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Siqi Zheng

Peking University – Lincoln Center

Institute of Real Estate Studies, Tsinghua University

Rongrong Ren

Peking University – Lincoln Center

Institute of Real Estate Studies, Tsinghua University of China,

Leo KoGuan Building, Suite 508, Peking University, Beijing 100871, China

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Capitalization of Urban Amenities in Residential Property Value and Land Value: Evidence from Beijing

Zheng SQ(Zheng Siqi)[1]
Institute of Real Estate Studies,
Tsinghua University of China,
zhengsiqi@tsinghua.edu.cn , 010-6277734,
13501010736

Ren RR(Ren Rongrong)[2]
Institute of Real Estate Studies,
Tsinghua University of China,
rrr04@mails.tsinghua.edu.cn , 010-62782427,
15810292800

***Abstract*—It has long been recognized that the price of residential properties depends primarily on their proximities to urban amenities. However, few of the extant literature focus on the question of how buyer's willingness-to-pay for urban amenities is translated into land values through housing consumption. The special institutional context in urban China, in which land for development is leased by local governments to private developers who then sell properties to households, gives us a good opportunity to explore this issue. Employing a unique dataset with matched residential projects' and land parcels' price and location information in Beijing, this study seeks to examine the local amenities' capitalization effects both in residential property value and in land value. We find that most urban amenities are significantly capitalized into property value. However, land value does not fully capture such benefits, which means that the value of local public services is partially captured by private developers. The findings may indicate that a property tax, as opposed to land sale revenue, may be a better way for local governments to capture the value of public services.**

Keywords- urban amenities; capitalization; property value; land value

I. INTRODUCTION

A house represents not only a bundle of structural attributes, but also a set of location-specific characteristics. It has long been recognized that the value of residential property or land parcels depends primarily on the location features or amenities. Increasing studies are conducted to evaluate how urban amenities are capitalized into housing values or land values. Earlier studies focus more on the distance to city center and the distance to transport service, which reflect the tradeoff between commuting cost and housing or land price (Hayes, 1957; Alonso, 1964). And then, attentions turn to more location-specific characteristics in terms of the environmental quality and local public goods (Diamond, 1980; Cheshire and Sheppard, 1995; Chattopadhyay, 1999; Zheng and Kahn, 2008). Various amenities are employed in the extant literature, such as the accessibility aspect including work places, shops, restaurant and entertainments, and the public goods or public service including schools, medical service, parks and natural sights, the environmental quality including air quality and the weather comfort, and the social conditions. However, due to the data limitation, it is still open to question how buyer's willingness-to-pay for urban amenities is translated into land values through housing consumption.

Fortunately, China's real estate market without property tax provides us a good opportunity to quantitatively estimate the translation process of the willingness-to-pay for amenities, because developers or buyers actually purchase the amenities when buying land parcels or housing units, respectively. Based on an unique data structure with matched residential projects' and land parcels' price and location information in Beijing, the study seeks to investigate the capitalization of urban amenities into housing values and land values. We attempt to answer two questions, in terms of how urban amenities are captured by land prices and housing prices respectively, and whether the buyer's pay for urban amenities reverts to their providers—local governments. In addition, some policy implications are drawn from our findings, which may provide references for China's real estate market without property tax.

The paper is structured as follows. In section II, we present the data structure and the methodology used in our empirical studies. And then, the estimation results are analyzed in section III. The paper is summarized and concluded in the last section.

II. DATA AND METHODOLOGY

A. Data structure

First, we collect the transaction data of newly-built housing projects from 2000 to 2005. The sample has 1314 projects, which are all commodity-housing projects. It includes the information of the total floor space, the total units and the total amount of sales in each project, and also includes the project's name and location. Second, we put all the projects to the satellite map of

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Beijing. Combining with the spatial distribution of public goods, we obtain the information about the projects' locational attributes, which are measured by their proximities to various urban amenities. At last, we match the project data with its lot attributes information, in terms of the land price, the lot size and the planned floor space, Due to some missing information on land lots, the final data sample has 694 matched property-land projects. Figure 1 demonstrates the spatial distribution of the projects, with the bigger dots indicating larger projects.

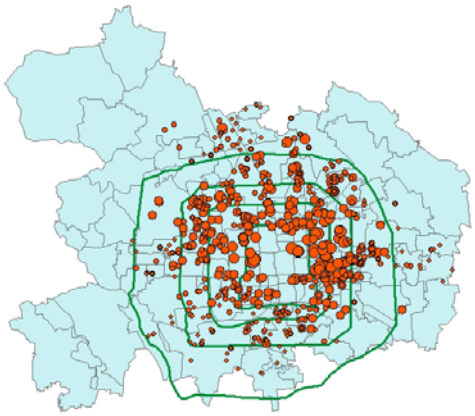

Figure 1. Spatial distribution of the projects

The urban amenity measures used in this paper include the distances to the closest inner-city subway stop (D_SUB1), suburb subway stop (D_SUB2), hospital (D_HOSP),core primary school (D_PSCH),core middle and senior high school (D_MHSCH), major university (D_UNIVER) and major park (D_PARK). All of the above distance variables are measured in kilometers. We use dummy variables to measure the proximities to these amenities. The cut-off point is 2 km (1.2 miles)[①], which means that, if the distance to the nearest amenity is less than 2 km, then the amenity variable equals to 1, otherwise, it equals to 0 in the hedonic pricing model.

B. *A brief introduction to China's real estate market without property tax*

Property tax plays dominant role in local public finance in most developed countries. It provides an important channel to finance the supply of local public goods. However, property tax has not been put into practice in China's real estate market yet. It makes the financing channel of the local public goods different from the countries with property tax.

[①] 2 km is used as the cut-off point to make sure that about 30% out of the total sample would be influenced by the amenities.

In China, land in cities is owned by the state. The developers can obtain the land use right through paying the land lease fees, which take a large ratio of local fiscal revenue. The land lease fee can be regarded as the present value of land rents for certain years (70 years for residential land), and the lease fee is usually called "land price" because of the long time horizon.. The developers implicitly purchase the public goods by buying land parcels. The capitalization of amenities into land values demonstrates the developer's willingness-to-pay for the amenities. However, the ultimate demand for the public goods derives from the homebuyers who benefit from consuming those amenities. The buyer's evaluation on amenities is captured by housing values through the sale of housing units. This translating process is shown in Figure 2.

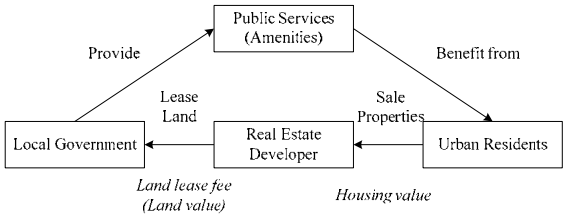

Figure 2. Finance of public goods without property tax

C. *Methodology*

Hedonic pricing model is employed in our study. Firstly, we construct the housing hedonic model and land hedonic model respectively:

$$LnHPRICE = c + \alpha_1 HSIZE + \alpha_2 HSIZE \wedge 2 + \alpha_3 D\_CBD + \beta_1 D\_SUB1 + \beta_2 D\_SUB2 + \beta_3 D\_HOSP + \beta_4 D\_PSCH + \beta_5 D\_MHSCH + \beta_6 D\_UNIVER + \beta_7 D\_PARK + \varepsilon \quad (1)$$

$$LnHPRICE = c + \alpha_1' HSIZE + \alpha_2' HSIZE \wedge 2 + \alpha_3' D\_CBD + \beta_1' D\_SUB1 + \beta_2' D\_SUB2 + \beta_3' D\_HOSP + \beta_4' D\_PSCH + \beta_5' D\_MHSCH + \beta_6' D\_UNIVER + \beta_7' D\_PARK + \varepsilon \quad (2)$$

Where $HPRICE$ and $LPRICE$ are the housing price per floor area in sqm and the land price per floor area in sqm. They are the dependent variables, and are employed in the model in logarithm. $HSIZE$ is the average unit size in the project, which is used as a structure attribute. Here, we also introduce the square of unit size, $HSIZE \wedge 2$, to reflect the diminishing marginal effect of unit size on housing price. For the land price determinants function, the floor area ratio, FAR, is the control variable for lot attributes. In addition, we include the distance to CBD (D_CBD), to measure the price gradient of residential properties or land parcels. Therefore, the coefficients of urban amenity variables in Equation (1) and (2) reveal the capitalizations of the public goods in housing values and land values,

respectively. In a competitive real estate market, the developer's valuation should equal to the buyer's willingness to pay, that is, if the estimated β_i in equation (1) is significant, β_i' in equation (2) should also be significant. Otherwise, it means that the benefits from proximities to the public goods are partly captured by the developers, instead of their providers, the local government. This is the main question we seek to investigate in this paper.

In order to test the robustness of our findings, we estimate the second equation with housing price in logarithm as the dependent variable and amenity variables and the predicted land price in logarithm from Equation (2) (*LnLPRICEF*) on the right hand side:

$$LnHPRICE = c + \alpha_0 LnLPRICEF + \alpha_1'' HSIZE + \alpha_2'' HSIZE \wedge 2 + \alpha_3'' D\_CBD + \beta_1'' D\_SUB1 + \beta_2'' D\_SUB2 + \beta_3'' D\_HOSP + \beta_4'' D\_PSCH + \beta_5'' D\_MHSCH + \beta_6'' D\_UNIVER + \beta_7'' D\_PARK + \varepsilon \quad (3)$$

We use predicted land value instead of actual land value on the right hand side to avoid measurement errors. If the household buyers' willingness to pay for urban amenities is fully captured by the land value, the amenity variables would be insignificant after controlling for land value in Equation (3). If some amenity variables remain significant, it may indicate that buyers' willingness to pay for these amenities are not fully translated to land price.

III. ESTIMATION RESULTS AND ANALYSIS

Table Ⅰ demonstrates the estimation results of Equation (1) to (3). In Equation (1), after controlling for the time when the project was sold (*YEAR DUMMYs*), the unit size and its square term explain 27.1% of the housing price variation. Including all location-specific increases the explaining power to 56.5%. Location variables also increase the R square significantly in the land price equation (from 18.7% to 45.0%). Therefore, the location-specific characteristics play important roles in the price determinants (Diamond, 1980; Cheshire and Sheppard, 1995).

Table I. ESTIMATION RESULTS OF THREE HEDONIC PRICING MODELS

Independent variables	**Housing price equation (Equ. (1))**		**Land price equation (Equ. (2))**		**Housing price equation with land price on rhs (Equ. (3))**	
	Column 1	**Column 2**	**Column 3**	**Column 4**	**Column 5**	**Column 6**
HSIZE	-0.010***	-0.007***			-0.007***	-0.007***
	(-4.01)	(-3.81)			(-3.76)	(-3.77)
HSIZE^2	6E-05***	4E-05***			4E-05***	4E-05***
	(6.02)	(6.20)			(6.19)	(6.21)
FAR			0.139***	0.036***		
			(9.49)	(2.63)		
FAR^2			-0.006***	-0.001*		
			(-7.13)	(-1.76)		
D_CBD		-0.028***		-0.041***		-0.010**
		(-8.97)		(-7.55)		(-2.29)
D_SUB1<2		0.123***		0.119***		0.066***
		(6.27)		(3.52)		(3.05)
D_SUB2<2.5		0.041**		0.047*		0.021
		(2.37)		(1.70)		(1.20)
D_HOSP<2		0.013		0.052		-0.026
		(0.62)		(1.49)		(-1.14)
D_PSCH<2		0.055***		0.029		0.044**
		(2.83)		(0.94)		(2.31)
D_MHSCH<2		0.049**		0.126***		-0.014
		(2.47)		(3.78)		(-0.66)
D_UNIVERS<2		0.050***		0.072***		0.006
		(2.77)		(2.73)		(0.29)
D_PARK<2		0.040**		0.098***		-0.006
		(2.15)		(3.21)		(-0.31)
LnLPRICEF					0.594***	0.441***
					(20.16)	(5.06)
YEAR DUMMY	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.968***	8.949***	6.047***	6.221***	5.176***	6.193***
	(58.98)	(76.40)	(17.44)	(17.80)	(24.69)	(11.06)
Adjusted R^2	0.271	0.565	0.187	0.450	0.572	0.579
Obs.	694	694	694	694	694	694

Notes: 1) Figures in the parentheses indicate t-stat. 2) *** significant at 1%, ** significant at 5%, *significant at 10%. 3) Dependent variable: LnHPRICE. 4) White Heteroskedasticity-Consistent Standard Errors & Covariance.

The price gradients with respect to distance to CBD (in kilometers) for residential properties and land parcels are 2.8% and 4.1% respectively. The steeper price gradient for land parcels is consistent with the substitution effect between land and capital.

In column (2) and column (4), we seek to examine how urban amenities are reflected in housing price and land price. The accessibilities to transport service are included to test the tradeoff between residential cost and commuting cost, as stated by the traditional monocentric city model. The coefficients of D_SUB1 and D_SUB2 are significant both in the housing and land equations. In addition, we include amenity variables measuring proximities to public services in the equations. Most amenity variables are significant in the housing price and land price equations. The hospital proximity variable (D_HOSP) is positive but insignificant in both equations. The proximity to core primary schools is significant in the housing price equation but is not significant at all in the land price equation, which may indicate that households' willingness-to-pay for the access to core primary schools are only capitalized in housing prices but not translated into land prices.

To further investigate the capitalization differentials between land price and housing price, we include the predicted land price on the right hand side (Equation (3)). Columns (5) and (6) demonstrate the estimation results. The coefficient of $LnLPRICEF$ is the land-price elasticity of housing-price. We can see that housing price will increase by 4.4% ~ 5.9% if land price increases by 10%. Put it in other words, About half of housing price growth is attributed to land price growth. Among the amenity variables, proximities to inner city subway stops and core primary schools remain significant. This indicates that the housing value appreciation arise from the accessibilities to these two amenities is not fully translated to land sale revenue, and the left-over is captured by developers. The findings of equation (3) support the results deduced from Table 1 and Table 2. However, the method of equation (3) is more sensitive to capture the amenities that are not fully capitalized into the land values.

IV. SUMMARY AND CONCLUSION

Employing a unique dataset with 694 matched pairs of residential projects and land parcels in Beijing, this study examines the local amenities' capitalization effects both in residential property value and in land value. We find that the values of most urban amenities specified in this paper are reflected in property value. However, controlling for land value, some amenity variables, e.g., proximities to inner-city subway stops and core primary schools, remain significant. This means that the local government does not fully capture the value of public services through land sale revenue, and part of the benefit is captured by private developers.

It has been well recognized that property tax, which can be regarded as the user fee for public services, is a good way for the local government to capture the value of services it provide. Without property tax, the local government has to rely on land sale revenue for infrastructure financing. Our findings indicate that land sale revenue does not perform this function well. Levying property tax on existing properties may be a better choice.

Our future work includes dealing with the potential problem of omitted variables in the hedonic equations, and finding more direct evidences supporting the argument that property tax is a better way for value capture in Chinese cities.

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Author Biography

1. Zheng Siqi, an Associate Professor at the Institute of Real Estate Studies, Tsinghua University. Her research interests include urban spatial structure, housing policy and urban development. He Shan Heng Building, Beijing, 100084, China.

2. Ren Rongrong, a Ph.D. Candidate at the Institute of Real Estate Studies, Tsinghua University. Her research interests include land market, urban spatial structure. He Shan Heng Building, Beijing, 100084, China.