Land Value Determination in an Emerging Market:

Empirical Evidence from China

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Abstract

A key asset that is important in international markets is real estate—raw land and developed properties. Also, real estate can clearly have difference local rules for investment and transactions based upon bankruptcy protection, appraisal standards, lending standards, taxation and planning processes across countries. This can be particularly true when assessing a developing country. In this research, we assess the relative pricing behavior for land in Beijing China. We see this as important for three core reasons. First, China has a strong growth economy but is still in many ways an undeveloped country and thus we do not have significant data about asset pricing behavior there. Second, China has not traditionally had a market based land and property transfer system. Thus, it is interesting to assess how prices are determined relative to typical market expectations. Third, we have extensive evidence on pricing behavior in the USA and Europe but little such evidence on China. Are the same variables important in Land pricing in China and are there other unique local variables. For example, there have been twenty-two articles published in core journals on Chinese land and only two provide empirical estimates of value attributes and none of there are as extensive as our study. Thus, we consider a large data set of land prices in Beijing China and assess the relative pricing behavior.

Our key results are that pricing behavior in general follows the traditional expected variables as determined by size, planning use, location and other neighborhood characteristics. However, we also find that land prices are associated with buyer characteristics; for example, foreign investors pay less than local investors.

Keywords: semi-parametric, kernel, nonparametric, hedonic price modeling

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1. Introduction

Real estate is an important local and international asset estimated to be about 55 percent of world assets not including human capital. Real estate has also been an important part of China's growth and has posed interesting challenges in that China until recently recognized no public market for real estate or related assets (e.g., development rights). An important part of real estate markets is the differing set of local rules for investment and transactions based upon bankruptcy protection, appraisal standards, lending standards, taxation and planning processes across countries. This can be particularly true when assessing a developing country such as China. In this research, we assess the relative pricing behavior for land in Beijing China. We believe that this is important for three core reasons. First, China has a strong growth economy but is still in many ways an undeveloped country and thus we do not have significant data about asset pricing behavior there. Second, China has not traditional had a market based land and property transfer system—thus, it is interesting to assess how prices are determined relative to typical market expectations. Third, we have extensive evidence on pricing behavior in the USA and Europe but little such evidence on China—are the same variables important in land pricing in China and are there other unique local variables[1]. There is also a scarcity of evidence from China. For example of the 22 key articles published on land in the last five years, only two article shave provided empirical estimates[2]. And those two articles are not as extensive in their data or analysis as this research. Thus, we consider a large data set of land prices in Beijing China and assess the relative pricing behavior.

Our key result is that pricing behavior in general follows the traditional expected variables as determined by size, planning use, location and other neighborhood characteristics. We also find that land prices are associated with buyer characteristics; for example, foreign investors pay less than local investors[3].

The paper is organized as follows. In section 2 the literature of land value determination is reviewed. Section 3 outlines the hypotheses to be tested and the

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[1] For example, although foreign direct investment is encouraged in China, it is highly regulated in real estate development area. On 6 March 2007, the Ministry of Commerce of the PRC issued some instructions on attracting foreign investment in 2007. It is clearly stated that real estate is one of the sectors where foreign investment is strictly restricted. (Source: http://www.mofcom.gov .cn/aarticle/b/f/ 200703/20070304485330.html).

[2] See Table 5 for details.

[3] We caution readers to be aware that this may be that the SOEs have bought a different bundle of goods than local investors that may not be captured by our explanatory variables. Later in the text we, argue that this is most likely true.

research design, as well as details of the data and empirical models used in our analysis. The empirical results are presented in session 4. Section 5 provides an overall discussion and Section 6 provides the conclusion.

2. Literature and Expectations

2.1 Background and Setting

China has gradually introduced market economy aspects into its once heavily centralized planning system and these reforms have effectively, along with strong economic growth, fueled strong urban expansion in China (Anderson and Ge, 2004). The central government first experimented with land right distribution to private users in 1987 in the costal city of Shenzhen[4]. Then, land values, or the premium payable to the government, were determined by private treaty between the government and potential buyers. Without a land market in place, the agreed price was unlikely to reflect the market value of the land[5]. The central government soon thereafter introduced additional means of land distribution – closed bidding (tender) and public auctions.

The central government recently pushed the sale of land use rights through tenders and auctions across major cities in China. The percentage of land right sales by private treaty drops steadily over years[6]. This more market-oriented land distribution system proved to be a double-edged sword: competition among potential buyers increased land (and house) prices.

There are extensive recent studies on China's land market (Ding, 2013, Ding and Lichtenberg, 2011, Khantachavana et al., 2013, Lin and Ho, 2003, Wu et al., 2014). The establishment of the land and housing markets in China has traditionally been a sensitive political matter because the ownership of the land by the people has been one of the key symbols of the communist system. However, land has been recognized by China's leaders as an important resource of economic activities. To accommodate the need for both economic development and political stability, the country adopted the

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[4] Shenzhen remains an important city for China's real estate market. JonesLangLaSalle in their recent report on China 30 use Shenzhen as the comparison city to measure the top 30 second tier cities. Even through JLL (2007) stress the growth opportunities of the second tier cities, Shenzhen tops them in terms of property index and economic index values (see city evaluation table, page 3).

[5] This argument is supported by the recent work of Choy and Chau (2007) where they argue that SOEs generally have been and continue to be given discounts on their land purchases. Their work was on Shenzhen, but we believe this is applicable to other Chinese cities as well.

[6] In 2000 the percentage of land right sales by private treaty in China is 83.83%. This figure dropped to 63.34% in 2003 (China Land Resource Year Book 2001 & 2004).

leasehold property right system[7]. More specifically, because the country owns all land in China, the land use rights are granted to land users for fixed periods of time, determined by the planning uses of the land parcels. Land users pay a lump sum premium to secure land leases from the government. An additional annual nominal land use tax is also imposed. In many cases this is to cover real maintenance and depletion costs associated with the property[8]. A secondary land market also developed to facilitate the exchange of land use right among lessees, which is essentially the transaction of land leases[9].

The significant economic growth in China's economy has also meant increased property values. These property value increases have attracted the attention of foreign as well as domestic investors. However a key concern is to what extent the values of property are market set? China's long history of planning, ownership and control of land raises concerns by investors and researchers about the stability of property market. Our conjecture is that the land market in China has not reached a mature market-oriented stage[10].

In a market-oriented land distribution method, land values are determined by common factors such as those suggested by traditional urban economics theory and supported broadly by empirical findings. However, the deep roots of the planning system and the nature of the communist system inevitably make uncertain the land value determination process in China. Hence land values may also be determined by non-market factors as well as traditional market and institution forces. In this research, we conduct an econometric analysis of the land value determination mechanism in China using data from Beijing.

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[7] After China is established in 1949, land transaction had been illegal. The Constitution is amended in 1988 to legalize the transfer of land-uses right. This marks the starting point of the land market in China.

[8] According to the 1988 Urban Land Use Tax Provisional Regulations the land use tax is 0.5RMB – 1RMB (1USD ≅ 8RMB) per square metre per annum in major cities.

[9] On 30 May 2001 the Ministry of Land and Resources P.R.C. released a guideline of regulating the China land market (http://www.mlr.gov.cn/pub/gtzyb/zcfg/tdglflfg/t20050406_66732.htm). It stressed that the transfer of land uses right should be conducted in open market. As a result, major cities in China started to establish land and property transaction centers to facilitate the transaction of land use rights. For example, the Beijing Land Transaction Centre is established on 28 Feb 2002 by the Beijing Land Resource Development and Reclamation Centre (http://www.bjtd.com/) to facilitate land uses right transactions.

[10] This is consistent with Choy and Chau's arguments (2007). They also argue that as markets are developed and there is less uncertainty as to land use (e.g., when major parts of cities have the development activity in place) they will be more market-based activities as opposed to government elated placements of land rights.

2.2 The Determinants of Land Value

Parcel size is traditionally recognized as an important determinant of land values. The parcel size gradient is essentially an indicator of the land subdivision and land assembly effects. A convex structure, or a plottage effect, suggests there is a gain of land assembly. On the other hand, if land subdivisions cause land value per unit to decrease with parcel size, then a concave relationship, or a plattage effect, present itself. The prevailing view in the literature is in favour of a concave function form between parcel size and land value (Colwell and Munneke, 1999, Thorsnes and McMillen, 1998).

There are also evidences suggesting a plottage effect of parcel size for small land parcels with relatively homogeneous characteristics (Lin and Evans, 2000, Tabuchi, 1996). The study by Colwell and Munneke (1999) provided an explanation of this puzzle by relating parcel size effect with location (e.g., distance to Central Business Districts). They found that land price per unit is negatively related to parcel size in most urban area except for the urban center where a positive relationship is observed. Considering that Lin and Evans (2000) and Tabuchi (1996) used data from highly urbanized cities in Taiwan and Japan, it is not surprising that a convex structure was identified in their studies.

Location is a second traditional determent of value and generally serves as a proxy of the social and economic characteristics of the neighborhood of the land parcel. Early studies on land value determination usually consider the distance to the Central Business District as the single important factor (Kau and Sirmans, 1979, Mcdonald and Bowman, 1979, Mcmillen, 1990). Box-Cox transformation (see, for example, Kau and Sirmans, 1979; McMillen, 1990) and polynomial regression (McDonald and. Bowman, 1979) are routinely utilized to detangle the relationship between the distance and land value. The empirical literature suggests that land values decrease consistently with the distance from the city center. Other measurement of location vary such as distance to airports (Colwell and Munneke, 1999, McMillen, 1996), distance to the nearest train station (Cervero and Duncan, 2004, Tabuchi, 1996), and distance from the region boundary (Kowalski and Paraskevopoulos, 1990). District dummy variables have also been used (Cervero and Duncan, 2004), to name a few. Consistently, land value is significantly influenced by location.

The use of location in land value functions is essentially an attempt to capture the social and economic environment of the land. Although measurement such as distance to CBD is a good proxy of these factors, it is always preferable to quantify these factors directly in the model. Some recent studies, benefiting from the increasing availability of information, consider a wide range of social-demographic attributes (Cervero and Duncan, 2004, Ihlanfeldt, 2007) and economic characteristics (McMillen and McDonald, 2002, Thorsnes, 2000) in the effort of modeling land value. These factors are found to be helpful in explaining the land value determination mechanism in different jurisdictions.

The zoning regulation and planning restrictions are also determining factors of land value. Empirical evidences suggest that land use types (e.g., mixed use or single family residential uses) can claim a price premium in land (Brownstone and Devany, 1991, Cervero and Duncan, 2004). Also it has been shown that density controls reduce the price of industrial land (Peiser, 1987) and that government regulation of rent also influence the estimation of land value function (Pasha, 1995).

In China land is owned by the government. There was no land market until late 1980s, when the central government initiated a pilot run of opening land market in Shenzhen, the southern frontier of China's open market policy. At the early stage land was distributed through private treaties between the government and buyers. Land values determined in these private treaties usually did not reflect its market value due to various political, social and economical considerations, and especially because the lack of knowledge of land value determination resulted by the planning system.

Given the high population density and unbalanced economic development in China, the land market is inevitably characterized by high density usage. High-raise apartment buildings dominate the residential property market. Even international retail giant Wal-Marts has settled for a three-storage building for its largest outlet in Asia instead of using its typical one storage layout. Without any government interventions, developers may trade living quality with profit maximization by building the maximum possible floor area on a given piece of land. To ensure a desirable living condition, the government has imposed density control in all land leases. The density control is usually specified in the form of plot ratios, which is essentially the ratio between floor area and parcel size. A larger plot ratio enables the developers to build more floor space, holding other elements constant.

Unlike in other freehold property right systems, the planning purpose or the usage of the land parcels is determined prior to the land transaction taking place. When municipal government has land parcels to be distributed by public auctions or tenders, information about these land parcels are released to the public. The published information includes the designated usage of the land (commercial, residential, industrial, or mixed), plot ratio, and other planning regulations. The change of any of these planning regulations such as switching an industrial land to residential land is subject to approval. Moreover, all land leases specify a maximum period before the developers start construction activities (usually 180 days). This does not allow much luxury of time for the developers to change land usage. Therefore the public auction and tender price reflect the price of a land parcel with a very specific usage.

Although China has been opened its door to the world for more than 20 years, the historic planning economy system is still deeply rooted in the country. The dominating role of state-owned companies in the national economy is one important example. It is still the fact that state-owned companies have the best access to financing. This is particularly important for land investment given the significant value involved in a typical transaction. Private owned companies typically cannot compete directly with

their state-owned counterparts. It is reasonable to expect that in public land auction state-owned companies have a better chance to win the auction because of their relatively larger size and easier access to capital.

To attract foreign investment to fuel the economic development in China, both central and municipal government have been setting up favorable policies to encourage direct investment such as setting up factories[11]. Besides conventional measures such as tax break and tax holidays, a discount on land price is also commonly used for this purpose. The ability of attracting foreign direct investment is also considered to be an important indicator that helps in getting promoted. Consequently, land parcels, and especially those for industrial usages, are leased to foreign invested companies with favorable price and/or lease terms.

3. Hypotheses and Models

3.1 Expectations

To summarize the discussion above, a market oriented land valuation system is still emerging in China and thus land value should be influenced by not only the 'usual suspects' such as size and location and regulations, but also by 'Chinese Characteristics' such as buyer traits. To test this argument, the following hypotheses are set up.

Hypothesis [1]: Land value is determined by traditional characteristics: parcel size, location, planning usage and neighborhood characteristics

Hypothesis [2]: Buyer type influences land prices: at least one of the buy characteristic dummies (state owned, privately owned, or foreign invested companies) should be significant

To test the hypotheses, it is important to correctly model the relationship between land value and its determinants. The relationship can be described by model (1) below.

$$Y = g(S) + f(D, N, U, B, T) + \varepsilon \qquad (1)$$

Where Y is a $n \times 1$ vector of land sales price, S denotes the parcel size, D is a $n \times k_1$ matrix of variables measure the location of the land parcel, N is a $n \times k_2$ matrix of neighborhood characteristics such as number of employees in retail sectors, and total land area in each district, U is a $n \times k_3$ matrix of dummy variables indicating the planning usage of the land, B consists of k_4 indicators of buyer characteristics, and

[11] See the review of China's tax incentive system in Chan and Mo (2000).

finally, T is a $n \times k_5$ matrix of time dummies to capture land value movement over time. In Model (1) $f(D,N,U,B,T)$ takes a linear function form, whilst the relationship between land value and parcel size is described by an unknown function $g(.)$. Therefore (1) can be re-written as follows.

$$Y = g(S) + X\beta + \varepsilon \tag{2}$$

where X is a $n \times k$ matrix combining D, N, U, B and T, and $k = \sum_{i=1}^{6} k_i$. Given the functional form of $g(.)$ is unknown, model (2) can be estimated with a two-step semi-parametric procedure suggested in Robinson (1988). A nonparametric estimator is adopted to obtain $E(X \mid S)$ and $E(Y \mid S)$ using X and Y as dependent variables respectively. β and $g(S)$ can be subsequently calculated with (3) and (4).

$$\hat{\beta} = \left[\left(X - E(X \mid S)\right)'\left(X - E(X \mid S)\right)\right]^{-1}\left(X - E(X \mid S)\right)'\left(Y - E(Y \mid S)\right) \tag{3}$$

$$\hat{g}(S) = Y - X\hat{\beta} \tag{4}$$

If both $E(X \mid S)$ and $E(Y \mid S)$ are estimated using ordinary least squares method, (3) will give the OLS coefficient estimates of X and (4) will give the OLS coefficient estimate of S. Alternatively, $E(\cdot \mid S)$ can be estimated using a nonparametric estimator that offers more flexibility in the model building. The following discussion illustrated the procedures to obtain $E(Y \mid S)$ using a kernel estimator. It can be easily extended to multivariate cases such as $E(X \mid S)$.

Each element of $E(Y \mid S)$ is estimated by a weighted average of the value of Y, where the weight is determined by S. More specifically,

$$\hat{y}_i = \frac{\sum_{j=1}^{n} K\left(\frac{s_i - s_j}{a}\right) y_j}{\sum_{j=1}^{n} K\left(\frac{s_i - s_j}{a}\right)} \tag{5}$$

where a is the smoothing parameter and $K\left(\frac{s_i - s_j}{a}\right)$ is the Gaussian kernel

function. The smoothing parameter controls the smoothness of the estimation. If a approaches zero the kernel function tends to interpolate the data, whilst a very large smoothing parameter gives raise to imprecise estimates. To select the optimal smoothing parameter the most commonly used method is minimizing the mean squared errors (MSE) by cross validation (Anglin and Gencay, 1996, Thorsnes and McMillen, 1998).

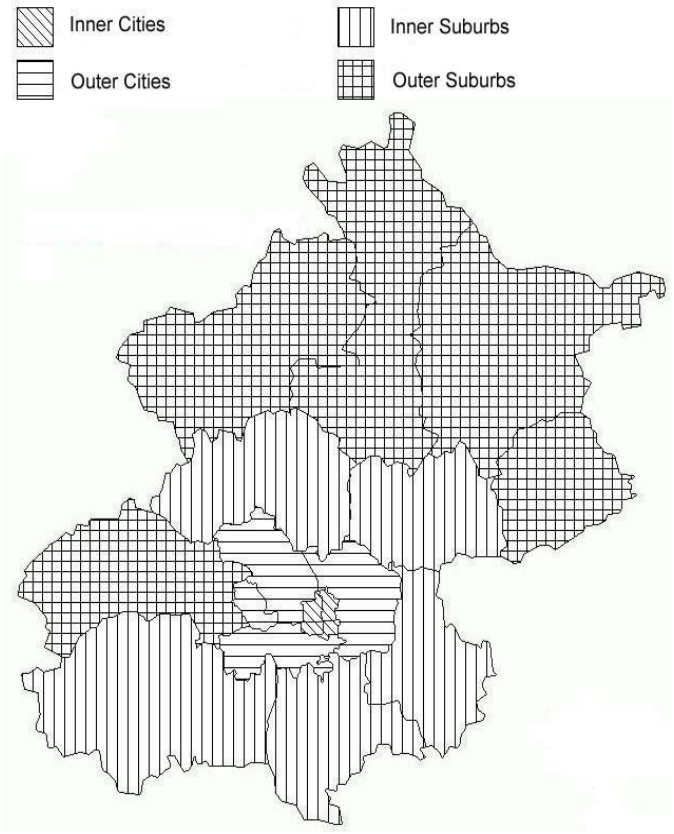
$$MSE = n^{-1}\sum_{i=1}^{n}\left(y_i - \hat{y}_i^*\right)^2$$

where $\hat{y}_i^*$ is calculated using (5) by omitting y_i.

3.2 Data and Empirical Model

Beijing is the political and culture centre of the nation. It has a population of 10.85 millions and covers an area of 16,808 square kilometers. There are 18 municipal districts or counties in Beijing: four "inner city districts" (Dongcheng, Xicheng, Chongwen, and Xuanwu), four "outer city districts" (Haidian, Chaoyang, Fengtai, and Shijingshan), five "inner suburb counties" (Fangshan, Daxing, Tongzhou, Shunyi, Changping), and five "outer suburb counties" (Mentougou, Pinggu, Huairou, Miyun, and Yanqing). Figure 1 depicts the geographic distribution of these functional regions of Beijing. The inner city districts support the core functions of the capital. The central government and most of the foreign embassies are located in these four districts. Outer city districts hosts clusters of rapidly expending research and educational institutions. The eight city districts are the pillar of the economic and culture prosperity of Beijing. Compared with the city districts, the suburb counties have less economic connection with the city core. However, these regions have been growing rapidly by leveraging its rich ecological and tourism resources. The concentration of military units and the development of heavy industry in the western suburb counties also fuel the development of this region (Ding, 2004). The land market in Beijing is not balanced among its functional regions. City districts witnessed a rapid development, but land for the physical expansion in these areas is limited. On the contrary, suburb counties have bountiful land and lower population density; thus, there is ample space for the land market development.

Figure 1 Beijing City and Its Four Functional Regions



The social and economics statistics given in Table 1 reveal the differences among the four functional regions in Beijing. Clearly the suburb regions are less developed, confirmed by their low population density, fewer migrants[12], and less retail sales. The inner cities have the highest population density and the most migrants per kilometers, suggesting its strong standing in the social and economic activities in Beijing. Nevertheless, the development potential of inner cities is limited due to the fact that the regions have already been fully developed. The outer cities benefit from the larger land areas, the concentration of higher education institutions, and easy access to CBD due to the fast expanding public transportation system. These suburb districts have been attracting a steadily growing amount of real estate development.

Table 1 Social and economic statistics by functional regions

	Population (in 10,000)	Area (in km^2)	Retail (in 100,Million RMB)	Migrants (in 10,000)
Inner cities	241.6	92.39	506.6	36.4
Outer cities	957.2	1275.93	1063.9	209.2
Inner suburbs	506	6295.57	264.7	94.4

[12] Migrants are residents that have been living in Beijing for more than six months but without changing their places of household registration to Beijing. It is also referred as 'floating population'. See Zhu (2006) for a discussion on floating population and the household registration (Hukou) system in China.

Outer suburbs	190.5	8746.65	134.9	17.3

Source: China Statistics Yearbook, 2004 – 2005

The data used in this analysis are land sales records in Beijing from January 2005 to September 2006. The data set pools land sale records from the Beijing Municipal Bureau of Land and National Resources, social and economics statistics from the China Statistics Yearbook, buyer characteristics from the Tianjin AoKe QiTong Technology Development Ltd., and geographical information from the Longmap (Beijing) Ltd. A total of 1,151 observations are collected, which accounts for more than 50% of all land transactions in each year (see Table 2).

Table 2 Sample Size by Year and Type

	Non-industrial	Industrial	Total
2005			
Public Transactions	26	0	26
	(48)	(0)	(48)
	[54.17%]	--	[54.17%]
Private treaty	398	163	561
	(434)	(267)	(701)
	[91.71%]	[61.05%]	[80.03%]
Sub-total	424	163	587
	(482)	(267)	(749)
	[87.97%]	[61.05%]	[78.37%]
2006			
Public Transactions	66	0	66
	(86)	(0)	(86)
	[76.74%]	--	[76.74%]
Private treaty	355	143	498
	(665)	(326)	(991)
	[53.38%]	[43.87%]	[50.25%]
Sub-total	421	143	564
	(751)	(326)	(1077)
	[56.06%]	[43.87%]	[52.37%]
Total	845	306	1151

Note: Figures in parentheses are the total number of land transactions in each category, and figures in square brackets are the sample size as a percentage of the total number of land transactions in each category.

Descriptive statistics by transaction type and planning use are given in Table 3. Public transactions (i.e., listings, auctions and tenders combined) accounts for about 8% of the overall transaction volume in the sampling period. In general, land parcels that are transacted publicly are larger, further away from the central business district, and bought by privately owned domestic companies primarily. Also, about one half of the residential land parcels are sold by public transaction, whist all industrial land parcels are

transacted through private treaty. The outer cities and Inner suburbs are the areas where the most transactions incurred, indicating a fast expansion of real estate development into these regions.

As a capital city, Beijing plays an important role in international affairs and serves as a center of politics and culture in China. It still has a prominent economic position but is gradually switching from a production center to a service center. As a result, land for industrial usage is declining, accounting for one-fifth of the developed land. Whilst in other major cities in China, this percentage of industrial land sales is much higher (Ding, 2004). Although China has performed the economic system reform for more than a decade, most of the characteristics of planning economy still exist. State-owned companies remain the pillar of china's economy. According to Table 3, roughly 50% of the buyers are state-owned companies. Foreign invested companies only bought less than 5% of the land parcels sold. The rest of the land parcels are purchased by privately owned domestic companies.

Models are estimated separately for industrial and non-industrial (i.e., residential, commercial, and mixed usages) land transactions because the prices of these two types of land parcels are determined differently. For non-industrial land sales, land sales through private treaty are also modeled separately from public transactions because these transactions do not necessarily follow market rules. In sum, two models, (6) and (7), are specified as given below. Model (6) is estimated using private treaty and public transaction data separately. Model (7) is applied to industrial land sales, which are conducted through private treaty solely. To facilitate comparison, variables included in the two models are identical, expect that USE_RES is omitted from model (7) because it's not relevant in that model.

Non-industrial land transactions (public transactions and private treaty):

$$\begin{aligned} luprice_{nonind} = {} & \beta_0 + g(lsize) + \beta_1 lpratio + \beta_2 ld\_cbd + \beta_3 ld\_train + \beta_4 lcitysub \\ & + \beta_5 dis1 + \beta_6 dis2 + \beta_7 dis3 + \beta_8 larea + \beta_9 lretail \\ & + \beta_{10} lmigrants + \beta_{11} use\_res + \beta_{12} fi \\ & + \beta_{13} private + \beta_{14} quarter1 + \beta_{15} quarter2 + \beta_{16} quarter3 \\ & + \beta_{17} quarter4 + \beta_{18} quarter5 + \beta_{19} quarter6 + \varepsilon \end{aligned} \quad (6)$$

Industrial land transactions (private treaty only)[13]:

$$\begin{aligned} luprice_{ind} = {} & \beta_0 + g(lsize) + \beta_1 lpratio + \beta_2 ld\_cbd + \beta_3 ld\_train + \beta_4 lcitysub \\ & + \beta_5 dis1 + \beta_6 dis2 + \beta_7 dis3 + \beta_8 larea + \beta_9 lretail \\ & + \beta_{10} lmigrants + \beta_{11} fi + \beta_{12} private + \beta_{13} quarter1 + \beta_{14} quarter2 \\ & + \beta_{15} quarter3 + \beta_{16} quarter4 + \beta_{17} quarter5 + \beta_{18} quarter6 + \varepsilon \end{aligned} \quad (7)$$

where $luprice_{nonind}$ is the logarithms sales price per square meter in 10,000 RMB for non-industrial land parcels, and $luprice_{ind}$ is the logarithms sales price per square meter in

[13] In our sample all industrial land transactions are of private treaty type. Therefore only one regression model is estimated for industrial land sales.

10,000 RMB for industrial land parcels, *quarteri* are Quarterly time dummies (i = 1,2,…,6). Other variables are defined in Table 3.

To test hypothesis one, we expect to see significant coefficient estimates for parcel size, plot ratio, planning usages, location variables, and neighborhood characteristics factors. Because unit land prices are used as the dependent variable in this study, a negative relationship between land prices and parcel size is expected. Also, land parcels with larger plot ratio and commercial planning usages should claim a premium. We also predict a negative relationship between land prices and the distance to essential transportation facilities (e.g., subway station for non-industrial land sales, and train station for industrial land sales). The social and economic characteristics of the neighborhood should have impacts on land sales price as well.

To test hypothesis two, the coefficient estimates of variables FI, PRIVATE, should be statistically significant. We suspect that state-owned companies pay more in land transactions because these firms have looser financial constrains and less profit-driven; foreign invested companies are more likely to get favorable sales prices given the municipal pro-foreign-investment policies.

Table 3 Descriptive Statistics by Transaction Types and Planning Usages

	Public Transactions		Private Treaties				Remarks
	Non-industrial		*Non-industrial*		*Industrial*		
	MEAN	STD	MEAN	STD	MEAN	STD	
LUPRICE	6.37	1.07	6.58	0.83	5.3	1.19	Logarithms sales price per square meter in 10,000 RMB (1USD ≈ 8RMB)
LSIZE	10.14	1.28	7.42	2.06	9.37	1.73	Logarithms parcel size in squared meters
LPRATIO	0.65	0.69	0.57	1.01	-0.81	1.32	Logarithms plot ratio
LD_CBD	2.43	1.21	1.72	1.17	2.19	0.85	Logarithms straight-line distance to the CBD in kilometers
LD_TRAIN	2.75	1.12	1.99	1.03	2.71	0.78	Logarithms straight-line distance to the nearest train station in kilometers
LCITYSUB	0.34	0.68	0.39	0.77	0.37	0.69	Logarithms straight-line distance to the nearest subway station in kilometers
DIS1	0.13	0.34	0.22	0.42	0.02	0.15	Inner city districts (Yes=1)
DIS2	0.28	0.45	0.47	0.5	0.27	0.45	Outer city districts (Yes=1)
DIS3	0.33	0.47	0.24	0.43	0.57	0.5	Inner suburb districts (Yes=1)
DIS4	0.26	0.44	0.07	0.26	0.14	0.35	Outer city districts (Yes=1)
LAREA	6.28	1.39	5.68	1.47	6.69	0.94	Logarithms district land area in thousand squared kilometers
LRETAIL	8.27	1.42	9.14	1.01	8.36	0.99	Logarithms district number of employees in retail sectors in 10,000
LMIGRANTS	2.52	1.26	3.23	1.04	2.56	1.12	Logarithms district migrants population in 10,000
USE_RES	0.5	0.5	0.11	0.32	0	0	Residential usage (Yes=1)
FI	0.02	0.15	0.04	0.2	0.06	0.24	Foreign invested company buyer (Yes=1)
PRIVATE	0.85	0.36	0.39	0.49	0.58	0.49	Private domestic buyer (Yes=1)
Sample size	92		753		306		

4. Empirical Outcomes

Table 4 through Table 6 give the estimates and diagnostic statistics of model (6) and (7). In all tables the semi-parametric model is compared with its parametric counterpart in terms of coefficient estimates, model fitting statistics and specification test. 10% of the observations were randomly selected and reserved to calculate out-of-sample MSE. The parametric benchmark models are estimated by specifying a linear functional form for $E(X \mid S)$ and $E(Y \mid S)$ in (3). It is equivalent to regressing Y on both X and Z using OLS method.

Overall the semi-parametric models yield more precise coefficient estimates and smaller prediction errors. To verify if the semi-parametric specification is valid, we adopted the Whang and Andrews version of Hausman-type specification test (Hausman, 1978, Whang and Andrews, 1993). This test has been applied to semi-parametric estimation of land price models by Thorsnes and McMillen (1998). Because $\chi^2_{0.01,20} = 37.57$ and $\chi^2_{0.01,18} = 34.81$, the null hypothesis of a linear functional form is rejected for all models. Hence discussions hereafter are based on the semi-parametric output in Table 4 through Table 6.

4.1 Non-industrial land sales (private treaty)

The estimation of Model (6) using non-industrial land sales by private treaty is given in Table 4. We find that the prices are determined by size, location, planning use, and neighborhood characteristics. One of the buyer characteristics indicators is statistically significant. In general these outcomes are consistent with other recent studies of Chinese land value determinants. Both of our hypotheses are supported by this set of findings.

Figure 2 demonstrates the semi-parametric estimation of the price-size relationship and shows a negative relationship in general. Unit land price drops as land parcel size increases except for land parcels of very large sizes. This is also supported by the negative coefficient loading of plot ratio (e.g., the -0.36 coefficient for LPRATIO is significant at the 1% level in Table 4). Generally speaking plot ratio determines the total floor space to be built on a site and a larger plot ratio tends to reduce the unit construction cost for these sites. The change of price-size pattern for very large land parcels is a possible outcome of the shortage of supply of this type of land.

We include commercial, mixed and residential property in the non-industrial land sample. The dummy variable USE_RES, indicating whether a land parcel is of residential use, is used to identify the hierarchy of these land uses in Beijing. We find that both commercial and mixed use land values are higher than residential ones. In Table 4 the coefficient estimates of USE_RES is negative and significant at the 1% level.

Buyers prefer land parcels that are closer to the train stations and the downtown subway network. Accessibility to the subway system is important for both business and leisure. The railroad transportation system has been the primary mode for freight and passenger movement in China (Xie et al., 2002). In Beijing most of the train stations are located at convenient, sometimes even central, locations. It is not surprising to find that developers tend to pay a premium to acquire land parcels near these train stations. LD_CBD is not significant, probably due to the fact that it's

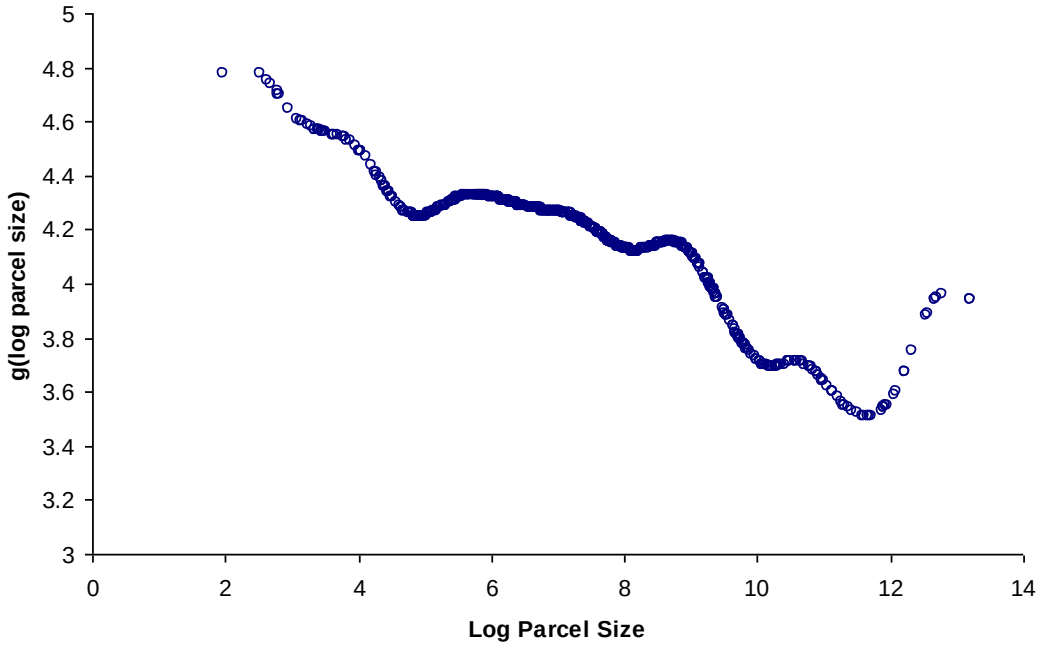
correlated with LCITYSUB (i.e., some subway stations are located near or in the CBD).

Table 4 Model estimation (Non-industrial land sales by private treaty)

	Parametric Model		**Semi-parametric Model**	
	Coef.	Std.Dev	Coef.	Std.Dev
INTERCEPT	4.94***	0.59		
LSIZE	-0.10***	0.01		
LPRATIO	-0.37***	0.02	-0.36***	0.02
LAREA	0.18**	0.09	0.19**	0.09
LRETAIL	0.12	0.08	0.09	0.08
LMIGRANTS	0.09	0.06	0.10	0.06
USE.RES	-0.41***	0.07	-0.43***	0.07
PRIVATE	0.00	0.08	0.02	0.08
FI	-0.28**	0.05	-0.25**	0.05
LD.CBD	-0.05	0.11	-0.05	0.11
LD.TRAIN	-0.22***	0.03	-0.19***	0.03
DIS1	1.46**	0.05	1.67***	0.05
DIS2	0.79**	0.57	0.94***	0.57
DIS3	0.01	0.35	0.06	0.35
LCITYSUB	-0.13***	0.16	-0.13***	0.16
QUARTER1	0.20***	0.03	0.17**	0.03
QUARTER2	0.11	0.07	0.11**	0.07
QUARTER3	0.19***	0.07	0.17**	0.06
QUARTER4	0.18**	0.07	0.16**	0.07
QUARTER5	0.17**	0.07	0.13	0.07
QUARTER6	0.36***	1.07	0.36***	1.07
R Squares	0.63		0.65	
F Statistics	56.98		65.01	
In-sample MSE	0.27		0.25	
Out-of-sample MSE	0.19		0.19	
Specification Test (Whang & Andrews 1993)	$\chi^2 = 42.95$, p-value < 0.01			

*: Significant at the 10% level
**: Significant at the 5% level
***: Significant at the 1% level

Figure 2 Price-size relationship (Non-industrial land sales by private treaty)



Foreign investment companies pay less in private treaty for land use rights. In China, performance of a company is often evaluated by its scale (e.g., total operating income) instead of profit. Consequently, Chinese companies tend to be less profit oriented (Firth et al., 2006). Domestic companies, privately or state owned, are more motivated to expand their business rather than maximize profits. In this sense it is often more important to obtain a land parcel than to negotiate a cheaper price. Furthermore, domestic companies have better access to financing through the state-owned banks. The tie between state-owned developers and banks is well recognized. What is not conspicuous to outsiders is the connection between private owned and state-owned land users. Most of the privately owned development companies are actually spin-offs of state-owned companies[14], or lead by people with close connection with the government. Therefore domestic companies generally have good 'Guanxi' with state-owned banks, which provide these companies with good access to funding for the land transactions. Thus, with better access to capital, it is not surprising that these state-related companies are able to pay more for land than outside investors. Another possible explanation of this phenomenon is that foreign investment is encouraged in general in China. Beijing is no exception. Foreign invested companies can leverage the pro-foreign-investment policies to agree upon a more favorable price in negotiations.

Our findings also suggest that the land value in Beijing had been increasing steadily until the third quarter of 2006. There are at least two reasons contributing to the sudden downturn of land prices. First, the number of sales in the third quarter of 2006 is almost doubled that of other quarters in the sampling period, indicating an increase in land supply in this period. Secondly, and more importantly, the central government announced several policies to dampen the over-heated property market, including a 20% value-added tax on property sales came into effect on 1 August 2006. The combined effect is a significant drop in land prices in the third quarter.

[14] For example, Vanke Co. Ltd, the largest domestic real estate developer in China, is evolved from a state-owned company in Shenzhen.

4.2 Non-industrial land sales (public transactions)

The outputs of Model (6) using non-industrial land sales by public transactions can be found in Table 5. We observe some differences in land prices determination between private treaty and public transactions. First of all, prices are influence by fewer factors in public transacted land sales. For example, plot ratio is not statistically significant; Planning uses have little impact on land prices because the coefficient loading of USE.RES is insignificant. Secondly, and more importantly, buyer characteristics do not influence land prices. It appears that in open market transactions land prices are determined by market force only. This is of significant policy implication by suggesting that public transaction is a more efficient way to determine land prices. In a well-functioning land market prices should not be influenced by buyer characteristics because all parties involved in the transaction have equal access to resources. Our findings are in support of Chinese governments' decision to gradually increase the proportion of land sales by public transactions.

It is also worth noting that the price-size relationship appears to be reversed. In Figure 3 the relationship between land value and parcel size is positive in general. This is not contradicting the findings in previous session if the average size of the land parcels sold in public transactions is taken into consideration. More specifically, most land parcels involved in open market sales are larger than those in private treaty. The pattern depicted in Figure 3 is consistent with the pattern observed in Figure 2 when parcel size is very large. Therefore both sets of findings suggest that very large land parcels in Beijing are sold at a premium due to its size. Unfortunately our data set does not contain the information that enables further investigation into this interesting pattern. We leave this matter for future research.

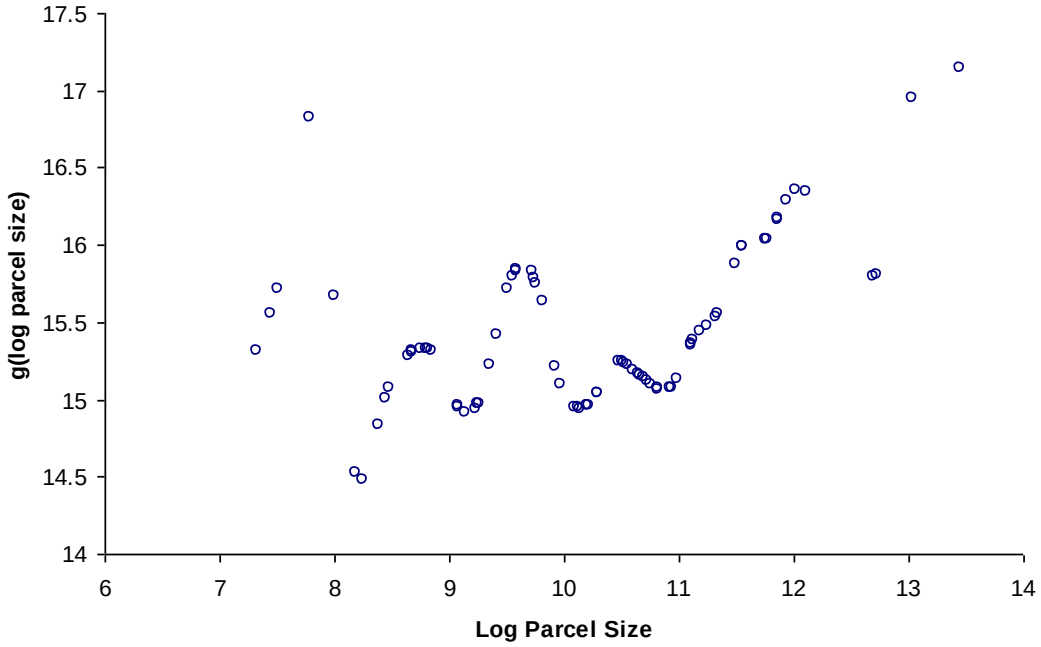
Table 5 Model estimation (Non-industrial land sales by public transactions)

	Parametric Model		**Semi-parametric Model**	
	Coef.	Std.Dev	Coef.	Std.Dev
INTERCEPT	11.11***	0.59		
LSIZE	0.13	0.01		
LPRATIO	-0.30	0.02	-0.20	0.02
LAREA	-0.85	0.09	-1.20**	0.09
LRETAIL	0.25	0.08	0.34	0.08
LMIGRANTS	0.65**	0.06	0.70***	0.06
PRIVATE	-0.32	0.07	-0.36	0.07
FI	-0.31	0.08	-0.06	0.08
USE.RES	0.91	0.05	0.30	0.05
LD.CBD	-0.28	0.11	-0.33	0.11
LD.TRAIN	-0.27	0.03	-0.53	0.03
DIS1	-5.19	0.05	-8.25**	0.05
DIS2	-4.01**	0.57	-5.31***	0.57
DIS3	-1.58**	0.35	-2.40***	0.35
LCITYSUB	-0.25	0.16	-0.44**	0.16
QUARTER1	1.22**	0.03	0.54	0.03
QUARTER2	0.85**	0.07	1.09**	0.07

QUARTER3	0.04	0.07	-0.23	0.06
QUARTER4	0.88**	0.07	0.75**	0.07
QUARTER5	0.02	0.07	-0.04	0.07
QUARTER6	-0.40	1.07	-0.36	1.07
R Squares	0.54		0.67	
F Statistics	3.38		6.32	
In-sample MSE	0.67		0.48	
Out-of-sample MSE	0.49		0.81	
Specification Test (Whang & Andrews 1993)	$\chi^2 = 3976.61$, p-value < 0.01			

*: Significant at the 10% level
**: Significant at the 5% level
***: Significant at the 1% level

Figure 3 Price-size relationship (Non-industrial land sales by public transactions)



4.3 Industrial land sales (private treaty only)

The land value determination mechanism for industrial land parcels is different from non-industrial land sales in many aspects (see Table 6). From analysis not shown in the tables, we also find that industrial land prices are less than those of commercial and residential lands[15]. Also, industrial development has not been recently a priority in

[15] In a preliminary analysis industrial and non-industrial land sales are pooled and modeled with regression method. Land use type dummies are included in the model to capture the price difference among different land uses. It is found that the coefficient estimate corresponding to industrial land use type has the smallest value among all land use type dummies. This indicates the industrial land value is the lowest in Beijing.

the Beijing area[16]. The politically sensitive domestic companies (private or state-owned) are understandably less interested in industrial land sales. Thus, the competition for land and the associated prices are lower in the Beijing for industrial land compared to commercial and residential land. Industrial land buyers may find it is easier to negotiate a favorable price in private treaty.

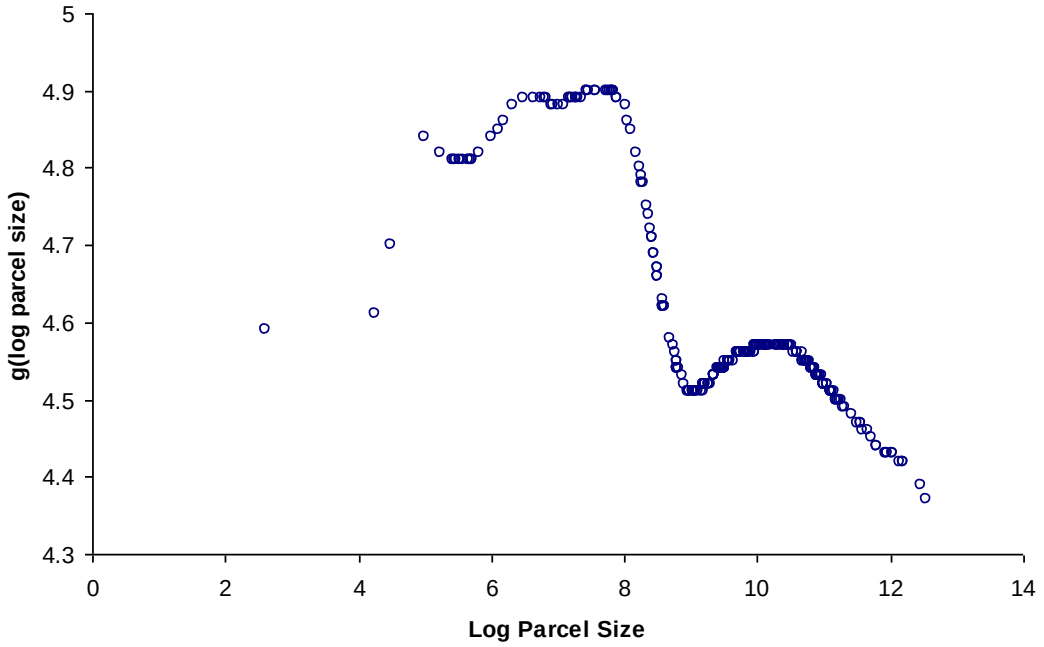
Table 6 Model estimation (Industrial land sales by private treaty)

	Parametric Model		**Semi-parametric Model**	
	Coef.	Std.Dev	Coef.	Std.Dev
INTERCEPT	5.77***	0.59		
LSIZE	-0.05***	0.01		
LPRATIO	-0.88***	0.02	-0.88***	0.02
LAREA	0.07	0.09	0.10	0.09
LRETAIL	-0.20**	0.08	-0.16**	0.08
LMIGRANTS	0.17***	0.06	0.11**	0.06
PRIVATE	0.01	0.07	0.02	0.07
FI	-0.06	0.08	-0.08	0.08
LD.CBD	0.11***	0.05	0.12***	0.05
LD.TRAIN	-0.38***	0.11	-0.33***	0.11
DIS1	2.29***	0.03	2.37***	0.03
DIS2	1.44***	0.05	1.57***	0.05
DIS3	0.86***	0.57	0.90***	0.57
LCITYSUB	-0.05	0.35	-0.05	0.35
QUARTER1	-0.17**	0.16	-0.12	0.16
QUARTER2	-0.12	0.03	-0.09	0.03
QUARTER3	-0.01	0.07	0.00	0.07
QUARTER4	0.04	0.07	0.12	0.06
QUARTER5	-0.02	0.07	0.02	0.07
QUARTER6	0.14	0.07	0.19**	0.07
R Squares	0.9		0.92	
F Statistics	123.77		158.79	
In-sample MSE	0.14		0.11	
Out-of-sample MSE	0.1		0.11	
Specification Test (Whang & Andrews 1993)	$\chi^2 = 5203.88$, p-value < 0.01			

*: Significant at the 10% level
**: Significant at the 5% level
***: Significant at the 1% level

[16] In 2006, among the 59 major projects undertook by the Beijing Municipal Commission of Urban Planning (BMCUP), only seven projects are industrial development (www.bjghw.gov.cn).

Figure 4 Price-size relationship (Industrial land sales by private treaty)



The nonlinear price-size relationship is much more obvious for industrial lands. The price-size pattern depicted in Figure 4 suggests that unit land price increases with parcel size initially and then decreases thereafter. All else equal, the most expensive industrial land parcels in Beijing are roughly 2,000 squared metres in size. We also find that land price is negatively related to plot ratio. The magnitude of coefficient loadings is larger for industrial land: the coefficient estimate of PRATIO is -0.88 for industrial land versus a -0.36 for non-industrial land sold by private treaty.

Neighborhood factors are more relevant in the determination of industrial land values. From Table 6, industrial land buyers are interested in land parcels in districts with less retails, and more migrants. Considering that industrial activities require significant storage spaces and an abundant supply of labor, this finding is not surprising.

Distance to the subway network was not found to be important in pricing industrial land. On the other hand, buyers prefer land parcels that are further away from the CBD and close to a train station (in Table 6 the coefficient of LD.TRAIN is -0.33 and significant: this shows that the further away one is from the station the less valuable industrial land is). Unlike developed countries where air transportation moves the most of the freight, rail transportation system still handles most domestic freight in China (Xie et al., 2002). Consequently buyers pay a premium to secure land parcels that are close to rail transportation hubs. It is also clear that the most expensive industrial land parcels are located in the inner city region, whilst the cheapest ones can be found in the outer suburb districts.

Although industrial land prices are found to be influenced by traditional price determinants as discussed above, foreign investment companies are not paying more compared with their domestic counterparts. There are no evidences that foreign invested companies are treated favorably in private treaty of industrial land sales. Thus the second hypothesis is not supported by this set of findings.

The last observation from Table 6 is that the industrial land prices in Beijing have been relatively stable during our sampling period.

5. Discussion

Although there has been growing interest in the land and housing markets in China, empirical studies in this area remain scarce. Case study and qualitative analysis methods dominate the literature. There is a lack of empirical analyses using statistical methods. Ding (2004) is the closest to our study. He uses a hedonic price model to study land sale prices in Beijing from 1993 to 2000. However, industrial and non-industrial land sales are modeled together; only two factors (distance to CBD and planning uses) are considered in the hedonic regression model; and, the OLS technique adopted by Ding does not allow flexible estimation of the hedonic price coefficients. In Tan, Heerink and Qu (2006), a richer set of independent variables are included in the two regression models. However, the purpose of their study is to understand the causes of land fragmentation, instead of the determinants of land value. Hence it is not directly relevant to our study.

In sum, there are limited empirical studies about China's land market in the current literature. Our study fills the gap in the literature in two ways. Firstly, this paper analyzes prices of non-industrial and industrial land separately using a comprehensive data set and a semi-parametric framework. Our empirical findings support this approach by showing that the price determination mechanism is different for the two types of lands. The data and flexible model specification allow the hedonic price coefficients to be estimated more accurately. Secondly, and more importantly, we find evidences that land prices in China are determined by both market force and 'Chinese Characteristics'. The land market, although established only recently, is at work. In line with the literature, determinants such as size and planning uses are found to be important in determining land prices. On the other hand, the market is not completely efficient because certain buyers paid less by leveraging their access to resources (e.g., pro-foreign-investor policies). Although this is only observed in non-industrial land sales by private treaty, this type of sales account for about 65% of all transactions in our sampling period. Therefore the impact of non-market force is not negligible.

6. Conclusions

We investigate the land value determination in Beijing China by estimating separate models for industrial and non-industrial land sales. We find that Beijing land prices are affected by the standard attributes and in the standard ways (e.g. lots closer to transportation are worth more) as in traditionally markets. Beijing land market prices are determined by parcel size, floor space, location, neighborhood characteristics and planning uses. Nevertheless, evidence is also found that some "Chinese Characteristics" still exist. Foreign investment companies pay less to obtain land use rights through private treaties. Possible reasons include that state owned and privately owned domestic companies are scale-drive instead of profit-driven; foreign investors can negotiate a better price under pro-foreign-investment policies. These are some unique Chinese characteristics..

In conclusion we find land values in China are determined by both market and non-market elements. It is very encouraging to see an effective land market in force.

Land users determine the price to pay based on the characteristics of the land and its surrounding environment. The government is also able to use the similar information to determine the reserve price for tenders and public auctions. Of course, some unique factors should also be considered when determining the land value in China. Our conclusion is the land market in China is still an emerging market.

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