garbage collection, and it not responsible for infrastructure construction. Therefore, the location choice of local public infrastructure projects is a centralized decision made by the municipal government. In this sense, the zone in this article is like a U. S. census tract (though its size is much larger than a census tract), which is a geographical unit of analysis that allows for research and data collection but not a political actor using tax revenue to provide public services.

BMA has an area of 1,368 km^2.[2] Beijing is a typical monocentric city with key government functions and cultural opportunities available at the City Center. The Central Business District (CBD) (*TianAnMen* Square and *JianGuoMenWai* Avenue) dominates the spatial distributions of population, land price and home price (Zheng and Kahn 2008). There are four ring roads in BMA from the inner to the outer city—the second, third, fourth and fifth ring roads, respectively (see the circles in Figure 1).

[2]Data source: Beijing Statistical Yearbook 2010.

Figure 1 ■ Land auctions (2005–2008) and new infrastructure improvements in Beijing.



The two largest local infrastructure improvement projects that have taken place recently in Beijing are the construction of new subway lines and the development of the 2008 Olympic Park. Five new subway lines were built from 2000 to 2009 (Lines No. 4, 5, 10, 13 and Batong), which cost $50.3 billion RMB. The construction of the 2008 Olympic Park started in 2003 and was completed in 2008, with the total investment of 20.5 billion RMB. The Olympic Park occupies 11.57 km^2, and 73% of it is green space so it added a major green amenity to Beijing.[3] Figure 1 displays the locations of the Olympic Park and the five new subway lines.[4]

[3]Carlino and Coulson (2004, 2006) use cross-city hedonic techniques to document that attracting a NFL team to a city raises local housing prices. Our estimates of the impact of the Olympic Village on local home prices reflects an analogous localized treatment. Unlike a sports stadium, the Olympic Village offers a bundle of increased green space and access to new infrastructure for holding large-capacity events.

[4]According to China Urban Construction Statistical Yearbook (2001–2009), there were three major local infrastructure improvement projects that cost over 10 billion in Beijing:

Figure 2 ■ Views at the Olympic Village location before and after the Village was built.

Before: Low-story poor-quality buildings and vacant land.

After: Modern stadiums and vast green space.

The location of these spatial investments was not chosen at random.[5] To investigate the motivations behind Beijing municipal government's place-based public investment decisions, we searched old documents and media reports and also interviewed relevant government officials. The Government chose to locate the 2008 Olympic Park outside of and adjacent to the North 4th Ring Road,[6] close and north to the 1990 Asian Games Village, which was located inside of the North 4th Ring Road. Figure 2 shows what the Olympic Village area looked like before it was built and contrasts this with its current form. There had been some old buildings and farmland in this area before the Olympic Park was built. Old buildings were demolished and farmland was converted to urban land. The Beijing government paid compensation to the original residents. The amount of compensation was determined case-by-case, but, generally, it was far below the market value. The Government had a dual goal for this location decision. The first, of course, was to ensure a successful Olympic Games. Choosing the location adjacent to the 1990 Asian Games Park can take advantage of the existing sports facilities built at that time. The second goal was to further gentrify this area. The *Zhongguancun* (IT) subcenter is not far away. By constructing the 2008 Olympic Park, the Government aimed to gentrify this area to be a subcenter with high-skilled industries and high quality of living.

construction of new subway lines (50.3 billion), the 2008 Olympic Park (20.5 billion) and the Beijing Capital Airport Terminal 3 (25 billion). The Airport Terminal 3 is far away from Beijing's urban area. Thus, we choose to study the first two key public investments in Beijing.

[5]Below, we will examine pretreatment trends across the city.

[6]This media report offers an example: http://house.focus.cn/news/2000–03–23/4579.html.

When deciding where to build the subway lines, the Government considered several factors including the mitigation of current road congestion and meeting the anticipated ridership growth (especially for the subway stops in and around the city core).[7] The Beijing Municipal Government regarded subway construction as a basic infrastructure provision intended to nudge growth to the previously underdeveloped areas. The history of urban development in Beijing left an important urban form legacy—North Beijing where most government branches, universities and schools are located is more developed and richer than South Beijing. The Beijing Municipal Government aims to promote the development in South Beijing by investing in more infrastructure projects there and restructuring the industry mix.[8] Building more subway lines there is one of the key stimulus policies.[9] New subway lines also extend to surrounding satellite towns to support their development.

The Empirical Framework for Testing for Gentrification

We posit that these place-based investments will gentrify nearby Beijing communities. The increase in green space and improvements in CBD access are likely to attract richer and more educated people to live there. We hypothesize that developers will build more housing units in the "treated areas." As new housing is built, this will attract more people and richer people to live near the public infrastructure. This will induce the opening of new restaurants nearby. In this sense, public investments and private investments are complements that act synergistically to gentrify previously underdeveloped areas within this booming city.

To test these gentrification claims, we will present results based on three pieces of data. The first piece of evidence comes from real estate prices. We use hedonic techniques to examine whether local infrastructure improvements are capitalized in land leasehold price (land price thereafter) and residential property price. Our unit of analysis is a residential property project (or an auctioned land parcel) j located in zone z in quarter t.

[7] For instance, the Beijing Municipal Commission of Urban Planning recently declared that subway line 6 and line 7 will be constructed to cope with the ridership growth of subway line 1 and the road congestion around the Beijing West Railway Station.

[8] See http://epaper.jinghua.cn/html/2010–01/30/content_512648.htm.

[9] See http://news.xinhuanet.com/politics/2008–02/28/content_7686576.htm and http://finance.ifeng.com/roll/20101215/3058359.shtml.

Equation (1) reports the hedonic pricing equation for residential property projects:

$$\begin{aligned}\log(homeprice_{jzt}) = \alpha_z + \Phi_t + a_{1t} \times Distance\ to\ CBD_{jz} + a_{2t} \\ \times \log(Distance\ to\ Olympics_{jz}) + \sum_{sb} a_{3,sb} \\ \times \log(Distance\ to\ Subway_{jzt,sb}) + a_4 \times X_{jz} + U_{jzt}.\end{aligned} \tag{1}$$

In the above regression equation we control for zone and quarter fixed effects (α_z, Φ_t). X_{jz} is a vector of project-specific time-invariant attributes. The subscript *sb* for *Distance to Subway* stands for the different subway types—old subway lines, new subway lines and un-built subway lines (see the detailed explanation in the empirical section below). We allow the CBD price gradient to vary over time to capture the possible suburbanization effect. To keep the econometric specification parsimonious, we assume this coefficient follows a linear time trend, *i.e.*, $a_{1t} = a_1 \times t$. (t counts the number of quarters that has passed since 2006Q1, so $t = 0, 1, 2, \ldots$). *Distance to Subway* varies over time for a given location—when a new subway line is constructed or the Olympic Park is built, its value will shrink. *Distance to Olympics* is a time-invariant variable. The 2008 Olympic Park was built over a long time period (2003 to 2008) and thus covers our study period (2006–2008). We hypothesize that the value of proximity to the Olympic Park becomes more valuable over time as Olympic Park is nearly completed. Our empirical test of this claim is to test whether the absolute value of a_{2t} rises over time. Similarly as a_{1t}, $a_{2t} = a_2 \times t$. If a_2 is statistically significant and negative, then this indicates that the value of proximity to the Olympic Park is rising over time.

We then turn to estimating count regression models to study the spatial distribution of new housing supply and new restaurant openings. Based on a revealed preference argument, these new housing unit count regressions establish which Beijing geographical areas are attractive locations to real estate developers. The unit of analysis in this case is a zone/quarter for residential projects and a zone/year for restaurants. We study how a zone's attractiveness evolves when it is "treated" by being closer to a nearby subway stop or to the Olympic Park. Those zones that are further from this new infrastructure represent our control group.

In addition to reporting counts of new housing, we also report the quantity regressions focused on studying the geographical patterns of new restaurant openings. In a similar spirit as Waldfogel (2008), we test whether restaurant counts increase in the treated zones. We view this as a direct test of gentrification from the demand side because such nationwide chain restaurants and stores such

as Starbucks have strong profit incentives to locate new stores in areas that offer customers.

We estimate both the residential project t and restaurant opening count regressions using negative binomial regressions. Taking the former as an example, for zone z in quarter t the outcome variable is a function of:

$$\begin{aligned} Count_{zt} = f(&\Phi_t + b_{1t,qd} \times Distance\ to\ CBD_z + b_{2t} \\ &\times \log(Distance\ to\ Olympics_z) + \sum_{sb} b_{3,sb} \\ &\times \log(Distance\ to\ Subway_{zt,sb}) + B_4 \times X_z + \Psi_{zt}) \end{aligned} \tag{2}$$

In the above regression equation we control for quarter fixed effects Φ_t. X_z is a vector of zone-specific time-invariant attributes. We allow the gradient with respect to the distance to CBD varies by quadrant and also changes over time (suburbanization effect). b_{2t} is also a linear function of t so it can be written as $b_{2t} = b_2 \times t$. Estimates of b_2 and b_3 allow us to test whether new housing and new restaurants are increasingly likely to cluster near the new placed-based infrastructure over time. The restaurant opening count regression has the same functional form, but the time interval is the year instead of quarter.

The third piece of evidence focuses on demographic changes by zone. Due to data availability constraint, we only have zone-level averages of income and years of schooling. We view these results as suggestive. After all the zone-wide average incorporates both new entrants to the zone and incumbents who have chosen not to move out.

It is difficult to obtain micro household data with geographic identifiers within a Chinese city. The National Bureau of Statistics of China conducted two waves of a large-scale survey in Chinese cities in 2007 and 2010. The sample size in Beijing is 26,187 and 24,348 for 2007 and 2010, respectively. The Bureau refuses to release micro household data to anyone due to confidential reasons. Through a close collaborative relationship with the Bureau, we have been able to access zone-level average annual household income ($income_z$) and household head's years of schooling (edu_z) in 2007 and 2010. In this way we only have a very small data set of 114 observations (by zone, we lose some zones because empty income and education attainment data) for each year. We use this data to run parsimonious regressions to test if the zones close to the Olympic Park and new subway stops have gentrified toward higher-income and better-educated residents. The model we estimate for zone z in year t is presented in

Equation (3).

$$\begin{aligned}\log(Y_{zt}) = constant + \sum_{q=2}^{4} QD_{q,z} + c_1 \times Y2010 + c_2 \\ \times Distance\ to\ CBD_z + c_3 \times Distance\ to\ CBD_z \times Y2010 + c_4 \\ \times \log(Distance\ to\ NewSubway_{zt}) + c_5 \\ \times \log(Distance\ to\ OldSubway_z) + c_6 \\ \times \log(Distance\ to\ OldSubway_z) \times Y2010 + c_7 \\ \times \log(Distance\ to\ Olympics_z) + c_8 \\ \times \log(Distance\ to\ Olympics_z) \times Y2010 + \Pi_{zt}(t = 2007, 2010)\end{aligned} \tag{3}$$

In the above equation, the dependent variable Y_{zt} is the zone-level average of annual household income ($income_z$) and household head's years of schooling (edu_z), respectively. $\sum_{q=2}^{4} QD_{q,z}$ are quadrant fixed effects (the first quadrant is the default). $Y2010$ equals one for year 2010. c_1 captures the average income/schooling growth rate from 2007 to 2010 for all zones. We test whether the spatial gradients with respect to the distance to CBD and to the closest old subway stop have changed during this three-year period by including the interaction terms of the distance variables and $Y2010$. What we are mostly interested in is whether the places close to new subway stops and the 2008 Olympic Park became richer and more educated in 2010 comparing to three years ago. Here $Distance\ to\ New\ Subway_{zt}$ is a time-variant variable (it becomes smaller when a new subway stop is open nearby) so we do not need to include the interaction term. We expect c_4 to be negative. Instead, $Distance\ to\ Olympics_z$ is a static variable so we include its interaction with $Y2010$. We expect c_8 to be negative.

Gentrification Evidence in Residential Property Market

Beijing New Residential Property Development Data Set

There are two auction types in China's urban land auction market—listing ("two stage auction") and bidding (regular English auction). Developers incur costs through buying land leasehold right from local government and constructing and operating the building. The costs of building materials and labor can be regarded as constant across space within Beijing. Figure 1 shows the distribution of the land parcels auctioned during 2006 to 2008 in the Beijing Metropolitan Area.

Once developers have purchased the land leasehold right, they engage in contracting the design and construction work to design companies and builders. In principle, developers cannot hold the vacant land in hand for longer than two years. But this "two-year rule" is sometimes violated by developers without effective penalty. They can start to presale the units when the progress of on-site construction work reaches a certain threshold (in Beijing, only after the main structure is completed the developer can start presale, about 90% or so of the construction).

Over the last ten years in the Beijing Metropolitan Area (built-up area), 80,000 to 100,000 units of new commodity housing have been built each year. New housing units are constructed and sold by real estate developers. A typical residential project developed by a developer always contains a couple of towers and hundreds or even thousands of housing units.

We study the spatial distribution of new housing construction using data on new commodity housing sales in Beijing from the first quarter in 2006 through the fourth quarter in 2008. The unit of observation in this data set is a housing unit, with an average floor-area of 148 m^2. There are altogether 1,596 projects and about 232 thousand units in our data set. Table 1 provides descriptive statistics. The price for such newly built commodity housing projects is high and has been surging for about seven years in Beijing. The total value of an average housing unit in our sample is 1,442,000 RMB (220,000 USD), which is 21 times the average annual household income in 2006 Beijing.[10] The upper-middle class and the wealthy (both Beijing locals and the rich from other cities or aboard) tend to buy those new commodity housing units. Therefore the construction of new commodity housing projects provides evidence of gentrification.

This micro transaction data set is not available to the public. We have a long-term collaborative relationship with Beijing Municipal Housing Authority, which allows us to obtain this valuable data set. We acknowledge that this time period is relatively short, but we are unable to extend it to earlier years because the transaction data for the years before 2006 are in article form. We are not able to convert them into electronic form. Our data set does cover the time period when there was considerable new housing construction and the time period when the Olympic Park and the new subways were being built.

We geocoded all land parcels auctioned and housing units sold in our study period on a Beijing Geographic Information System (GIS) map. Figure 3 shows that the majority of new residential construction takes place between the third ring road and the fourth ring road. There is little new construction inside the

[10]Data source: Beijing Statistical Yearbook 2007.

Table 1 ■ Variable definitions and summary statistics.

Variable	Definition	Period	Obs.	Mean	Std. Dev.
1. Project/Parcel Level					
LN_HP	Log average price of a residential project, by project/quarter (Yuan per square meter).	2006Q1–2008Q4	7091	9.276	0.502
D_CBD_h	A residential project's distance to CBD, in km, static variable.		1596	10.456	5.271
$D\_OLYMPIC_h$	A residential project's distance to Olympic Park, in km, static variable.		1596	12.553	5.559
$D\_NEWSUB\_S_h$	A residential project's distance to the closest new subway stop (construction started), dynamic variable.	2006q1–2008q4	7091	3.716	3.620
$D\_NEWSUB\_C_h$	A residential project's distance to the closest new subway stop (construction completed), dynamic variable.	2006q1–2008q4	7091	6.126	4.585
D_OLDSUB_h	A residential project's distance to closest old subway stops, static variable.		1596	4.610	3.582
$D\_\ UNBUILT\ \_SUB_h$	A residential project's distance to the closest potential subway stop, static variable.		1596	4.749	4.197
SOE_h	Binary, 1 = the residential project is developed by a SOE developer, 0 = otherwise.		1596	0.449	0.498
LN_LP	Log price of a land parcel (Yuan per square meter).	2005–2008	86	8.227	0.671
D_CBD_l	A land parcel's distance to CBD, in km.		86	11.878	5.301
$D\_OLYMPIC_l$	A land parcel's distance to Olympic Park, in km.		86	12.800	6.402
$D\_NEWSUB\_S_l$	A land parcel's distance to the closest new subway stop (construction started).	2005–2008	86	3.407	4.009

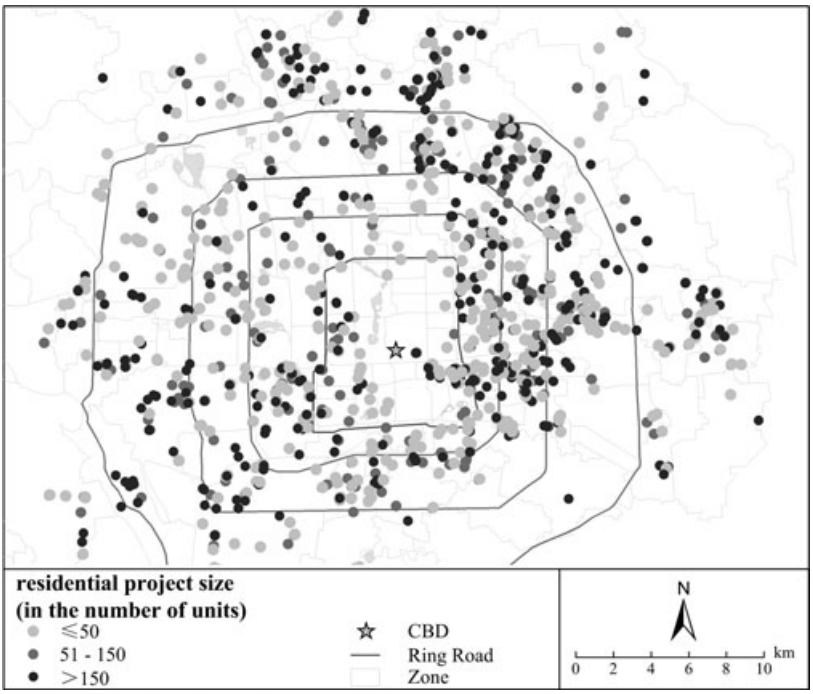
Table 1 ■ Continued

Variable	Definition	Period	Obs.	Mean	Std. Dev.
$D\_NEWSUB\_C_l$	A land parcel's distance to the closest new subway stop (construction completed).	2005–2008	86	5.783	5.031
$D\_UNBUILT\_SUB_l$	A land parcel's distance to the closest un-built subway stop.		86	7.410	4.037
D_OLDSUB_l	A land parcel's distance to the closest old subway stop.		86	5.644	3.475
BIDDING	Binary, 1 = the auction type of the land parcel is bidding, 0 = otherwise.		86	0.471	0.502
SOE_l	Binary, 1 = the land parcel is bought by a SOE developer, 0 = otherwise.		86	0.506	0.503
2. Zone Level					
UNITS	The number of sale units, by zone/year.	2006q1–2008q4	1620	136.2	258.4
RESTAURANT	The number of restaurants opened, by zone/year.	2006–2010	675	1.2	2.0
LN_AREA	Log zone size, in square km.		135	15.527	1.055
$INCOME_z$	Zone-level average annual household income, in thousand RMB.	2007, 2010	228	72.971	30.234
EDU_z	Zone-level average years of schooling of household head.	2007, 2010	228	12.658	1.551
D_CBD_z	A zone's distance to CBD, in km, static variable.		135	10.885	6.782
$D\_OLYMPIC_z$	A zone's distance to Olympic Park, in km, static variable.		135	60.484	32.389
D_NEWSUB_z	A zone's distance to the closest new subway stop (completed), dynamic variable.	2006q1–2008q4	675	8.162	0.982
D_OLDSUB_z	A zone's distance to closest old subway stops, static variable.		135	8.036	0.997
$D\_UNBUILT\_SUB_z$	A zone's distance to the closest un-built subway stop, static variable.		135	5.096	4.759

Table 1 ■ Continued

Variable	Definition	Period	Obs.	Mean	Std. Dev.
$NEARBY_{Olympic}$	Binary, 1 = zone which locates within 10 km from the 2008 Olympic Park.		114	0.350	0.478
Q1	Binary, 1 = zone which locates in the first quadrant of Beijing (Tiananmen as the origin), 0 = otherwise.		135	0.274	0.446
Q2	Binary, 1 = zone which locates in the second quadrant, 0 = otherwise.		135	0.370	0.483
Q3	Binary, 1 = zone which locates in the third quadrant, 0 = otherwise.		135	0.178	0.382
Q4	Binary, 1 = zone which locates in the fourth quadrant, 0 = otherwise.		135	0.178	0.382
3. Time trend					
TIME_Q	Quarterly time trend, 2006q1–2008q4 = 1, 2, 3, 4, 5, . . . , 12.	2006q1–2008q4			
TIME_Y	Yearly time trend, 20 05–2008 = 1, 2, 3, 4.	2005–2008			
Y2010	Binary, 1 = year 2010.				

Figure 3 ■ New residential units (2006–2008) in Beijing.



second ring road (the most inner ring road) where places are well developed and the redevelopment cost is very high. There is also less new construction in the places outside the fifth ring road since such remote locations are underdeveloped with short supply of infrastructure and public services. We run a simple OLS regression of zone-level development density (the units of new construction per square kilometer, in logarithm) on the distance to CBD and its quadratic term, and we find a clear reverse-U shape relationship:

$$\log(\textit{development density}) =$$

$$2.064 + 0.123^{*}(\textit{distance to CBD}) - 0.008^{*}(\textit{distance to CBD squared})$$

$$(10.67^{***})\ (3.34^{***}) \qquad (-5.30^{***}) \qquad R^2 = 0.059 \qquad (4)$$

We present t statistics in parentheses.

Land Price and Home Price Hedonics

We estimate two sets of hedonic regressions. One set is land price hedonics and the other is home price hedonics. We are especially interested in the

Table 2 ■ Land price hedonic regressions.

	(1)	(2)	(3)	(4)	(5)
D_CBD_l	−0.0314**	−0.0259*	−0.0146	−0.0202	−0.0225*
	(−2.49)	(−1.89)	(−1.08)	(−1.56)	(−1.74)
$Log(D\_OLYMPIC_l) \times TIME\_Y$			−0.0586*	−0.0367	−0.0247
			(−1.94)	(−1.13)	(−0.75)
$Log(D\_NEWSUB\_S_l)$			−0.0931		
			(−1.63)		
$Log(D\_NEWSUB\_C_l)$				−0.144**	−0.182***
				(−2.36)	(−2.77)
$Log(D\_OLD\_SUB_l)$		−0.0668	−0.108*	−0.103	−0.147**
		(−1.01)	(−1.69)	(−1.65)	(−2.15)
$Log(D\_UNBUILT\_SUB_l)$					0.126
					(1.50)
BIDDING	0.0729	0.0570	0.0492	0.0323	0.0291
	(0.44)	(0.35)	(0.32)	(0.21)	(0.19)
SOE	0.0937	0.104	0.130	0.0739	0.0728
	(0.76)	(0.84)	(1.11)	(0.64)	(0.64)
Constant	8.009***	8.489***	9.892***	10.23***	9.723***
	(44.75)	(16.68)	(15.20)	(15.35)	(13.10)
Land physical status (fixed effects)	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	86	86	86	86	86
R^2	0.418	0.426	0.502	0.521	0.536

t statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$.
Dependent variable: *LN_LP*.

capitalization effects of the new infrastructure projects—namely the Olympic Park and the new subways (see Table A3 in the Appendix for the construction start and completion dates of the Olympic Park and new subway lines).

In the land price hedonic regressions reported in Table 2, the unit of analysis is a land parcel sale. This table reports estimates similar to Equation (1). Since the sample size is small, we are unable to include zone fixed effects. We include characteristics of the land parcel's physical condition such as when it is auctioned and the connections to basic public infrastructure facilities (such as water, road, electricity, *etc*.).[11] In column (1), we estimate a significant negative price gradient of −0.031 with respect to the distance from CBD. We also control for a dummy variable indicating whether the developer is a state-owned

[11]There is a ranking of four levels defined by the local land authority: very raw, raw, less developed and developed. Three dummies are included, with "very raw" as the default category.

enterprise (SOE) and auction type.[12] In our residential property development data set (introduced below), there are altogether 833 real estate developers, 30.7% of which are SOE developers. SOE and non-SOE developers produce similar products.[13] They compete in land auctions, and face the same explicit labor costs and building material costs. However, the SOE developers may be able to obtain inside information on urban planning details due to their close connections with local government officials. The SOE developers buy land leaseholds at slightly (but not significantly) higher prices. This parsimonious model can explain 42% of the variation in land prices. There are two old subway lines built prior to 2000 in Beijing. The CBD gradient coefficient shrinks when the proximity to a nearby old subway stop is included (column (2)).

In columns (3) and (4) we include the land parcel's distance to the 2008 Olympic Park and its distance to the closest new subway stop. The latter distance has two versions: *D_NEWSUB_S* refers to the start effect, while *D_NEWSUB_C* refers to the completion effect. The constructions of the five new subway lines had already been started before our study period, so *D_NEWSUB_S* is a time-invariant variable. *D_NEWSUB_C* is a time-variant variable—during our study period, when the construction of a new subway line was completed, this variable of nearby land parcels changes thereafter.[14] This approach allows us to test whether prices adjust immediately after the start date or do not adjust until the final completion of the infrastructure.[15] We find that the construction start effect is only marginally significant, but the completion effect is significant at the 5% level and its coefficient size is large. Land price decreases by 1.4% when its distance to the closest new subway stop increases by 10%. Based

[12]Cai, Henderson and Zhang (2009) argue that in theory the so-called "bidding auction" would most likely maximize sales revenue for "cold" properties with fewer bidders. But listing auction is more corruptible, so city officials intend to divert hotter properties to this form. They find the corruption evidence by comparing the "hotness" and prices of the land parcels under these two auction forms. In our sample we compare the two groups' average distances to CBD, subway stops and the Olympic Park. We find that the listing land parcels do locate in better locations. Our land price regressions also show that the listing land parcels are slightly cheaper than bidding ones though the effect is insignificant.

[13]The average sale price and unit size of the units developed by SOE developers is 10,039 RMB per square meter and 156 square meters, and the averages produced by private developers are 10,233 RMB per square meter and 163 square meters.

[14]For instance, in 2006, a certain residential project's *D_SUB_C* is the minimum value of all the distances from this project to existing subway stops. After subway Line 5 was completed in 2007, this distance variable will be replaced by the minimum value of all the distances to existing stops plus Line 5 stops. If this project is close to one of the Line 5 stops, this distance variable will decrease.

[15]We are unable to test the announcement effect separately because the announcements and starts of the four lines were both before our study period.

on Equation (1), we include the interaction term of the log of the distance to the Olympic Park times a linear time trend variable. This interaction term is significantly negative at 10% level in column (3), showing that land prices near the Olympic Park have been growing moderately.

We recognize that we are attributing all of the posttreatment variation to the construction of the Olympic Park and the new subways. To substantiate our claim, we construct a few control groups.[16] The Beijing municipal government has put forward a series of subway construction strategy plans. According to these plans, 20 new lines will be built from 2000 to 2020, and the total mileage will reach over 1,000 km. However, the exact locations and construction dates of the proposed new subway lines are ambiguous in those strategy plans. By 2008, the five lines we study had been constructed, and the locations of the other two lines had been announced (Line 6 and Line 7), but the exact construction time of the latter two lines is uncertain. Therefore the two un-built subway lines that did not attract government' investment in the first place provide us with a control group. We create a new distance variable ($D\_UNBUILT\_SUB_h$) measuring each land parcel's distance to the closest un-built subway stop. We find that for the places where the government intends to build new subway lines, only those where the real construction has been started experience home price appreciation. A possible explanation for this insignificant announcement effect is that the Beijing municipal government does not have a clear timetable for its subway construction strategy plan and the proposed rough timetable is always changing. Therefore even after the subway line locations are announced, it is still uncertain when the money will arrive so that the line will actually be built. In column (5) in Table 2 we include the control variable ($D\_UNBUILT\_SUB_l$), and its coefficient is insignificant. This indicates that the government is collecting more revenue on land sales for land near the public infrastructure when the infrastructure is completed.

The home price regressions are presented in Table 3. Each project has many housing units. The sale of a project may last several quarters, and for each quarter many housing units in that project are sold. The unit of analysis is the average sale price for each project for each quarter. We include zone fixed effects in the equation to control for the existing public goods such as schools and local green parks by zone. In column (1), we find a significant negative price gradient with respect to the distance from CBD. The size of this negative gradient (-0.021) is quite similar to that reported in Zheng and Kahn (2008).

[16]Greenstone, Hornbeck and Moretti (2010) offer the most compelling case control study of the causal effects of local investments. They compare the *ex post* outcomes for areas that attracted an industrial production plant to other areas who were the "runner up" in attracting the plant but lost.

Table 3 ■ Home price hedonic regressions.

Dependent Variable Independent Variable	LN_HP (1)	LN_HP (2)	LN_HP (3)	LN_HP (4)	LN_HP (5)
D_CBD_h	−0.0211***	−0.00333	0.00196	−0.00296	0.00209
	(−4.54)	(−0.66)	(0.38)	(−0.58)	(0.39)
$D\_CBD_h \times TIME\_Q$	0.000391	0.000353	0.000423*	0.000652**	0.000423*
	(1.58)	(1.43)	(1.70)	(2.52)	(1.70)
$Log(D\_OLYMPIC_h) \times TIME\_Q$			−0.00494**	−0.00499**	−0.00494**
			(−2.47)	(−2.49)	(−2.48)
$Log(D\_NEWSUB\_S_h)$			−0.0656***		−0.0656***
			(−6.58)		(−6.56)
$Log(D\_NEWSUB\_C_h)$				−0.0289***	
				(−3.02)	
$Log(D\_OLDSUB_h)$		−0.131***	−0.125***	−0.129***	−0.125***
		(−8.56)	(−8.19)	(−8.39)	(−8.19)
$Log(D\_UNBUILT\_SUB_h)$					−0.000955
					(−0.08)
SOE_h	−0.0103	−0.0111	−0.00549	−0.0101	−0.00546
	(−1.02)	(−1.11)	(−0.55)	(−1.01)	(−0.54)
Constant	9.205***	10.08***	10.52***	10.28***	10.53***
	(193.77)	(89.55)	(81.41)	(76.80)	(67.49)
Zone fixed effects	Yes	Yes	Yes	Yes	Yes
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	7091	7091	7091	7091	7091
R^2	0.486	0.492	0.495	0.493	0.495

t statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$.
Dependent variable: *LN_HP*.

The interaction term of *D_CBD* and the quarterly time trend is positive, showing some evidence of suburbanization. In column (2) we include the residential project's distance to the closest old subway stop. The areas around these stops are well-developed business clusters. As expected, places near old subway stops have higher home prices. We notice that after including the distance to the old subway stop, the CBD gradient variable becomes insignificant. These two distance measures are highly correlated. In columns (3) and (4) we include the two new infrastructure improvement variables. We find that the construction start effect is quite significant and the size is large. Home price decreases by 0.6% when its distance to the closest new subway stop increases by 10%. The completion effect of subway construction is smaller than the start effect. This means that the capitalization effect takes place immediately after the news comes that the new subway line construction has started.[17] The Olympic Park

[17]Recall that as shown in Table 2, land prices do not rise immediately after the start date, but rise only after the completion date. This slow response is different from the immediate announcement effect in home price hedonic. A possible explanation is that home buyers can directly benefit from infrastructure improvements, so they are willing to pay more for new infrastructures. Real estate developers are sensitive to this

distance variable is also significantly negative, showing that home prices near the Olympic Park are higher than other places and the gap is increasing. In all of the regressions we control for whether the residential project is built by a SOE developer. Holding other factors constant, SOE sell their commodity housing units at a price discount but this discount is insignificant.

New Housing Construction

We now test whether developers are building new housing near the new infrastructure sites. Such new housing is expensive and is bought by the upper-middle class and the wealthy. Therefore, by tracking where new commodity housing projects are developed we are able to identify the gentrified areas with increasing purchasing power.

Table 4 reports the results of the quantity regression by zone/quarter using a negative binomial count model, based on Equation (2). We control for quarter fixed effects, and standard errors are clustered by zone. We include the distance to the CBD (D_CBD_z) and its interaction with linear time trend to test the suburbanization effect. In columns (1) and (2) all residential property units are counted. Columns (3) and (4) only count the projects developed by SOE developers, while columns (5) and (6) count those developed by non-SOE developers to see if there are any differences between the development location decisions by those two developer types.

In Column (1), the two variables proxying for access to the new public infrastructure improvements ($\log(D\_OLYPMIC_z) \times TIME\_Q, \log(D\_NEWSUB\_S_z)$) are both statistically significant. In column (2) we substitute $D\_NEWSUB\_S_z$ (start) with $D\_NEWSUB\_C_z$ (completion), and the latter has a larger effect and is more significant. We conclude that developers are responding to the government investment by investing in constructing new housing towers nearby. If a zone's distance to the closest new subway stop (construction completed) increases by 10%, the number of sales in the zone drops by 3.5%. Little new residential construction takes place near old subway stops, and the positive and statistically significant interaction term of $D\_CBD_z \times TIME\_Q$ shows that as time goes on, new residential construction is suburbanizing. This may be due to the fact that land is much scarcer and redevelopment costs are higher around the city center and the old subway stops. We interact the distance from CBD variable with quadrant dummies to allow the distance gradient to vary

market signal. However, land sales are between local government and developers. The government is less experienced and responds slowly to market dynamics, so land prices may lag behind the market information.

Table 4 ■ New commodity housing units quantity regressions (negative binomial).

	(1)	(2)	(3)	(4)
	All		SOE	Non-SOE
LN_AREA	1.013***	0.993***	0.865***	1.347***
	(5.26)	(5.68)	(4.17)	(7.33)
Log(D_OLYMPIC$_z$) × TIME_Q	−0.0154***	−0.0186***	−0.0136*	−0.0232***
	(−3.57)	(−3.60)	(−1.90)	(−6.85)
Log(D_NEWSUB_S$_z$)	−0.276**			
	(−2.14)			
Log(D_NEWSUB_C$_z$)		−0.350***	−0.407***	−0.302**
		(−2.89)	(−2.64)	(−2.34)
Log(D_OLDSUB$_z$)	−0.00866	0.0234	−0.0176	0.171
	(−0.05)	(0.16)	(−0.08)	(1.16)
Log(D_UNBUILT_SUB$_z$)	−0.0994	−0.128	0.0598	−0.268
	(−0.72)	(−0.95)	(0.29)	(−1.39)
D_CBD$_z$	−0.0319	−0.0743	−0.0188	−0.168***
	(−0.59)	(−1.44)	(−0.28)	(−2.68)
*D_CBD$_z$*Q2*	−0.0622**	−0.0417	−0.0852**	0.0138
	(−2.11)	(−1.44)	(−2.22)	(0.42)
*D_CBD$_z$*Q3*	0.0169	0.0466	0.0336	0.0497
	(0.49)	(1.24)	(0.61)	(1.38)
*D_CBD$_z$*Q4*	−0.0402	−0.0347	−0.0672	−0.00988
	(−1.17)	(−1.08)	(−1.23)	(−0.22)
*D_CBD$_z$*TIME_Q*	0.00509*	0.00651**	0.00440	0.00761***
	(1.83)	(2.06)	(0.93)	(3.11)
Constant	−6.973***	−5.558**	−5.534*	−11.34***
	(−2.65)	(−2.13)	(−1.86)	(−3.66)
Quarter fixed effects	Yes	Yes	Yes	Yes
Observations	1620	1620	1620	1620

z statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$.
Dependent variable: *UNITS* by zone/quarter; standard errors clustered by zone.

within Beijing. The north area in Beijing historically has better environmental quality and education resources. The control group variable's coefficient (log(*D_UNBUILT_SUB$_z$*)) is statistically insignificant.

We divide the sale counts to SOE-developed ones and non-SOE-developed ones and run separate quantity regressions. Non-SOE developers respond to the Olympic Park construction more sensitively than SOE developers, while the coefficient of new subway distance variable (completion) is larger (and more significant) for SOEs than for non-SOEs. A possible reason is that the information for the 2008 Olympic Park site selection and planning is more transparent than that for subway lines.

Gentrification Evidence Based on Chain Restaurant Openings

New Restaurant Openings in Beijing

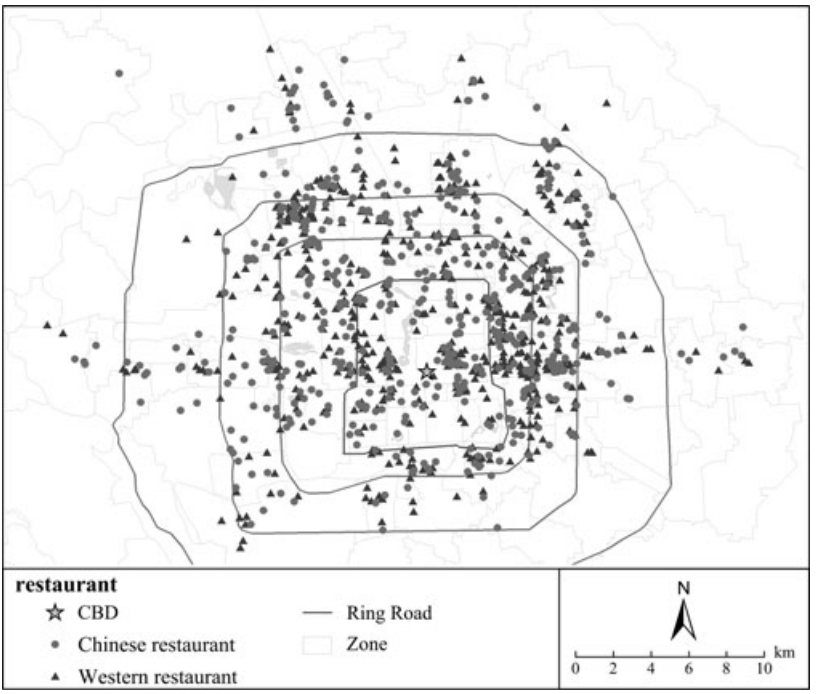
We examine the spatial distribution of locally available restaurants (a typical type of local private goods) and its change over time within Beijing. The restaurant industry provides a good indicator of residential sorting and gentrification. If more people are moving into an area and if they are richer than the average person, then we will expect to see the count and quality of restaurants rise over time in the "treated" areas. Similar to Glaeser, Kolko and Saiz's (2001) work on the rise of the "Consumer City," we envision the growth of "Consumer Neighborhoods" near the new public infrastructure.

Since no systematic data on restaurant cuisine and patronage exists in Beijing, we have to construct our own indicators. We identify the restaurant chains that fit the preferences (taste, service quality and price) of the upper-middle class and the wealthy who can afford new commodity housing. We interviewed 20 representative households in five new commodity housing communities to get a list of 33 chains they favor (11 western-cuisine ones and 22 Chinese-cuisine ones—see Table A1 in the Appendix for a list of these chains). When interviewing them, we asked them to list the chains around their communities that they patronize with their family members most frequently. These chains account for 42.8% of all restaurant chains operating in Beijing. We know in the U.S. Starbucks opens its coffee shops where rich people are, but McDonald's always locates in poor communities or near highways. In China, both Starbucks and McDonald's seek to locate where rich and fancy Chinese urban residents are because they find huge demand there.

We go to the most famous food guide and review website www.dianping.com to collect the location and opening date information of all the 902 establishments of these 33 chains and geocode them in a Beijing GIS map. Figure 4 shows this fourth geocoded data set in our article. The market for chain restaurants in Beijing has been growing fast. There were only 303 establishments by the end of 2005, but at the end of 2008 this number tripled. We further compute the number of existing restaurants (as a stock variable) and new restaurants (as a flow variable) by zone/year. The zone-level correlation coefficient of new restaurants and newly built commodity housing units sold is 0.21.

We run similar quantity regressions of chain restaurant openings by zone/year (2006–2010) (Table 5). Chain restaurant openings follow the same spatial patterns followed by new commodity housing construction—more restaurants opened around the Olympic Park and new subway stops. In column (1), if a zone's distance from the closest new subway stop (start) increases by 10%,

Figure 4 ■ Chain restaurant openings (2006–2008) in Beijing.



the annual number of chain restaurant openings in the zone drops by 4.9%. In column (2) this effect is even larger (4.9%) when we substitute the subway start variable with the completion variable. We also find that new chain restaurants are opening near existing subway stops. In column (3) we include the additional control variable of un-built subway lines, and it is statistically insignificant. There are more restaurant openings downtown, but the positive interaction term of *D_CBD* × *TIME* shows that chain restaurants are also undergoing suburbanization.

Gentrification Evidence from Demographic Changes

Our final piece of evidence on gentrification trends is based on estimating the demographic regressions. Using the zone/year level data, we test for evidence of direct demographic gentrification. Table 6 presents the results based on Equation (3). The first two columns are regressions with log($INCOME_z$) as the dependent variable. The income gradient with respect to the distance

Table 5 ■ Chain restaurant openings regressions (negative binomial).

	(1) Restaurant	(2) Restaurant	(3) Restaurant
LN_AREA	0.618***	0.606***	0.609***
	(5.07)	(5.43)	(5.51)
Log(D_OLYMPIC$_z$) × *TIME_Y*	−0.122***	−0.0964**	−0.0895**
	(−2.88)	(−2.45)	(−2.23)
Log(D_NEWSUB_S$_z$)	−0.458***		
	(−5.38)		
Log(D_NEWSUB_C$_z$)		−0.486***	−0.501***
		(−6.60)	(−6.50)
Log(D_OLDSUB$_z$)	−0.323***	−0.239**	−0.271**
	(−3.17)	(−2.25)	(−2.45)
Log(D_UNBUILT_SUB$_z$)			0.0753
			(0.82)
D_CBD$_z$	−0.0863***	−0.155***	−0.155***
	(−2.75)	(−4.98)	(−5.03)
D_CBD$_z$ × *Q2*	−0.0118	0.000728	−0.00135
	(−0.61)	(0.04)	(−0.07)
D_CBD$_z$ × *Q3*	0.00447	0.0200	0.0143
	(0.17)	(0.78)	(0.53)
D_CBD$_z$ × *Q4*	−0.0489*	−0.0533**	−0.0579**
	(−1.78)	(−2.02)	(−2.12)
D_CBD$_z$ × *TIME_Y*	0.00989*	0.0210***	0.0211***
	(1.82)	(3.31)	(3.31)
Constant	−1.948	−1.568	−1.905
	(−1.09)	(−0.89)	(−1.06)
Year dummies	Yes	Yes	Yes
Observations	675	675	675

z statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$.
Dependent variable: *RESTAURANT*, by zone/year; standard errors clustered by zone.

to CBD is negative, and it does not change much over time. In column (1), log(*D_NEWSUB_C$_z$*) has a negative sign and is statistically significant, which supports our gentrification hypothesis. Places near old subway stops do not show significant income gentrification. Contrary to our expectation, the interaction term of log(*D_OLYMPIC$_z$*) × *Y*2010 has a positive sign (though the coefficient is not significant). After further examining the GIS maps, we find this effect is mainly attributed to the fact that the previous underdeveloped south part in Beijing has experienced faster income growth, while the Olympic Park is located in the very north part in Beijing. Therefore, we further test if the Park has some local impact on the income distribution in its vicinity. In column (2) we introduced a new variable called *Nearby*, which is a dummy

Table 6 ■ Demographic changes: 2007 and 2010 (by zone).

	$\log(INCOME_Z)$		$\log(EDU_Z)$	
	(1)	(2)	(3)	(4)
Y2010	−0.986	−0.0580	−0.595**	−0.0984
	(−1.36)	(−0.19)	(−2.04)	(−0.80)
D_CBD	−0.0124*	−0.0130*	−0.00120	−0.00162
	(−1.65)	(−1.77)	(−0.40)	(−0.54)
*D_CBD*Y2010*	0.00431	0.00427	−0.00107	−0.000466
	(0.53)	(0.55)	(−0.32)	(−0.15)
log(D_NEWSUB_C$_z$)	−0.0659**	−0.0676**	−0.0312***	−0.0314**
	(−2.23)	(−2.28)	(−2.62)	(−2.60)
log(D_OLDSUB$_z$)	−0.00459	−0.000219	−0.00937	−0.00788
	(−0.14)	(−0.01)	(−0.69)	(−0.57)
log(D_OLDSUB$_z$) × *Y2010*	0.0375	0.0397	0.0173	0.0168
	(0.85)	(0.92)	(0.98)	(0.95)
log(D_OLYMPIC$_z$)	−0.101	−0.0922	−0.0746***	−0.0575**
	(−1.62)	(−1.61)	(−2.95)	(−2.47)
log(D_OLYMPIC$_z$) × *Y2010*	0.0945		0.0510*	
	(1.39)		(1.85)	
log(D_OLYMPIC$_z$) × *NEARBY*		0.000740		0.00178
		(0.09)		(0.51)
log(D_OLYMPIC$_z$) × *NEARBY*Y2010*		−0.0211**		−0.00778**
		(−2.42)		(−2.19)
Constant	12.53***	12.44***	3.501***	3.335***
	(20.42)	(20.99)	(14.15)	(13.82)
Quadrant fixed effects	Yes	Yes	Yes	Yes
Observations	228	228	228	228
R^2	0.392	0.408	0.311	0.318
Joint F-test for *D_CBD* and *D_CBD*Y*2010	1.48		0.30	
Joint F-test for *log(D_OLYMPIC$_z$)* and *log(D_OLYMPIC$_z$)* × *Y*2010	1.48		4.39**	
Joint F-test for *log(D_OLDSUB)* and *log(D_OLDSUB)* × *Y*2010	0.56		0.48	
Joint F-test for *log(D_OLYMPIC$_z$)*, *log(D_OLYMPIC$_z$)* × *NEARBY* and *log(D_OLYMPIC$_z$)* × *NEARBY* × *Y*2010		2.98**		3.60**

t statistics in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$ and $^{***}p < 0.01$.

indicating whether a zone is within 10 km of the Park.[18] The coefficient of $\log(D\_OLYMPIC_z) \times NEARBY \times Y2010$ is significantly negative, and the joint F-test for the three Olympic-related variables is also significant at 5% level, so there is some sign of income gentrification in the places near the Park.

Columns (3) and (4) are the regression results of the same specifications with $\log(EDU_z)$ as the dependent variable. Similarly, we find steeper skill gradients with respect to the distances to the closest new subway stop and also in the vicinity of the Olympic Park.

We are unable to run micro-level regressions and are also unable to control for other household demographic attributes due to data constraints in the above regressions. We understand that those zone-level averages contain the information of both new entrants to the zone and the incumbents who have chosen not to move out, so the above empirical evidence can only be regarded as suggestive.

Conclusion and Discussion

Government infrastructure projects can have dramatic effects on local real estate markets. Whether the example is Boston's Big Dig or the possibility of a Subway to the Sea in Los Angeles, such major public projects have been shown to stimulate spatially targeted private investments and gentrification. This article has documented that the same dynamic plays out in Beijing.

As the city government invested in the Olympic Village and in new subways, local home prices increased, developers increased their construction and more restaurants of higher quality opened nearby. Higher-income and more highly educated households are attracted to live in those places. All three of these pieces of evidence support the claim that government investment and the private sector are complements that work together to gentrify previously underdeveloped areas.

Gentrification, however, is not a "free lunch." It brings in opportunities as well as challenges. The urban poor are likely to be displaced from land whose value has increased. We do observe that, at the places where infrastructure improvement and new real estate development are taking place in Beijing, the homes of poor people, such as rural migrants, are demolished and they are pushed further out to the remote suburban areas. This phenomenon has been documented in the United States by scholars such as Brueckner and Rosenthal

[18]The distance from the 2008 Olympic Park and Tian'anmen Square (the geographical center of Beijing) is 10 km. The results are robust when we choose other cutoff values smaller than 10 km.

(2009), but we know of no studies investigating such patterns in LDC (less-developed country) cities. Those poor people do not leave Beijing because they can find jobs here, but they have to commute longer distances from the city fringe to work places. To mitigate this problem, the Beijing municipal government has built a limited number of public affordable housing projects near suburban subway stops. However, only the poor households with Beijing local *hukou* are eligible for such subsidized public housing.

How to finance such large infrastructure projects effectively is another challenge. There is no property tax in Chinese cities.[19] Local governments in China face tight budget constraints since they are responsible for most financial obligations (*i.e.*, infrastructure construction, health care and pension) (Zhou and Zhang 2008). They have to expand extra-budgetary revenue in their jurisdictions, in which land sale revenue is a major part (Tao, Yuan and Cao 2007, Guo 2008).[20] In 2009, the total revenue from land sales in Beijing was 494.17 million RMB, and 64.6% of it was spent on infrastructure construction.[21] Large loans are also made to finance infrastructure investments. Without municipal bonds, Chinese cities create so-called municipal investment companies to borrow tens of billions of dollars mainly from state-run banks.[22] Those debts do not appear on the city's official financial balance sheet. The collateral for many loans is local land valued at high prices. Our empirical findings show that if there is enough demand, such infrastructure investment will stimulate real estate prices to sustain the cash flows to pay back the loans. However, these results may not generalize to smaller Chinese cities. Some mayors of small cities in China have ambitions to build major infrastructure projects such as huge town squares. If the demand is weak, oversupply of such infrastructures will cause high default risk in the future.

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[19]In 2010, Chongqing and Shanghai launched the pilot program of property tax. This newly designed property tax is more like a luxury tax, under which only high-end properties (less than 5% of the total housing stock) will be taxed. There is no property tax in other cities.

[20]Urban land is owned by the state. In practice, the local (city) land bureau is responsible for the allocations of land through auction sales of leasehold rights (70 years for residential land use). After the year 2004, leaseholds are, in principle, all sold at public auction (Cai, Henderson and Zhang 2009).

[21]Data source: http://news.xinhuanet.com/house/2010–03/19/content_13204816.htm.

[22]According to the statistics from China's National Audit Office, as of the end of 2010, the total balance of municipality loans was 10.7 trillion for all cities. The number for Beijing is 374.5 billion, accounting for 27.2% of Beijing's GDP in 2010 (see: http://www.audit.gov.cn/n1992130/n1992150/n1992500/2752208.html).

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Appendix

Table A1 ■ List of chain restaurants.

Western	Chinese	
McDonald	Yang Fang hotpot	Dong Lai Shun
KFC	TianWaiTian	Lu Lu restaurant
ORIGUS Pizza	Lao Cheng Yi Guo	Chun Xia Qiu Dong hotpot
Pizza Hut	Qingnian restaurant	Quanjude roast duck
Subway	Ma La Xiang Guo	Wa Ha Ha
Starbucks Coffee	Sanqianli steak	Qiao Jiang Nan
UBC Coffee	Guo Lin restaurant	Wu Ming Ju
Haagen-Dazs	YongheDawang	Wan Long Zhou seafood
TOKUGAWA	Hong Zhuang Yuan	Xiang Lin Tian Xia
Yama Teppanyaki tricks	XiabuXiabu	Hei Song Bai Lu
Wang Steak	Xiao Fei Yang	PingrangHaitanghua

Table A2 ■ The number of chain restaurant openings by year.

Open Date	Chinese-Cuisine Chains (22 Chains)	Western-Cuisine Chains (11 Chains)	Total
Before 2006 ("old")	171	132	303
2006	58	63	121
2007	72	55	127
2008	116	235	351
Total	417	485	902

Table A3 ■ The event dates for the Olympic Park and the new subway lines.

Project Name	Start Date	Completion Date
The Olympic Park	2002	2008
Subway Line 4	Before 2004	2009/2/11
Subway Line 5	Before 2002	2007/10/7
Subway Line 10	2004	2008/7/19
Subway Line 13	2000	2003/1/28
Subway Line Batong	2001	2003/11/26

Data source: http://zh.wikipedia.org.