Three Essays on the Chinese Housing Market: Amenities, Environment, and Policies

by

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Abstract

This dissertation includes three essays that address economic impacts of amenities, environmental change, and development policy on the Chinese housing market. Chapter 1 examines the impact of the city water system improvement project on house prices in Guilin, China. Through model estimation, we determined housing characteristics with varying degrees of influence on house price, which are arranged sequentially with respect to housing characteristic categories from structural to location: area, age, floor level, annual income, proximity to CWSIP, proximity to downtown, proximity to major roads, and type of housing. Results suggest housing close to the CWSIP can receive a price premium, and housing with a further distance to the CWSIP receive a price discount. Further, an implicit price barrier of housing in the CWSIP surrounding areas has been revealed. These findings are consistent with consumer preference theory and the principle of resource scarcity.

Chapter 2 applies a residential sorting model to identify demand for the city water system improvement. The estimation indicates that population density, GDP per capita, average personal income, and government revenue per capita positively affect the demand for the housing market, while government revenue per capita and total sales per capita are negatively correlated with the housing market demand. The second stage suggested the CWSIP is a heterogeneous commodity, as the coefficients associated with the different distance with the house location. Because the area of the city water system improvement project constitutes the study area, house prices in the district were positively impacted by CWSIP. Welfare decreases with increasing distance to the CWSIP. Household welfare reduces by 4,670 yuan, 3,812 yuan, and 2,781 yuan, when the distance to CWSIP

increases from buffer 1 (within 500 m) to buffer 2 (501-1,000 m), increases from buffer 2 (501-1,000 m) to buffer 3 (1,001-1,500 m), and buffer 3 (1,001-1,500 m) to buffer 4 (over 1,500 m). The partial total welfare changes are estimated to be 1.16 billion yuan, 0.95 billion yuan, and 0.70 billion yuan respectively.

Chapter 3 employs the “difference in differences” approach to examine the impact of a city hall relocation plan on housing market. Results indicate that the governmental plan and subsequent outcomes significantly improve housing prices in the affected areas. Moreover, housing prices increased quickly after the announcement of the city hall relocation plan and its impact continues through the plan implementation stage. However, these lingering impacts might weaken after the relocation has been implemented. Our finding suggests that the city hall relocation plan positively is correlated with the house price. In the short run, larger positive impacts on the untreated group occurred immediately after the announcement. However, the actual impact of relocating the city hall was weaker than the announcement on house prices in the long run. The relocation announcement has a positive gross effect on house price in the city of Guilin, which is consistent with the government’s goal of improving local economic development. However, successful governmental behavior is not only focused on one point or one area; but it also needs to balance other factors to achieve the optimal goal of improving the overall quality of life and public services.

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"Happy families are all alike; every unhappy family is unhappy in its own way." – Leo Tolstoy

"Failure is not an option." – Eugene Francis "Gene" Kranz

The year of 2011 was an important turning point in my life. During the summer, I was accepted by Auburn's agricultural economics program along with the other eight students who were from four continents. During the five years of my doctoral study, I appreciate all of the arrangements from god and all of the great people I have ever met. First, I would thank Dr. Herny Kinnucan, Dr. Diane Hite, Dr. Valentina Hartarska, Dr. Henry Thompson, Dr. Denis Nadolnyak and all other instructors and professors of my PhD coursework. Without them, I would not have had a chance to explore my way in world of economics and to learn quantitative research methods. Second, I would like to thank Dr. Herny Kinnucan, Dr. Diane Hite, Dr. Valentina Hartarska, and Dr. Curtis Jolly who provided me enormous help and support during my most difficult time in my life. Without them, I could not move on from my family hardship and continue my study in Auburn. I also appreciate the opportunities to be a teaching and research assistant at Auburn.

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War Eagle!

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CHAPTER 1

Impact of the City Water System Improvement Project on House Prices in Guilin, China

1. Introduction

Housing is a heterogeneous product, which Harsman and Quiley (1991) define through the following characteristics: complexity, fixity, and durability. Complexity implies that housing meets a variety of family's demands and is closely related to the residents' life, work, amusement, etc. Fixity indicates that considerations of location and neighborhood attributes are involved with the choice of housing. Since housing is fixed under current technologies, migration costs may be high. Durability implies that housing replacement can be carried out to meet consumer's preferences and utility maximization. These characteristics imply that the price of a house is influenced by complicated factors closely related to housing characteristics. Since housing has heterogeneity characteristics, scholars often use the hedonic price model to estimate the value of each characteristic.

Previous studies suggest that higher consumer willingness to pay for housing is influenced by or tied in the improved quality of life, especially when amenity values are increased. Numerous studies have focused on defining the housing factors that influence house price (Maclennan 1977; Clapp and Giaccotto 1994; Can and Megbolugbe 1997; Boyle and Kiel 2001; Girouard *et al.* 2006). Empirical studies have estimated the prices that consumers are willing to pay for environmental goods, such as air quality, water quality and distance from toxic or potentially toxic sites (Boyle and Kiel 2001). Several articles have looked at the literature concerning a specific environmental good in order to see what variables affect the prices or to look for consistency in the results (Nelson, Genereux, and Genereux 1992; Clapp and Giaccotto 1994; Goodman and Thibodeau 1995; Calhoun 1996; Can and Megbolugbe 1997; Hort 1998; Boyle and Kiel 2001b; Girouard et al. 2006; Li and Yao 2007). As a consequence, it is important to understand the interaction between socio-economic and ecological/environmental factors. There is no doubt that ecological factors have a socio-economic value; the question is how these values transfer to the house price. Most of the links between economy and ecology are found in the house price premium within an attractive, green setting appeal over houses in a less favorable location. This premium is an expression of the socio-economic significance of ecological services (Abelson 1979; Luttik 2000; Cheshire and Sheppard 1995; Gibbons and Machin 2008).

Several studies have tried to examine the implicit price premium associated with public goods and services in China's housing market. Wang *et al.* (2004), Zheng (2004) estimated impacts of the subway proximity on house prices. Gu and Jia (2008) examined the effects of expected transport improvements on house price and found significant positive impacts. In another study, Ma *et al.* (2003) analyzed the determinants of house price in Beijing based on housing characteristics factors. Even more recently, Wen *et al.* (2004, 2005) examined factors influencing prices in Hangzhou and found that 14 factors had a significant influence on house price. They argued that house area, orientation, decoration, floor level, and distance to the central business district (CBD) have a marginally positive effect on house price while a public institution nearby shows an implicit price discount effect on house price. Yin *et al.* (2009) estimated the effect of amenity value of green space on house price. However, many of these studies fail to address the CWSIP area.

In this chapter, we focus on the role of the CWSIP in urban areas. We aim to clarify how and when the CWSIP arise house price in Guilin, China, by using the hedonic price approach. Before the quantitative analysis, we provide a background of China's housing market and city water system. Hedonic price theory model specifications are based on the existing literature. The empirical results are reported, along with a discussion of the findings for future research.

2. Housing Market in China and City Water System

2.1. Housing Market in China

Barth *et al.* (2012) state that "China has gone a long way toward commercializing homes for its citizens since the economic reform began in 1978." Before the economic reform of the 1970s, all land was state owned, so that no individual land transaction was permitted. Citizens had a free right to use land without a time limit. However, they could not transfer their land to other private citizens. Housing resource allocation was based on the number of years that a person worked, position in his or her workplace, and the size of the household, among other factors. Housing became a subsidy that the government provided to citizens. Associated with the establishment of privately owned enterprises, such a housing allocation system had to be replaced by an alternative housing system. Housing reform in China started in the mid-1980s. In 1988, land transactions were permitted and written into a constitutional amendment. Thus, the privatization of housing has been introduced into China.

The most significant reforms began in 1994, when rent reform, sales of public housing, and provisions of affordable housing and property rights were included in the national development planning guidelines. Affordable housing and commercialized housing were specified under national law in 1998, enabling local governments to determine the prices of affordable housing. Thus, only 3%-5% higher than the total cost can be charged as a house price, targeted to lower and medium incomes. The market determines the commercialized housing price. There are four other housing categories: resale housing, self-built housing, welfare housing and relocation housing. Resale housing is defined as housing that has been previously used. The market determines the price of resale housing. Self-built housing is defined as housing that is built for personal use. Thus, transactions in this category are prohibited. Unlike resale housing, the house price of welfare housing is partially covered by state-owned enterprises, government agencies, and institutions.

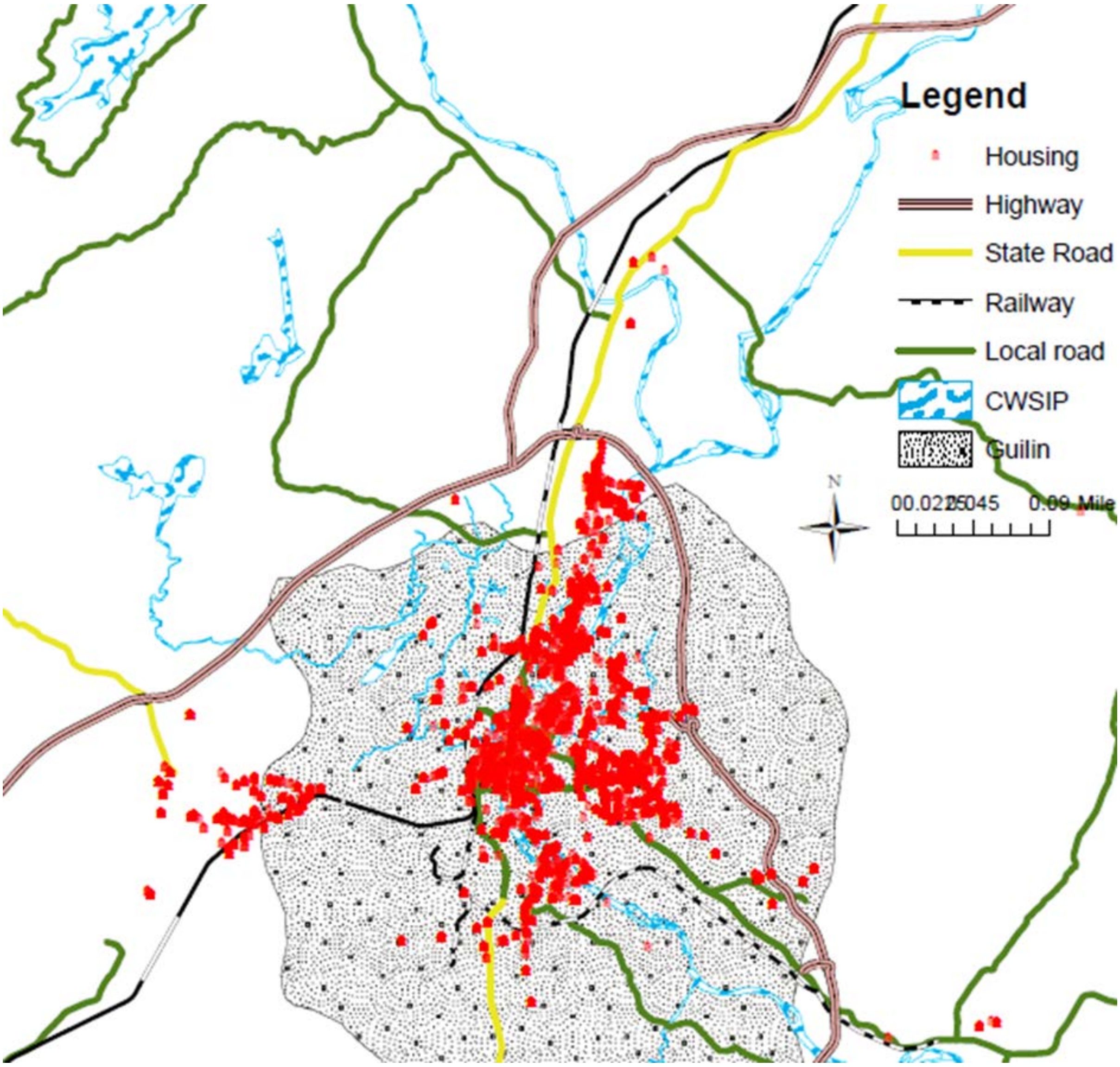
Housing transactions by individuals in this category are prohibited as well. Relocation housing is defined as the subsidized housing for residents who lost their house due to area rezoning or redevelopment projects. However, after 2000, China's housing allocation policy was officially abolished. With the establishment of competitive market clearing conditions in commercialized housing and resale housing, along with heterogeneous product characteristics, the implicit prices of housing characteristics in China - with respect to the related categories - can be revealed by applying the hedonic price theory.

2.2. City Water System

The original city water system was established in ancient times, with the function to protect the city as a moat. In our study area, Guilin city, the water system was initially formed during the Tang and Song dynasties. As the city expanded, the lakes and rivers of the system were gradually cut off from one another. Associated with improvements in quality of life and the advancement of urbanization, as well as the need for protecting and redeveloping the historical and cultural heritage, a series of protection and reconstruction projects integrating ecology, tourism and sightseeing functions, have been carried out and defined as a prototype city water system improvement project in China. Guilin's city water system improvement project has reconnected rivers and lakes, dredged up sewage and widened the water system, improving the ecological environment of the central city areas and restoring the history of Guilin. As China's first CWSIP project, Guilin's city water system improvement project was launched in 1998, and the first stage was completed and became operational in 2002, thus becoming the largest park-like amenity in Guilin (see Figure 1).

In recent years, city water system improvement projects (or CWSIP) have become popular in China. After a prototype project was completed Guilin, other cities like Nanning (in Guangxi province), Shijiazhuang and Tangshan (in Hebei province), Huhehaote (in Inner Mongolia province), Shenyang (in Liaoning province), Hefei (in Anhui province), and Beijing have developed their own city water system improvement projects due to the project's important ecological and socio-economic functions. As a successful urbanization representation, Guilin's city water system improvement project was awarded the China National Award of Human Settlement Program in 2004. Residents' quality of life and the city's image have been significantly improved as a result of the CWSIP.

Consumers take accessibility to the CWSIP into account when purchasing housing. Many real estate companies have been involved in the development projects in the surrounding area. Numerous residential housing communities have been built and sold quickly. The resale housing market became popular in related areas as well, partly because people are willing to pay more money to be located in the area surrounding the CWSIP. In general, Guilin's CWISP has created a series of unique characteristics for residential housing in Guilin.



Source: Author created using Google base map in Arc GIS 10.

Figure 1. Map of Guilin’s City Water System Improvement Project

3. A Spatial Hedonic Model

As with most of the previous studies in house price, we employ a hedonic price model to estimate the impacts of the city water system in the local house prices. Hedonic price theory is widely applied to the study housing markets because of its heterogeneity. The theoretical foundation mainly includes two parts: Lancaster's partiality theory and Rosen's characteristic market equilibrium analysis. Lancaster (1966) argued that the demand for a heterogeneous product not be based on the product itself, but on its characteristic. This kind of product is sold as the gathering of integrated characteristics. Therefore, the price of a product decomposed into a series of prices of its corresponding characteristics. Rosen (1974) defined the hedonic price as "the implicit prices of attributes and are revealed to economic agents from the observed price if differentiated products and the specific amounts of characteristics associated with them under competitive market clearings condition and maximizing consumer's utility and producer's profit goals." Based on these two articles, hedonic price theory has been well-established and developed as a part of empirical studies.

Hedonic price theory suggests that the price of properties is linked to a preference for particular housing attributes. There is a wide amount of literature estimating the implicit price of public goods on house prices. Bejranonda *et al.* (1999) estimated the impact of agricultural sedimentation on lakeside property values. They found that lakeside residents generally have a higher willingness to pay on an annualized basis for sediment reduction from upstream soil conservation than for lake dredging. Luttik (2000) examined the impact of water, trees and open space on house value. This study concluded that house value is affected by accessibility to nearby water and landscape views in the Netherlands. Tajima (2003) analyzed the impact of open space on property value in Boston and found significant results indicating that the proximity to open space affected house price. Nicholls and Crompton (2005) examined the impact of greenways on property value in Austin, Texas, finding that greenways had an implicit price premium effect on house price. Cho, *et al.* (2006) measured the contribution of water and green space on house price, which revealed the significant effect of proximity to water bodies and green space on house price in Knox County, Tennessee. Anderson and West (2006) argued that the impacts of open space on house price be closely related to house neighborhood characteristics and accessibility of to open space in Minneapolis. Troy and Grove (2008) showed that proximity to parks and the rate of crime have a significant effect on property value. Also, they discovered that the steeper relationship between park proximity and home value is obtained when the crime index value is further from the threshold value for a particular property existing in Baltimore.

In China, some studies have used the hedonic model to research the housing market. Ma *et al.* (2003) indicated that housing characteristics contributed to the house price in Beijing. Wen et al. (2005) analyzed urban housing in Hangzhou and found 14 housing characteristics that influenced house price. Wen *et al.* (2006), Wang (2006), Zhang and Chen (2008) analyzed the price of housing characteristics in Shanghai. The Gao (2010) study emphasized the effect of house size on house price while considering the house size standards in Beijing. Results revealed a significant impact of the certain size of house characteristics on house prices. Some researchers have examined amenity value of the public goods area. For example, Zheng (2004), Wang *et al.* (2004), Yiu and Wong (2005), and Liang *et al.* (2007) indicated the significant impact of city subway transportation on house price. Gu (2006) examined house prices in Hangzhou, finding that a transportation improvement project has a significant impact. Thus, the expectation of such a project has an implicit price premium. Gu and Jia (2008) analyzed the effects of expected transportation improvements on house price and price spatial distribution in Hangzhou. They argued that an expected transportation improvement has a substantial influence on house price in suburban areas, but not in urban areas. Further, the pre-approval planning period and post-approval period of a transportation improvement project have an impact on house prices in affected areas, showing a significant effect in projects during the post-approval period. Yin *et al.* (2009) examined the amenity value of urban green space on house price in Shanghai, which indicated that accessibility to green space and landscape metrics have a significant bearing on housing prices. Further, they argued that the impact of accessibility on different types of green space might present different results from one to another. Long *et al.* (2009) analyzed the impact of local public services on house prices in Beijing. The aforementioned scholarship demonstrates that public goods have an implicit price. The consumer’s willingness to pay increases with an increase in public goods, such as accessibility, amenity value, etc.

The literature establishes a solid foundation for hedonic price theory. Based on this, the econometric approach can be used to estimate the hedonic price function and measure the implicit price of housing characteristics that relate to the CWSIP in Guilin. Based on hedonic price theory, the relation between house price and housing characteristics can be constructed as follow:

$$P = f(X) \tag{1a}$$

where, P is house price, and X is the vector of included city water system, housing characteristics, and buyer's characteristics. By taking the partial derivative of equation (1) on each housing characteristic X_i, the implicit price of housing characteristics is calculated correspondingly. The hedonic price equation is expressed as follow:

$$P_{Xi} = \frac{\partial P}{\partial Xi} \tag{1b}$$

Numerous studies have analyzed the relationship between house prices and amenities / landscape (Netusil, 2001; Irwin, 2002). Most of these studies employ a spatial equilibrium model to deal with the additional premium from some types of amenities/landscapes regarding the value of neighboring homes (Graves and Linneman 1979; Graves 1980; Haurin 1980; and Roback 1982). We follow Graves and Linneman and extend equation (1a) to be a spatial structural:

$$P = \rho WP + Z\alpha + X\beta + \mu \tag{2}$$

where, P is a vector of house price on the dependent variable X, a vector of observations on exogenous variables; Z is a corresponding matrix of observations on endogenous variables; μ is the disturbance vector with zero mean; ρ is the spatial autoregressive parameter; W is a spatial weights matrix of known constants, and α and β are regression parameters. The regression parameters can be estimated as

$$\hat{\delta} = \hat{\delta}(\rho, \alpha, \beta) = (\hat{B}'B)^{-1}\hat{B}'P \tag{3}$$

where, $B = (W, P, X, Z)$ and $\hat{B} = (H(H'H)^{-1}H')B$. H is a matrix of instruments constructed as a function of X and W. $H(H'H)^{-1}H'$ will be a unit matrix when there are no exogenous issues. Otherwise $\hat{\delta}$ will be a 2SLS estimator as $\widehat{\delta_{2SLS}}$.

4. Data and Estimation

4.1. Study Area and Data

The study area consists of five districts in Guilin city, China. Census in this area show that it contains 975, 630 people and that they have relatively homogeneous statistics population characteristics, economic status, and living conditions. The GDP per capita was $2,858 USD in 2009, ranking it no. 125 among 659 Chinese cities. The city is situated on the west bank of the Li River. Its name means "forest of sweet osmanthus," owing to a large number of fragrant osmanthus trees located in the city. Millions of people visit Guilin city each year as a tourism destination.

Housing transaction data and household income data from June 2005 to September 2012 were obtained from the Bureau of Housing and Urban-Rural Development (BHUD) in Guilin. The dataset contains parcel information for completed transactions, housing address, district affiliation, house price, sales date, housing type, buyer's identity, and buyer's household income information. Using a survey method, student volunteers from Guangxi Normal University in Guilin, China collected data on housing orientation information, decoration information, scenic view information, and community management information. There were 20,663 records obtained from the housing transaction dataset. However, only commercialized housing and resale housing data records were selected because these are the only prices determined by the market.[1] Therefore, 9,357 records were chosen.[2] Before analyzing the data, duplicate records were deleted.[3] Proximity information was calculated using ArcGIS 10 software. Housing price and household income were adjusted for inflation.[4] After cleaning, there were 8,007 observations contained within the final dataset. The urban district in which a house is located is an important variable affecting house price, because of the differences in local public goods provisions. Therefore, five dummy variables with respect to district were included to identify the unobservable characteristics across districts. Moreover, another dummy variable is

[1] Original dataset contains commercialized housing, affordable housing, resale housing, welfare housing, relocating housing, and self-built housing records. Following Barth, et al.(2012), only commercialized housing and resale housing's price were determined by market. According to competitive market clearings and heterogonous goods assumptions, only those two types of housing's implicit price of housing characteristics can be revealed.
[2] City of Guilin contains five urban districts and twelve suburb counties. The urban districts include: Qixing district, Xiufeng district, Diecai district, Xiangshan district, and Yanshan district.
[3] Duplicated record errors occurred in dataset generating process.
[4] Adjusted housing price and household income were calculated by treating price and income in 2012 as baseline.

created to capture the housing type characteristic.

According to the descriptive statistics in Table 1, the average housing price is approximate 332,000 yuan (RMB), which is equivalent to about $51,077 (USD); Housing price per square meter is about 3,000 yuan, which is $462 in US dollars. The mean annual personal income is 30,000 yuan (RMB), which is equivalent to $4,600 (USD); the average age for the individual buyers when they purchased current house is about 37 and of 90% of them were born in this city. The average floor level is 5 and area for individual house is 112 m^2. For each house, the average number of living rooms and bedrooms are 2 and 3, respectively. 70% of houses are sold in the regular housing market, and only 2% houses are price-restricted. 40% of houses are located within a 500-meter distance to the CWSIP; 10 % is between 500-1000 meters; less than 1% are located between 1,000-1,500 meters and the remaining 49% are located over 1,500 meters away. 40% of houses in the entire sample were located in Qixing district, 10% were from Xiufeng district, 20% were from Diecai district, 30% were located in Xiangshan district, and the rest were located in Yanshan district.

Table 1. Descriptive Statistics of Housing Characteristics and Household Characteristics

Variable	Description	Mean	Std. Dev.	Min	Max
house price	House price (in 100 ,000 yuan)	3.32	1.91	0.15	25.24
house price $/m^2	House price per square meters (in 1,000 yuan)	2.99	1.66	0.37	81.53
	VARIABLES FOR HOUSEHOLD CHARACTERISTICS				
personal income	Personal income (in 1,000 yuan)	30.0	1.9	0.1	140
# houses owned before	Number of housing owned before current transaction date	0.1	0.4	0	2
male	Dummy variable = 1 if owner is male, otherwise = 0	0.7	0.5	0	1
age	Age of owner on current transaction date	36.81	8.0	19	61
household born locally	Dummy variable = 1 if household was born in Guilin, otherwise = 0	0.9	0.32	0	1
transaction year	Year of the transaction	2008	2	2005	2012
	VARIABLES FOR HOUSING CHARACTERISTICS				
area	Total area of house (in m^2)	112	32	21	299
floor level	Number of floor levels	4.5	2.6	1	35
# living room	Number of living room	1.8	0.5	1	4
# bedroom	Number of bedroom	2.8	0.7	0	5
regular house	Dummy variable = 1 if house sold in the regular commercial market, otherwise = 0	0.7	0.4	1	1
price-restricted house	Dummy variable = 1 if house price is restricted, otherwise = 0	0.02	0.18	1	1
distance to CWSIP	Distance to Guilin's City Water System Improvement Project (in kilometer)	0.84	1.08	0.00	10.33
distance to railway	Distance to railway (in kilometer)	1.25	0.99	0.00	8.04
distance to state-road	Distance to state road (in kilometer)	2.16	1.80	0.00	65.88
distance to country-road	Distance to country road (in kilometer)	1.01	1.55	0.00	31.47
distance to highway	Distance to highway (in kilometer)	3.72	2.30	0.01	24.09
distance to supermarket	Distance to supermarket (in kilometer)	0.49	0.48	0.00	22.77
distance to restaurant	Distance to restaurant (in kilometer)	0.54	0.53	0.00	25.84
distance to bank	Distance to bank (in kilometer)	0.71	0.53	0.01	6.49
distance to hospital	Distance to hospital (in kilometer)	0.63	0.49	0.01	13.37

distance to downtown	Distance to downtown (in kilometer)	4.85	5.74	0.12	115.33
buffer within 500 m	Dummy variable = 1 if house is located within 500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.41	0.46	0	1
buffer 501-1,000 m	Dummy variable = 1 if house is located within 501-1000 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.12	0.18	0	1
buffer 1,001-1,500 m	Dummy variable = 1 if house is located within 1001-1500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.01	0.23	0	1
buffer over 1,500 m	Dummy variable = 1 if house is located over 1500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.49	0.51	0	1
Qixing district	Dummy variable = 1 if house is located in Qixing District, otherwise = 0	0.39	0.51	0	1
Xiufeng distrct	Dummy variable = 1 if house is located in Xiufeng District, otherwise = 0	0.12	0.32	0	1
Diecai district	Dummy variable = 1 if house is located in Diecai District, otherwise = 0	0.21	0.4	0	1
Xiangshan district	Dummy variable = 1 if house is located in Xiangshan District, otherwise = 0	0.33	0.53	0	1
Yanshan district	Dummy variable = 1 if house is located in Yanshan District, otherwise = 0	0.01	0.12	0	1

4.2. Dependent Variables and Explained Variables

This study estimates two hedonic models. The dependent variable is the house sales price from 2005 to 2012. In the second model, the dependent variable is the house sales price-per-square meter during the same period.

Our primary variables are derived using GIS in ESRI's ArcGIS 10.1, measured in two ways: (1) the direct distance to properties and (2) four buffers around the project. We anticipate that the location of CWSIP will be endogenously selected based on household/neighborhood characteristics across the regions. We will incorporate the district dummy variables as the instrument variables to account for unobserved heterogeneities.

As in most hedonic studies (Rosen, 1974), we include the total area of housing, whole living room and total bedroom area into our analysis of housing characteristics. We attempt to account for some factors associated with sorting or selectivity by the demographic group to avoid omitted variable bias. For example, we account for the personal income of buyers, the age of the purchasers, the gender of the buyer. Following the hedonic literature, we also include some variables to control for housing location, such as distance to downtown, distance to school, and distance to the highway.

Omitted variable bias may still arise if there are unobservable differences across district areas associated with population density, economic development, and the amenity measures. Thus, specific district area dummy variables are included to account for unobservable, fixed differences across district areas regarding housing. These variable measurements are summarized in Table 1.

4.3. Empirical results

In addition to OLS regression, we apply a 2SLS regression to estimate the influence of CWSIP on house prices, along with attempting to define the implicit price related to Guilin's CWSIP. District dummy variables are selected as instrumental variables in the 2SLS estimation.

Table 2. The Estimation Results of OLS and 2SLS

VARIABLES	Model 1 OLS house price (in 1,000 yuan)	Model 1 OLS house price $/m^2$ (in yuan)	Model 2 OLS house price (in 1,000 yuan)	Model 2 OLS house price $/m^2$ (in yuan)	Model 3 2SLS house price (in 1,000 yuan)	Model 3 2SLS house price $/m^2$ (in yuan)
distance to CWSIP	-8.83***	-88.08***			-22.47***	-81.47
	(1.21)	(8.97)			(4.45)	(62.31)
buffer within 500 m			28.52***	149.00***		
			(4.82)	(41.23)		
buffer 501-1,000 m			19.75***	58.40		
			(4.86)	(42.09)		
buffer 1,001-1,500 m			4.29	-128.46***		
			(4.51)	(43.73)		
personal income	12.64***	106.19***	12.56***	106.43***	12.36***	107.29***
	(2.60)	(22.67)	(2.57)	(22.61)	(0.69)	(9.73)
male	-6.53***	-54.81*	-6.13***	-51.92*	-5.82***	-54.41**
	(2.08)	(28.27)	(2.07)	(28.25)	(1.85)	(25.88)
age	-0.16	-3.57**	-0.17	-3.61**	-0.13	-3.41**
	(0.10)	(1.46)	(0.10)	(1.45)	(0.11)	(1.52)
household born locally	-12.45***	-111.81***	-12.18***	-113.4***	-11.4***	-116.00**
	(3.58)	(32.07)	(3.56)	(31.47)	(3.52)	(49.33)
area	2.71***	3.28***	2.71***	3.35***	2.70***	3.26***
	(0.08)	(0.54)	(0.08)	(0.54)	(0.05)	(0.71)
floor level	0.11	-4.48	0.12**	4.63**	0.05	5.11**
	(0.35)	(5.90)	(0.05)	(1.91)	(0.02)	(1.50)
# living room	3.04	82.43***	2.76	73.85***	3.87*	83.03***
	(2.04)	(26.30)	(2.04)	(25.82)	(2.05)	(28.71)

# bedroom	-17.98***	-187.34***	-17.93***	-189.87***	-17.60***	-190.03***
	(2.42)	(29.97)	(2.43)	(30.08)	(2.17)	(30.36)
regular house	132.98***	1,230.81***	133.54***	1,241.82***	131.97***	1,239.00***
	(2.46)	(27.72)	(2.47)	(28.19)	(2.13)	(29.80)
distance to railway	1.10	10.00	0.25	-9.05	1.02	-0.18
	(0.93)	(7.59)	(1.21)	(8.76)	(1.28)	(17.93)
distance to state-road	1.24**	-0.16	0.80	1.39	-1.05	1.69
	(0.62)	(3.75)	(0.62)	(4.29)	(0.84)	(11.71)
distance to country-road	-1.86**	1.87	-1.68*	-9.69	-0.06	-10.02
	(0.74)	(6.06)	(0.96)	(8.59)	(1.14)	(16.04)
distance to highway	-0.43	6.53	-0.77	-3.30	5.62***	18.95
	(0.67)	(5.24)	(0.66)	(5.34)	(1.29)	(18.10)
distance to supermarket	-4.68*	-58.93**	-9.27*	-86.38**	-11.23***	-114.77***
	(2.78)	(24.49)	(4.90)	(39.77)	(2.34)	(32.73)
distance to hospital	-8.39***	-53.79**	-3.61	-2.04	-0.91	-19.05
	(2.38)	(21.24)	(3.07)	(26.22)	(2.67)	(37.39)
distance to downtown	-0.37***	-3.63***	-0.36***	-4.05***	-0.10	-3.36
	(0.09)	(0.56)	(0.09)	(0.64)	(0.20)	(2.73)
Qixing district	58.09***	447.65***	53.35***	342.59***		
	(9.78)	(72.80)	(10.07)	(76.22)		
Xiufeng distrct	55.98***	391.83***	52.12***	300.79***		
	(9.84)	(71.64)	(9.97)	(73.84)		
Diecai district	37.63***	319.57***	34.38***	213.43***		
	(9.32)	(75.82)	(9.89)	(74.44)		
Xiangshan district	64.69***	434.42***	60.38***	333.07***		
	(9.60)	(70.26)	(9.97)	(74.99)		

Constant	-142.1***	1,173.6***	-169.4***	1,139.24***	-101.3***	1,535.04***
	(12.47)	(118.44)	(14.47)	(149.32)	(7.92)	(110.99)
Observations	8,007	8,007	8,007	8,007	8,007	8,007
R-squared	0.684	0.312	0.684	0.311	0.676	0.311

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

Table 2 presents our estimation results corresponding to OLS (Model 1 and Model 2) and 2SLS (Model 3). Table 3 presents the spatial model (Model 4 and Model 5) and Spatial 2SLS (Model 6). The spatial dependence parameter estimate (ρ) turned out to be positive and significant, which indicates that price effects have spilled over because they influence each other's prices positively.

All the regression results indicate a constant influence of the distance to CWSIP on house price, which is consistent with basic economic theory. Following Model 3, which is the best estimation, a unit distance (1 kilometer) away from CWSIP will decrease total house price by 22,470 yuan, and will decrease house price per square meters by 81.47 yuan. Those magnitudes are smaller in general structure since the lag price variables are positively significant. Similar results are indicated by another measurement, the buffer around the CWSIP; the housing close to CWSIP suggests a higher value. The findings reveal that CWSIP and proximity to CWSIP housing characteristics are scarce. Due to CWSIP's economic function, an implicit price barrier of housing is created in the area surrounding CWSIP. Li *et al.* (2014) have a similar study regarding the willingness to pay for the urban river restoration in Hangzhou and Nanjing, China. They found that the public's willingness to pay for the urban river restoration in those two cities was roughly 50 yuan per person per year. This result is consistent with the estimation. Although Li *et al.*(2014) did not directly indicate that the urban river restoration will increase the house sell price, the public's willingness to pay for the project implies the demand for a good amenity and will indirectly incentive people's demands for a house with a good environment. This will raise the price of housing in the CWSIP surrounding the area.

Table 3 The Estimation Results of Spatial Lag and Spatial 2SLS

	Model 4 Spatial Lag		Model 5 Spatial Lag		Model 6 Spatial 2SLS	
VARIABLES	house price (in 1,000 yuan)	house price $/m^2 (in yuan)	house price (in 1,000 yuan)	house price $/m^2 (in yuan)	house price (in 1,000 yuan)	house price $/m^2 (in yuan)
rho (ρ)	2.34***	2.15***	2.36***	2.09***	2.36***	1.89***
	(0.07)	(0.76)	(0.08)	(0.59)	(0.09)	(0.33)
lambda	-0.02*	0.00	-0.02*	-0.00	-0.03***	-0.01
	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.03)
distance to CWSIP			-6.58***	-4.35***	-32.51***	-181.08***
			(1.24)	(1.12)	(4.29)	(59.39)
buffer within 500 m	14.24**	41.64				
	(6.21)	(89.59)				
buffer 501-1,000 m	7.35	-50.79				
	(6.36)	(91.78)				
buffer 1,001-1,500 m	-10.90*	-240.50***				
	(6.25)	(89.99)				
personal income	11.27***	92.52***	11.30***	94.25***	11.19***	93.43***
	(0.66)	(9.61)	(0.66)	(9.62)	(0.69)	(9.67)
male	-5.17***	-44.06*	-5.45***	-49.71*	-4.59**	-44.90*
	(1.78)	(25.72)	(1.78)	(25.74)	(1.84)	(25.83)
age	-0.14	-2.87*	-0.13	-2.83*	-0.14	-2.91*
	(0.10)	(1.51)	(0.10)	(1.52)	(0.11)	(1.52)
household born locally	-11.08***	-99.69**	-10.78***	-102.13**	-9.86***	-94.97*
	(3.37)	(48.74)	(3.37)	(48.78)	(3.49)	(49.01)
area	2.69***	2.70***	2.69***	2.65***	2.69***	2.68***
	(0.05)	(0.72)	(0.05)	(0.72)	(0.05)	(0.72)

floor level	0.17	-3.95	0.18	-3.78	-0.01	-4.79
	(0.31)	(4.48)	(0.31)	(4.48)	(0.32)	(4.48)
# living room	3.34*	82.47***	3.90**	89.84***	5.46***	102.13***
	(1.98)	(28.62)	(1.97)	(28.55)	(2.05)	(28.80)
# bedroom	-15.36***	-157.01***	-15.28***	-158.42***	-15.17***	-156.36***
	(2.09)	(30.26)	(2.09)	(30.28)	(2.17)	(30.41)
regular house	136.03***	1,265.81***	135.63***	1,267.70***	133.66***	1,252.53***
	(2.08)	(30.07)	(2.08)	(29.94)	(2.17)	(30.38)
distance to railway	-1.22	-7.96	-0.09	4.61	1.08	16.23
	(1.21)	(17.50)	(1.16)	(16.80)	(1.28)	(17.91)
distance to state-road	1.32**	4.33	1.32**	11.67	-2.04***	-11.65
	(0.60)	(8.70)	(0.58)	(7.86)	(0.79)	(11.01)
distance to country-road	-2.03**	-13.18	-1.47*	-12.59	2.00*	10.74
	(1.00)	(14.40)	(0.89)	(12.22)	(1.08)	(15.11)
distance to highway	-1.04	-3.32	-0.68	-11.03	8.36***	49.96***
	(0.71)	(10.30)	(0.71)	(9.63)	(1.19)	(16.64)
distance to supermarket	-3.22	-36.98	-3.34*	-49.19*	-6.98***	-69.92**
	(2.04)	(29.44)	(2.02)	(29.22)	(1.97)	(27.68)
distance to hospital	-5.37**	-26.83	-9.18***	-82.34**	-0.60	-26.29
	(2.66)	(38.43)	(2.54)	(36.76)	(2.67)	(37.53)
distance to downtown	-0.38**	-3.80	-0.33*	-4.03	0.13	-0.65
	(0.17)	(2.50)	(0.17)	(2.49)	(0.20)	(2.76)
Qixing district	56.13***	370.90	62.76***	461.56*		
	(17.95)	(259.41)	(17.82)	(257.55)		
Xiufeng distrct	54.32***	321.64	60.22***	449.01*		
	(17.84)	(257.69)	(17.70)	(255.77)		

Diecai district	33.03*	212.03	40.16**	335.00		
	(17.72)	(256.06)	(17.53)	(253.36)		
Xiangshan district	63.00***	367.27	69.27***	484.26*		
	(17.73)	(256.13)	(17.58)	(254.10)		
Constant	-161.89***	1,154.53***	-154.11***	1,089.90***	-112.21***	1,402.87***
	(20.92)	(302.28)	(18.81)	(271.79)	(7.70)	(108.13)
Observations	8,007	8,007	8,007	8,007	8,007	8,007

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

Considering the expected signs of housing characteristics, the study revisited Table 2 and 3 to discover some interesting results. A positive, significant implicit price for areas on housing price has been revealed. Further, results from regression indicated that larger houses enjoyed a 2,700 yuan price premium for every square meter increase, and a slight price premium (3 yuan) was discovered on housing price-per-square meter. The bonus (was on housing price-per-square meter, which revealed that consumers prefer to have a larger house. The parameters were positively significant in some bedrooms but showed a positive marginal effect of the number of living rooms but the negative marginal effect of the number of bedrooms. Besides, people may be willing to pay a higher price for a higher floor for favorable air and views.

Compared with the previous scholarly work conducted by Gu and Jia (2008), a similar conclusion was obtained in this paper. Gu and Jia (2008) argued that transportation (proximity to road and highway) improvement projects have a marginally positive effect on house price, which helps set up the house price barrier in the surrounding area. However, in this study, there is the effect of proximity to the railways and state road are still ambiguous. A strong explanation is that such transportation characteristics in the study area are not ware enough by households. Thus, its implicit price may not be reflected into the housing price.

5. Conclusion

This Chapter uses the hedonic price model for analyzing the implicit price of housing characteristics related to public goods. The study focuses on Guilin’s city water system improvement project and constructs an empirical application with selected housing characteristics. A spatial regression is conducted to find the marginal effects of CWSIP on housing price. Through model estimation and coefficient analysis, we determined housing characteristics with different influence degrees on house price, which are arranged sequentially with respect to housing characteristic categories from structural to location: area, age, floor level, personal income, household born locally, proximity to CWSIP, proximity to downtown, proximity to the major roads, Qixing district, Xiufeng district, Xiangshan district, Diecai district, and type of housing.

Among these statistically significant characteristics, the coefficient of household's characteristics, and housing's characteristics were interesting to interpret. Housing close to CWSIP can receive a price premium, and housing with a further distance to CWSIP can also receive a price discount. Further, an implicit price barrier of housing in the CWSIP surrounding areas has been revealed. These findings are consistent with consumer's preferences theory and resource scarcity principle.

It is true that Guilin's city water system improvement project has created a scarcity for the housing characteristic of CWSIP. Thus, a scarce characteristic of public goods can be charged for an implicit price in the housing market. Also, because the area of Guilin's city water system improvement project is located in conjunction with the Xiufeng district, Qixing district, and Xiangshan district, house prices in such districts are positively impacted by CWSIP. Regression results showed that price might increase by significantly in the Xiufeng district, Qixing district, and Xiangshan district respectively. Although other districts, such as Diecai district and Yanshan district, may bury some cost on their housing price, Guilin's city water system improvement project indirectly makes a contribution to the local housing market. After examining the homogeneity problem, a 2SLS regression was proposed to solve this issue.

This chapter is the first attempt to analyze the impact of the city water system improvement project on house price in China. Guilin's case has provided supportive evidence to show that the city water system improvement project can help with creating new housing characteristics and differentiating the local housing market. Also, as mentioned in the previous section, Guilin's city water system improvement project is the first project in China. Therefore, this study may also be considered as a reference to support similar, forthcoming public goods and service improvement projects nationwide.

CHAPTER 2

Valuing the City Water System Improvement Project in a Residential Sorting Model

1. Introduction

Household location choices in urban areas are determined to a large extent by accessibility to desirable natural areas and environmental resources, such as coastal, river or woodland habitats, along with managed and protected areas (Gibbons *et al.*, 2014). For example, natural areas in household location decisions include the following considerations: opportunities for recreation, leisure and wildlife viewing, the possibility of improved physical health through green exercise, visual amenities, improved mental or psychological well-being, artistic inspiration, and ecological education (Gibbons *et al.*, 2014). More recent scholarship found that such location choices could also be affected by amenities. Powe *et al.* (1995) develops a theory and empirical model to evaluate urban amenities using a hedonic price model. Their findings show a premium offered by particular housing attributes, or environmental characteristics, in an urban setting. Luttik (2000) estimates the value of trees, water, and open space as reflected by house prices in the Netherlands. The study shows that the largest increases in housing price are due to environmental factors (up to 28%) for houses with a garden facing the water, which is connected to a sizeable lake. He also was able to demonstrate that a pleasant view can lead to a considerable increase in house price, particularly if the house overlooks water (8–10%) or open space (6–12%) (Luttik, 2000).

Correspondingly, natural amenities also provide value for cities, which always reflect the housing price and household's choice. Environmental amenities preserved in the cities seem to function as an anchor point for shops, restaurants, theaters, and other urban amenities. Brueckner *et al.* (1999) develop a theory of the sorting of households in urban areas, which indicates the importance of various urban amenities, particularly those found in downtown areas. Their approach is based on the assumption that the marginal valuation of these amenities rises sharply with income (Brueckner *et al.*, 1993, 1999). The results show that higher-income households are willing to pay for central city locations contingent upon the presence of urban amenities (as in Paris), yet they still prefer to consume more space in suburban areas. Follow the sorting concept (Tiebout, 1956), Epple *et al.* (2001) examine how households sort on a system of local jurisdictions to obtain an optimal level of a public good. Qiu and Tu (2014) describe how social interactions among neighbors impact household's future neighborhood choices in Tianjin, China. Some researchers provide empirical evidences to prove that sorting framework can be used in capturing household heterogeneity in Chinese housing market cases (Zheng, 2013; Liang and Tang, 2008).

Recent studies have shown that economic valuation methods, such as stated and revealed preference techniques, have been widely applied to estimate the ecosystem benefits associated with environmental resources (Earnhart 2001; Poor *et al*., 2007). In particular, hedonic price studies that measure environmental values by investigating the effect of environmental amenities on property prices are widely applied in the housing market. For example, Hoehn *et al.* (1987) develop a general multivariate hedonic model appropriate for a national, interregional study of wages, housing prices, and location-specific amenities. In a more recent study, Gibbons *et al.* (2014) use a hedonic property price approach, which estimates the amenity value associated with proximity to habitats, designated areas, domestic gardens and other natural amenities. Also, a former examination by Tyrväinen (1997) determines the external benefits and costs of urban forests associated with housing.

The problem of hedonic models is that they cannot identify agents that sort on characteristics. It is necessary to address the sorting problem in hedonic models. This chapter extends a spatial sorting model between districts by applying this class of hedonic models. Empirical evidence is provided for evaluating Guilin's city water system improvement project (CWSIP), which is based on the premise that households choose among locations with particular consideration for the property's accessibility to urban amenities. Additionally, this chapter attempts to measure the value of such amenities by focusing on location choices through the use of sorting techniques for an equilibrium setting. This approach allows us to estimate the marginal welfare change with respect to the heterogeneous characteristics of such projects.

2. Sorting model

2.1 Conceptual foundation

We conducted a sorting model that closely follows the framework developed by Bayer *et al.* (2005), Bayer and Timmins (2007), and Bayer *et al.* (2007). Bayer *et al.* (2005) presented a new equilibrium framework for analyzing economic and policy questions related to the sorting of households within a large metropolitan area, which incorporates choice-specific unobservable to identify household preferences over choice characteristics. Bayer *et al.* (2007) used the same method and developed a framework for estimating household preferences for school and neighborhood attributes in the presence of sorting. Following Bayer *et al.* (2005, 2007, 2009), this study includes the following random utility function, which assumes that each household *i* selects a particular housing in location *h* to maximize utility ${U_h}^{i^{max}}$. The choice strictly depends on the observable and unobservable characteristics of the chosen option. The aforementioned study defined C^i as the observable characteristics of house *i*, which included characteristics of the house itself (e.g., size and type). Let H^i represent household and characteristics and Let N_h^i represent a bond of the characteristics of the specified neighborhood (e.g., amenities, sociodemographic composition, locations and environmental qualities). In particular, the following research focuses on the evaluation of Guilin's city water system improvement project with consideration for household location decisions. Access to the project is assumed as a part of component (W), which is included in the characteristics of its neighborhood with other factors (O). Denote ρ_h^i as the household *i*'s housing price in location *h*; P is the price of composite commodity G with the income *I*. Household *i*'s optimization problem is given in the equation:

$$\underset{h}{Max}:\ U_h^i\left(C_h, N_h^i(W,O), H^i, \rho_h^i,\ \xi_h\right) + \varepsilon_h^i;\ s.t. PG + \rho_h^i Q = I \quad (1)$$

where, ε_h^i is an error term that captures the unobserved variation in household *i*'s preference for a particular housing choice h. *Q* represents the quantity of house and *I* stands for the total income.

After substitution of the optimal value of these given variables into the utility function (1), the indirect utility function is determined as:

$$V(I, P, \rho_h^i,\ C_h, N_h^i(W, O)\ H^i,\ \xi_h) \tag{2}$$

Appling Roy's identity, the uncompensated demand function for house can be expressed as:

$$Q = -\frac{V_{\rho_h^i}}{V_I} \tag{3}$$

Then, the implicit price of the amenity can be derived as:

$$P^* = Q\,\frac{d_{\rho_h^i}}{N_h^i} - \frac{dI}{N_h^i} \tag{4}$$

Following Bayer *et al.* (2009), this project incorporates the utility function that assumes individual i lives in location *h* dependent on its own characteristics, as H^i, including the following: income, age, birth place status, and consumed quantities G (assume the price for G equal to 1). The indirect utility function can be expressed as follows:

$$V_h^i = I^{\beta_I} e^{-\beta_{\rho_h^i} \ln \rho_h^i + \beta_{C_h} ln\, C_h + \beta_{N_h^i} \ln N_h^i + \xi_h + \varepsilon_h^i} \tag{5}$$

where, ξ_h contains unobserved characteristics of location. The following equation is used to account for the factors associated with housing characteristics and price that vary with a household's own characteristics as a component:

$$\Theta_h^i = \beta_{C_h} ln\, C_h + \beta_{N_h^i} \ln N_h^i + \xi_h \tag{6}$$

Θ_h^i represents household *i*'s preference for choice characteristic h. C_h is the number of household characteristics and N_h^i is the location h's characteristics. This specification allows for heterogeneous preferences through interactions between attributes of housing that are constant across households and socio-economic characteristics that vary with households. Sorting outcomes are generated by heterogeneity. In addition, the city water system improvement project characteristics included among the neighborhood variables N_h^i are multi-dimensional across the whole characteristics of the neighborhood. The preferences for those characteristics are allowed to vary by household demographics and interacting household characteristics.

To define market equilibrium, a household's decision depends on the characteristics of all housing types in their choice set. Assume the stochastic component of the utility function ε_h^i as independent from the rest of the utility function. Therefore, the probability that any household *i* chooses a housing in location *h* also depends on the characteristics across the market and can be expressed as:

$$Pr_h^i = \left(V_i^h > V_i^k; h \neq k\right) \tag{7}$$

2.2 Empirical model implementation

To identify the parameters in Eq. (5), we follow Berry *et al.* (2005)'s two-step estimation strategy. The first step is to capture the mean indirect utilities by a maximum likelihood procedure that treats housing prices and neighborhood sociodemographic characteristics as exogenous from the individual's point-of-view. The second stage of estimation decomposes the mean indirect utilities from the first stage into observable and unobservable components.

This study revises the indirect utility function in Eq. (2) as

$$lnV_h^i = \beta_I lnI + \Omega_h + v_h^i \tag{8}$$

$$\Omega_h = -\beta_{\rho_h} \rho_h + \theta_X X_h + \lambda_h \tag{9}$$

where, V_h^i is the direct utility for household *i* choose a house in location *h*. Ω_h is a location-specific term. X includes all the other variances. This project assumes that all the random terms are independently and identically distributed (McFadden, 1973).

For this division, the first stage captures the mean indirect utilities via maximizing the utility function, which allows the decomposition of the mean indirect utility into its observable and unobservable components accordingly. To estimate the first stage, this study assumes ε_h^i is an independent and identically distributed extreme value, so that the conditional logit probability of a household's choice of type *h* emerges as

$$\Pr_h^i = \frac{e^{\beta_I lnI + \Omega_h + v_h^i}}{\sum e^{\beta_I lnI + \Omega_h + v_h^i}} \tag{10}$$

The log likelihood function is

$$\mathrm{L} = \sum \sum I_h^i \ln(\Pr_h^i) \tag{11}$$

where I_h^i equals 1 if an individual chooses housing *h* and equals zero otherwise.

2.3 Price estimation

The price of a particular housing in location *h* reflects characteristics based on the spatial location, the size, and the period in which the housing transaction occurred, as well as any unobserved attributes that are unique to a particular housing (Klaiber *et al.*, 2010). To construct a house price estimate in each location, this projection adjusted the mean of sales prices for homes falling in a particular housing location, where the adjustment accounts for price appreciation across the years included in a single period. In particular, this study accounted for regressions through the following form,

$$\Psi = {\beta_\rho}^h ln\rho + {\beta_N}^h \ln N + {\beta_C}^h \ln C + \omega \tag{12}$$

where, Ψ is the value of the house in location *h;* ρ_h^i is the observed housing price as a scaling parameter. The individual house characteristics in this analysis contain the number of living rooms, the number of bedrooms, and the areas of the house. The district characteristics are measured by the social-economics index, including the GDP, population, total sales, total investment, and so on (see in Table 1).

Table 1. Descriptive Statistics of Housing Characteristics, Household Characteristics, and District Characteristics

Variable	Description	Mean	Std. Dev.	Min	Max
house price	House price (in 100,000 yuan)	3.32	1.91	0.15	25.24
house price $/m^2	House price per square meters (in 1000 yuan)	3	1.656	0.368	81
	VARIABLES FOR HOUSEHOLD CHARACTERISTICS				
personal income	Personal income (in 1,000 yuan)	30	1.9	0.1	140
# houses owned before	Number of housing owned before current transaction date	0.1	0.4	0	2
male	Dummy variable = 1 if owner is male, otherwise = 0	0.7	0.5	0	1
age	Age of owner on current transaction date	36.81	8	19	61
household born locally	Dummy variable = 1 if household was born in Guilin, otherwise = 0	0.9	0.32	0	1
transaction year	Year of the transaction	2008	2	2005	2012
	VARIABLES FOR HOUSING CHARACTERISTICS				
area	Total area of house (in 100 m^2)	1.12	0.32	0.21	2.99
floor level	Number of floor levels	4.5	2.6	1	35
# living room	Number of living room	1.8	0.5	1	4
# bedroom	Number of bedroom	2.8	0.7	0	5
regular house	Dummy variable = 1 if house sold in the regular commercial market, otherwise = 0	0.7	0.4	1	1
price-controlled house	Dummy variable = 1 if house sold in the as price floor, otherwise = 0	0.02	0.18	1	1
distance to CWSIP	Distance to Guilin's city water system improvement project (in kilometer)	0.84	1.08	0.00	10.33
distance to railway	Distance to railway (in kilometer)	1.25	0.99	0.00	8.04
distance to state-road	Distance to state road (in kilometer)	2.16	1.80	0.00	65.88
distance to country-road	Distance to country road (in kilometer)	1.01	1.55	0.00	31.47
distance to highway	Distance to highway (in kilometer)	3.72	2.30	0.01	24.09
distance to supermarket	Distance to supermarket (in kilometer)	0.49	0.48	0.00	22.77
distance to restaurant	Distance to restaurant (in kilometer)	0.54	0.53	0.00	25.84
distance to bank	Distance to bank (in kilometer)	0.71	0.53	0.01	6.49
distance to hospital	Distance to hospital (in kilometer)	0.63	0.49	0.01	13.37

distance to downtown	Distance to downtown (in kilometer)	4.85	5.74	0.12	115.33
buffer 1: within 500 m	Dummy variable = 1 if house is located within 500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.41	0.46	0	1
buffer 2: 501-1,000 m	Dummy variable = 1 if house is located within 501-1000 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.12	0.18	0	1
buffer 3: 1,001-1,500 m	Dummy variable = 1 if house is located within 1001-1500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.01	0.23	0	1
buffer 4: over 1,500 m	Dummy variable = 1 if house is located over 1500 meter to the Guilin's City Water System Improvement Project (CWSIP), otherwise = 0	0.49	0.51	0	1
Qixing district	Dummy variable = 1 if house is located in Qixing district, otherwise = 0	0.39	0.51	0	1
Xiufeng distrct	Dummy variable = 1 if house is located in Xiufeng district, otherwise = 0	0.12	0.32	0	1
Diecai district	Dummy variable = 1 if house is located in Diecai district, otherwise = 0	0.21	0.4	0	1
Xiangshan district	Dummy variable = 1 if house is located in Xiangshan district, otherwise = 0	0.33	0.53	0	1
Yanshan district	Dummy variable = 1 if house is located in Yanshan district, otherwise = 0	0.01	0.12	0	1
VARIABLES FOR DISTRICT CHARACTERISTICS					
district's GDP	Annual GDP across five districts (in 10 billion yuan)	1.35	0.48	0.12	1.71
district's population	Annual population across five districts (in 10,000 person)	20.12	4,53	7.45	24.16
district's areas	Annual total areas across five districts (100 km^2)	0.84	0.26	0.49	2.88
district's gov. revenue	Annual government revenue across five districts (in 10 billion yuan)	0.09	0.03	0.01	0.12
district's investment	Annual total investment across five districts (in 10 billion yuan)	0.79	0.23	0.11	0.98
district's total sales	Annual total sales across five districts (in 10 billion yuan)	0.74	0.26	0.02	1.1
district's avg. personal income	Annual average personal income across five districts (in 10,000 yuan)	2.49	0.08	2.28	2.55
district's GDP per capita	Annual GDP per capita across five districts (in 10,000 yuan)	6.73	1.84	2.82	8.09
district's gov. revenue per capita	Annual government revenue per capita across five districts (in10,000 yuan)	0.47	0.15	0.15	0.62
district's inv. per capita	Annual investment per capita across five districts (in 10,000 yuan)	4.02	0.96	1.42	4.98
district's total sales per capita	Annual total sales per capita across five districts (in 10,000 yuan)	3.83	1.49	0.22	7.62
district's pop. density	Annual population density across five districts (in 10,000 per square meter)	0.25	0.05	0.03	0.34

Table 2a. Measurements of characteristics by district (Qixing district, Xiufeng district, and Diecai district)

	Qixing			Xiufeng			Diecai		
Variable	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
house price $/m^2	3.42	0.20	15.49	3.42	0.29	17.97	3.06	0.15	25.24
house price	2.97	0.41	10.05	3.17	0.55	8.39	2.85	0.37	80.53
area	1.18	0.27	2.98	1.07	0.29	2.95	1.09	0.30	2.97
floor level	4.54	1	17	4.87	1	17	4.72	1	17
# living room	1.9	1	4	1.7	1	4	1.79	1	4
# bedroom	2.92	0	5	2.76	0	5	2.75	0	5
personal income	3.15	0.105	40	3.02	0.7	25	2.77	0.3	25.26
# houses owned before	0.18	0	2	0.15	0	2	0.1	0	2
male	0.67	0	1	0.61	0	1	0.65	0	1
age	36	60	21	37	58	23	37	58	23
transaction year	2008	2005	2012	2008	2005	2012	2008	2005	2012
household born locally	0.88	0	1	0.94	0	1	0.95	0	1
regular house	0.66	0	1	0.76	0	1	0.79	0	1
distance to CWSIP	1.36	0.00	7.85	0.28	0.00	4.36	0.32	0.00	9.92
distance to railway	1.40	0.00	8.04	1.01	0.00	5.61	1.58	0.00	8.04
distance to state-road	2.91	0.04	39.07	1.47	0.00	23.00	1.71	0.00	85.30
distance to country-road	1.18	0.00	24.82	1.11	0.01	13.43	0.57	0.00	14.39
distance to highway	5.28	0.02	13.80	3.15	0.01	21.13	1.23	0.01	7.23
distance to supermarket	0.48	0.00	3.94	0.32	0.01	22.77	0.65	0.01	3.47
distance to restaurant	0.56	0.01	3.88	0.31	0.00	25.84	0.77	0.01	13.16
distance to bank	0.72	0.01	3.82	0.44	0.01	3.05	0.79	0.02	3.44
distance to hospital	0.66	0.01	3.93	0.45	0.02	2.76	0.73	0.04	3.66
distance to downtown	6.03	0.17	115.33	2.38	0.16	61.31	4.96	0.20	102.10
district's GDP	1.27	0.99	1.59	0.48	0.37	0.62	0.43	0.33	0.54
district's population	0.18	0.17	0.20	0.08	0.05	0.11	0.17	0.16	0.18
district's areas	0.97	0.97	0.97	0.49	0.49	0.49	0.52	0.52	0.52

district's gov. revenue	0.10	0.07	0.12	0.04	0.03	0.05	0.03	0.02	0.04
district's investment	0.64	0.37	0.98	0.28	0.16	0.43	0.29	0.17	0.44
district's total sales	0.38	0.23	0.52	0.55	0.32	0.84	0.39	0.21	0.63
district's avg. personal income	0.19	0.14	0.25	0.18	0.13	0.23	0.19	0.14	0.25
district's GDP per capita	0.59	0.48	0.72	0.23	0.19	0.28	0.59	0.48	0.72
district's gov. revenue per captia	4.38	2.80	6.46	11.57	7.04	16.92	4.38	2.80	6.46
district's inv. per capita	3.56	2.15	5.30	79.88	45.40	120.43	3.56	2.15	5.30
district's total sales per capita	2.51	2.35	2.68	0.24	0.23	0.26	2.51	2.35	2.68
district's pop. density	0.10	0.07	0.12	0.04	0.03	0.05	0.03	0.02	0.04

Table 2b. Measurements of characteristics by district (Xiangshan district and Yanshan district)

	Xiangshan			Yanshan		
Variable	Mean	Min	Max	Mean	Min	Max
house price $/m^2	3.31	0.20	14.67	2.22	0.23	4.25
house price	3.08	0.38	24.56	1.69	0.45	3.50
area	1.08	0.21	2.99	1.37	0.52	2.00
floor level	4.36	1	35	4.72	1	10
# living room	1.75	1	4	1.89	1	2
# bedroom	2.68	0	5	3.41	1	5
personal income	2.99	0.4	55	2.64	0.5	6
# houses owned before	0.1	0	2	0.01	0	1
male	0.66	0	1	0.61	0	1
age	37	59	21	37	53	28
transaction year	2008	2005	2012	2009	2005	2011
household born locally	0.94	0	1	0.9	0	1
regular house	0.81	0	1	0.27	0	1
distance to CWSIP	0.51	0.10	10.33	1.39	0.26	3.46
distance to railway	0.88	0.00	8.04	2.26	1.83	2.99
distance to state-road	1.45	0.00	58.07	7.45	0.97	15.89
distance to country-road	0.98	0.01	31.47	7.63	0.11	17.77
distance to highway	3.00	0.02	24.09	2.10	1.25	2.97
distance to supermarket	0.46	0.00	22.88	0.99	0.75	1.42
distance to restaurant	0.42	0.00	25.97	0.96	0.58	1.30
distance to bank	0.70	0.01	6.49	1.07	0.78	1.43
distance to hospital	0.59	0.01	13.36	1.18	0.84	2.06
distance to downtown	35.21	0.12	87.67	12.39	4.63	22.99
district's GDP	1.31	1	1.71	0.16	0.12	0.21
district's population	0.22	0.21	0.24	0.07	0.07	0.07
district's areas	0.88	0.88	0.88	2.88	2.88	2.88
district's gov. revenue	0.08	0.06	0.1	0.01	0.01	0.01

district’s investment	0.56	0.32	0.84	0.07	0.04	0.11
district’s total sales	0.69	0.39	1.1	0.01	0.01	0.02
district’s avg. personal income	0.19	0.14	0.25	0.18	0.13	0.23
district’s GDP per capita	0.59	0.48	0.72	0.23	0.19	0.28
district’s gov. revenue per captia	0.29	0.23	0.35	0.80	0.67	0.94
district’s inv. per capita	4.38	2.8	6.46	11.57	7.04	16.92
district’s total sales per capita	3.56	2.15	5.3	79.88	45.4	120.43
district’s pop. density	2.51	2.35	2.68	0.24	0.23	0.26

Separately, the average housing value in Qixing district and Xiufeng district are relatively higher than those in other districts. Yanshan districts indicate the lowest housing price, which only average 220,000 yuan. The house price per square meter is relatively higher in Xiufeng district and Xiangshan district, which indicates that housing areas in Qixing district are much larger than those in other districts. The economic development level is much higher in Qixing district and Xiangshan district, with a total GDP of roughly 12.7 billion yuan and 13.1 billion yuan respectively. Note that the GDP per capita in Qixing district and Xiufeng district ranked top two in the study area. Population density in Yanshan district and Xiangshan district are much higher; this may differ from the ranking in house price per square meters. Traditionally, housing demand is higher in high population density areas may forces an increase in the house price per square meters. The following analysis will focus on the role of CWSIP on the housing market and aim to estimate the value of CWSIP in the study area.

This project will provide an overview of the estimation results based on the basic residential sorting model. This model includes the first-step estimation results, which are based on the conditional logit model, and then addresses the second-step estimation results.

Using the first step of the residential sorting model developed by Bayer *et al.* (2004), this study estimates the mean indirect utilities across five districts and the coefficients of Equation (5) via the conditional logit model with the location choice (municipality) of households as the dependent variable. There are five districts included in the study areas for this project; the following research also distinguishes household and locational characteristics. Interactions between household characteristics and locational characteristics were also created and incorporated into the first-stage estimation to identify the interacted effects that pass through both the household and districts.

The estimates for the parameters of household characteristics and locational characteristics are reported in Table 3. Model 1 shows the results without interactions and the accompanying table represents the estimations with the interaction. The estimates from the first-stage are, for the most part, consistent with our prior expectations and considered statistically significant. Most of the control variables provide evidence that the model confirms stylized facts. For example, population density, GDP per capita, and total investment per capita all positively affect the housing demand market, while government revenue per capita and total sales per capita are negatively correlated with the housing market's demand. Most coefficients of interactions significantly affect the household's choice. For example, the interaction of personal income with district's population density, and the interaction of personal income with district's GDP per capita etc.

Table 3. First Stage Estimation Results

VARIABLES	Model 1	Model 2
personal income	-0.016	-1.297
	(0.011)	(1.076)
age	-0.001	0.237*
	(0.002)	(0.122)
household born locally	0.017	6.459***
	(0.054)	(2.074)
district's pop. density	0.001***	-0.002***
	(0.000)	(0.001)
district's total sales per capita	-0.001*	-0.001***
	(0.000)	(0.000)
district's inv. per capita	0.001***	0.002***
	(0.000)	(0.000)
district's gov. revenue per capita	-0.001***	-0.001***
	(0.000)	(0.000)
district's GDP per capita	0.001***	-0.000
	(0.000)	(0.000)
district's avg. personal income	0.001***	0.001***
	(0.000)	(0.000)
distance to state-road		-0.417
		(1.217)
distance to highway		0.287
		(0.702)
distance to supermarket		3.573
		(13.861)
distance to downtown		-0.063
		(1.359)
personal income squared		-0.000
		(0.001)
personal income * age		-0.000
		(0.001)
personal income * household born locally		0.051
		(0.055)
personal income * district's pop. density		0.001***
		(0.000)
personal income * district's total sales per capita		0.001*
		(0.000)
personal income * district's inv. per capita		-0.000
		(0.000)
personal income * district's gov. revenue per capita		0.001***
		(0.000)
personal income * district's GDP per capita		0.001***
		(0.000)
personal income * district's avg. personal income		-0.000
		(0.000)
personal income * distance to state-road		-0.053
		(0.268)

personal income * distance to highway	-0.076
	(0.134)
personal income * distance to supermarket	-1.411
	(2.965)
personal income * distance to downtown	0.122
	(0.303)
age * household born locally	-0.000
	(0.009)
age * district's pop. density	0.001***
	(0.000)
age * district's total sales per capita	0.001***
	(0.000)
age * district's inv. per capita	-0.001***
	(0.000)
age * district's gov. revenue per capita	0.000
	(0.000)
age * district's GDP per capita	-0.001*
	(0.000)
age * district's avg. personal income	-0.001***
	(0.000)
age * distance to state-road	0.005
	(0.024)
age * distance to highway	0.002
	(0.016)
age * distance to supermarket	0.045
	(0.327)
age * distance to downtown	-0.006
	(0.032)
household born locally * district's pop. density	0.001***
	(0.000)
household born locally * district's total sales per capita	0.001***
	(0.000)
household born locally * district's inv. per capita	-0.001***
	(0.000)
household born locally * district's gov. revenue per capita	0.001*
	(0.000)
household born locally * district's GDP per capita	-0.000
	(0.000)
household born locally * district's avg. personal income	-0.001***
	(0.000)
household born locally * distance to state-road	0.359
	(0.593)
household born locally * distance to highway	-0.184
	(0.295)
household born locally * distance to supermarket	-1.760
	(2.653)

household born locally * distance to downtown		-0.0001***
		(0.000)
Constant	-5.84***	-17.381***
	(0.382)	(5.380)
Observations	8,006	8,006

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

The second step of the residential sorting model is consistent with the estimation of Equation (5). The dependent variable is the vector of mean indirect utilities in the five districts, which is calculated from the first stage. In this stage, an underlying assumption is that house prices are uncorrelated with unobserved characteristics of residential locations (districts). However, the observed prices are often correlated with the unobservable attributes. For instance, house prices may be affected by the prices of the nearby houses and, if the endogeneity of house prices are disregarded, the estimation results will be biased. Thus, to eliminate the correlation between unobserved location characteristics and house prices, as well as the correlation between unobserved local attributes and amenity, this chapter followed Bayer (2005) and Chay and Greenstone (2005) in the estimation of equation (9) by moving $\theta_{0\rho}\rho_h$ to the left; then equation (9b) can be written as

$$\Omega_h + \theta_{0\rho}\rho_h = \theta_{0c}C_h + \theta_{0n}N_h + \zeta_h \qquad (9b)$$

where, $\theta_{0\rho}$ is the share of income spent on house. To estimate the share, this study incorporates the annual average 10-year fixed mortgage rate of 2008 and 2012 (which is 4.9%) to calculate the individual's share of housing spending ($\theta_{0\rho}$).

In comparison, 2SLS is also incorporated into this structure to deal with the issue of endogeneity of house prices. Two instrumental variables are created: one is the districts' mean housing price exclude the within districts' mean housing price; the other variable represents the difference between the individual's housing price and the districts' mean housing price. Those two variables are closely correlated with the housing price but not correlated with the mean utilities.

3. Spatial extensions

The residential sorting model in this chapter is used to analyze location decisions of households. This project’s basic unit of analysis is the parcels level, and there are little over 8,000 parcels in the study area. The focus of this chapter is on CWSIP across districts, and the impact of this amenity may also extend over boundaries. CWSIP occurs across all districts and is important for residents of the districts in which they are located, but also bears relevance for people living in the proximity who like to commute and enjoy visiting such centers for shopping, dining, and recreation. The impacts of CWSIP are not only contained within each of these five districts, but also expanded across districts, which may affect the household’s choice. In order to account for the possibility that the attractiveness of such amenities interact across districts, this study will extend the traditional sorting model by also incorporating a weighted sum of district characteristics in the proximity. Equation 9c is expressed as:

$$\Omega_h = -\theta_{0\rho}\rho_h + \theta_{0c}C_h + \theta_{0n}N_h + u_h \tag{9c}$$

$$u_h = Wu_h + \vartheta \tag{13}$$

where, u_h is the autoregressive parameter and W represents the spatial weight matrix which signifies the inverse distance between parcels. The inverse-distance spatial-weighting matrices, as discussed by Haining (2003) and Cliff and Ord (1981), are created by Stata 14 with the spatial package.

The results of the estimation in the second stage can be found in Table 4 and Table 5, which report the effect of specific district characteristics and household characteristics. Table 4 reports the result of estimation when moving the housing price into the left as a component of the dependent variable weighed by the spending share in housing. Table 5 reports the results across the selected models without considering the endogeneity. Model 1and Model 2 in Table 5 is estimated by OLS and Model 3 and Model 4 are 2SLS results with different instrument variables. Model 5 reports the results from spatial estimation.

Table 4. Second Stage Estimation Results (Dependent Variable = Indirect Utility +Share * Price)

Dependent Var. Indirect Utility + Share * Price	Model (1)	Model(2)
distance to CWSIP	-0.014***	
	(0.004)	
buffer 1: within 500 m		0.078***
		(0.021)
buffer 2: 501-1,000 m		0.087***
		(0.021)
buffer 3: 1,001-1,500 m		0.054***
		(0.021)
male	-0.067***	-0.066***
	(0.007)	(0.007)
age	-0.001***	-0.001***
	(0.000)	(0.000)
household born locally	-0.065***	-0.064***
	(0.013)	(0.013)
area	0.004***	0.004***
	(0.000)	(0.000)
floor level	-0.002	-0.002
	(0.001)	(0.001)
# living room	0.005	0.006
	(0.007)	(0.007)
# bedroom	-0.032***	-0.032***
	(0.008)	(0.008)
regular house	0.178***	0.178***
	(0.007)	(0.007)
distance to railway	-0.020***	-0.018***
	(0.004)	(0.004)
distance to state-road	0.004**	0.003
	(0.002)	(0.002)
distance to country-road	-0.018***	-0.013***
	(0.003)	(0.003)
distance to highway	0.018***	0.018***
	(0.002)	(0.002)
distance to supermarket	-0.044***	-0.049***
	(0.008)	(0.008)
distance to hospital	0.060***	0.061***
	(0.010)	(0.010)
distance to downtown	-0.001**	-0.001**
	(0.001)	(0.001)
Constant	0.530***	0.444***
	(0.026)	(0.036)
Observations	8,006	8,006

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

Table 5. Second Stage Estimation Results (Dependent Variable = Indirect Utility)

Dependent Var. Indirect utility	Model (1) OLS	Model (2) OLS	Model (3) IV	Model (4) IV2	Model (5) Spatial
rho					2.342***
					(0.043)
house price	-0.002***	-0.002***	-0.009***	-0.008***	-0.007***
	(0.0001)	(0.0001)	(0.001)	(0.001)	(0.001)
distance to CWSIP		-0.009***	-0.016***	-0.007***	-0.006***
		(0.002)	(0.003)	(0.002)	(0.002)
buffer 1: within 500 m	0.079***				
	(0.008)				
buffer 2: 501-1,000 m	0.092***				
	(0.009)				
buffer 3: 1,001-1,500 m	0.067***				
	(0.008)				
male	0.004	0.003	0.007**	0.004	0.005**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
age	0.000	0.000	0.001***	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
household born locally	-0.063***	-0.064***	-0.066***	-0.055***	-0.062***
	(0.005)	(0.005)	(0.008)	(0.008)	(0.005)
area	0.001***	0.001***	0.000	0.000**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
floor level	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# living room	-0.003	-0.005*	-0.004	-0.003	-0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
# bedroom	-0.023***	-0.024***	-0.018***	-0.023***	-0.018***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
regular house	-0.000	0.001	0.007**	0.001	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
distance to railway	-0.009***	-0.011***	-0.010***	-0.010***	-0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
distance to state-road	0.001	0.003***	0.002**	0.002***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance to country-road	-0.005***	-0.011***	-0.014***	-0.011***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance to highway	0.021***	0.021***	0.026***	0.021***	0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
distance to supermarket	-0.043***	-0.038***	-0.050***	-0.036***	-0.037***
	(0.003)	(0.003)	(0.009)	(0.004)	(0.003)
distance to hospital	0.039***	0.039***	0.048***	0.040***	0.039***
	(0.004)	(0.004)	(0.006)	(0.004)	(0.004)
distance to downtown	-0.001**	-0.001***	-0.001***	-0.001***	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Constant	0.276***	0.366***	0.350***	0.350***	0.351***
	(0.015)	(0.011)	(0.013)	(0.011)	(0.010)
Observations	8,006	8,006	8,006	8,006	8,006

Note:
1. In Model 3, instrumental variable = the districts' mean housing price exclude the within districts' mean housing price; In Model 4, instrumental variable = the difference between the individuals housing price and districts' mean housing price.
2. ***Statistically significant at 1%; **statistically significant at 5%; *statistically significant at 10%. The asymptotic t statistics are in parentheses.

There are expected signs for most variables, including the following designations: a negative coefficient on hosing price, distance to CWSIP, distance to supermarket, distance to downtown and positive signs for proximity CWSIP buffer, floor and distance to the railway. In the spatial framework, the spatial dependence parameter estimate (ρ) turned out to be positive and significant, which indicates that the effects have spilled over because they influence each other's impacts positively. The magnitude of the marginal effect from the spatial estimate is slightly larger than the regular sorting model.

The particular interest in this analysis is the CWSIP. Results for these variables strongly support the hypothesis that certain housing amenities indicate a heterogeneous commodity, as the coefficients associated with the different distance with the house location. Due to the fact that the area of the city water system improvement project is located in conjunction with the study area, the house price in such districts was positively impacted by CWSIP. In other words, the value of CWSIP can be reflected from the heterogeneous housing market. The next section will provide some scenario analysis to estimate the welfare change with respect to the CWSIP, which implies the housing price.

Compared the two methods that deals with endogeneity of house prices, estimation from equation 9b indicated a larger magnitude of marginal effects in most of variables. This might because the income share that spent on housing has been added into the mean utilities. The magnitudes of the marginal effects for each models that estimating 9b include both (1) the effect on indirect utilities and (2) housing spending. Since the share of income that spent on housing is fixed, the results estimated from this model may include a degree of bias. However, the magnitudes of marginal effects from 2SLS models are relatively small. Those variances are all from the indirect utility. Model 3's results based on a district's mean value, which incorporates relatively lower variances; the results indicated higher effects on the utility from some of variables, e.g. distance to CWSIP, where the coefficient is 0.016 vs. 0.007 in Model 4.

4. Welfare Change

From the sorting framework, one can directly measure the partial equilibrium welfare effects in quasi-fixed goods. Traditional hedonic price model only allowed estimating the welfare efforts of discrete changes in amenity levels by computing or approximating in special cases. This limitation is addressed in the sorting model by a second stage estimation (Klaiber, 2010). Besides, an important assumption in the hedonic price model is that the housing price is stable price equilibrium in the housing market, while shocks to this equilibrium complicate inferences by using the estimated price function. An efficient way to address these limitations was introduced by Walsh (2007) and compromised using a stylized vertical sorting model to measure the value of open space amenities (Epple, 2009). In contrast to the vertical model estimated, Klaiber (2010)'s estimation is well suited to incorporating a large variety of heterogeneous type of open space, allowing to relax assumptions of perfect substitutability between different types of open space respecting various of policies.

In this chapter, Klaiber (2010)'s estimation is applied. Partial equilibrium measures constrain households to the current location by eliminating the possibility of resorting and the establishment of new equilibrium prices. The partial equilibrium welfare measures can be computed by given the conditions of 1) the extreme value error distribution and 2) linear in-price specification. In particular, the familiar log-sum rule is applied to compute a single household's expected willingness to pay for a policy change as,

$$\Delta \mathrm{E(CS)} = \frac{1}{\theta_{0\rho}}\left[\ln\left(\frac{\sum_h e^{V_h^{i1}}}{h}\right) - \ln\left(\frac{\sum_h e^{V_h^{i0}}}{h}\right)\right] \tag{14}$$

where, the superscript 1 refers to conditions after the policy change, the superscript 0 refers to conditions before the policy change. Table 6 reports the welfare changes as increasing in distance to CWSIP. On average, household welfare reduces by 4,670 yuan when the distance to CWSIP increases from buffer 1 (within 500 m) to buffer 2 (501-1,000 m). There was a decrease by 3,812 yuan when the distance increased from buffer 2 (501-1,000 m) to buffer 3 (1,001-1,500 m) and went down by 2,781 yuan when the distance increased over 1,500 meter (Buffer 4). Considering a total of 0.25 million households living in the study area, the total welfare will decrease by 1.16 billion yuan, 0.95 billion yuan, and 0.70 billion yuan respectively. The marginal changes in the welfare are decreasing, which represents findings consistent with van Duijn (2012)'s estimation.

Table 6 Welfare Changes as Increasing in Distance to CWSIP

	Partial average household welfare changes (in yuan)	Partial total welfare changes (in billion yuan)
buffer 1 to buffer 2	-4,670	-1.16
buffer 2 to buffer 3	-3,812	-0.95
buffer 3 to buffer 4	-2,781	-0.70

5. Conclusion and Discussion

This chapter uses the sorting model for analyzing the implicit price of housing characteristics related to CWSIP and, based on this model, provides an estimate for the value of CWSIP in Guilin, China. This project primarily focuses on Guilin's city water system improvement project and includes an empirical study where selected housing characteristics are applied to test the aforementioned theoretic model. A spatial regression is conducted to find the intact effects of CWSIP on housing price. Covariance (including household characteristics, housing characteristics, and district characteristics) is incorporated into a two-stage model to control the underlying and unobserved heterogeneous issues.

This estimation indicates that the first-stage interactions are, for the most part, consistent with our prior expectations and statistically significant. All of the control variables provide evidence that the model confirms stylized facts. For example, population density, GDP per capital, average personal income, and government revenue per capital positively affect the housing demand market, while government revenue per capital and total sales per capital are negatively correlated with the housing market's demand. The second stage suggested that the CWSIP is a heterogeneous commodity, as the coefficients associated with the different distance are in accordance with the house location. Since the area of the city water system improvement project is located in conjunction with the study area, the house price in such districts was positively impacted by CWSIP.

This study found that welfare decreases as the distance to CWSIP increases. Household welfare reduces by 4,670 yuan, 3,812 yuan, and 2,781 yuan, when the distance to CWSIP increases in accordance with buffer 1 (within 500 m) to buffer 2 (501-1,000 m), and increases from buffer 2 (501-1,000 m) to buffer 3 (1,001-1,500 m), and buffer 3 (1,001-1,500 m) to buffer 4 (over 1,500 m). The partial total welfare change are 1.16 billion yuan, 0.95 billion yuan, and 0.70 billion yuan respectively.

It is no doubt that Guilin's city water system improvement project has created extra value for the housing market. This project will remain an important policy with possibilities for further implementation in years to come. Recent events in the included study area support this assessment. The government has increased investments in the study area to improve the quality of water and built several bridges that include additional water systems. Those further stage of the projects have increased the housing price along the water system by 50% since 2012. This indicates a scarcity in public goods that will significantly raise the housing price in the future economic market.

CHAPTER 3

The Effect of the Municipal Government City Hall Relocation Plan on Property Price in Guilin, China: A Difference in Differences Approach

1. Introduction

Local economic development groups often look to improve landscape as a way to quicken the pace of economic growth in their communities. This is especially true in areas where the pace of growth is perceived to be lagging or where the economic development is rapid (Hite *et al.*, 2001). After completing the city development project in 2004, Guilin city has improved its image and residents' quality of living by adding the city water system amenities. Associated with this achievement, the current location of Guilin municipal government city hall became more valuable because of its well-developed location (center of the city and surrounded by the Guilin city water system amenities).

In China, it is understandable that wherever the city hall is located, business properties would be developed nearby. Thus, to accelerate city development and support improvements in other parts of the city, the Guilin municipal government has planned to expand and develop the city in a new way by relocating the existing city hall to a new location. The official announcement of this plan was made at the end of 2005 and related construction projects had been initiated since 2006. In 2010, the final relocation was implemented. As many resources were moved to the new location, the selected region and even its outlying areas have enjoyed major benefits from the relocation plan, such as the development of the public infrastructure and amenity construction projects. Residents who live around the area of the new city hall would gain several benefits on public goods and services, presenting the potential for an increase in their property values. Therefore, it is interesting to strip off and examine how such city hall relocation policies and behaviors might impact residential properties from the announcement of the project to its final implementation.

Seldom studies focus on the relationship between city hall relocation and house price. Jud (1980) isolates the effects of zoning on single-family residential property values. He provides strong evidence to suggest that large-lot zoning lowers the cost of single family residential housing constructed on large lots. Frieden *et al*. (1991) indicate some ideas regarding how America rebuilds cities. In their study, they suggest the role of the downtown area in city development and how to build a city according to different endowments. Turok (1992) examine how the property could contribute to urban economic regeneration. The Turok study indicates that property development can have positive economic effects, but it has to be part of a more holistic approach that embodies concerns for people living in deprived areas and for the underlying condition of the local economy. Uunk and Dominguez Martinez (2002) analyze relocation flows of native Dutch; they find that housing price significantly increases when more residents concentrate into the same area.

However, unlike most developed countries, the city hall in China does not only mean a place located in the downtown area, but also refers to the center of the city. All of the facilities, businesses, cultures and residents' daily life radiate around the city center. The demand for house, land, and commercial activities around the city hall will extremely exceed the supply. Thus, similar studies in some developed countries might not be applied to the situation in China. His research finds that residential displacement by urban regeneration in western economies and forced relocation in third world countries are contentious issues. Chang *et al.* (2013) investigate the potential relationship between land prices and intra-country industrial relocation in China. They built a conceptual model to explore the causalities of urban expansion, land prices, and coastal-to-inland business relocation. They find that relocation is mainly driven by high land prices resulting from urban expansion, and the relocation will also affect the land value around the areas.

Based on previous studies, the purpose of this chapter is to capture the effect of governmental behaviors on housing price using the difference in differences approach. We particularly trace the house price changes during siting decision districts. Kiel *et al.* (1995) develop a theoretical framework to find the change in house prices during the siting decision stages in the case of an incinerator from rumor through the operation. They find that the adjustment of house prices to the construction and operation of an undeniable facility is much more complex and prolonged than previously indicated. The remainder of this paper will discuss the model specification and data, the empirical results, and main findings.

2. Government Relocation Plan in Guilin, China

After completing the first stage of Guilin's city water system improvement project in 2002, the government of Guilin has planned to expand and develop the city in a new way by relocating its existing municipal government city hall to a new location. A series of related panel discussions and public hearings were launched in 2004. Rumors of potential city hall locations started to spread from 2005 onward. Qixing district, Yanshan district, and Diecai district were considered to be the most promising potential locations. Numerous construction projects have been planned and executed in association with the rumors through the period. In 2009, the municipal government of Guilin's general land-use planning for 2006-2020 remarkably revealed that they would lead the direction of the city hall relocation plan. Yet, it was still undecided where the new city hall of Guilin would be located. However, a year later Qixing district was officially selected to replace the old city hall in Xiufeng district by receiving the State Council of China's approval notice of its submission in the urban development master plan. In the approval notice, the State Council of China further stated the Guilin's city hall relocation schedules and time frames of related arrangements. Thus, Qixing district has been determined as the new home for the municipal government offices. Existing construction and investment projects during the rumored period were still ongoing, with more new resources being concentrated in the Qixing district after the release of the final decision in 2010. According to the schedule that was enclosed in the State Council of China's decision, the new city hall for government of Guilin is expected to present a grand opening in early 2015. Figure 1 shows the timeline of the procedures for executing Guilin's city hall relocation plan.

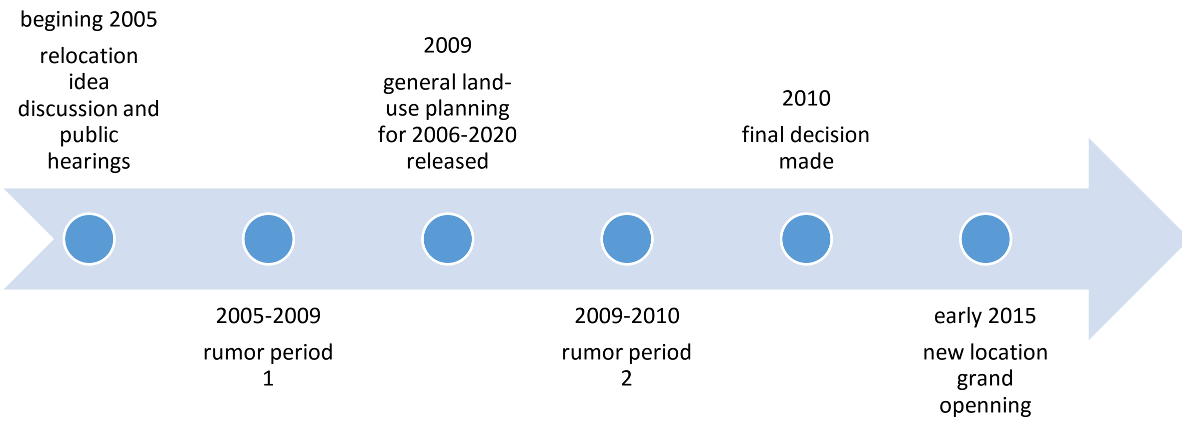


Figure 1. Timeline of Procedures of Executing the City Hall Relocation Plan in Guilin City, China

3. Methodology

This chapter differs from most prior research because this research not only focuses on the city hall relocation plan effect, but also devotes attention to the announcement effect on house price of a city hall accommodates to a new location. This study will measure the change in house price both before and after the announcement of the city hall relocation, as well as account for those house price changes after the new city hall has been operational use.

Potential problems with the preexisting city hall relocation studies are that they examine the effects of relocation in an ex post dimension; that is, after the new locations are chosen, it will allow property markets to have time to adjust. The problem with this approach is that, after the fact, the new hall's location is very highly correlated with other aspects of the property market, such as traffic congestion and other neighborhood/location amenities. This chapter utilizes an event study methodology by Fama *et al.* (1969), who developed the market model in a pre-announcement on stock prices with respect to the new information (usually from an announcement). Similarly, Brown and Warner (1980, 1985) tested variations of the event study in the daily stock market and demonstrate that the use of dummy variables for the days of the announcement period can provide identical results to the use of the regression residuals. Burnett *et al.* (1995) offer a general methodology to account for changes in market parameters. Donald (2006) introduces a more direct way to use dummy variables to estimate the announcement of an airport expansion.

Following Donald *et al.* (2006)'s study, the following research adheres to a hedonic price model for property *i* at time t as:

$$P_{it} = \beta_0 + \beta_1 T_{it} + \beta X + \varepsilon_{it} \quad (1)$$

where, T_{it} is the period's dummy variable, which indicates when the announcement occurs; and X is a vector of other variables that will affect the housing price.

In addition to considering the announcement's effect, this study also demonstrates an interest in the effects after the actual relocating to the new city hall. One additional time period dummy variable, E_{it}, will also be included into model 1 as:

$$P_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 E_{it} + \beta X + \varepsilon_{it} \quad (2)$$

Moreover, to isolate the impacts of such city hall relocation announcement from actual relocation of the city hall, a "difference in differences" (DID) method applies. This method has been widely used to examine certain policy impacts. For instance, Ashenfelter and Card (1985) adopted it to estimate the labor market; Donohue *et al.* (2002) used it to evaluate civil rights topics; Duflo (2001) applied it to examine school construction; and Dynarski (2004) identified the effect of a policy change in the state of Georgia. More generally, the DID method can be applied to problems in which some subpopulations are subject to a treatment and others are not. Each treatment and control group's outcomes are measured both pre- and post- policy. The extension of the DID model for different groups and time periods is as follows:

$$P_{it} = \beta_0 + \beta_1 E_{it} + \beta_2 G_{it} + \beta_3 G_{it} * E_{it} + \beta X + \varepsilon_{it} \quad (3)$$

where, G_{it} is the treatment group dummy variable. If G_{it}= 1, the observation i belongs in the treated group that will be treated eventually; $G_{it} * T_{it}$ is the interaction term, indicating the treatment group after the intervention.

In this case, research in this area should consider the period impacts from the official announcement to the relocation implementation. During this period, housing prices will be shocked in both the treatment and control groups. Hence, this study will incorporate a DID model with multiple time periods. As support for this study, Besley and Burgess (2004) estimated the impacts of policies in India's labor market. In their paper, it happens that the inclusion of state-specific time trends overwhelms the estimated treatment effect. A typical way to estimate a DID model with more than two time periods is to add year dummies instead without specifying whether each year belongs to the pre or post treatment period. The equation can be expressed as follows:

$$\mathrm{P}_{it} = \beta_0 + \beta_1 T_{it} + \beta_2 E_{it} + \beta_3 G_{it} + \beta_4 G_{it} * E_{it} + \beta X + \varepsilon_{it} \quad (4)$$

4. Data and Empirical Results

4.1 Data Source

Housing transaction data is used in the empirical model. The data is provided by the Bureau of Housing and Urban-Rural Development of Guilin, which contains 20,663 observations during the time period from 2005 to 2012. After dropping missing variables, the total number reduced to 16,645. 45% of houses are assigned to the treatment group. 8% of the houses sold before the announcement and 62% of the houses finished their transactions during the announcement and actual moving. The remaining 29% of houses were sold after the new city hall relocation. This study selected the house prices as the dependent variables. From Table 1, the following research finds the mean house price in the study area to be about 328,900 yuan (roughly $50,400 USD) from 2005 to 2013, while the mean prices in the subsample are more diverse. The mean house prices in three periods - before announcement, after announcement, and after move - are 193,150 yuan, 286,990 yuan, and 456,930 yuan respectively. There is a 136% increase in house price in the specified areas from 2005-2012. This is consistent with the situation of the housing market in most cities during the past decade.

Table 1. Descriptive Statistics of Housing Characteristics, Household Characteristics, and District Characteristics

	Full Sample (Obs.=16,645)			Houses sold before announcement (Obs.=1,382)			Houses sold after announcement (Obs.=10,396)			Houses sold after moving (Obs.=4,867)		
Variable	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
house price	3.29	0.15	25.24	1.93	0.20	6.90	2.87	0.15	15.30	4.57	0.50	25.24
announcement time	0.62	0	1	0	0	0	1	1	1	1	1	1
move time	0.29	0	1	0	0	0	0	0	0	1	1	1
treated district	0.44	0	1	0.41	0	1	0.44	0	1	0.46	0	1
male	0.66	0	1	0.74	0	1	0.66	0	1	0.64	0	1
age	36.78	19	61	37.82	19	60	37.03	21	61	35.94	20	60
household born locally	0.92	0	1	0.96	0	1	0.93	0	1	0.89	0	1
area	1.12	0.21	2.99	1.10	0.34	2.98	1.15	0.27	2.99	1.07	0.21	2.97
floor level	4.55	1	35	4.57	1	17	4.56	1	35	4.52	1	17
# living room	1.82	1	4	1.90	1	4	1.84	1	4	1.76	1	4
# bedroom	2.81	0	5	2.88	1	5	2.86	0	5	2.69	0	5
regular house	0.73	0	1	0.57	0	1	0.70	0	1	0.83	0	1
distance to CWSIP	1.09	0.00	10.33	1.27	0.00	8.97	0.94	0.00	10.33	1.39	0.00	5.68
distance to railway	1.36	0.00	8.04	1.21	0.00	6.61	1.34	0.00	8.04	1.49	0.00	5.09
distance to state-road	2.56	0.00	68.49	2.19	0.00	65.88	2.42	0.00	68.49	3.06	0.00	9.20
distance to country-road	1.44	0.00	31.47	1.46	0.00	20.25	1.24	0.00	31.47	1.94	0.00	7.06
distance to highway	4.03	0.00	24.09	4.27	0.01	24.09	3.83	0.01	15.82	4.44	0.00	11.94
distance to supermarket	0.61	0.00	22.77	0.59	0.00	22.77	0.56	0.00	6.79	0.74	0.00	2.08
distance to hospital	0.75	0.00	13.36	0.70	0.01	2.96	0.70	0.00	13.36	0.87	0.00	2.62
distance to downtown	6.33	0.01	115.33	5.36	0.13	81.31	5.75	0.01	115.33	8.14	0.01	27.41

Table 2 reports the housing prices between the treated and untreated groups in those time periods. Before the announcement, the mean housing prices in the treated and untreated groups were 171,950 yuan and 223,750 yuan; the difference is about 52,000 yuan. However, after the announcement, the difference decreases to only 9,000 yuan. This may be due to the impact of rumors across the larger areas of China. Since people actually have limited knowledge about the new location, rumors will impact all the potential districts and improve the housing price in all of the aforementioned areas during that period. After the actual move happened, the housing price in the new location was raised significantly. This can be shown in the last group of Table 2; the house price in the treated group increased to 473,620 yuan, while the price in the untreated group was calculated at 301,000 yuan, representing an approximate 172,000 yuan difference.

Table 2a. Descriptive Statistics of Housing Characteristics, Household Characteristics, and District Characteristics

	Houses sold before announcement						Houses sold after announcement time					
	Untreated (Obs.=812)			Treated (Obs.=573)			Untreated (Obs.=5,854)			Treated (Obs.=4,535)		
Variable	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
house price	1.72	0.20	6.01	2.24	0.20	6.90	2.87	0.15	15.30	4.57	0.50	25.24
announcement time	0	0	0	0	0	0	1	1	1	1	1	1
move time	0	0	0	0	0	0	0	0	0	1	1	1
treated district	0	0	0	1	1	1	0.44	0	1	0.46	0	1
male	0.72	0	1	0.77	0	1	0.66	0	1	0.64	0	1
age	38.14	19	59	37.34	24	60	37.03	21	61	35.94	20	60
household born locally	0.97	0	1	0.95	0	1	0.93	0	1	0.89	0	1
area	1.00	0.34	2.29	1.24	0.39	2.98	1.15	0.27	2.99	1.07	0.21	2.97
floor level	4.71	1	17	4.37	1	17	4.56	1	35	4.52	1	17
# living room	1.73	1	4	2.13	1	4	1.84	1	4	1.76	1	4
# bedroom	2.67	1	4	3.18	1	5	2.86	0	5	2.69	0	5
regular house	0.51	0	1	0.65	0	1	0.70	0	1	0.83	0	1
distance to CWSIP	0.73	0.00	8.97	1.98	0.00	5.53	0.94	0.00	10.33	1.39	0.00	5.68
distance to railway	1.30	0.00	8.04	1.01	0.00	6.00	1.34	0.00	8.04	1.49	0.00	5.09
distance to state-road	2.02	0.02	65.88	2.51	0.03	5.01	2.42	0.00	68.49	3.06	0.00	9.20
distance to country-road	1.18	0.00	20.25	1.98	0.00	6.00	1.24	0.00	31.47	1.94	0.00	7.06
distance to highway	3.06	0.01	24.09	6.09	0.02	10.39	3.83	0.01	15.82	4.44	0.00	11.94
distance to supermarket	0.58	0.01	22.77	0.64	0.01	2.16	0.56	0.00	6.79	0.74	0.00	2.08
distance to hospital	0.64	0.01	3.00	0.76	0.04	2.31	0.70	0.00	13.36	0.87	0.00	2.62
distance to downtown	4.66	0.13	81.31	6.51	0.70	11.44	5.75	0.01	115.33	8.14	0.01	27.41

Table 2b. Descriptive Statistics of Housing Characteristics, Household Characteristics, and District Characteristics

	After Moving					
	Untreated (Obs.=2,631)			Treated (Obs.=2,243)		
Variable	Mean	Min	Max	Mean	Min	Max
house price	3.01	0.50	25.24	4.74	0.73	15.49
announcement time	0	0	0	0	0	0
move time	0	1	1	1	1	1
treated district	0	0	0	1	1	1
male	0.48	0	1	0.65	0	1
age	8.13	20	60	35.88	20	60
household born locally	0.26	0	1	0.84	0	1
area	0.30	0.21	2.97	1.13	0.37	2.75
floor level	2.56	1	17	4.59	1	17
# living room	0.48	1	4	1.83	1	4
# bedroom	0.69	0	5	2.77	0	5
regular house	0.21	0	1	0.68	0	1
distance to CWSIP	0.74	0.00	4.41	1.60	0.00	4.60
distance to railway	0.77	0.00	4.15	1.65	0.01	4.47
distance to state-road	1.49	0.00	7.97	3.40	0.00	9.91
distance to country-road	1.13	0.00	6.15	1.87	0.00	6.21
distance to highway	1.72	0.00	10.68	5.29	0.02	11.40
distance to supermarket	0.45	0.00	2.50	0.76	0.00	2.54
distance to hospital	0.40	0.00	2.26	0.88	0.00	2.37
distance to downtown	4.51	0.02	21.90	8.59	0.03	28.36

4.2 Model Design

The study starts with the implementation of simple models by separating the full sample into two groups: treated and untreated. In the treated group, all the housing transactions occurred at the new location for the city hall. By incorporating the announcement time and move time as dummy variables, six models are estimated in those two groups, which include the announcement time, move time, or both variables. The results of these calculations are reported in Table 3.

To isolate the impacts from both the announcement and actual relocation, the DID model is employed in the next series of estimations. This study incorporates all the samples and estimates five models by including (1) announcement time only, (2) move time only, (3) both announcement time and move time, (4) move time, treated dummy and interaction with moving time, and (5) announcement time, move time, and treated dummy, and interaction with moving time. Each of these models is used to estimate different impacts. Table 4 shows the results in this stage.

In addition, this study also places emphasis on the impacts from announcement and actual relocation in a short run. Five estimations with regard to the announcement and the actual move in the short run are reported in Table 5. Model 1 assesses the impact of the initial announcement by only including the dummy of announcement time and the subsample is limited to the period from 2005-2007. Similarly, the second model tried to find the short-run effect from the actual move within the specified time period from 2009-2011. Model 3 incorporates both variables and addresses the extended time frame from 2005-2011. The last two models are in accordance with the DID model by not including the announcement time and including the announcement time. The subsamples are observations from both 2009-2011 and 2005-2011.

4.3 Estimation Results

Table 3 report results of estimating the effect of the city hall relocation in two treated and untreated groups. The announcement has more impact on the untreated group, which indicates a difference around 4.1% compared with 2.8% in the treated group. The actual move made a larger impact on the treated group, which increased by 14.1% versus 3.7% increases in untreated group. In considering both announcement and move variables (model 5 and 6), the impact based on the initial announcement is strengthened in untreated group and is steady in treated group when compared with the scenario that only consider announcement (model 1 and 2). On the other hand, the effect of actual move increased substantially in treated group in model 5 than model 4. However, it turned insignificant in untreated group in model 6 when compared with 3.7% increases in model 4. These indicate there may be an induced effect within each group after the city hall moved to the new location. It also implies a substitution effect between the treated and untreated group.

Table 3. Parameter Estimates for House Price in Subsample (Treated vs. Untreated)

Dependent var. = log house price	(1) Treated	(2) Untreated	(3) Treated	(4) Untreated	(5) Treated	(6) Untreated
announcement time	0.028***	0.041***			0.024*	0.078***
	(0.007)	(0.008)			(0.013)	(0.014)
move time			0.141***	0.037***	0.243***	0.007
			(0.011)	(0.003)	(0.023)	(0.021)
income	0.044***	0.050***	0.044***	0.049***	0.044***	0.050***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
male	-0.025***	-0.036***	-0.025***	-0.035***	-0.025***	-0.034***
	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)
age	-0.002***	-0.001***	-0.002***	-0.001***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
household born locally	-0.004	-0.023**	-0.004	-0.024**	-0.004	-0.024**
	(0.013)	(0.010)	(0.013)	(0.010)	(0.013)	(0.010)
area	0.010***	0.008***	0.010***	0.008***	0.010***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
floor level	0.001	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# living room	0.101***	0.075***	0.101***	0.073***	0.101***	0.075***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
# bedroom	-0.004	0.006	-0.004	0.004	-0.005	0.003
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
regular house	0.710***	0.726***	0.708***	0.722***	0.709***	0.724***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.007)	(0.008)
distance to CWSIP	-0.018***	-0.010*	-0.017***	-0.011**	-0.018***	-0.010*
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
distance to railway	-0.018***	0.019***	-0.018***	0.020***	-0.018***	0.018***
	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)
distance to state-road	0.002	-0.005*	0.002	-0.004	0.002	-0.004
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
distance to country-road	-0.013***	0.001	-0.013***	0.000	-0.013***	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
distance to highway	0.006***	0.000	0.007***	0.001	0.007***	0.001
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)

distance to supermarket	-0.014**	-0.021*	-0.014**	-0.017	-0.014**	-0.011
	(0.007)	(0.012)	(0.007)	(0.012)	(0.007)	(0.012)
distance to hospital	-0.021**	0.010	-0.021**	0.008	-0.021**	0.009
	(0.009)	(0.011)	(0.009)	(0.011)	(0.009)	(0.011)
distance to downtown	-0.000	-0.001	0.000	-0.001	-0.000	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
time trend	0.116***	0.109***	0.110***	0.087***	0.113***	0.077***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Constant	-228.904***	-214.504***	-218.053***	-171.360***	-223.423***	-151.501***
	(3.820)	(4.142)	(5.217)	(5.947)	(6.622)	(6.834)
Observations	7,895	6,682	7,895	6,682	7,895	6,682
R-squared	0.825	0.785	0.825	0.789	0.825	0.790

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

Table 4 estimated five models in the full sample. Model 1 and Model 2 report the impact of the announcement and the actual move separately. The increase after the announcement is about 2.7% and 7.7% from moving. However, from the results of Table 3, it concluded that the price increase from the announcement occurs across the all specified territories, but the housing price appreciation after the move is mainly from the treated group. Those fluctuations might positively affect the regular property market from demand and supply aspects. The price in the regular housing market could be both raised and dropped while the price in the policy related regions will be dramatically changed. Model 4 and Model 5 are two DID estimators. Model 4 ignores the impact of the announcement and the coefficient for the interaction is 0.057, which means that the actual impact from city hall moving is about 5.7%. When adding a dummy variable of the announcement, the key interaction variable is positively correlated to the house value with 0.061, which implies that the city hall relocation will appreciate the property value in the treated areas by 6.1% on average. This result takes out the impact from the announcement. When the dummy variable of the announcement was added into the regression, the magnitude of the interaction variable increased about 0.4%.

As expected, the city water system improvement project will increase the house price. Gender is an important factor that affects the housing price. Women are willing to spend more on a higher quality environment. People who have a higher income are prone to buy a higher value property since they have enough fiscal power to afford it. Housing with more living room area is more expensive, but number of bedrooms showed statistically insignificant to housing price. The houses far away from downtown, supermarkets, and county roads indicate lower prices. Houses close to major highways indicate a positive relationship with housing prices.

Table 4. Parameter Estimates for House Price in Full Sample Set 2005-2012.

Dependent var.= log house price	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
announcement time	0.027***		0.036***		0.035***
	(0.005)		(0.009)		(0.009)
move time		0.077***	0.127***	0.050***	0.098***
		(0.009)	(0.015)	(0.010)	(0.016)
treated district				0.025***	0.021***
				(0.007)	(0.007)
move time*treated district				0.057***	0.061***
				(0.010)	(0.010)

income	0.048***	0.048***	0.048***	0.047***	0.047***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
male	-0.027***	-0.026***	-0.026***	-0.026***	-0.026***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
age	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
household born locally	-0.021**	-0.021***	-0.021**	-0.015*	-0.016*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
area	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
floor level	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# living room	0.097***	0.097***	0.097***	0.094***	0.094***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
# bedroom	0.003	0.002	0.001	0.003	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
regular house	0.710***	0.708***	0.707***	0.715***	0.714***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
distance to CWSIP	-0.016***	-0.016***	-0.016***	-0.019***	-0.018***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
distance to railway	0.004	0.004	0.004	0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
distance to state-road	0.002	0.002	0.002	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
distance to country-road	-0.011***	-0.011***	-0.011***	-0.006***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
distance to highway	0.010***	0.010***	0.010***	0.006***	0.006***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
distance to supermarket	-0.025***	-0.025***	-0.024***	-0.018***	-0.018***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
distance to hospital	0.004	0.005	0.005	0.002	0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
distance to downtown	-0.001	-0.001	-0.001*	-0.001*	-0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
time trend	0.114***	0.104***	0.098***	0.103***	0.098***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-225.295***	-204.173***	-193.831***	-203.926***	-193.667***
	(2.740)	(3.898)	(4.721)	(3.907)	(4.766)
Observations	14,486	14,486	14,486	14,486	14,486
R-squared	0.804	0.804	0.804	0.805	0.805

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

Table 5 shows the impact of the announcement and the actual relocation in short run. The following estimates indicate that the housing impacts are much more significant in a short run. The confidents of interaction in model 4 and model 5 are larger than those in Table 4. This implies the housing price will increase substantially after the city hall relocation since more housing is demanded in the new location. Some of those impacts are stimulated by marketing, advertisements, and some potential promotions. While in a long run, those effects will be weakened as people's housing choices are directed back to narrower region.

Table 5. Parameter Estimates for House Price in Subsample Set (Time Periods).

Dependent var. = log house price	Model (1) 2005-2007	Model (2) 2009-2011	Model (3) 2005-2011	Model (4) 2009-2011	Model (5) 2005-2011
announcement time	0.095***		0.235***		0.045***
	(0.013)		(0.008)		(0.010)
move time		0.054***	0.605***	0.086***	0.124***
		(0.016)	(0.010)	(0.017)	(0.017)
treated district				0.020	0.021***
				(0.013)	(0.008)
move time*treated district				0.071***	0.061***
				(0.015)	(0.011)
income	0.039***	0.050***	0.059***	0.048***	0.047***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
male	-0.018***	-0.031***	-0.031***	-0.029***	-0.024***
	(0.007)	(0.008)	(0.005)	(0.008)	(0.005)
age	-0.003***	-0.001	-0.002***	-0.001	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
household born locally	-0.047***	0.007	-0.026***	0.016	-0.014
	(0.013)	(0.013)	(0.010)	(0.013)	(0.009)
area	0.010***	0.008***	0.009***	0.008***	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
floor level	0.001	0.002	0.000	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
# living room	0.066***	0.137***	0.077***	0.133***	0.089***
	(0.007)	(0.010)	(0.006)	(0.010)	(0.006)
# bedroom	-0.034***	0.017*	-0.025***	0.018**	-0.008
	(0.008)	(0.009)	(0.006)	(0.009)	(0.006)
regular house	0.655***	0.811***	0.722***	0.826***	0.713***
	(0.008)	(0.011)	(0.006)	(0.011)	(0.006)
distance to CWSIP	-0.035***	0.008	-0.015***	0.003	-0.022***
	(0.004)	(0.006)	(0.004)	(0.006)	(0.004)
distance to railway	0.012***	0.010*	0.014***	0.004	0.009***
	(0.004)	(0.006)	(0.004)	(0.006)	(0.003)
distance to state-road	0.001	0.003	0.000	0.000	-0.002
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
distance to country-road	-0.005*	-0.012***	-0.001	-0.006	-0.003
	(0.003)	(0.004)	(0.002)	(0.004)	(0.002)

distance to highway	0.014***	0.014***	0.015***	0.007***	0.010***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
distance to supermarket	-0.025***	-0.023**	-0.013**	-0.013	-0.020***
	(0.007)	(0.010)	(0.006)	(0.010)	(0.006)
distance to hospital	0.011	0.010	0.018**	0.009	0.008
	(0.009)	(0.012)	(0.008)	(0.012)	(0.007)
distance to downtown	-0.002***	0.001	-0.001	0.001	-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
time trend	0.061***	0.208***	0.214***	0.209***	0.092***
	(0.007)	(0.010)	(0.010)	(0.010)	(0.003)
Constant	-119.559***	-414.504***	3.541***	-415.229***	-180.056***
	(14.369)	(19.987)	(0.023)	(19.857)	(5.389)
Observations	6,968	4,759	11,727	4,759	11,727
R-squared	0.790	0.754	0.788	0.757	0.808

Note: ***Statistically significant at 1%; **Statistically significant at 5%; *Statistically significant at 10%. The asymptotic t statistics are in parentheses.

5. Concluding Remarks

In this chapter, systematic models are used to estimate the impact of the announcement and actual relocation if the city hall. A difference in differences approach has been emoloyed to isolate the impact of different stage of relocation plan on the housing market. Results indicate that the governmental plan and subsequent outcomes significantly improve housing prices in the affected areas. Moreover, housing prices increased quickly after the city hall relocation plan announcement and its impact continues through the relocation implementation. These lingering impacts might weaken after the relocation has been implemented. The findings of this research suggest that relocation plan is positively correlated with the house price. In the short run, larger positive impacts occurred immediately after the announcement on untreated group. However, the actual impact of relocating the city hall was weaker than the announcement on house price in the long run.

In China, especially in most tier 3 and tier 4 level cities, urban development and city expansion are following the “government led” model, which different from “market led” model in major metropolitans and big city clusters. This chapter examines a typical tier 3 city, Guilin, to demonstrate how government policy or behavior affects the housing market. The result clearly paints a picture of how government behaviors (decision making process) impact the people’s preferences and housing price. Due to the uncertainty of new location of the city hall, people are willing to pay more to reside in the candidate areas after relocation announcement has made. It's because that the expectations of increase property value in those areas are much higher than the non-candidate areas and the demand has been stimulated. Once city hall relocation occurred, the impacts reduced as people's housing choices are directed back to narrower region instead of candidate areas in the long run.

The relocation announcement has a positive gross effect on house prices in the city of Guilin, which is consistent with the government's goals. However, successful government policy is not only focused on one point or one area; it also needs to balance other factors to achieve the optimal goal of improving the overall quality of life and public services. In this study, the owners of the property (sellers) in Qixing district are obviously the biggest beneficiaries, yet it might not be a favorite policy for the house seeker who cannot afford the higher price.

This chapter studied a case of "government led" urban development behavior on housing price and found positive impacts of such behavior on housing market. However, whether or not the "government led" style is good for other cases still remain unclear. In Guilin's case, the city hall relocation plan stimulated the housing market and local economy via the "announcement – action" strategy, however, in some other case, such as ghost city case, the "government led" model doesn't seem right. Thus, future study on government policy analysis should incorporate its own characteristics and specific circumstances of urban development levels. Besides, due to data availability issue current literature and scholarly research are more focusing on static analysis on this subject, thus more attention may be given to improving its compatibility and dynamic nature in the future.

References

Abadie, A. (2005). Semiparametric Difference-in-differences Estimators. *The Review of Economic Studies*, *72*(1), 1-19.

Abelson, P. W. (1979). Property Prices and the Value of Amenities. *Journal of Environmental Economics and Management*, *6*(1), 11-28.

Alatas, V., & Cameron, L. A. (2003). The Impact of Minimum Wages on Employment in a Low Income Country: An Evaluation Using the Difference-in-differences Approach. *World Bank Policy Research Working Paper,* (2985).

Anderson, S. T., & West, S. E. (2006). Open Space, Residential Property Values, and Spatial Context. *Regional Science and Urban Economics*, *36*(6), 773-789.

Ashenfelter, O., & Card, D. (1985). Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs. *The Review of Economics and Statistics*, 648-660.

Barth, J. R., Lea, M., & Li, T. (2012). China's Housing Market: Is a Bubble About to Burst?. *Available at SSRN 2191087*.

Bassanini, A., & Venn, D. (2007). *Assessing the Impact of Labour Market Policies on Productivity: A Difference-in-Differences Approach* (No. 54). OECD Publishing.

Bayer, P., & Timmins, C. (2007). Estimating Equilibrium Models Of Sorting Across Locations*. *The Economic Journal*, *117*(518), 353-374.

Bayer, P., & Timmins, C. (2005). On the Equilibrium Properties of Locational Sorting Models. *Journal of Urban Economics*, *57*(3), 462-477.

Bayer, P., Ferreira, F., & McMillan, R. (2007). A Unified Framework for Measuring Preferences for Schools and Neighborhoods. *Journal of Political Economy*, *115*(4), 588-638.

Bayer, P., Keohane, N., & Timmins, C. (2009). Migration and Hedonic Valuation: The Case of Air Quality. *Journal of Environmental Economics and Management*, *58*(1), 1-14.

Bayer, P., McMillan, R., & Kim, R. (2004). An Equilibrium Model of Sorting in an Urban Housing Market. *NBER Working Paper Series*, 10865.

Bayer, P., Ferreira, F., & McMillan, R. (2007). A Unified Framework for Measuring Preferences for Schools and Neighborhoods. *NBER Working Paper Series*, 13236.

Bayer, P., McMillan, R., Murphy, A., & Timmins, C. (2011). A Dynamic Model of Demand for Houses and Neighborhoods. *NBER Working Paper Series*, 17250.

Bejranonda, S., Hitzhusen, F. J., Hite, D., Uri, N. D., & Lewis, J. A. (1999). Agricultural Sedimentation Impacts on Lakeside Property Values. *Agricultural and Resource Economics Review*, *28*(2), 208-218.

Berry, S. T. (1994). Estimating Discrete-choice Models of Product Differentiation. *The RAND Journal of Economics*, 242-262.

Bertrand, M., Duflo, E., & Mullainathan, S. (2002). How Much Should We Trust Differences-in-differences Estimates? *NBER Working Paper Series*, 8841.

Besley, T., Burgess, R., & Esteve-Volart, B. (2004). Operationalizing Pro-poor Growth: India Case Study. *Department of Economics, London School of Economics. Processed*.

Borenstein, S. (1991). The dominant-firm advantage in multiproduct industries: Evidence from the US airlines. *The Quarterly Journal of Economics*, 1237-1266.

Bowden, R. J. (1992). Competitive Selection and Market Data: The Mixed-index Problem. *The Review of Economic Studies*, *59*(3), 625-633.

Boyle, M., & Kiel, K. (2001). A Survey of House Price Hedonic Studies of the Impact of Environmental Externalities. *Journal of real estate literature*, *9*(2), 117-144.

Brasington, D. M., & Hite, D. (2005). Demand for Environmental Quality: a Spatial Hedonic Analysis. *Regional science and urban economics*, *35*(1), 57-82.

Brueckner, J. K. (1993). Inter-store Externalities and Space Allocation in Shopping Centers. *The Journal of Real Estate Finance and Economics*, *7*(1), 5-16.

Brueckner, J. K., Thisse, J. F., & Zenou, Y. (1999). Why Is Central Paris Rich and Downtown Detroit Poor? An Amenity-based Theory. *European Economic Review*, *43*, 91-107.

Buscha, F., Maurel, A., Page, L., & Speckesser, S. (2008). The Effect of High School Employment on Educational Attainment: A Conditional Difference-in-differences Approach. *IZA Discussion Paper,* 3696.

Calhoun, C. A. (1996). OFHEO House Price Indexes: HPI Technical Description. *Office of Federal Housing Enterprise Oversight*, 1-15.

Chang, G., Jiang, C., Chang, K., & Alam, B. (2013). Land Prices and Intracountry Industrial Relocation in China: Theory and the Yangtze Delta Area Case. *Chinese economy*, *46*(2), 54-73.

Cheshire, P., & Sheppard, S. (1995). On the Price of Land and the Value of Amenities. *Economica*, 247-267.

Cho, S. H., Bowker, J. M., & Park, W. M. (2006). Measuring the Contribution of Water and Green Space Amenities to Housing Values: An Application and Comparison of Spatially Weighted Hedonic Models. *Journal of Agricultural and Resource Economics*, 485-507.

Chu, H.Y. (1999). The Fashion of Occultism and Social Change. *Taiwanese Journal of Sociology,* 22, 1-45.

Clapp, J. M., & Giaccotto, C. (1994). The Influence of Economic Variables on Local House Price Dynamics. *Journal of Urban Economics*, *36*(2), 161-183.

Cliff, A. D., and Ord, J. K. (1981), Spatial Processes: Models and Applications, Pion, London.

Conley, T. G., & Taber, C. R. (2005). Inference with" Difference in Differences" with a Small Number of Policy Changes. *NBER Technical Working Paper Series*, 312.

Davis, R. K. (1963). Recreation Planning as an Economic Problem. *Natural Resources Journal*, *3*, 239-249.

Donald, S. G., & Lang, K. (2007). Inference with Difference-in-differences and Other Panel Data. *The review of Economics and Statistics*, *89*(2), 221-233.

Donohue III, J. J., Heckman, J. J., & Todd, P. E. (2002). The Schooling of Southern Blacks: The Roles of Legal Activism and Private Philanthropy, 1910-1960. *Quarterly Journal of Economics*, 225-268.

Duflo, E. (2001). Schooling and Labor Market Consequences of School Construction in Indonesia: Evidence from an Unusual Policy Experiment. *The American Economic Review*, *91*(4), 795-813.

Duijn, M. van, & Rouwendal, J. (2012). Analysis of Household Location Behaviour, Local Amenities and House Prices in a Sorting Framework. *Journal of Property Research*, *29*(4), 280-297.

Dynarski, S. (2004). The New Merit Aid. In: *College Choices: The Economics of Where to Go, When to Go, and How to Pay for It* (pp. 63-100). University of Chicago Press.

Earnhart, D. (2001). Combining Revealed and Stated Preference Methods to Value Environmental Amenities at Residential Locations. *Land Economics*,*77*(1), 12-29.

Epple, D., & Sieg, H. (1999). Estimating Equilibrium Models of Local Jurisdictions. *Journal of Political Economy*, *107*(4), 645-681.

Epple, D., Romer, T., & Sieg, H. (2001). Interjurisdictional Sorting and Majority Rule: an Empirical Analysis. *Econometrica*, *69*(6), 1437-1465.

Ferreira, F., Gyourko, J., & Tracy, J. (2010). Housing Busts and Household Mobility. *Journal of Urban Economics*, *68*(1), 34-45.

Frieden, B. J., & Sagalyn, L. B. (1991). *Downtown, Inc: How America Rebuilds Cities*. MIT Press.

Fuguitt, D., & Wilcox, S. J. (1999). *Cost-benefit Analysis for Public Sector Decision Makers*. Greenwood Publishing Group.

Gao, Xiao-lu (2010). Size Effect of Housing Price and Size Standard in Beijing. *Geographical Research, 39(3),* 500-509.

Gibbons, S., & Machin, S. (2008). Valuing School Quality, Better Transport, and Lower Crime: Evidence from House Prices. *Oxford Review of Economic Policy*, *24*(1), 99-119.

Gibbons, S., Mourato, S., & Resende, G. M. (2014). The Amenity Value of English Nature: a Hedonic Price Approach. *Environmental and Resource Economics*, *57*(2), 175-196.

Girma, S., & Görg, H. (2007). Evaluating the Foreign Ownership Wage Premium Using a Difference-in-differences Matching Approach. *Journal of International Economics*, *72*(1), 97-112.

Girouard, N., Kennedy, M., Den Noord, V., Joseph, P., & Andre, C. (2006). Recent House Price Developments: The Role of Fundamentals. *Available at SSRN 1618196.*

Goodman, A. C., & Thibodeau, T. G. (1995). Age-related Heteroskedasticity in Hedonic House Price Equations. *Journal of Housing Research*, *6*(1), 25-42.

Greenstone, M., & Gallagher, J. (2005). Does Hazardous Waste Matter? Evidence from the Housing Market and the Superfund Program. *NBER Working Paper Series*, 11790.

Gu, J., & Jia, S. H. (2008). The Effects of Expected Transport Improvements on House prices and Price Spatial Distribution---Hangzhou-Based Research Evidence of Planing the Mass Transit Railway. *Economic Geography,* 28(6), 1020-1024.

Hårsman, B., & Quigley, J. M. (1991). *Housing Markets and Housing Institutions: An International Comparison*. Boston/Dordrecht/London: Kluwer Academic Publishers.

Haining, R. P. (2003). *Spatial data analysis: theory and practice*. Cambridge University Press.

Hite, D., Chern, W., Hitzhusen, F., & Randall, A. (2001). Property-value Impacts of an Environmental Disamenity: the Case of Landfills. *The Journal of Real Estate Finance and Economics*, *22*(2-3), 185-202.

Hobden, D. W., Laughton, G. E., & Morgan, K. E. (2004). Green Space Borders—a Tangible Benefit? Evidence from Four Neighbourhoods in Surrey, British Columbia, 1980–2001. *Land Use Policy*, *21*(2), 129-138.

Hoehn, J. P., Berger, M. C., & Blomquist, G. C. (1987). A Hedonic Model of Interregional Wages, Rents, and Amenity Values*. *Journal of Regional Science*, *27*(4), 605-620.

Hort, K. (1998). The Determinants of Urban House Price Fluctuations in Sweden 1968–1994. *Journal of housing Economics*, *7*(2), 93-120.

Jud, G. D. (1980). The Effects of Zoning on Single-family Residential Property Values: Charlotte, North Carolina. *Land Economics*, *56*(2), 142-154.

Kaufman, D. A., & Cloutier, N. R. (2006). The Impact of Small Brownfields and Greenspaces on Residential Property Values. *The Journal of Real Estate Finance and Economics*, *33*(1), 19-30.

Kiel, K. A., & McClain, K. T. (1995). House Prices during Siting Decision Stages: the Case of an Incinerator from Rumor through Operation. *Journal of Environmental Economics and Management*, *28*(2), 241-255.

Kingdon, J.W. (1995). *Agendas, Alternatives, and Public Policies (2nd Edition).* New York: Harper Collins.

Klaiber, H. A., & Phaneuf, D. J. (2010). Valuing Open Space in a Residential Sorting Model of the Twin Cities. *Journal of Environmental Economics and Management*, *60*(2), 57-77.

Kong, F., Yin, H., & Nakagoshi, N. (2007). Using GIS and Landscape Metrics in the Hedonic Price Modeling of the Amenity Value of Urban Green Space: A Case Study in Jinan City, China. *Landscape and Urban Planning*, *79*(3), 240-252.

Lancaster, K. J. (1966). A New Approach to Consumer Theory. *The Journal of Political Economy*, 74(1), 132-157.

Li, S., Zhang, Y., Zhang, Y., Zhang, L., & Wang, L. (2014). Willingness to Pay for the Urban River Ecosystem Restoration in Hangzhou and Nanjing, China. *World Review of Science, Technology and Sustainable Development*,*11*(1), 14-25.

Li, W., & Yao, R. (2007). The Life-Cycle Effects of House Price Changes. *Journal of Money, Credit and banking*, *39*(6), 1375-1409.

Liang, Qinghuai, Kong, Lingyang, & Deng, Wenbin (2007). Impact of URT on Real Estate Value: The Case of Beijing Metro Line. *China Civil Engineering Journal,* 40(4), 98-103.

Liang, R. B.,& Tang, Y. (2008). Tiebout Model and the Provision of Local Public Goods: An Empirical Study on Chinese Housing Price (in Chinese), *The Journal of World Economy, 10*, 71-83.

Lin, C. C., Chen, C. L., & Twu, Y. C. (2012). An Estimation of the Impact of Feng-Shui on Housing Prices in Taiwan: A Quantile Regression Application. *International Real Estate Review*, *15*(3), 325-346.

Long, F., Zheng, S., Wang, Y., & Guo, M. (2009). Value Estimates of Local Public Services Using a Spatial Econometric Model. *Journal of Tsinghua University (Science and Technology)*, 49(*12)*, 2028-2031.

Long, B. T. (2007). Do Loans Increase College Access and Choice? Examining the Introduction of Universal Student Loans. *Federal Reserve Bank of Boston, Working Paper,* 07-1.

Lu, Y.C. (1999). *From the Source of Feng–Shui to Critic the Superstition of Feng-Shui in the Modern Society.* Paper Presented at the Fifth Science History Conference, Academia Sinica, Taipei, Taiwan.

Luttik, J. (2000). The Value of Trees, Water and Open Space as Reflected by House Prices in the Netherlands. *Landscape and Urban Planning*, 48(3), 161-167.

MacLennan, D. (1977). Some Thoughts on the Nature and Purpose of House Price Studies. *Urban Studies*, *14*(1), 59-71.

Muth, R. F. (1972). The Demand for Non-Farm Housing, in: *Readings in Urban Economics*, *Edel, M. and Rothenberg, J. (eds.)*, MacMillan, New York, 227-45.

Nelson, A. C., Genereux, J., & Genereux, M. (1992). Price Effects of Landfills on House Values. *Land Economics*, 359-365.

Nicholls, S., & Crompton, J. L. (2005). The Impact of Greenways on Property Values: Evidence from Austin, Texas. *Journal of Leisure Research*, *37*(3), 321-341.

Nie, C., Wen, H. Z., & Fan, X. F. (2010). The Spatial and Temporal Effect on Property Value Increment with the Development of Urban Rapid Rail Transit: An Empirical Research. *Geographical Research,* 29(*5),* 801-810.

Poor, P. J., Pessagno, K. L., & Paul, R. W. (2007). Exploring the Hedonic Value of Ambient Water Quality: A Local Watershed-based Study. *Ecological Economics, 60*(4), 797-806.

Powe, N. A., Garrod, G. D., & Willis, K. G. (1995). Valuation of Urban Amenities Using an Hedonic Price Model. *Journal of Property Research,12*(2), 137-147.

Qiu, L., & Tu, Y. (2014). Neighborhood Social Interactions and Residential Location Choice. *IRES Working Paper Series, IRES2014-019*

Rosen, S. (1974). Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy*, *82*(1), 34-55.

Se Can, A., & Megbolugbe, I. (1997). Spatial Dependence and House Price Index Construction. *The Journal of Real Estate Finance and Economics*,*14*(1-2), 203-222.

Smith, B. A. (1978). Measuring the Value of Urban Amenities. *Journal of Urban Economics, 5*(3), 370-387.

Studenmund, A. H. (2006). *Using econometrics: A practical guide. (5th ed.)*. Boston: Pearson Education.

Tajima, K. (2003). New Estimates of the Demand for Urban Green Space: Implications for Valuing the Environmental Benefits of Boston's Big Dig Project. *Journal of Urban Affairs, 25*(5), 641-655.

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures. *The Journal of Political Economy*, 416-424.

Troy, A., & Grove, J. M. (2008). Property Values, Parks, and Crime: A Hedonic Analysis in Baltimore, MD. *Landscape and Urban Planning*, *87*(3), 233-245.

Turok, I. (1992). Property-led Urban Regeneration: Panacea or Placebo? *Environment and Planning A*, *24*(3), 361-379.

Tyrväinen, L. (1997). The Amenity Value of the Urban Forest: An Application of the Hedonic Pricing Method. *Landscape and Urban planning*, *37*(3), 211-222.

Uunk, W. & Dominguez Martinez, S. (2002). Wijken in beweging: Migratie in en uit concentratiewijken. Assen: Koninklijke Van Gorcum.

Walsh, R. (2007). Endogenous Open Space Amenities in a Locational Equilibrium. *Journal of Urban Economics*, *61*(2), 319-344.

Wang, X.Y. (2006). *The Research of Housing Characteristic Price in Shanghai Based on Hedonic Model.* Ph.D dissertation, Tongji University, August.

Wang, Xia, Zhu, Dao-lin, & Zhang Ming-ming. (2004). Analysis of the Influence of Rail Transit on the Distribution Layout of Real Estate Prices: A Case Study of Beijing Light Rail Line. *Urban Problems*, *6*, 39-42.

Wen, H. Z., Jia, S. H., & Guo, X. Y. (2005). Hedonic Price Analysis of Urban Housing: An Empirical Research on Hangzhou, China. *Journal of Zhejiang University (Science)*, 6A(8), 907-914.

Yin, H. W., Xu, J. G., & Kong, F. H. (2009). Impact of the Amenity Value of Urban Green Space on the Price of House in Shanghai. *Acta Ecologica Sinica*, 29(8), 4492-4500.

Yiu, C. Y., & Wong, S. K. (2005). The Effects of Expected Transport Improvements on Housing Prices. *Urban Studies*, *42*(1), 113-125.

Zhang, M. & Chen, S.M. (2008). Empirical Analysis of the Shanghai Real Estate Price Based on Hedonic Price Theory. *Finance and Economy,* 6,72-74.

Zhang, Z., & Hite, D. (2016). *Residential Location Impacts of Environmental Disamenity: The Case of Gravel Pit Operation and Landfills.* Paper presented at the Southern Agricultural Economics Association's 2016 Annual Meeting, San Antonio, Texas, February, 6-9 2016

Zheng, S. Q. (2013). Research on Interactions between Public Goods Allocation and Housing Market: A Review (in Chinese), *Urban Problems, 217(8)*, 95-100.