Understanding the Value of Amenities:
A Study of the Land Value Determination Process in Hangzhou, China

Ching-Ching Chen

Dr. Charles Becker, Faculty Advisor
Dr. Kent Kimbrough, Seminar Instructor

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Table of Figures

Tables

Figures

Abstract

This paper seeks to investigate the determinants of land value within Hangzhou China. There are two main goals that the research paper will attempt to address. The first is to build upon existing research on land pricing in terms of the theories outlined by the monocentric city and hedonic pricing models. Second, the paper will use a dataset of Hangzhou land sales transactions between the years of 2003 and 2011 to investigate the possible existence of "luxury residuals" among commercial and residential land parcels. After evaluating the data with OLS Regressions, the results suggest that both environmental and convenience-based amenities have significant influence on pricing. Nonetheless, due to the presence of large residuals, while the regression results offer important insight on the impact of amenities, the extent to which Chinese consumers value certain amenities is not fully captured by these results. Rather, a number of case studies of outliers are used to fully examine the influences of these amenity variables in driving such extreme prices. The results support the hypothesis that China, located at the bottom of Kuznets environmental curve, values amenities at extreme levels as a result of scarcity.

JEL classification: R0, R14, R52, Q51

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I. Introduction

Urban Land Development in China has been studied with increasing fervor in recent years. From popular journals and blogs to academic literature in China and the US, a number of studies regarding the valuation metrics of urban land have been published. These articles have consistently applauded urbanization as a “sustainable engine for economic growth” that has the potential to bring tens of millions of rural residents to the cities. Urbanization has also been credited for increasing labor productivity and hence wages and in turn boosting domestic consumption in real estate and a number of related industries (Chen and Ning 2011). In China today, the boosts in domestic consumption are substantial as research suggests that one rural resident moving to an urban area will lead to over 100,000 Yuan ($15,240) in infrastructure construction and public services (Chen and Ning 2011). The result has been a rapid conversion of rural agricultural land in China and steep price appreciation within the land market.

Similar to zoning ordinance in the US land market, these converted urban land parcels are divided and designated for particular uses as determined by the government (residential vs. commercial vs. industrial). With all land being state owned, the government then grants land use rights for these particular parcels for a fixed period of time, via land sale auctions, in return for a lump sum premium paid by the winning bidder securing land leases.[1] These lump sum price tags are of particular interest given that they have sky-rocketed in the recent years.

Nonetheless, the degree of price appreciation has been inconsistent among various parcels. Holding market demand and location equal, parcels of land designated for commercial or residential use have very different pricing patterns than parcels designated for industrial use.

[1] The land lease grants are typically 40 years for commercial land, 50 years of industrial land, and 70 years for residential land. For the purpose of this paper, they will be titled as land sales due to the large durations. It is not typical for winning bidders to re-sell land before maturity.

Furthermore, even parcels with seemingly similar characteristics may see extreme discrepancies in pricing based solely on the presence of one particular amenity. Such patterns of urban land pricing patterns are important to understand due to the increasing number of urban land developments. The UN-HABITAT *State of Asian Cities Report 2010/11*, estimated that between the years of 1990 and 2010, Asia's urban demographic expansion amounted to the combined populations of the US and the European Union. Furthermore, based on a study by the China Development Research Foundation, more than 24 trillion Yuan (~$6 trillion or about 60% of China's 2010 GDP) of governmental spending alone is estimated to be invested into urban infrastructure by 2020 (Stratfor Global Intelligence).

With major capital flow into the urbanization process in China, it is important to understand the determinants of urban land prices. Depending on the land use, distance from the city center, neighborhood amenities and a number of other amenity traits, land grant leases may incur a wide range of varying costs. The question remains of how to value the price of these parcels of land. What are the drivers behind demand and why does the government have the ability to sell certain parcels of land at significant premiums? Are there certain qualities or amenities that consumers value more than others?

When studying the factors behind price appreciation of urban land within China, certain cities are of particular interest due to the substantial increase in land and real estate prices they have experienced in the recent years. Beijing, Shanghai, Guangzhou, and Hangzhou are among the cities that have experienced the most dramatic increases in prices. In certain cities such as Shanghai, Beijing, and Guangzhou, the reasons behind price appreciation seem apparent as each city is driven by market demand as a result of its role as the economic, political, and export central of the country, respectively. Thus, among the top four Chinese cities in terms of real estate price appreciation, Beijing, Shanghai, and Guangzhou have long been favorites among economists and investors (Tang 2010). However, it is important to note that a recent addition to the list of top four Chinese cities, Hangzhou, is neither an economic, political, nor export center; yet, in 2010, it managed to top the list of mainland cities with the highest property costs. Known for its beautiful scenery and tourist attractions centered on the famous West Lake, in addition to being named as one of China's best places to live, Hangzhou has become a city of interest.

Hangzhou is of particular interest because unlike Shanghai, Beijing, and Guangzhou, which are valued by consumers for their financial and political centers, Hangzhou's main value to consumers comes from it natural lakefront amenities, neighborhood characteristics, and environmental amenities. This is of importance because China is arguably at the industrial economy stage of the Kuznets environmental quality curve, shown in Figure 1 below, and at the point where environmental degradation is at its height (Panayotou 1993).[2]

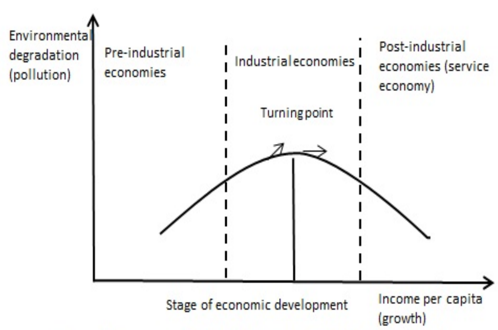


Figure 1: Kuznets Environmental Curve

With a scarce level of natural amenities, the steep value consumers place upon these amenities may very well be the key driver behind the steep land price appreciation experienced

[2] The Kuznets environmental curve hypothesizes that as a country develops, environmental degradation rises but beyond a certain level of income per capita, environmental improvements are made (Payatonou 1993).

within Hangzhou. Determinants of land price appreciation can be modeled through theories such as the monocentric city model and the hedonic pricing model where location, land use, transportation, and amenity variables act as determinants of land prices.[3]

A study of these drivers of demand and determinants of land price exists within many recent works of economic literature but data are both sparse and limited.[4] Moreover, given that data are available only for select years for a few select locations, studies are limited based on the availability of data. Thus, many of these studies focus on land markets in Beijing and very few are empirically based. Moreover, a majority of these works focus solely on the patterns of land value determination within the framework of the monocentric city model and hedonic pricing models by focusing on the role of transportation, land use, and location/distance from the city center in driving price appreciation. Nonetheless, while these studies provide solid theoretical frameworks, the scarcity of natural amenities within China combined with Hangzhou's possession of highly valued environmental amenities makes it necessary to encompass an amenity-based hedonic theory in order to truly understand the determinants of land valuation.

Hence, while the value of transportation and land usages are captured within existing studies of urban land in China, existing models fail to account for the amenities valued by consumers that may be critical to explaining the drastic range of land parcels. This paper therefore distinguishes itself from past research as it intends to encompass the traditional hedonic and monocentric models for land valuation in addition to an adapted hedonic model

[3] The hedonic pricing model, and the monocentric city model will be discussed in detail in Section 3: Theoretical Framework.
[4] Ding and Lichtenberg (2007) went as far as to claim that "information on land values is highly fragmentary. Data on real estate transactions are available only for a few cities and only for a few select years, making it impossible to assess the contribution of land to the urban economy (and hence the strength of incentives for urban spatial expansion) in any systematic fashion."

that accounts for amenity variables not included within the models in existing literature. Thus, by expanding existing pricings models beyond Beijing and Shanghai, this paper will be one of the first academic works focused on land valuation in Hangzhou, China and it will also be one of the first to examine the influence of amenities on land prices in Hangzhou.

By providing a more up to date, comprehensive study of land sale prices within Hangzhou, China, this study aims to provide the most updated and one of the first empirical studies examining land sales records for Hangzhou, China. Specifically, I plan to study 625 land sale transactions recorded by the Hangzhou Bureau of Land and Resources between the years of 2003 and 2011. An empirical study of the determinants of land valuation in Hangzhou will be carried in an effort to understand patterns for urban land price appreciation. Based on the current theoretical framework and the theories presented by the monocentric city model and the hedonic pricing model, the goal is to first understand to what extent land value is determined by market drivers such as location, usage, transportation, date, and size. It will then be important to identify first the type of amenities valued by Hangzhou residents in order to understand the extent of their impact on land prices.

For organizational purposes, the paper proceeds as follows. Section 2 offers an overview of the literature pertinent to the study. The succeeding sections will describe the empirical strategy and data, present the results and discussion, and offer concluding remarks.

II. Literature Review

A study of the patterns for urban land price appreciation therefore requires an understanding of the key determinants of market demand. Are certain amenities, locations, and land uses drivers behind demand and determinants of price discrepancies? Most studies focus on characteristics such as size of land parcel, location, income growth, and land usage. Within the existing literature, regardless of the city or country of focus, the hedonic pricing model and the monocentric city model have been the most prevalent theoretical frameworks for understanding the patterns for land price appreciation. Location, size, and transportation amenities are thus the most prevalent variables of study. Nonetheless, given the often idiosyncratic patterns of pricing that have emerged among modern day cities, the amenity-based variables of the hedonic pricing model have been adopted in an effort to explain for instances in which the distance from the city center or access transportation fails to explain pricing pattern. However, while this amenity-based hedonic theory has been applied in studies within Europe and America, its application within literature on the Chinese real estate market has been sparse.

Instead, literature on the Chinese land market has been dominated by theories based on the monocentric city model and dates back past the early 1980s. A number of studies based on the monocentric city model, confirm the value of location and transportation. Chengri Ding (2004) tests the monocentric city model as his study portrays the impact of emerging land markets in Beijing and the impact of land policy reform on the characteristics of urban spatial development. An empirical study is carried out to understand the relationship between the distance from the city core and the price of land and the development density of land. Ding studies a period of time from 1993 to early 2000 as he observes the land use rights granted during that time period. He also explores competitive land use, trends in land development patterns, and the dynamics of urban spatial patterns in an attempt to understand the impacts of land prices on land development decisions and to determine to what extent land policy affects urban land development. The results illustrate that both land prices and land development density decrease with distance to the city core. Moreover, the competitiveness and market value of the locality of land affect land rent curves and the ultimate use of the land. Ding (2004) thus verifies the value of location as outlined by the monocentric city model by concluding that locations close to the city center, office and commercial development have an economic advantage. On the other hand, industrial development is often pushed farther away towards the suburbs while residential development typically takes places somewhere in between.

In Baum-Snow (2006), the monocentric city model is further tested as the study suggests that metropolitan area population spreads out along new highways. Thus, the availability of transportation is expected to decrease the value and demand for city center land as each additional highway ray causes about a 10 percent decline in the population of the city center. Highways are thus used to explain urban population decentralization as Baum-Snow attributes the 28% population decline of the average central city almost entirely to the construction of highways. The study includes 138 metropolitan city centers and the time period of study ranges from 1950-1990. Baum-Snow's study, however, applies mainly to the US and while the theory can be tested in the case of Hangzhou, the study itself provides limited insight to Hangzhou's city structure.

Similar to Baum-Snow (2006), a number of other works of literature also study transportation and infrastructure driven price appreciation, but under the framework of the hedonic pricing model. In Gu (2007), 141 house prices nearby the Batong Line in Beijing, China, are examined in a validation of the submarket effect of rail transit's impacts. Gu combines his empirical analysis with theoretical analysis to hypothesize that the submarket effect of rail transit's impact exhibits different characteristics for different types of properties. In the case of commercial and office property, the value premium produced by rail transit is higher near the city center than in the suburbs. On the other hand, it is just the reverse for residential properties. The results indicate that the Batong Line has significant impacts on the residential property values in suburbs but a weaker impact near the urban center. For example, in Tongzhou - located far from the urban center - housing prices increase by 1.8% for every 1,000m nearer to railway stations. Chaoyang, on the other hand, is located closer to the city center but is minimally impacted in terms of housing prices as influenced by distance from railway stations. Hence, Gu (2007), presents another framework for land pricing as determined by the hedonic pricing model.

Another alternative theory, beyond traditional monocentric and hedonic pricing models can be seen within Brueckner, Thisse, and Zenou (1997), where an amenity-based hedonic theory of pricing is applied to account for the differences between the wealth within central Paris as opposed to the poverty within downtown Detroit. While this work is not focused within China, it presents theories that will be extremely applicable to Hangzhou. Within the paper, they classify the urban amenities that drive prices within three categories, with Categories 1 and 2 being exogenous, and Category 3 endogenous. Category 1 includes natural amenities that are measured by the natural topographical features, including rivers, hills, and coastline. Category 2 includes historical amenities such as monuments, buildings, parks, and other urban infrastructure from past eras that are aesthetically pleasing to current residents of the city. Category 3 includes the largely endogenous variables called modern amenities with their levels depending on the current economic conditions in a neighborhood, especially the local income level. Such amenities might include restaurants, theaters, and modern public facilities such as swimming pools and tennis courts. Modern amenities may also be linked to historical amenities.

More recently, this amenities-based hedonic model has been applied to studies within China as Zheng and Kahn (2008) examine amenity variables such as local public goods, access to public transit infrastructure, core high schools, clean air, and major universities as important drivers behind real estate prices. Nonetheless, their examination of real estate/land prices and population/building densities continues the trend of focusing on the monocentric city model. They conclude that land prices, real estate prices, and population density decline as they increase in distance from the city center. Zheng and Kahn use two geocoded data sets to present new evidence on the real estate price gradient, land price gradient, population densities, and building densities in Beijing. They examine a period of time between 1991 and 2005 and conclude that the population experienced a growth of 40.6% and per capita income (in constant RMB) by 273.9%. Nonetheless, their most surprising discovery finds that despite increasing distances from the City Center, residential building heights and housing unit sizes remained the same. In this case, the monocentric theory therefore fails to explain their results as Zheng and Kahn attribute this to binding urban planning policies.

The amenity-based hedonic theory, as applicable to China, is further developed in Kong, Ying, and Nakagoshi (2006), where the amenity value of urban green spaces is studied to determine the value of leisure opportunities and aesthetic enjoyment. The study was motivated by urban policy makers' tendency to ignore green spaces, due to their lack of a market price.

Kong et al. thus emphasize the importance of the non-market price benefits of these green spaces by applying the hedonic pricing model to Jinan City, China. The results were in line with the hedonic pricing model and confirmed the positive amenity impact of urban green spaces on housing prices located near urban green spaces. The independent variables used to test for prices included land-use patch richness, location sector, education environment, size-distance index of scenery forest, accessibility to park and plaza, percentage of urban green spaces – all of which were highly significant, with the latter 3 significant at the 5% level.

Thus, the amenities-based hedonic theory attempts to account for a multiplicity of location patterns across cities, consistent with real-world observation by depicting instances in which the monocentric city model fails as the idiosyncratic relationships between location and pricing can be explained by highly demanded amenities. Within this context, this paper contributes to the literature in a number of ways. First, it will be one of the first academic works focused on land valuation in Hangzhou, China and it will also be one of the first to examine the pricing of land in Hangzhou as influenced by a combination of hedonic, monocentric, and amenity-based variables. This paper will further distinguish itself by providing a more recent and comprehensive study of land sale prices by examining land sales records for Hangzhou, China in from 2003-present. The following section outlines this model in detail while sections IV and V outline the empirical heart of the study.

III. Theoretical Framework

The underlying goal of this research paper is to understand the factors determining urban land values in quasi-market transition economies by examining the Hangzhou market in China. The paper will begin by addressing the monocentric city model in an effort to understand the patterns of price appreciation within different parts of Hangzhou as dependent on location and distance from the city center. The theoretical model will then be expanded to a study of pricing as influenced by transportation and infrastructure by addressing another popular model known as the hedonic city model. It will then expand upon the hedonic city model to an encompassing discussion of the amenities-based hedonic model. Nonetheless, it is important to note that while the monocentric and hedonic models are applicable, given that the focus of this paper is limited to the city of Hangzhou where transportation is prevalent and location to the city center close in proximity regardless of the district of study, much of land price discrepancies are driven by the presence of amenities. Thus, while the regression models intend to incorporate theories from all three models, unlike the models used in past studies of land price theory, they will be primarily dominated by the amenities-based theory.

3.1 - Monocentric City Model

The pricing characteristics reflected by the monocentric city model focus on the influences of location. In order to understand the internal pricing behavior within Hangzhou, the theoretical framework of the monocentric city model will be applied to explain why certain locations have higher land and real estate prices along with taller buildings.

The monocentric model provides the most basic framework for analysis of urban land by assuming an otherwise featureless plane with a pre-determined central employment area. Firm and household decisions/demand are therefore driven largely by accessibility to the central employment district as both firms and households are attracted to those markets with (1) favorable factors of attraction, such as amenities and accessibility characteristics and (2) favorable labor market characteristics, such as a large (skilled) labor pool for firms and a better accessibility to (high-paid) jobs for households. As a result of such concentrated demand within the realms of the economic center, the monocentric model yields the following results:

RESULT 1: land rent rises more than linearly as one gets closer to the city center

RESULT 2: the capital/land ratio also rises rapidly as one nears the city center. Thus, one sees tall building at the center of a city, and less on the outskirts.

The model thus predicts a 'concentric ring' of urban land use around central business district and the presence of a declining density gradient. Based on the monocentric city model, we can provide a theoretical framework to understand the patterns of land development within Hangzhou. It will help us understand residential patterns and city growth. Therefore, location relative to the city center is expected to affect both pricing and capital/land ratios.

3.2 - Hedonic City Model: Amenities Based Focus

Building on the monocentric city model, we can then examine the impact of a number of amenities, transportation or environmental, on variations in pricing. While the theory behind transportation as an amenity is outlined below, it is not directly applicable to Hangzhou given that this study focuses on a concentrated area near the city center where transportation is readily accessible regardless of the location or distance to the city center.

The model posits that the decrease in transportation cost to urban center will directly increase the residents' bids for land and thus raise land values (Alonso, 1964). It also tests whether there is a variance of the impacts of proximity to rail transit and a submarket effect based on the bid-rent model (Gu 2007).

Thus, a rail line, bus station or subway station located at $x_{1,}$ which reflects a certain distance from the suburbs to the City Center (CBD), will decrease the cost of transportation and raise rent prices from R_1 to R_2. The rent of properties in x_1, now at R_2, will be equivalent to the rent of properties in x_2 (see Figure 2). While x_2 is closer to the city center, which theoretically signifies higher rent as modeled by the monocentric city model, it lacks a nearby rail line, subway station, or bus station. Thus, the presence of a rail transit system is equivalent in impact to a reduction in the distance from a certain location to CBD. Moreover, these rail transit, subway and bus stations lead to a rise in rent for properties located nearby them, which is increasing in x when x< x1 and decreasing in x when x> x1. It may be possible that accessible transportation has led to high demand all across the city of Hangzhou thus driving prices all across.

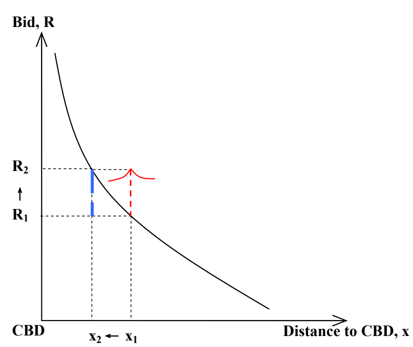


Figure 2 The impact of rail transit on property values

While the existing literature tends to focus on the transportation aspect of the hedonic pricing model, the model itself also addresses the value of other natural and financial amenities that are more applicable to our study of Hangzhou. Thus, as described by Kong et al. (2006), a traditional hedonic pricing model can be defined as a function of:

$$P = f(v_1,v_2,...,v_n)$$

where P is the market price of the house or parcel of land and v_1, v_2, …,v_n are characteristics that can be categorized as accessibility variables, neighborhood environmental characteristics, and structural variables. As mentioned before, I plan to focus on the neighborhood environmental variables. Structural variables, which relate directly to the structure of real estate properties, aren't very applicable to this study given its focus on land parcels rather than structural buildings. Accessibility variables, which define the ease of transportation and ease of access to various amenities is also outside of my focus due to the prevalence of amenities and transportation access within the central portion of the city of Hangzhou. Neighborhood qualities on the other hand, are of significant interest and describe the quality of surroundings from industrial pollution to indicators regarding the type and structure of land use (Kong, Yin, Nakagoshi 2006).

A theoretical framework encompassing both of the theories outlined above will be used to test the importance of location, land use, natural amenities. Moreover, a model incorporating a number of other neighborhood characteristics such as geographic trade advantages, education, and industry focuses will be outlined within Section 5.1.

IV. Data

To test the effectiveness of the theoretical framework and regression model, I compiled a dataset of Hangzhou land sale transactions between the dates of April 22, 2003 and December 11, 2011, as reported by the Hangzhou Bureau of Land and Resources. The data set was extracted from the records of the Hangzhou Bureau of Land and Resources and includes information regarding location, size, transaction price, and the date of transaction.[5] Originally, the dataset comprised of 723 observations, however, all land parcels not designated for either

[5] Retrieved from: http://www.hzgtj.gov.cn:81/jpm/static/ztbj/tdsc/cjxx/P-1031168b49b-1002124.html

residential, commercial, or industrial use, as well as all observations that are not located within the districts of interest, have been removed. The remaining 619 variables will be used to test theories outlined by the monocentric city model and hedonic pricing model, as well as the importance of amenity variables in determining land value.

The reports include statistics such as location, size, price, date, and land usage. For the purpose of my regression model, I have translated and simplified the reported data as follows (Table 1). These key variables will be discussed in further details in Sections 4.1-4.3.

Table 1: Key Variables Defined

Price:	Reported in the dataset as a Real Price/Meter^2 variable - price reported in Chinese Yuan
Size:	Converted into meters^2 for consistency - reported inconsistently in acres or meters^2 by the Hangzhou Bureau of Land and Resources
Land Usage:	Simplified into 3 categories - Residential, Commercial, Industrial
Location:	Provided addresses were used to categorize land parcels into 7 districts (Gongshu, Hangzhou Economic and Technological Development Zone, Jianggan, Binjiang, Xiacheng, Xihu, Shangcheng)

Real Price/Meter^2 will be the only dependent variable used for all regression models. All prices are reported in real terms using the World Bank's GDP implicit deflators with a 2003 base year (Table 20 in the Appendix). Running some basic summary statistics immediately reveals some points of interest. As shown in Table 2 below, the average *Real Price/Meter^2* is 12,039 Yuan, which is less than the standard deviation of 15,763 Yuan, signifying a huge variance in the dataset. Moreover, a maximum of 113,610 Yuan and a minimum of 285 Yuan indicate that the average is an inaccurate representation of the sample data.

Table 2: Summary Statistics *Real Price/Meter^2*

Variable	Observations	Average	Median	Standard Deviation	Max	Min
Real Price/Meter^2	631	12,039.33	6,903.33	15,763.35	113,610.4	285.16

Such a wide dispersion of land prices thus motivates our question of what determinants of land value are accounting for such drastic differences. *Size, land_use,* and *district*, reported by the Hangzhou Bureau of Land and Resources, are among the independent variables used by existing studies and will be discussed in Section 4.1-4.3. In addition to the statistics reported by the Hangzhou Bureau of Land and Resources, I have also assigned a number of descriptive district amenity variables to each transaction. These amenity variables, discussed in Sections 4.4-4.11, are motivated by the theory presented by Kuznets environmental curve and are included to capture the degree to which consumers value natural and neighborhood amenities. For the purpose of clarity, discussion of descriptive statistics for key independent variables will be divided into separate sections for each variable.

4.1 – Size

Size is measured in meters^2 and has been included within the regression model in an effort to capture whether or not discounts are offered for large bulk sales. Similar to *real price/meters^2*, the *size* of all land parcels sold between the years of 2003-2011 varies drastically. Again, the standard deviation, at 58,201 meters^2 signified a large variance in the dataset. The median and actual concentration of the data is around 27,238 meters^2; yet, with a range that spans from 1,021 meters^2 to 459,347 meters^2, the upper range of outliers leads to a skewed average despite the fact that parcels that are larger than 100,000 meters^2 comprise of less than 8% of total observations.

Table 3: Summary Statistics *Size/Meter^2*

Variable	Observations	Average	Median	Standard Deviation	Max	Min
Size	628	42,991.65	27,237.50	58,200.98	458,346.96	1,021

4.2 – Land Use

Land Use will be accounted for as 3 separate variables, *commercial, residential, and industrial* and used to test the theory outlined by the hedonic pricing model. Within the context of our regression model, there are 247 *commercial* observations, 230 *residential* observations, and 145 *industrial* observations.

Starting with residential land, we see in Table 4 an expected increase in the annual averages for the price/meters^2 of land sales. The average price increases over time but a large variation in the range of prices, ranging from 468 Yuan/meters^2 (in 2007) to 89,531 Yuan/meters^2 (in 2010), exists. Nonetheless, the consistent distribution between the maximum and minimum prices accounts for the consistent appreciation in average prices with the exception of 2006, where a majority of the data is concentrated below the median. Circumstances such as 2006 can therefore be explained by the lack of luxury land transactions recorded within the dataset rather than by a true drop in the average market value of land. An analysis of commercial land transactions yields similar results. Summary Statistics are depicted in Table 5 of page 22.

Table 4: Residential Land Sale Price/Meters^2 Summary Statistics

	Average	Median	Max	Minimum
2003	7,258.65	6,988.52	13,235.24	598.25
2004	7,531.02	6,862.53	14,410.05	4,461.19
2005	7,811.65	5,706.12	14,038.57	2,302.35
2006	2,913.03	1,494.61	17,229.48	599.72
2007	16,638.55	8,702.19	74,061.14	468.12
2008	14,518.12	11,754.23	32,721.15	5,955.46
2009	21,599.18	18,263.00	66,953.99	9,367.32
2010	29,983.19	28,240.20	89,531.55	11,191.35
2011	20,287.74	20,012.46	32,860.34	10,097.63

Table 5: Commercial Land Sale Price/Meters^2 Summary Statistics

	Average	Median	Max	Minimum
2003	4,107.05	4,285.04	7,168.66	373.62
2004	6,790.01	4,254.53	29,239.77	1,566.92
2005	9,758.06	4,237.70	44,024.60	765.18
2006	4,308.67	1,243.81	77,916.30	285.16
2007	21,605.49	11,778.98	75,544.50	1,020.25
2008	23,091.64	15,979.82	98,427.70	2,794.86
2009	19,496.23	12,747.84	88,084.28	2,507.22
2010	23,898.53	18,108.09	119,701.83	4,132.38
2011	27,207.74	16,799.36	99,750.49	6,673.00

Table 6: Industrial Land Sale Price/Meter^2 Summary Statistics

	Average	Median	Max	Minimum
2003	N/A	N/A	N/A	N/A
2004	N/A	N/A	N/A	N/A
2005	N/A	N/A	N/A	N/A
2006	N/A	N/A	N/A	N/A
2007	601.42	463.27	1,214.87	462.53
2008	540.17	454.48	1,049.63	446.10
2009	492.89	446.32	1,114.39	445.41
2010	624.05	512.11	1,277.46	510.69
2011	487.72	454.71	1,135.14	453.82

Industrial land, exhibits a drastic difference in pricing behavior. Data are unavailable until 2007 given that land was essentially free as an incentive to boost investments until 2007, when minimum prices for the sale of land for industrial use were set for the first time as a result of rampant illegal land acquisition, ruined farmland, and redundant construction projects. Nonetheless, prices are still extremely subsidized, with averages ranging between 453 Yuan/meters^2 (2011) to 1,277 Yuan/meters^2 (2010), which is a significant discount to the 119,701 Yuan/meters^2 maximum paid for commercial land (2010). Moreover, very little price appreciation has been experienced within the last few years as a distribution of the prices below portrays the lack of correlation between the year and price. This idiosyncratic behavior is of great interest and further study of policy-induced reductions in prices would be of interest. For example, a policy announced by the Chinese government in early 2010 to lower industrial land prices by 30% in an effort to induce investments can possibly be used to explain the price drop in 2011 averages. Such policies may be valuable to study in further detail.

Comparing these results, it is important to note that the standard deviation of industrial land price/meters^2 is 179.4 Yuan, while the standard deviation for commercial and residential land is 19,973 Yuan and 9,350 Yuan, respectively, signifying a huge difference in the variance within the data points. Thus, while consumers of residential and commercial land value amenity variables and a number of other determinants of land value to an extent that accounts for over a 400 time difference in *Price/Meter^2*, industrial land remains concentrated within a limited range with a variance that is close to the average. The theories motivated by Kuznets environmental curve, the monocentric city model, and the hedonic pricing model are thus most likely less applicable in the case of industrial parcels where scarcity is not driving a large variance in consumer demand.

4.2 –Location

Given inconsistencies in transaction reports, physical addresses were only available for a limited number of transactions. Location is thus accounted for on a district basis within the data set. Comprised of 6 districts within the City Center, and 7 suburban and rural districts, Hangzhou is home to approximately 8.7 million inhabitants in an area of approximately 16,847 kilometers^2 (Chen 2010). A break-down of the districts is shown in Figure 3 and Table 7 on page 24. The dataset focuses solely on the 6 city center districts and the Hangzhou Economic and Technological Development Zone (denoted at HETDZ here on after), which is a sub-district of

Jianggan. For the purpose of this paper, it will be studied as a separate entity since it is a state-level development zone with characteristics that differ drastically from the rest of the Jianggan district.

Figure 3: Hangzhou Districts

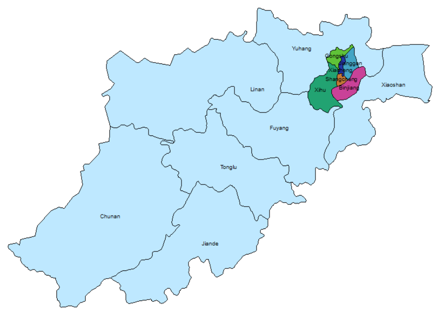


Table 7: Hangzhou District Summary Statistics

Subdivision	Area	Population	Subdivision	Area	Population
City center			*Suburban and Rural*		
Gongshu District	87.49 km²	280,000	**Yuhang District**	1,223.56 km²	826,900
Xiacheng District	31.46 km²	330,000	**Xiaoshan District**	1,420.00 km²	1,150,000
Shangcheng District	18.30 km²	310,000	**Lin'an City**	3,126.80 km²	520,000
Jianggan District	210.22 km²	350,000	**Fuyang City**	1,831.20 km²	640,000
Xihu District	308.70 km²	520,000	**Jiande City**	2,321.00 km²	510,000
Binjiang District	72.02 km²	120,000	**Tonglu County**	1,825.00 km²	400,000
			Chun'an County	4,427.00 km²	450,000

The six city center districts are characterized by varying industry focuses, neighborhood characteristics, sizes, and concentration of population. While Shangcheng district has a population of 310,000 people within a density of 18.3 kilometers^2, Jianggan has a similar population of 350,000 for a space of 210 kilometers^2.

Of the seven district variables, 87 observations come from Gongshu, 101 observations are from the HETDZ, 111 from Binjiang, 123 from Jianggan, 24 from Shangcheng, 99 from West Lake, and 44 from Xiacheng. With the exception of Shangcheng and Xiacheng, the remaining districts have a pretty evenly distributed number of land transactions by land type, recorded within the last eight years.

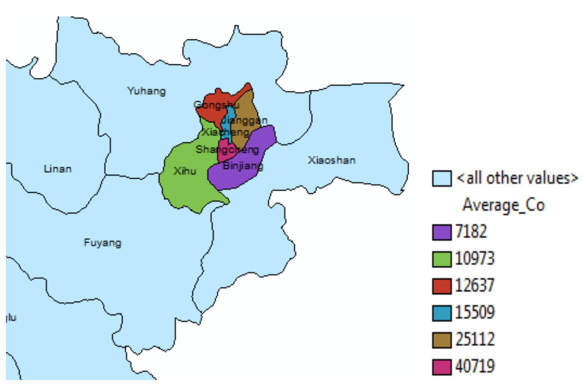
Table 8: Number of Land Sales from 2003-present

District	Commercial	Industrial	Residential
Gongshu	37	25	25
HETDZ	21	56	24
Binjiang	45	32	34
Jianggan	55	8	60
Shangcheng	16	0	8
West Lake	32	22	45
Xiacheng	39	2	3

Shangcheng and Xiacheng are also the two smallest districts in terms of area squared at 18.3 kilometers^2 and 31.46 kilometers^2 respectively which most likely explains the smaller number of land parcels available for transaction. The distribution of commercial, residential, and industrial land is also pretty evenly dispersed among the different districts, although HETDZ, as a development zone, is dominated by industrial activity, while Shangcheng, known for its quality of life and commercial activity has zero transactions recorded; Xiacheng has a limited number of both industrial and residential land transactions.

In addition to the distribution of land transaction quantities within the various districts, the range of average prices also varies among the different district. As shown in Figure 4 below, the range of commercial price/meters^2 averages differs by almost a factor of four (7,182 versus 25,113 Yuan). The prices in Figure 4 below are listed in Chinese Yuan in real terms.

Figure 4: Average Commercial Price/Meters^2 by District



The large variance of average industrial and residential prices per district is also apparent, as shown in Table 9 below, although industrial prices have remained within a tighter range between 481 Yuan (Jianggan) and 991 Yuan (Xiacheng). The different levels of scarcity and prices ranges based on location, as depicted by the dataset, will be useful in testing location theory at outlined by the monocentric city model.

Table 9: Average Land Prices 2003-present (Yuan)

District	Commercial	Industrial	Residential
Gongshu	12,636.50	759.41	18,872.65
HETDZ	17,475.67	494.35	13,771.48
Binjiang	7,181.87	495.02	8,843.59
Jianggan	25,112.26	481.38	17,421.61
Shangcheng	40,718.14	N/A	16,842.80
West Lake	10,973.33	626.11	15,545.90
Xiacheng	15,508.92	991.30	3,443.16

4.3 Amenity variables

In testing the amenity-based hedonic pricing model, the impact of amenity variables on land prices will be studied. The eight amenity variables and the respective districts that possess those amenities are listed in Table 10 below. These variables were assigned based on personal research as summarized under sub-sections 4.5-4.11, where a deeper discussion of how these variables are defined in the context of specific districts is provided.

Table 10: Amenity Variables by District

Amenity Variable	Districts
Geographical Trade Advantage	Gongshu
Commercial Financing System or Subsidy	Binjiang
Industrial Zone	HETDZ, Gongshu
Financial Center	Jiangan, Xiacheng
Tech Center	HETDZ Zone, Binjiang, Gongshu
Education center	HETDZ, Binjiang, Shangcheng
Military Headquarters	Shangcheng
Quality of Life Honors	Xihu, Shangcheng

4.4 - Geographical Trade Advantage:

Gongshu District's geographical advantage comes from its northern location. It has a developed network of transport and infrastructure that is far in outreach and of the central city districts, Gongshu is closest in proximity to northern economic centers such as Shanghai and Beijing. Emphasizing modern goods flow, commerce, and trade, Gongshu's growth has benefitted from its geographic advantages (Hangzhou Municipal Economic Commission 2005).

4.5 - Industrial Zone:

While a number of industrial centers are located throughout the city of Hangzhou, the HETDZ is the only one dominated primarily by industrial activity. The HETDZ zone is one of four state-developed zones and is dominated by the biology, medicine, machinery, manufacturing, and food and beverages industries. Gongshu District has also been included since it is home to the Gonshu Scientific Industrial Park and is dominated by the presence of the textile manufacturing industry (CPC Hangzhou Committee 2012).

4.6 - Financial Center

Jianggan District is located in the center of the metropolis of Hangzhou and is considered to be one of the "economic power districts" within the city. Xiacheng is another financial center known globally for real estate its infamous Silk Town and Wulin Female Fashion Street and has earned the titles "Top District of Private Economics" and "King of Genuine Leather Garments" (Hangzhou Municipal Economic Commission 2005). Xiacheng was named as the Commercial District of China in 2009. The district was awarded this honor at the China Commercial Street Development Summit Forum that took place in 2009, where 500 commercial street delegates from 20 cities discussed optimal commercial development policies (Chen Saiyan 2009).

4.7 - Commercial Financing System and Subsidies

Binjiang has a Multi-Enterprise Financing System and Venture Capital Fund aimed at supporting and providing easy capital and credit for small medium enterprises. While other districts also have some sort of financing system, policies within Binjiang are particular preferential. Nine out of the global Fortune 500 Companies have invested in Binjiang District; Cerberus Private Equity fund alone has more than 40 concentrated venture investments within the district. Binjiang also has preferential taxation policies that provide favorable tax subsidies for foreign-invested companies (Zheng 2009).

4.8 - Tech Center

The city of Hangzhou is a hub for technological development but this variable focuses on three technological development centers within Hangzhou. Binjiang District, originally known as the Hi-tech Industry Development Zone, is the most innovative and influential center for science and technology within the Zhejiang Province. It is home to five hi-tech industries including, software technology, photo-electro-mechanical integration, and bio-medicine. HETDZ is also a center for technological development, and home to a number of global hi-tech companies including Siemens High Voltage Circuit Breaker Company, and Panasonic Motors (Hangzhou Municipal Economic Commission 2005). Finally, Gongshu is home to the Northern Software Park and thus the base to the national electronic information industry. It is thus a hub for software development (CPC Hangzhou Committee 2012).

4.9 - Education Center

While universities are located throughout many districts within Hangzhou, HETDZ is the largest college town in Hangzhou. It is home to the Xiasha Higher Education Park and seven higher education institutions including Zhejiang University of Media and Communications, Zhejiang University of Finance and Economics, and Hangzhou Normal University. It is also home to middle schools, primary schools, teachers' apartments, and scientific research industry land. (Li 2012) While HETDZ hosts the largest college town, the most prominent college town still lies within the Binjiang District which is home to more than 30 universities, most notably the famous Zhejiang University and China Academy of Fine Arts. Binjiang is also home to 70% of academicians in the Zhejiang province (Zheng 2009). Finally, Shangcheng District has been included given that it is home to Hangzhou's four academies of classical learning including the Wansong Academy. Shangcheng is not home to a traditional college town but its ancient roots to classical learning make it a noteworthy center for education.

4.10 - Military Headquarters and Quality of Life Honors

Shangcheng District is home to Hangzhou's Military Base. It won the national "Human Settlement Environment Award" along with a number of other national and provincial quality of life honors (CPC Hangzhou Committee 2012). Along with Shangcheng, the Xi Hu District, home to the infamous West Lake, has also been praised consistently as heaven on earth due to its beautiful scenic environments. From green mountains to clear waters to teahouses, it is often praised for its natural amenities (Hangzhou Municipal Economic Commission 2005).

From *size, date, and land use*, to amenity variables such as *quality of life honors, industrial zone*, and *education center*, all the variables discussed above are hypothesized to have an influence on land prices. Nonetheless, by including amenity variables within the regression models, this paper aims to distinguish itself from existing studies to depict the importance of amenities as a determinant of land value. The variables discussed within this section will be tested in a number of regression variations and the results will be discussed in sections 5.1-5.3.

V. Empirical Specifications and Discussion

As mentioned, the data set used to test the hypothesis is a compilation of land sale reports from the Hangzhou Bureau of Land and Resources and includes 619 complete observations of land sale transactions from 2003-present. The independent variables I used are defined within Table 19 in the Appendix. In Section 5.1, I discuss the results of various regression models applied to the entire dataset. Data is then divided into 3 sets by land use (commercial, residential, and industrial) as Section 5.2 discusses the results of the 3 separate regression models specific to each type of land use. Finally, Section 5.3 summarizes and compares the results and implications of all models. For the purpose of clarity, a roadmap outlining the motivations behind the various regression models is shown below.

Table 11: Regression Model Road Map

Model	Motivations behind the model	Section/Page
Combined Models		
Baseline Model:	Used to test the models and theories within existing literature	5.1, 32
Model 1	Adapted to account for amenity variables in an effort to test the amenity-based hedonic theory as motivated by Kuznets environmental curve	5.1, 32
Model 2	Adapted version of Model 1; accounts for district variables and land use variables as separate dummy variables	5.1, 35
Model 3	Dropped district variables; utilized Principal Component Analysis to group amenity variables into 3 factors	5.1, 35
Model 4	Model 3 with the addition of a Quality of Life amenity variable	5.1, 35
Models Separated by Land Usage		
Commercial	Separate models were used to capture the varying impact of amenity variables across different types of land.	5.2, 40
Residential		5.2, 40
Industrial		5.2, 40

5.1 - Regression Results: Full Dataset

While I hypothesize that amenity variables are critical in determining land value within Hangzhou, I decided to run a baseline model testing the methods and theories outlined within existing literature as shown below.

Baseline Model:

$$LogPrice = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Land\_Use + \beta_4 District$$

The initial regression combines the location theory outlined by the monocentric city model with the land use theory outlined by the hedonic pricing model by regressing *logPrice* (natural logarithm) on the following independent variables: *size, date, district, and land_use*. As mentioned in Section 4.2, *price/meters*^{2} has been adjusted for in real terms and has factored in inflation setting 2003 as a base year. I obtained the results shown in the Baseline Model column of Table 12, page 32.

As expected, the date coefficient shows that even controlling for changing land use, land prices were rising at about 12 percentage points per year. Furthermore, given that *land_use0* is denoted as (1-Commercial, 2-Residential, 3-Industrial), the coefficient confirms that commercial land sales on average are at a significant premium while Industrial land provides on average over a 130% discount to residential land sales. *Size/meters*^{2} has a slightly negative impact on land prices but at a number nearing zero, it appears to be economically insignificant within this model, thus signifying that no discounts are provided for bulk land sales within Hangzhou.

Motivated by the theories presented by Kuznets environmental curve, a number of amenity variables were incorporated into the baseline model to test the amenities-based hedonic theory in an effort to explain why certain parcels of land of the same land use, sold on the same date and in district are sold at a significant premium or discount. These amenity variables will be used to test whether or not district amenity characteristics are the reasons behind (1) land price appreciation, (2) different degrees of land appreciation.

Table 12: Preliminary Regression Results

Summary Statistics

	Baseline Model	Model 1
R-squared	0.428	0.501
# of Observations	621	621

	Baseline Model	Model 1
Size	-3.22e-06* (8.77e-07)	-2.51e-06* (8.27e-07)
Date0	0.1173* (.021)	0. 1173* (.020)
Land_use0	-1.2841* (.066)	-1.1975* (.064)
District_N~r	0.0697* (.066)	-0.1744* (.061)
Commercial~m		-0.4949* (.198)
Industrial~s		(omitted)
Geographic~e		(omitted)
Financial_~r		0.9504* (.278)
Tech_Center		(omitted)
Educational~r		-0.3478* (.169)
Military_H~S		0.8443* (.332)
Quality_of~s		0.9078* (.345)
_cons	10.0629* (.198)	10.3955* (.199)

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 1%, 5%, and 10% level, respectively

Therefore, the baseline regression model was adapted to account for such factors. In the second amenities-based hedonic model, adjustments are made to account for amenity variables (accounted for in binary form), such as *edu_center, and quality_of_life_honors*. The variables and method of measurement are defined within Table 19 in the Appendix and the results are juxtaposed in Table 12 column 2 on page 32 to allow for a comparison with existing models. Model 1, shown below, thus expands existing models to account for an amenities-based hedonic pricing theory.

Model 1:

$$LogPrice = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Land\_Use + \beta_4 District + \beta_5 Commercial{\sim}m + \beta_6 Industrial{\sim}s + \beta_7 Geographical{\sim}e + \beta_8 Financial{\sim}r + \beta_9 Tech\_Center + \beta_{10} Edu\_Center + \beta_{11} Military\_H{\sim}s + \beta_{12} Quality\_of{\sim}s$$

Under adapted Model 1, R-squared improved to .50 (versus .43 for the Baseline Model) signifying a better fit. *Size, date, and land use* depict similar results to the regression results yielded by the baseline model. Nonetheless, among the new variables that are not collinear and are statistically significant, the presence of a *commercial financing system* appears to decrease pricing by almost 50 percentage points while land located within an *educational zone* decreases pricing by nearly 35 percentage points. Finally, housing within a district inhabited by *military headquarters* appears to increase pricing by nearly 84 percentage points. These are significant results of great interest, however, while existing models and the baseline model attempt to define *land use* and *district* as single variables by using a 1-3 and 1-7 defining system, using dummy variables would be a more accurate method of measuring the different land use types and districts. Measuring *land use* as (1-Commercial, 2-Residential, 3-Industrial) allows land use to be captured within a single variable, however, using such a method falsely assumes that commercial parcels are the priciest followed by residential and industrial. Moreover, accounting for the various districts using a 1-7 denotation further assumes that district prices averages rank from highest as denoted by 1 to lowest as denoted by 7. Thus, in Model 2 below, the model is adapted to include binary measurements for each land use and each district variable. The results are presented in Table 13 of page 35.

Model 2:

$$LogPrice = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Commercial + \beta_4 Residential + \beta_5 Industrial + \beta_6 Gongshu + \beta_7 HETDZ + \beta_8 Binjiang + \beta_9 Jiangan + \beta_{10} Shangcheng + \beta_{11} WestLake + \beta_{12} Xiacheng + \beta_{13} Commercial{\sim}m + \beta_{14} Industrial{\sim}s + \beta_{15} Geographical{\sim}e + \beta_{16} Financial{\sim}r + \beta_{17} Tech\_Center + \beta_{18} Edu\_Center + \beta_{19} Military\_H{\sim}s + \beta_{20} Quality\_of{\sim}s$$

Including binary measurements for each variable, however, lead to huge problems of collinearity, thus leading to a number of omitted variables. I was especially concerned by the omission of the Industrial land use variables as logically and economically, industrial parcels are sold at significant discounts that should have a significant impact on the model and the dependent price variable.

Thus, due to the large number of correlated variables, Model 3 drops all district variables as depicted below.

Model 3:

$$LogPrice = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Commercial + \beta_4 Residential + \beta_5 Commercial{\sim}m + \beta_6 Geographical{\sim}e + \beta_7 Factor1 + \beta_8 Factor2 + \beta_9 Factor3$$

Model 3 also utilizes Principal Components Analysis to group remaining correlated variables among the Amenity variables.

Principal Component Analysis is a multivariate statistical technique used to reduce the number of variables in a data set into a smaller number of “dimensions” It is used to create uncorrelated indices or components from an initial set of n correlated variables – each component is calculated as a linear weighted combination of the initial variables.

For example, from a set of variables X_1 through to X_n

$$\mathrm{PC}_1 = a_{11}X_1 + a_{12}X_2 + \cdots + a_{1n}X_n$$
$$\vdots$$
$$\mathrm{PC}_m = a_{m1}X_1 + a_{m2}X_2 + \cdots + a_{mn}X_n$$

where a_{mn} represents the weight for the m^{th} principal component and the n^{th} variable.

Table 13: Regression Results

Summary Statistics

	Model 2	Model 3	Model 4
R-squared	0.797	0.795	0.797
# of Observations	619	619	619

Size	-8.04e-06* (5.59e-07)	-8.10e-06* (5.61e-07)	-8.04e-06* (5.59e-07)
Date0	0.1841* (.013)	0.1814* (.013)	0.1841* (.013)
Commercial	2.9912* (.085)	2.6407* (.125)	2.4447* (.147)
Residential	3.5088* (.088)	3.1816* (.124)	2.9623* (.051)
Industrial	(omitted)		
District Dummies			
Gongshu	(omitted)		
HETDZ	(omitted)		
Binjiang	(omitted)		
Jianggan	(omitted)		
Shangcheng	(omitted)		
West_Lake	-0.7878* (.197)		
Xiacheng	-1.4921* (.228)		
Amenity Variables			
Commercial~m	(omitted)	-0.4206* (.086)	-0.2650* (.1053)
Industrial~s	0.4604* (0.099)		
Geographic~e	(omitted)	0.1638*** (.096)	0.2470* (.101)
Financial_~r	0.7297* (.098)		
Tech_Center	-1.2464** (.196)		
Edu_Center	-0.1178 (.101)		
Military_H~S	(omitted)		
Quality_of~s	(omitted)		0.8824* (.352)
Factor Variables			
factor1		-0.0678** (0.032)	0.2417** (0.127)
factor2		-0.2323* (.051)	-0.3551* (.070)
factor3		0.0928* (.032)	0.0799* (.032)
_cons	6.0612* (.218)	5.5799* (.131)	5.5104* (.134)

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 1%, 5%, and 10% level, respectively

Principal Components Analysis, when applied to 7 highly correlated Amenity variables, yielded the following results in Table 14 (Smith 2002).

Table 14: Principal Component Analysis

	Factor 1	Factor 2	Factor 3
Industrial	-0.087	0.521	-0.294
Industrial~s	0.223	0.259	0.169
Financial_~r	0.156	-0.487	-0.001
Tech_Center	0.409	-0.023	0.046
Educational~r	0.119	0.054	0.543
Military_H~S	-0.098	-0.225	0.594
Quality_of~s	0.454	0.178	-0.028

Table 15: Predicted Factors

Factor 1: (Commercial center)	Financial~r, Tech _Center, Quality_of~s
Factor 2: (Industrial zone/parcel)	Industrial, Industrial~s
Factor 3: (Neighborhood amenities)	Educational~r, Military_H~S

As shown in Table 15, Factor Analysis grouped Financial Center, Tech Center as Factor 1, Industrial and Industrial~s as Factor 2, and Education Center and Military Headquarters as Factor 3. Quality of Life Honors, however, failed to fit within any of the factors and as a result, a Model 4 alternative is provided, as shown below, that incorporates the Quality of Life Honors variables along with all the variables used within Model 3.

Model 4:

$$LogPrice = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Commercial + \beta_4 Residential + \beta_5 Commercial{\sim}m + \beta_6 Geographical{\sim}e + \beta_7 Factor1 + \beta_8 Factor2 + \beta_9 Factor3 + \beta_{10} Quality\_of{\sim}s$$

Regardless of the Model, all three of these Models provided favorable and consistent coefficients along with R-squared values above 0.7. With improved significance levels and R-squares values, the results presented by Models 2-4 appear to represent improvements from the results yielded by the Baseline Model and Model 1. Consistently, *size* at around 8e-06, is close to zero and essentially has little to no impact on land prices. Its coefficient is negligible and is economically negligible as well when multiplied by its standard error. Furthermore, an increase in the *date* variable by 1 year is expected to increase the price of land by around 18 percentage points while *commercial* and *residential* land parcels are expected to be offered as a premium of over 200 percentage points as compared to industrial parcels, thus confirming the presence of market subsidies within the industrial land market.

While Model 2 fails to capture the industrial variable due to collinearity, Models 3 and 4 group the *industrial* land use variable with the *industrial focus* amenity variable to combine for a factor variable with a significant coefficient that impacts land prices by around 23 percentage points. Other variables of interest include *Factor 3* (*education and military headquarters*), *geographic trade advantage, commercial subsidy*, and in the case of Model 4, *quality of life honors*. From the coefficients, we can conclude that buyers within Hangzhou place a strong emphasis on amenities such as quality of life, education, safety, and geography. Thus, being located within a college district or military headquarter increases pricing by around 8 percentage points while being located within a district with a geographical trade advantage can raise prices by around 20 percentage points. Moreover, as captured within Model 4 only, districts that have been honored by quality of life awards within national publications experience on average a 90-percentage point increase in prices from those districts that have not been honored.

Finally, Models 3 and 4 also capture the presence of commercial subsidies or a commercial financing system within certain districts, thus accounting for the varying averages in commercial land parcels among the different districts. Binjiang district, for example, has a small medium enterprise financing system, which thus explains the nearly 43-percentage point discount, captured within the *commercial_subsidy* variable in Model 3. Nonetheless, it must be noted that while a discount for commercial parcels exists, the extent of the 43 percentage point discount captured within Model 3 may be reflective of a reverse causality effect in which commercial financing systems tend to be located within less developed districts facing less demand and a need to incentivize consumer demand with cheaper prices.

All the combined models discussed within Section 5.1 offer substantial insight into the value of amenities across the Hangzhou land market. Yet, given the drastic differences between residential, commercial, and industrial land parcels, amenity variables should not be interpreted to have equal impacts across land uses. A commercial subsidy that benefits commercial developments should not be applied in the same way to residential parcels. In particular, industrial parcels have a smaller price range and are less subjective to market influences. The degree to which amenity variables influence demand and drive up pricing for industrial parcels will therefore differ drastically from residential or commercial land parcels. Thus, as a supplement to my current findings, section 5.2 analyzes separate models by land use.

5.1 – Separate models by land use

To understand the different degree to which amenity variables impact land prices within the context of different land usages, separate models by land use, as shown below, are tested; the results can be found in Table 16 of page 40.

Commercial Model:

$$LogPrice_{M2} = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Commercial{\sim}m + \beta_4 Industrial{\sim}s + \beta_5 Geographical{\sim}e + \beta_6 Tech\_Center + \beta_7 Edu\_Center + \beta_8 Quality\_of{\sim}s$$

Residential Model:

$$LogPrice_{M2} = \beta_0 + \beta_1 Size + \beta_2 Date + \beta_3 Commercial{\sim}m + \beta_4 Industrial{\sim}s + \beta_5 Geographical{\sim}e + \beta_6 Finance{\sim}r + \beta_7 Tech\_Center + \beta_8 Edu\_Center + \beta_9 Quality\_of{\sim}s + \beta_{10} Military\_H{\sim}s$$

Industrial Model:

$$LogPrice_{M2} = \beta_0 + \beta_1 Size\_M2 + \beta_2 Date + \beta_3 Commercial{\sim}m + \beta_4 Industrial{\sim}s + \beta_5 Tech\_Center + \beta_6 Finance\_{\sim}r + \beta_7 Edu\_Center + \beta_8 After\_2010$$

Immediately, the discrepancies between the models are apparent. *Size*, while close to zero for all 3, is significant for only commercial and residential parcels. Nonetheless, there is consistency between the models thus confirming the lack of bulk sale discounts. Further discrepancies arise in the results of the *date* variable, which appears to have a huge positive impact on the land prices of commercial and residential parcels, but a negative effect on industrial parcels. As shown in Table 16 on page 40, while commercial and residential parcels increase by 24 percentage points and 16 percentage points respectively each year, industrial parcels on average decrease in price by 11 percentage points each year on average with a spike in price in all transactions that take place after 2010. Given that records of industrial land sales only date back to 2007, this negative coefficient and the *After_2010* dummy variable most likely captures an end to the 2009 policy aimed at lowering industrial land prices.

Beyond the Size_M2 and Date variables, the remaining amenity variables used within the models above are inconsistent among the 3 models. Whereas the *commercial~m* variable decreases the price of commercial land parcels significantly by 138 percentage points 38 percentage points respectively, it was omitted within the industrial model. Moreover, while being located within an *industrial zone* lowers the price of commercial parcels, it positively affects the price of industrial and residential parcels. However, it is important to note that while residential prices appear to increase within industrial zones, this is most likely capturing the benefits of being located in an education district as college towns tend to be located within state-level industrial development zones. Yet, being located in an *education district*, when studied as a district amenity, raises commercial prices while lowering industrial and residential prices. This may reflect subsidized residential parcels designated for dormitories and employee residencies.

Table 16: Regression Results

Summary Statistics

	Commercial	Residential	Industrial
R-squared	0.545	0.643	0.511
# of Observations	247	230	145

Size	-9.72e-06* (1.44e-06)	-8.67e-06* (6.08e-07)	-4.36e-07 (6.11e-07)
Date0	0.2397* (.025)	0.1642* (.018)	-0.1087* (.027)
Commercial~m	-1.3782* (.170)	(omitted)	0.3819* (.153)
Industrial~s	-2.0393* (0.340)	0.4279* (.155)	0.7553* (.155)
Geographic~e	1.0834* (.352)		
Financial_~r		0.2448 (.147)	0.3277* (.138)
Tech_Center	0.7505* (.181)	0.1095 (.188)	-0. 6228* (.147)
Edu_Center	1.1195* (.263)	-0.2887* (.157)	-0.3872* (.046)
Quality_of~s	-0.3616*** (.204)	0.5577* (.243)	
Military_HQ		0.2849* (.296)	
After_2010			0.3448* (.065)
_cons	8.0023* (.216)	8.5732* (.241)	7.0415* (.173)

Standard errors are reported in parentheses.
*, **, *** indicates significance at the 1%, 5%, and 10% level, respectively

The effects of being located near commercial activity are further captured within the *finance center, tech center, and geographical trade advantage* variables. The *geographical trade advantage* amenity variable is solely statistically significant when applied to commercial parcels but as expected, raises land prices by over 108 percentage points. Being located within a *finance center* increases land prices for industrial land by over 33 percentage points and increases residential prices by around 24 percentage points. The *hi-tech* variable, on the other hand, increase commercial land prices by almost 75 percentage points; yet, they decrease industrial land prices by more than 60 percentage points. While the increase in commercial prices can be explained by demand from tech companies looking to establish themselves within a hi-tech district, the decrease in industrial land prices is most likely the result of the prevalence of districts acting as both a tech center and industrial development zone. Since industrial land prices are not market driven, this may reflect that government policy favors investments in hi-tech industries. The decrease in price thus captures the incentives offered within many of these development zones aimed at spurring industrial investments.

Finally, neighborhood amenities are captured via the *quality of life* and *military headquarter* variables. Both benefit residential prices thus confirming that residential consumers value scenic neighborhoods, safety (as captured by the military headquarters), and quality living conditions. *Quality of life honors*, however, negatively impact the price of commercial parcels. This most likely reflects the Chinese consumer's preference for residencies located within areas that are not bustling with commercial activity. Reflecting the theory outlined by Kuznets environmental curve, residential preferences for natural amenities and neighborhood amenities can be confirmed. Thus, an area that possesses quality residential traits is most likely unfavorable for commercial activity and reflected by the negative quality of life honors coefficient experienced by commercial parcels.

5.2 – Summary of Results

Despite a countless number of regression results and the varying results presented by each model, some common themes prevail. For one, regressions with amenity variables always obtained a higher r-squared value, indicating a better fit and indicating that despite the limited focus existing literature has placed upon amenity variables as determinants of land value, researchers need to include amenity variables within future models of Hangzhou, and arguable China as a whole.

Moreover, the drastic difference in the signs and magnitude of amenity variable coefficients across the different models confirm that different land types are influenced by amenity variables to varying degrees. *Quality of Life Honors*, seemingly beneficial for the entire dataset as presented by Model 4, actually decreases the value of commercial parcels while driving up the value of residential parcels.

Finally, along the lines of Kuznets environmental theory, the degree to which consumers value scarce amenities was not fully captured by an of the regression models. While some results captured, such as those of the *Quality of Life Honors* variable, were in line with confirming that consumers (residential in this case) value neighborhood and natural amenities enough to drive up pricing by over 50 percentage points, other results such as the positive impact of *industrial zone* on residential prices, were not as consistent. While explanations for such results were presented within section 5.2, it is important to note that such results are most likely as driven by residuals. Moreover, the extent to which amenities have the capabilities to drive outliers is not fully captured within the results presented by regression model. If China is truly at the Industrial Economy stage of Kuznets environmental curve and if the scarcity of natural amenities within China is truly driving pricing to extreme levels, the extent to its value is not fully captured within the regression models and in order to fully understand its value, case studies of select outliers is necessary.

5.3 – Case Studies of Outliers

Thus, the analysis of the coefficients presented by the regression results in Section 5.1-5.3, while insightful, are insufficient. Due to the huge range in land prices within Hangzhou, residual analysis and a study of outliers is necessary in order to fully understand the drivers behind such discrepant pricings. With the exception of the Industrial land sale dataset, all other datasets suffered from issues of skewness and kurtosis as presented in Table 17 below.

Table 17: Skewness and Kurtosis Test

	Pr(skewness)	Pr(Kurtosis)	adj chi2	prob>chi2
Industrial	0.0000	0.0001	26.68	0.0000
Commercial	0.2622	0.9101	1.28	0.5270
Residential	0.1254	0.0026	10.15	0.0062

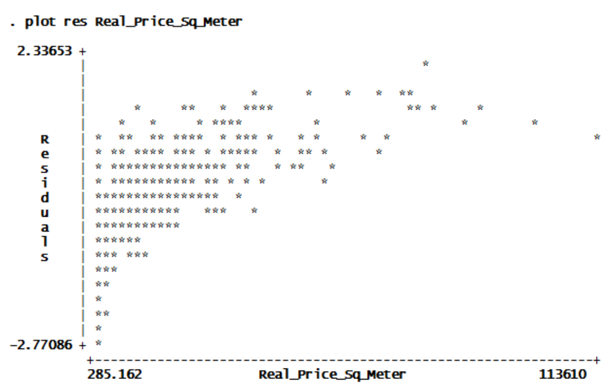


Figure 5: Residential Land Price Residuals

The lack of normality and the prevalence of outliers in both the upper and lower range for *Price/Meters*^{2} data points motivated a case study of six outliers presented below. A residual plot for residential land prices is depicted above but additional residual plots can be found in Figures 8-15 within the Appendix.

Hence, a number of outliers were thus examined in an effort to explain the steep price premiums or discounts present within these particular parcels. We will begin with an analysis of four of the most expensive parcels, in real terms, sold within the last eight years and proceed with an assessment of two of the cheaper parcels. However, it is important to note that the lower outliers discussed are not the two cheapest parcels that exist within the entire dataset. Instead, I have selected two of the cheaper commercial and residential parcels, given that a majority of the cheapest land parcels are industrial parcels that are not true outliers within the industrial dataset. Moreover, given limitation in transparency, information regarding certain transactions is limited. Thus, the two lower outliers that have been chosen are simply two of the cheaper commercial and residential parcels with the most transparent information in terms of location and buyer characteristics.

Parcel [2010] 11 was sold on March 11, 2010 for 827,470,000 Yuan. At a size of 7354 meters^2, the real price/meters^2 of 113,610.38 Yuan/meters^2 was the highest of all transactions that have taken place since 2003. The parcel was sold for commercial purposes and is located in the Shangcheng district.

Figure 6: Map of Shangcheng District

It is a Hubin (Lakeside) unit and is located within the major waterfront Hubin sub-district on the eastern shore of West Lake. Moreover, the parcel of land was used for the renovation and building of the headquarters for Hangzhou regional trade and tourism. Thus, the value of this property is derived largely from its lakefront amenity value and from its favorable location as the center for trade and tourism. Some other parcels that benefit from their lake front location include [2007] 35 and [2006] 35, which were sold for 77,916.29 Yuan/meters^2 and 74,061.14 Yuan/ meters^2 respectively. [2007] 35 was bought by the Poly Real Estate Group Co., Ltd on July 25, 2007 and is located southeast along a river within the Hangzhou Economic and Technological Development Zone. The parcel was 29,076 meters^2 and cost 2,020,000,000 Yuan.

Parcel [2011] 8 was sold on April 14, 2011 and is located within the Jianggan District. At 16,781 meters^2, the parcel was sold for a price of 1,771,000,000 Yuan, or 99,750.49 Yuan/ meters^2 and is the second most expensive parcel sold. It was designated for commercial use and was bought by the Zheshang Property Insurance Company. Its premium, however, is driven not by its commercial advantage but by its location within the Qianjiang New Town. The Qianjiang New Town is a sub-district located primarily within the Jianggan district, although around 15% of the town is classified within the Shangcheng district. Most of its development has taken place within the last 10 years as it is currently being developed into a new central business district. The town is known for being home to the International Conference Center, the Grand Theatre, City Balcony, and the Civic Center.

Figure 7: Qianjiang New Town

With a Civic Center that has restaurants, hotels, a gym, swimming pool, recreational area, the largest library in Hangzhou, and a City Balcony that overlooks the Qiantang River, the town is valued for both its residential amenities and its environmental amenities. Moreover, known for a large amount of grass and trees, it is no surprise that 4 out of the 10 most expensive parcels that have been sold in the last 8 years have been located within the Qianjiang New Town.

Among the most negative outliers, [2006] 52 is a residential parcel located within the Binjiang district. It was purchased by the Hangzhou Jinsheng Real Estate Co., Ltd. and despite its favorable location within the tech-driven, commercially subsidized Binjiang district. This particular parcel is located east of the Hangzhou Jinsheng Industrial Park, and south of the Hangzhou Puyan Transport Co., Ltd. Thus, much of the discount may be driven by the unfavorable placement next to an industrial park. The parcel was sold on July 5, 2006 and at a real price of 701.51 Yuan/meters^2, it was offered at an enormous discount when compared to the 113,610.38 Yuan/ meters^2 premium that Parcel [2010] 11 was sold at. It is however, interesting to note that at a size of 289,754.92 meters^2, and a price of 210,990,000 Yuan, the size of the parcel is considerably larger than the size of most residential parcels. Thus, even though the regression results disprove the presence of bulk sale discounts, this parcel in particular may have benefitted from some type of bulk sale discounts. Finally, [2006] 11 is a commercial parcel located within the Binjiang District and was bought on July 5, 2006 by Hangzhou Hemingstone Properties Limited. It was bought for the purposes of high-tech commercial activity and as a storage facility and most likely benefited significantly from the discounts offered by the Binjiang tech subsidies.

Such results confirm that amenities are unusually scarce and in extremely high demand in China. In particular, Chinese consumers value lakeside parcels and parcels located within Qinjiang New Town. On the other hand, parcels located in industrial zones are less desirable and thus discounted. Japan and Korea, two countries who have preceded China in reaching the industrial economy stage of Kuznets environmental curve, have also experienced similar stages where environmental degradation was at a height and amenities scarce. I do not have access to a full dataset of Japanese land sale transactions so I cannot offer any insight and direct comparisons of specific parcel outliers, yet comparing the dispersed range of average residential land prices across cities provides a ground for comparison.

As Japan entered a stage of industrial growth in 1985, across 27 major cities, the average residential land value ranged from 56,000 to 260,000 Yen/ $meters^2$. The combined average price of all 27 major cities was 117,000 Yen, yet, the average residential parcel in Tokyo, at 736,000 $Yen/Meters^2$, was 13 times of the lower bound of averages (Smith 1992). The difference in pricing can be attributed to demand and a consumer preference for the living environment offered by each respective city or region. Tokyo, with its advantage as a metropolitan center combined with its reputation for safety, cleanness, and ease of transportation provides consumers with the ideal city of residency that they are willing to pay 13 times more for over the less idea residential city.

In the US, a comparison was done across regions rather than districts or cities and the results portrayed a large range in the average residential land prices. In the Midwest, the average 2004 parcel cost only 79,000 dollars while in the West Coast, the average price cost 440,000 dollars (Davis 2007). Data were unavailable on the per $meters^2$ basis so this is not the best comparator. Yet, with the difference in demand being attributed to preference and demand based on quality of life, whether that quality is attributed to the financial opportunities of Silicon Valley versus Detroit, or the warm beaches of San Diego versus the cold winters of Chicago, it confirms the role of amenities in determining land prices. Table 18 below offers a comparison of ranges across Hangzhou, Japan and the US.

Table 18: Residential land price ranges across countries

	Hangzhou Yuan/Meters^2	**Japan Yen/Meters^2**	**US $**
Lower bound	元 598	¥56,000	$79,000
Upper bound	元 185,098	¥736,000	$440,000
Price measures	Specific transactions	City averages	Regional averages

Thus, amenity variables are applicable across different land markets and can be used to explain discrepant pricings in land markets throughout the world; yet, in places such as China and Japan where amenities are abnormally scarce and a wider range in pricing is apparent, it appears to have a more significant role in impacting land prices.

VI. Conclusion

The existing literature has tested and confirmed the monocentric city model and hedonic pricing model as frameworks for understanding the determinants of land prices. Existing studies tend to focus on size, date, land use, and location as drivers behind land prices. This paper, however, focuses on amenity variables as drivers behind pricing. The importance of distance to city center and transportation, as outlined by the monocentric city model and hedonic pricing model, are of interest to this study but of little importance given that all parcels included within the current dataset are located within the urban city area of Hangzhou where transportation is plentiful. I therefore test the impact of a number of amenity variables in an effort to understand the amenities valued by consumers and the impact these amenities have on land prices within Hangzhou. Using a dataset of 619 land sale transactions that have taken place in Hangzhou between the years of 2003 and 2011, I postulate that the huge range in land prices is driven largely by land use. Among parcels designated for similar use, neighborhood characteristics and natural amenities have the largest impact on price discrepancies due to the scarcity of natural amenities within China, as anticipated by Kuznets environmental curve.

To test the hypotheses above, I constructed a number of OLS regressions. I also included detailed case studies regarding six selected outliers in an effort to explain the drastic premiums or discounts that they were sold at. The results were statistically, and economically significant and both the combined model and the separated by land use models confirm the importance of land use and amenities in driving land prices. Nonetheless, while all regression models support the importance of quality of life metrics as driven by scarcity, the degree to which scarcity is driving up prices is not fully captured within the regression models. Rather, the six case studies offered within this paper offer a potential explanation for the outrageous premiums or discounts offered for particular land parcels. From lakefront locations, to green space surroundings, these amenities were valued by both residential and commercial developers to an extent that they were willing to pay over 100,000 Yuan/meters^2 for one parcel of land.

The results of the case studies confirm that amenities, scarce and in extremely high demand in China, play a huge role in determining land value and accounting for drastic price ranges. However, such dispersion in the range of average residential land prices is not unique to Hangzhou as a similar phenomenon can be seen across cities in Japan, who preceded China in reaching the industrial economy stage of Kuznets environmental curve. Moreover, similar comparisons with the US confirm that while amenities can be used to explain discrepant pricings in land markets throughout the world, however, in places such as China and Japan where amenities are abnormally scarce, a wider range in pricing is apparent. In the US, where amenities are plentiful, if land prices within a specified area are abnormally high, another substitute district is readily available. In China, however, substitutes are limited which thus explains the existence of extremely expensive outliers.

The findings in this paper add value to the research community in several ways. First, it provides a translated, manually compiled, comprehensive dataset of land sale transactions since 2003. Second, the paper outlines the value of a number of amenity variables as it offers insight into the value of these amenities in determining land prices, especially in areas where environmental and neighborhood amenities are scarce.

In addition, the evidence presented in the paper can have policy implications for both Hangzhou and a number of developing cities within China. The value of education towns, the benefits of natural amenities, and the prestige of quality of life honors have proven to be huge drivers behind land prices. The development of urban green spaces, a residential atmosphere, and a community of education may therefore be of value as the loss in an ability to capitalize on the land within urban green spaces appears to be more than offset by the rise in land values within parcels possessing such environmental amenities. Hence, it is not unreasonable to believe that other cities within China might replicate Hangzhou's pattern of urban land pricing and emphasize the value of amenities. This may be especially apparent as China moves out of the industrial economy stage of Kuznets environmental curve to the point where environmental improvements are made. Of course, further studies on the relationship between natural amenities and land price will be needed to understand the benefits of enacting a policy for the development of green spaces. However, this paper contributes to our understanding of the extent to which living amenities are valued by Chinese consumers amidst a market in which environmental amenities are scarce.

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Appendix

Table 19: Independent Variables Defined

Size	$Meters^2$
Date of Transaction	Actual Transaction Date (Month/Date/Year)
Land Use	1-Commercial 2-Residential 3-Industrial
District	1-Gongshu District 2-Hangzhou Economic and Technological Development Zone 3-Binjiang District 4- Jianggan District 5-Shangcheng District 6-West Lake District 7-Xiacheng District
Commercial Financing System	Binary measurement: 1-Denotes the presence of a Financing system or subsidy program 0-No Financing system or subsidy program
Industrial Focus	Binary measurement: 1-Denotes an Industrial District 0-Denotes any District where Industrial activity is not the main focus
Geographical Trade Advantage	Binary measurement: 1-Denotes that a District is located near a port that is advantageous for trade 0-No advantage
Financial Center	Binary measurement: 1-Denotes a District labeled as a Commercial zone 0-Non-Commercial Zone
Tech Center	Binary measurement: 1-Denotes Districts labeled as Tech hubs 0-Non-Tech Zone
Educational Center	Binary measurement: 1-Denotes Education District 0-Non-Education District

Military Headquarters	Binary measurement: 1-Denotes the presence of Military Headquarters within the District 0-No Headquarters
Quality of Life Honors	Binary measurement: 1-Denotes any District that has been nominated for Quality of Life Honors by the Chinese government 0-No Honors
Size	$Meters^2$
Date of Transaction	Actual Transaction Date (Month/Date/Year)
Land Use	1-Commercial 2-Residential 3-Industrial
District	1-Gongshu District 2-Hangzhou Economic and Technolgical Development Zone 3-Binjiang District 4- Jianggan District 5-Shangcheng District 6-West Lake District 7-Xiacheng District
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Financial Center	Binary measurement: 1-Denotes a District labeled as a Commercial zone 0-Non-Commercial Zone
Tech Center	Binary measurement: 1-Denotes Districts labeled as Tech hubs

	0-Non-Tech Zone
Educational Center	Binary measurement: 1-Denotes Education District 0-Non-Education District
Military Headquarters	Binary measurement: 1-Denotes the presence of Military Headquarters within the District 0-No Headquarters
Quality of Life Honors.	Binary measurement: 1-Denotes any District that has been nominated for Quality of Life Honors by the Chinese government 0-No Honors

Table 20: GDP Deflator by Year

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2.1%	0.6%	2.6%	6.9%	3.9%	3.8%	7.6%	7.8%	-0.6%	5.8%

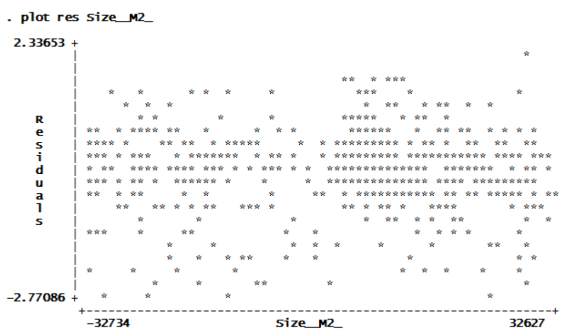

Figure 8: Size_M2 Residuals

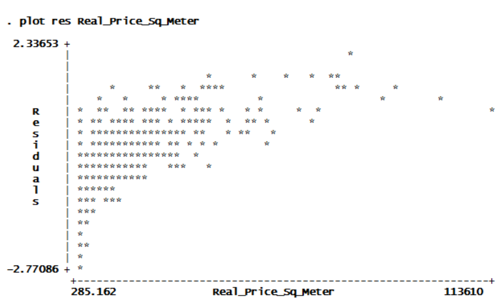

Figure 9: Real_Price_Sq_Meter Residuals

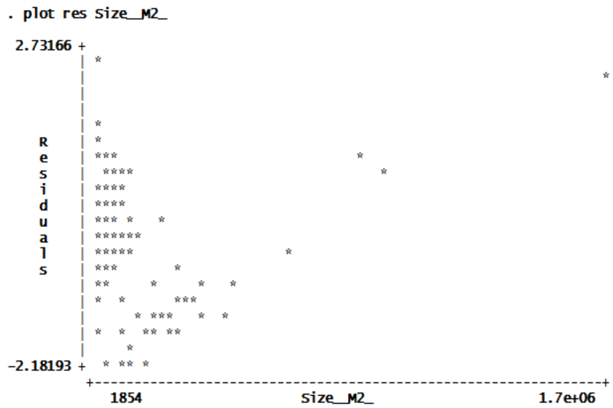

Figure 10: Residential Size_M2 Residuals

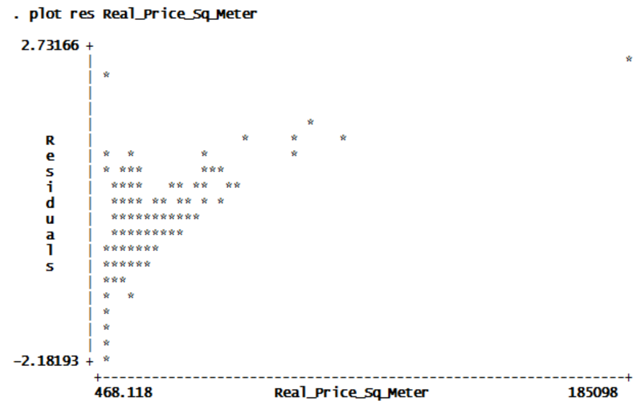

Figure 13: Residential Real_Price_Sq_Meter Residuals

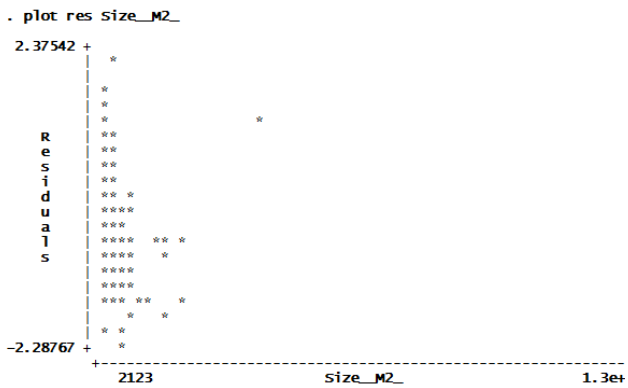

Figure 11: Commercial Size_M2 Residuals

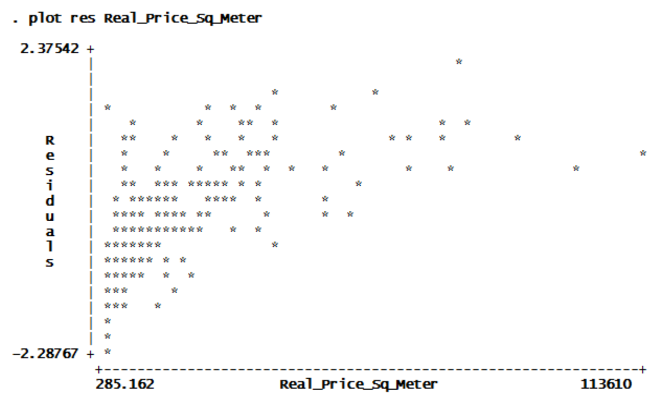

Figure 14: Commercial Real_Price_Sq_Meter Residuals

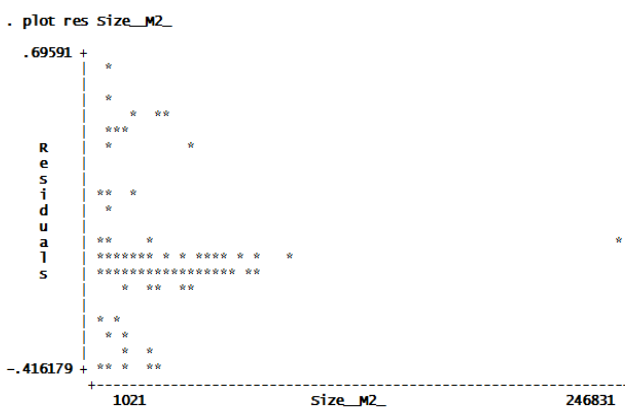

Figure 12: Industrial Size_M2 Residuals

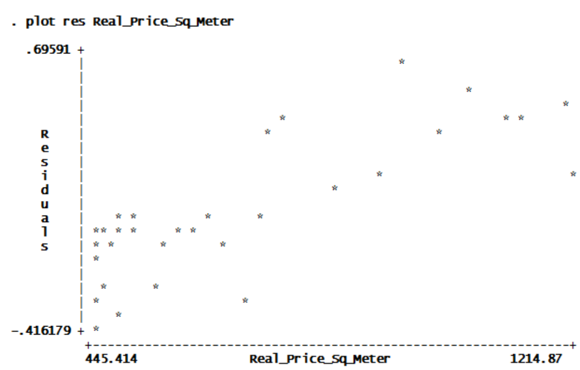

Figure 15: Industrial Real_Price_Sq_Meter Residuals