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ABSTRACT

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 and restaurant data, 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.

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Introduction

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 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. 20.5 billion RMB was spent to construct the 2008 Olympic Park between 2003 and 2008.[1] These place based investments have been concentrated in some of the less desirable areas of Beijing.

In this paper, we use unique data to study how developers and restaurant entrepreneurs respond to this change in the quality of specific areas within Beijing. We test whether public investments and private sector investments are complements that act synergistically to gentrify previously depressed areas within this booming city.

Our investigation of the real estate market consequences from place based investments in a fast growing developing city contribute to a recent U.S literature focused on urban gentrification. Guerrieri, Hartley and Hurst (2010) document spatial spillovers such that exogenous increases in income in one community bid up real estate prices in adjacent communities. Kahn (2007) documents the increase in local home prices in major U.S cities such as Boston and Washington DC that have opened "walk and ride" subway stops for fast new subways. 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 many 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

[1] The official exchange rate is 7 RMB per dollar.

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 (Waldfgoel 2008).

This paper documents that similar dynamics are taking place in those Beijing areas where the state has made significant investments. Using several new data sets, we report three new facts. First, homes near the new government infrastructure sell for a price premium. Second, developers are increasing the number of housing units produced in a vicinity of this infrastructure. Third, new restaurant openings have also increased in the neighborhoods close to the Olympic Village and the new subways. These findings all support the claim that public investment and private investment are complements.

Recent Local 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. Four new subway lines were built between 2000 to 2009 (Lines No. 4, 5, 10 and 13), 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 square kilometers and 73% of it is green space so it added a major green amenity to Beijing.[2] Figure One displays the locations of the Olympic Park and the four new subway lines.[3]

**** Insert Figure One about here ****

[2] 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.

[3] According to China Urban Construction Statistical Yearbook (2001-2009), there were three major local infrastructure improvement projects which cost over 10 billion in Beijing: construction of new subway lines (50.3 billion), 2008 Olympic Park (20.5 billion) and Beijing Capital Airport Terminal 3 (25 billion). The Airport Terminal 3 is far away from Beijing's urban area. So we choose to study the first two key public investments in Beijing.

These spatial investments were not chosen at random.[4] To better understand the sitting process, it is necessary to provide some details about Beijing's governance structure. The administrative system has three levels: Beijing municipality, district and *Jiedao* (*Jiedao* is referred to as zone thereafter in this paper). While the Beijing Administrative Area consists of eighteen 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), which is the spatial range we examine in this paper. BMA has an area of 1368 square kilometers.[5] Beijing is a monocentric city with key government functions and cultural opportunities available at the City Center. The 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 bold circles in Figure One). Within the BMA, 135 *Jiedao*s (zones) exist as the fundamental administrative organization (the average size of each *Jiedao* is about 10 square kilometers). Unlike the United States, which has a highly decentralized public goods provision system, public infrastructure and services are provided by the Beijing municipal government. Services such as transportation, education and healthcare are provided at this level. The *Jiedao* (zones) are only responsible for street cleaning, distributing subsidies to low-income households and enforcing the "one-child" policy. *Jiedao* is not responsible for infrastructure construction and public service provision. Therefore, the locational choice of local public investments is a centralized decision made by the municipal government. In this sense, the zone in this paper is like a U. S. 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.

To investigate the motivations behind Beijing municipal government's place based public investment decisions, we searched old documents and media reports, as well as 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 to the 1990 Asian Games Village which was

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[4] Below, we will examine pre-treatment trends across the city.

[5] Data source: Beijing Statistical Yearbook 2010.

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

located inside of the North 4th Ring Road. The Asian Games Village area had developed into a city subcenter with office buildings, shopping places and new residential communities before the Olympic Park was built. The Government had a dual goal for this location decision. The first, of course, was to ensure a successful Olympic Games. The Government favored the place that already had good existing infrastructure as well as a large green space. The existing sports facilities built at the time of the 1990 Asian Games could also be taken advantage of. 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 further gentrify this area to be a larger subcenter with high-skilled industries and high quality of living.

When deciding where to build the subway lines, the Government considered several factors. The first was to mitigate current road congestion or to meet the anticipated ridership growth (especially for the subway stops in and around the city core).[7] The Beijing Municipal Government regarded subway construction as basic infrastructure provision intended to nudge growth to the previously under-developed areas. The history of urban development in Beijing left an important urban form legacy—North Beijing where most of 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.

New Residential Construction in Beijing

Over the last ten years in the Beijing Metropolitan Area (built-up area), 80 to 100 thousand 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

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[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

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 dataset is a housing unit, with an average floor-area of 148 square meters. There are altogether 1,596 projects and about 232 thousand units in our dataset. Table One provides descriptive statistics. The price for such newly-built commodity housing 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 thousand RMB (220 thousand 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 does provide evidence of gentrification.

This micro transaction dataset is not available to the public. We have a long-term collaborative relationship with Beijing Municipal Housing Authority, which helps 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 paper 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.

In this paper, the unit of analysis for the home price hedonic regressions is a housing unit, while the unit of analysis for the quantity regressions is a zone. We geocoded all housing unit sales on a Beijing GIS map. From the GIS map (Figure One) we can see 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 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 under-developed 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 find a clear reverse-U shape relationship:

[10] Data source: Beijing Statistical Yearbook 2007.

$$Log(Development\ Density) = 2.064 + 0.123*D\_CBD - 0.008*D\_CBD^2$$

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

The R square is relatively low, so there may be other spatial factors affecting the locations of new residential development. This paper studies the determinants of new residential construction by zone by quarter from 2006Q1 to 2008Q4.

The Beijing Residential Development Process

Urban land is owned by the state. In practice, the local (city) land bureau is responsible for the vast majority of 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. Henderson et. al. (2009) provide a detailed background of China's urban land market and the institutional arrangements of auction sales of leasehold rights. They find evidences showing that corruption may exist in land auction process. Corruption is not the focus of our paper, but we test if our data supports Henderson et. al. 's argument.

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. We have a third geo-coded micro data set of recent residential land auctions to recover the hedonic cost per unit of land throughout the city. Our land data set includes 86 land parcels which were auctioned during 2005-2008. Figure Two shows the distribution of these land parcels in 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 2 years. But this "2-years rule" is sometimes violated by developers without effective penalty. They can start to pre-sale 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).

Distinguishing Private Developers from State Owned Enterprise Developers

The new residential towers are produced by SOEs and private developers in Chinese cities. There are 577 private developers in our sample. The top ten biggest ones produce 17% of the total units built by private developers. We investigate whether SOE (State owned enterprise) developers and private developers respond to such public investment signals equally.

In the commodity housing development sector, SOE developers and private developers compete with each other. In our sample, there are altogether 833 real estate developers, 30.7% of which are SOE developers. 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. So they produce similar products. The two developer groups also compete in land auctions, and they face the same explicit labor costs and building material costs (for institutional background on land auction, see the next section). However, SOE developers may be implicitly subsidized since they face less uncertainty in forecasting future public infrastructure investment planning. They may also face smaller bureaucratic and regulation costs, as well as financing costs if they can get cheaper loans from SOE banks.[11]

The Empirical Framework and Results

We have a three-fold empirical strategy. First, we use hedonic techniques to examine whether local infrastructure improvements are capitalized in residential property price and land leasehold price (land price thereafter). At this step our unit of analysis is a residential property

[11] SOEs have some privileges to resources and finance. The existing four largest banks in China are all state-owned. They are willing to lend their money to SOEs in various industries, including real estate development, because the banks think the risks are low -- those SOEs are too big to fail (Deng et. al., 2010). SOE developers also have close connections with the central or local governments (depending on it is a central SOE or a local SOE). They may be able to obtain internal information on public investment plans for infrastructure or urban planning details. They may also escape from being punished when violating the real estate development rules set by the government. For instance, they may be able to hold their vacant land in hand for longer than 2 years which violates the “2-years rule”, or increase the FAR limitation for a particular land parcel.

project by quarter or an auctioned land parcel. Second, we estimate count level regression models to study the spatial distribution of new housing supply. 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.[12] Third, we use restaurant data to estimate count regressions. In a similar spirit as Waldfogel (2008), we test whether restaurant counts increase in the vicinity of the new Olympic Village and new subways. To preview our results, we find that the new government infrastructure is capitalized into sales prices. The count of new housing and new restaurants increases in a vicinity around the new Olympic Village and new subways.

Home Price and Land Price Hedonics

We estimate two sets of hedonic regressions. One set is home price hedonics and the other is land price hedonics. We are especially interested in the capitalization effects of the new infrastructure projects; namely the Olympic Park and the new subways (see Table A3 in the Appendix for the event dates of the Olympic Park and new subway lines).

**** Insert Table Two about here ****

The home price regressions are presented in Table Two. 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 effects of existing public goods such as schools and local green parks. In Column (1), we find a significant negative price gradient with respective to the distance from CBD, and the size of this negative gradient (-0.019) is the same with that in our earlier study (see Zheng and Kahn, 2008). In Column (2) we include the residential project's distance to the closest old subway stop. There are two old subway lines built prior to 2000 in

[12] We assume that each developer viewing himself as "small" takes these hedonic gradients as given and chooses where and how much to construct.

Beijing, and 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 old subway stop, the CBD gradient variable becomes insignificant. These two distance measures are highly correlated.

In Column (3) we include the residential project'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 four new subway lines had already been started before our study period, so *D_NEWSUB_S* is a static variable. *D_NEWSUB_C* is a dynamic variable—during our study period, when the construction of a new subway line was completed, this variable changes thereafter[13]. Through this way, we are able to test whether prices adjust before the infrastructure is put into use[14]. 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%. This means that the capitalization effect takes place immediately after the news of new subway line construction is started. Since the construction of the 2008 Olympic Park took a relatively long time period, we interact the log of this distance variable with a linear time trend variable to capture the gradually increasing effect. This interaction term is also significantly negative, showing that home prices near the Olympic Park have been growing. In Column (3) we substitute the subway start variable (*D_NEWSUB_S*) with the completion variable (*D_NEWSUB_C*). The completion effect becomes smaller.

We recognize that we are attributing all of the post-treatment variation to the construction of the Olympic Park and the new subways. To substantiate our claim, we construct a few control groups.[15] The Beijing municipal government has put forward a series of subway construction strategy plans. According to these plans, 20 new lines will be built during 2000 to 2020 and the total mileage will reach over 1,000 kilometers. In those strategy plans the exact locations and

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[13] 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.

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

[15] 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.

construction dates of the proposed new subway lines are ambiguous. Till 2008, the four lines we study had been constructed, and the locations of the other 2 lines had been announced (Line 6 and Line 7), but the exact construction time of the latter 2 lines is uncertain. Therefore the 2 un-built subway lines provide us a control group. We create a new distance variable ($D\_UNBUILT\_SUB_h$) measuring each residential project'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 the subway line locations are announced, it is still uncertain concerning when the lines will be built.

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.

**** Insert Table Three about here ****

There are two auction types in China's urban land auction market—listing ("two stage auction") and bidding (regular English auction).[16] In the land price hedonic regressions reported in Table Three, the unit of analysis is a land parcel sale. Since the sample size is small, we are unable to include zone fixed effects. We include the fixed effects of the land parcel's physical condition when it is auctioned (the connections to basic public infrastructure facilities, such as water, road, electricity, etc. There is a ranking of four levels, so three dummies are included). In Column (1) and (2), we find that the price gradient's distance to CBD elasticity is much steeper

[16] Cai et. al. (2009) argue that in theory the latter type 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.

than what we estimated in the housing price hedonic. Proximity to old subway stops is capitalized into land prices. In Column (3) we include the two new infrastructure improvement variables. The Olympic Park variable is marginally significant but the new subway (start) variable is insignificant. Recognizing that we do not know when market prices reflect information, in column (4) we change the definition of the "new subway" indicator from the start measure to the completion measure. This variable's coefficient is significantly negative. Land price decreases by 1.4% when its distance to the closest subway stop increases by 10%. It seems that land prices respond to public amenity investments more slowly than home prices. In Column (5) we also include the control variable ($D\_UNBUILT\_SUB_l$) and it is insignificant. The construction of new subway lines does trigger the appreciations of land prices and home prices nearby. In all of these regressions we control for SOE and auction type. SOE buy land leaseholds at slightly (but not significantly) higher prices.

Gentrification Evidence Based on 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.

Tables Four and Five reports the results of the quantity regression by zone/quarter. Table Four reports the results using OLS while Table Five reports the results using a negative binomial count model. We control for quarter fixed effects, and standard errors are clustered by zone. We include the distance to CBD (D_CBD_z) and its interaction with linear time trend to test the suburbanization effect. In Column (1) and (2) all residential property units are counted. Column (3) and (4) only count the projects developed by SOE developers; while Column (5) and (6) count that 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 of new infrastructure improvements ($\log(D\_OLYPMIC_z)*TIME\_Q$, $\log(D\_NEWSUB\_S_z)$) are both 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. So the construction activity response may lag the price response to new infrastructure improvements. The above evidence supports the claim that the public infrastructure is triggering a gentrification process as more new commodity housing construction emerges near the Olympic Park and along the four new subway lines. 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 4.3%. Little new residential construction takes place near old subway stops, and the significantly negative interaction term of D_CBD_z*TIME shows that as time goes on, more and more new housing units are built further away from the city center.[17] This may be due to the fact that land is much scarcer and redevelopment cost is high around the city center and the old subway stops. The control group variable's coefficient (log($D\_UNBUILT\_SUB_z$)) is also statistically insignificant.

We divide the sales to SOE-developed ones and non-SOE-developed ones and run separate quantity regressions. SOE developers respond to public infrastructure investments more sensitively. The coefficient of the Olympic Park distance variable is larger for SOEs than that for non-SOEs. The coefficient of new subway distance variable (completion) is significant for SOEs but not for non-SOEs. SOEs have an advantage of obtaining the internal information of the exact locations of new infrastructure investments ahead of time due to their close relationships with government bureaus, so they are able to respond to such new infrastructure investment projects faster than their counterparts in the private sector.[18]

**** Insert Table Four about here ****

**** Insert Table Five about here ****

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[17] We interact the distance from CBD variable with quadrant dummies to allow the distance gradient to vary within Beijing.

[18] SOEs are likely to have an information advantage in deciding where they invest because of their "insider" relationship with government bureaus. In theory the construction plan of such huge infrastructure projects (timetable and exact sites) should be clearly listed in the master plan which should be released to the public. So it should be a public knowledge. However, in this fast-growing economy, the urban development and redevelopment activities are rapidly and intensively booming. The city government and its urban planners are unable to make a long-term and clear infrastructure investment plan. It is possible that in some cases, SOE developers are able to have better information or obtain the internal information earlier than private developers because the former group may have closer connections with the local government.

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 to rise over time in the "treated" areas. Similar to Glaeser et. al.'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 5 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). These chains account for 42.8% of all restaurant chains operating in Beijing. We used the most famous food guide and review website www.dianping.com to collect the location and opening date information for all the 902 establishments of these 33 chains. We geocoded the locations and mapped them. Figure Three displays the data. The market for chain restaurants in Beijing has been growing quickly. 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.

Tables Six and Seven reports the results of the restaurant quantity regressions by zone/quarter. Table Six reports the results using OLS while Table Seven reports the results using a negative binomial count model. Chain restaurant openings follow the same spatial patterns as that of 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 (completion) increases by 10%, the annual number of chain restaurant openings in the zone drops by 2.0%. In Column (2) this effect is even larger (2.4%) when we substitute the subway completion variable with construction start variable, which supports our gentrification hypothesis. We also find that new chain restaurants are opening near existing subway stops. In Column (3) we include additional control variables and they are statistically insignificant. The interaction term of *D_CBD*TIME* shows that chain restaurants are also suburbanizing.

**** Insert Table Six about here ****

**** Insert Table Seven about here ****

Conclusion

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. This paper 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. All three of these pieces of evidence support the claim that government investment and private sector investment are complements that work together to gentrify previously under-developed areas.

But, gentrification is not a "free lunch". 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. 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. But only the poor households with Beijing local *hukou* permits are eligible to live in such subsidized public housing.

We do not know if our results will generalize to smaller Chinese cities. Some mayors of small cities in China have ambitions to build major infrastructure projects such as huge town squares. The causal effects of such investments are unclear. Will such investments slow out-migration or accelerate in migration?

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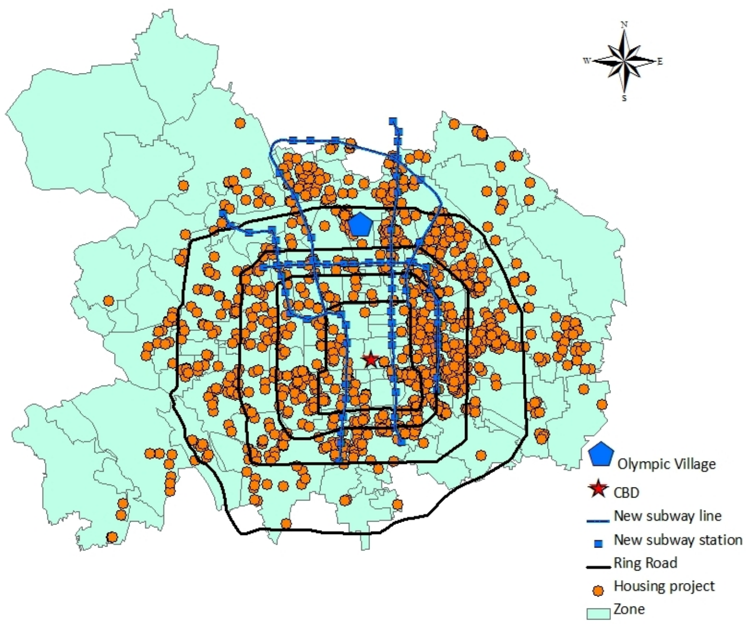

Figure One: New Residential Units (2006-2008) and New Infrastructure Improvements

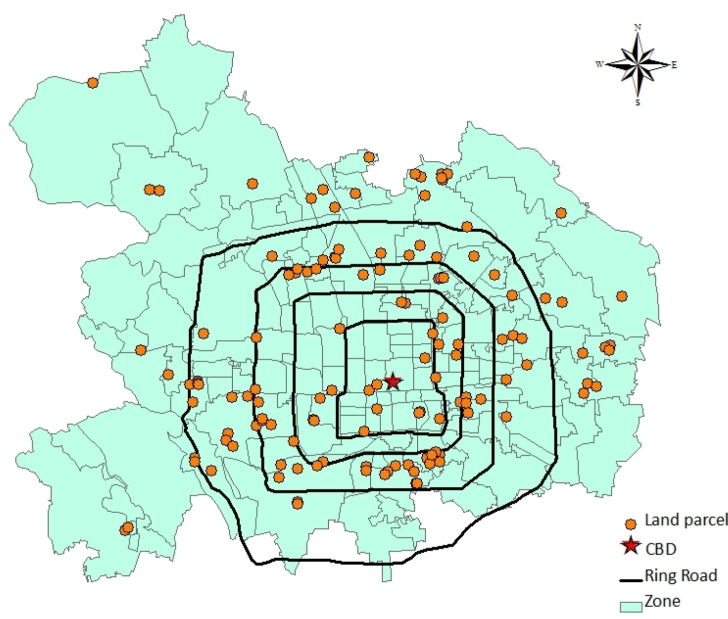

Figure Two Land Auctions in Beijing (2005—2008)

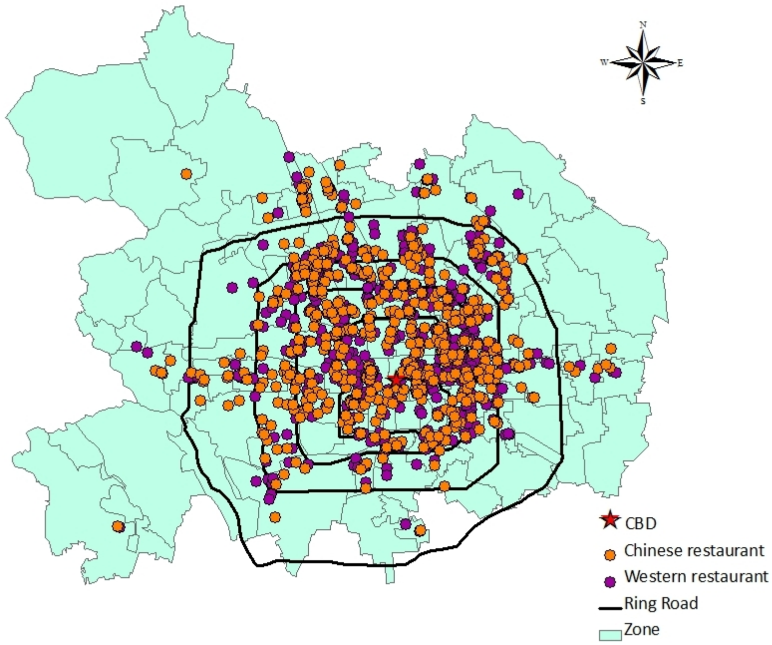

Figure Three: Chain Restaurants in Beijing

Table One: Variable definitions and summary statistics

1. Project/parcel level

Variable	Definition	Period	Obs.	Mean	Std.dev.
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
$D\_POTENTIAL\_SUB_h$	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
$D\_NEWSUB\_C_l$	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 unbuilt 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

Variable	Definition	Period	Obs.	Mean	Std.dev.
LN_UNITS	Log (the number of sale units+1), by zone/year	2006q1-2008q4	1620	3.028	2.369
LN_RESTAURANT	Log (the number of restaurants opened+1) , by zone/year	2006-2010	675	0.551	0.654
LN_AREA	Log zone size, in square km.		135	15.527	1.055
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 unbuilt subway stop, static variable.		135	5.096	4.759
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, 2005-2008, =1,2,3,4.	2005-2008			

Table Two: Hedonic Home Price Regressions

Dependent variable: *LN_HP*

Dependent Variable	*LN_HP*	*LN_HP*	*LN_HP*	*LN_HP*	*LN_HP*
Independent Variable	(1)	(2)	(3)	(4)	(5)
D_CBD_h	-0.0186***	-0.00101	0.00455	0.00104	0.00466
	(-4.25)	(-0.21)	(0.93)	(0.21)	(0.91)
$Log(D\_OLYMPIC_h)*TIME\_Q$			-0.00450**	-0.00440**	-0.00450**
			(-2.27)	(-2.21)	(-2.27)
$Log(D\_NEWSUB\_S_h)$			-0.0657***		-0.0658***
			(-6.59)		(-6.58)
$Log(D\_NEWSUB\_C_h)$				-0.0222**	
				(-2.42)	
$Log(D\_OLDSUB_h)$		-0.131***	-0.126***	-0.130***	-0.126***
		(-8.58)	(-8.22)	(-8.47)	(-8.22)
$Log(D\_UNBUILT\_SUB_h)$					-0.000754
					(-0.07)
SOE_h	-0.00991	-0.0108	-0.00502	-0.00970	-0.00500
	(-0.98)	(-1.07)	(-0.50)	(-0.96)	(-0.50)
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	0.492	0.495

Table Three: Hedonic Land Price Regressions

Dependent variable: *LN_LP*

	(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)
$Log(D\_OLYMPIC_l)*TIME\_Y$			-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

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table Four

New Commodity Housing Units Quantity Regressions

Dependent variable: *LN_UNITS* by zone/quarter, standard errors clustered by zone

	ALL		SOE		NON-SOE	
	(1)	(2)	(3)	(4)	(5)	(6)
LN_AREA	1.182***	1.171***	0.813***	0.822***	1.030***	1.018***
	(5.67)	(5.68)	(3.79)	(3.80)	(5.49)	(5.49)
$Log(D\_OLYMPIC_z)*TIME\_Q$	-0.0123***	-0.0172***	-0.0123***	-0.0166***	-0.0117***	-0.0148***
	(-3.67)	(-4.41)	(-3.92)	(-4.28)	(-3.33)	(-3.68)
$Log(D\_NEWSUB\_S_z)$	-0.348**		-0.142		-0.270	
	(-2.02)		(-0.73)		(-1.38)	
$Log(D\_NEWSUB\_C_z)$		-0.426**		-0.424**		-0.260
		(-2.50)		(-2.40)		(-1.41)
$Log(D\_OLDSUB_z)$	-0.0864	-0.0171	0.184	0.191	-0.123	-0.0634
	(-0.41)	(-0.09)	(0.80)	(0.91)	(-0.61)	(-0.34)
$Log(D\_UNBUILT\_SUB_z)$	-0.0848	-0.115	-0.105	-0.153	-0.110	-0.124
	(-0.37)	(-0.51)	(-0.46)	(-0.69)	(-0.53)	(-0.60)
D_CBD_z	-0.0195	-0.0687	-0.0317	-0.0411	-0.0243	-0.0654
	(-0.22)	(-0.83)	(-0.34)	(-0.51)	(-0.28)	(-0.89)
D_CBD_z*Q2	-0.0874	-0.0619	-0.0763	-0.0616	-0.0648	-0.0462
	(-1.52)	(-1.09)	(-1.33)	(-1.13)	(-1.27)	(-0.94)
D_CBD_z*Q3	-0.00648	0.0275	-0.0483	-0.0155	0.000189	0.0213
	(-0.11)	(0.46)	(-0.83)	(-0.26)	(0.00)	(0.40)
D_CBD_z*Q4	-0.0392	-0.0335	-0.0685	-0.0568	-0.0449	-0.0430
	(-0.63)	(-0.54)	(-1.05)	(-0.92)	(-0.68)	(-0.65)
$D\_CBD_z*TIME\_Q$	0.00300	0.00503**	0.00324	0.00501**	0.00268	0.00399
	(1.35)	(2.19)	(1.65)	(2.30)	(1.10)	(1.56)
Constant	-10.08***	-8.891**	-8.886**	-6.232	-8.595**	-8.282**
	(-2.88)	(-2.46)	(-2.33)	(-1.60)	(-2.50)	(-2.38)
Quarter fixed effects	Yes	Yes		Yes		Yes
Observations	1620	1620	1620	1620	1620	1620
R^2	0.262	0.268	0.177	0.194	0.210	0.210
Joint F-test for D_CBD, D_CBD_Q2, D_CBD_Q3, D_CBD_Q4		5.42***		3.23**		4.01***

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table Five: New Commodity Housing Projects Regressions

Dependent variable: SALE_UNITS by zone/quarter, standard errors clustered by zone

	ALL		SOE		NON-SOE	
	(1)	(2)	(3)	(4)	(5)	(6)
LN_AREA	1.013***	0.993***	0.861***	0.865***	1.420***	1.347***
	(5.26)	(5.68)	(4.03)	(4.17)	(7.31)	(7.33)
$Log(D\_OLYMPIC_z)*TIME\_Q$	-0.0154***	-0.0186***	-0.0109*	-0.0136*	-0.0188***	-0.0232***
	(-3.57)	(-3.60)	(-1.75)	(-1.90)	(-6.39)	(-6.85)
$Log(D\_NEWSUB\_S_z)$	-0.276**		-0.194		-0.389**	
	(-2.14)		(-1.31)		(-2.54)	
$Log(D\_NEWSUB\_C_z)$		-0.350***		-0.407***		-0.302**
		(-2.89)		(-2.64)		(-2.34)
$Log(D\_OLDSUB_z)$	-0.00866	0.0234	0.0144	-0.0176	0.0837	0.171
	(-0.05)	(0.16)	(0.06)	(-0.08)	(0.54)	(1.16)
$Log(D\_POTENTIAL\_SUB_z)$	-0.0994	-0.128	0.0799	0.0598	-0.288	-0.268
	(-0.72)	(-0.95)	(0.39)	(0.29)	(-1.42)	(-1.39)
D_CBD_z	-0.0319	-0.0743	0.00433	-0.0188	-0.0927	-0.168***
	(-0.59)	(-1.44)	(0.06)	(-0.28)	(-1.34)	(-2.68)
D_CBD_z*Q2	-0.0622**	-0.0417	-0.0994**	-0.0852**	-0.0142	0.0138
	(-2.11)	(-1.44)	(-2.50)	(-2.22)	(-0.41)	(0.42)
D_CBD_z*Q3	0.0169	0.0466	0.00307	0.0336	0.0172	0.0497
	(0.49)	(1.24)	(0.06)	(0.61)	(0.48)	(1.38)
D_CBD_z*Q4	-0.0402	-0.0347	-0.0776	-0.0672	-0.0248	-0.00988
	(-1.17)	(-1.08)	(-1.43)	(-1.23)	(-0.51)	(-0.22)
$D\_CBD_z*TIME\_Q$	0.00509*	0.00651**	0.00329	0.00440	0.00526**	0.00761***
	(1.83)	(2.06)	(0.78)	(0.93)	(2.23)	(3.11)
Constant	-6.973***	-5.558**	-7.908***	-5.534*	-11.83***	-11.34***
	(-2.65)	(-2.13)	(-2.62)	(-1.86)	(-4.00)	(-3.66)
Quarter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1620	1620	1620	1620	1620	1620

z statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The estimates report negative binomial regressions.

Table Six: Chain Restaurant Openings Regressions

Dependent variable: *LN_RESTAURANT*, by zone/quarter, standard errors clustered by zone.

	(1)	(2)	(3)
	LN_RESTAURANT	*LN_RESTAURANT*	*LN_RESTAURANT*
LN_AREA	0.202^{***}	0.203^{***}	0.204^{***}
	(5.42)	(5.54)	(5.64)
$Log(D\_OLYMPIC_z)*TIME\_Y$	-0.00703^{***}	-0.0182^{***}	-0.0185^{***}
	(-2.90)	(-6.21)	(-6.26)
$Log(D\_NEWSUB\_S_z)$	-0.202^{***}		
	(-5.47)		
$Log(D\_NEWSUB\_C_z)$		-0.244^{***}	-0.254^{***}
		(-7.86)	(-7.95)
$Log(D\_OLDSUB_z)$	-0.176^{***}	-0.160^{***}	-0.185^{***}
	(-4.00)	(-3.70)	(-4.07)
$Log(D\_UNBUILT\_SUB_z)$			0.0572
			(1.38)
D_CBD_z	-0.0228^{*}	-0.0468^{***}	-0.0460^{***}
	(-1.91)	(-4.37)	(-4.33)
D_CBD_z*Q2	-0.00474	0.00151	-0.00123
	(-0.61)	(0.21)	(-0.16)
D_CBD_z*Q3	-0.00169	0.00996	0.00637
	(-0.19)	(1.20)	(0.71)
D_CBD_z*Q4	-0.0195^{**}	-0.0154^{*}	-0.0178^{**}
	(-2.26)	(-1.79)	(-2.04)
$D\_CBD_z* TIME\_Y$	0.00418^{***}	0.00876^{***}	0.00888^{***}
	(2.75)	(5.10)	(5.13)
Constant	0.695	1.323^{**}	1.129^{*}
	(1.14)	(2.18)	(1.79)
Observations	675	675	675
R^2	0.236	0.273	0.276
Joint F-test for D_CBD, D_CBD_Q2, D_CBD_Q3, D_CBD_Q4		11.27^{***}	11.63^{***}

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table Seven:

Chain Restaurant Opening Regressions

Dependent variable: RESTAURANT, by zone/quarter, standard errors clustered by zone.

	(1)	(2)	(3)
	LN_RESTAURANT	*LN_RESTAURANT*	*LN_RESTAURANT*
LN_AREA	0.614***	0.637***	0.638***
	(4.91)	(5.50)	(5.61)
$Log(D\_OLYMPIC_z)*TIME\_Y$	-0.0182***	-0.0479***	-0.0478***
	(-3.61)	(-6.81)	(-6.85)
$Log(D\_NEWSUB\_S_z)$	-0.487***		
	(-6.35)		
$Log(D\_NEWSUB\_C_z)$		-0.621***	-0.633***
		(-7.81)	(-7.84)
$Log(D\_OLDSUB_z)$	-0.252**	-0.215**	-0.266***
	(-2.53)	(-2.20)	(-2.62)
$Log(D\_POTENTIAL\_SUB_z)$			0.107
			(1.18)
D_CBD_z	-0.111***	-0.176***	-0.174***
	(-3.54)	(-5.69)	(-5.66)
D_CBD_z*Q2	-0.0105	0.00619	0.00261
	(-0.52)	(0.31)	(0.13)
D_CBD_z*Q3	-0.0120	0.0280	0.0208
	(-0.44)	(1.04)	(0.74)
D_CBD_z*Q4	-0.0678**	-0.0578**	-0.0621**
	(-2.46)	(-2.12)	(-2.26)
$D\_CBD_z* TIME\_Y$	0.0124***	0.0243***	0.0239***
	(2.94)	(4.52)	(4.48)
Constant	-2.518	-1.005	-1.393
	(-1.40)	(-0.59)	(-0.81)
Observations	675	675	675

z statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table reports negative binomial regressions.

Appendix

Table A1 List of Chain Restaurants

Western	Chinese	
McDonald	Yang Fang hotpot	Dong Lai Shun
KFC	Tian Wai Tian	Lu Lu restaurant
ORIGUS Pizza	Lao Cheng Yi Guo	Chun Xia Qiu Dong hotpot
Pizza Hut	Qingnian restaurant	Quanjude toast 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	Yonghe Dawang	Wan Long Zhou seafood
TOKUGAWA	Hong Zhuang Yuan	Xiang Lin Tian Xia
Yama Teppanyaki tricks	Xiabu Xiabu	Hei Song Bai Lu
Wang Steak	Xiao Fei Yang	Pingrang Haitanghua

Table A2 The Number of Chain Restaurant Openings by Year

Open date	Chinese-Cuisine Chains (22 chains)	Western-Cuisine Chains (11 chains)	Total
before2006 (“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

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