The Hedonic Approach to the Price Effect of Mass Transits on the Apartment Houses: The Case of New Towns in Seoul, Korea

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Abstract: The apartment houses are the most favored type of housing in Korea, and they have been constructed mostly in large scale residential complexes. The connectivity of the efficient mass transit in such complexes have thus been one of the most crucial factors that affects the price structure of the apartment houses. This study delves into empirically quantifying the magnitude of transportation environment in the price structure of new town apartments via hedonic price modelling technique performed on the GIS platform. The modes of transportation are centered on the bus and the subway services. It is hoped that the findings could help providing the efficient mass transit services in the upcoming large scale new towns to be built in Korea in the near future.

Keywords: hedonic price modelling, spatial statistics, new town development, mass transportation

1. Introduction

Apartment houses have been the most favored type of housing in Seoul City since they could have accommodated the rapidly growing populations during the last few decades thus have prevented the serious housing shortage that the Seoulites might have faced otherwise. The City certainly could use its limited lands more efficiently owing to them. In numerous older sectors of the City, nevertheless, decaying neighborhoods filled with the houses built ages ago in rather a disorderly fashion with insufficient infrastructure yet prevailed until the last decade. The adversities eventually urged the City to adopt the massive planned redevelopments in their places since the mid-2000. The series of the Seoul's well-known 'new town in town' projects that extended to the third stage up to now have been started that way.

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This study tries to analyze the constructs of the prices of those apartment units built in such new towns via the hedonic price model. Since most new towns were planned with the scale of a regional community, the role of the mass transits to accommodate their commuting residents have been one of the most crucial factors to gauge the level of residential convenience, hence became a determining factor of a successful new town. The hedonic model of the study, in this context, places an emphasis more on the mass transit facilities than other typical residential variables commonly used in the conventional hedonic approach. In particular, all the major distance variables of the model are constructed on the GIS platform as they are measured by either the air-distances, the most frequently used distance measures, or the cost-weighted distances adopting specifically the NEAR function available in the GIS tools.

2. Study cases and data

2.1 Study cases

The case new towns taken for the study are 18

among all the new town projects completed by the City since mid-2000, including the total 92 residential complexes. The housing samples are extracted from the 2015 housing sales records of Seoul City, and the total number of samples mobilized for the study are 9,641 in its entirety. As can be seen in Figure-1, the case new towns scatter rather evenly across the city but concentrate more in the Kang-Buk (River-North) area than in Kang-Nam (River-South).

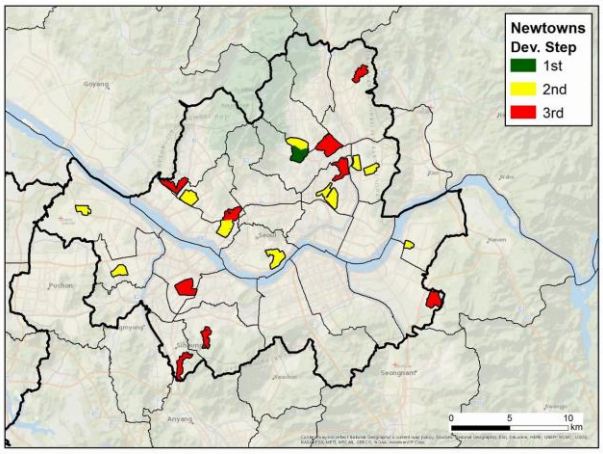

Figure-1 Location of the case new towns

2.2 Data description

The study used the dataset available from the shared big-data platform provided in the 'Big Data Campus' of Seoul City. More specific details of each of the dataset used are summarized in Table-1 below.

Table-2 Description of the dataset

Category	Dataset Name	Spatial Scope	Provider
R. Estate	Apt. Prices	Entire Seoul	KB Bank
Transport	Transfer Records	Entire Seoul	Seoul City (Smart Card Co.)
Transport	Frequency of the Mass Transit Riding	Entire Seoul	Seoul City (Smart Card Co.)
Transport	Transit Facilities	Entire Seoul	Seoul City
Facility	Apartment DB	Entire Seoul	Open Mate
Facility	Bldg. Register	Entire Seoul	MOLIT

Source: http://bigdata.seoul.go.kr/data

The apartment price (KRW) per unit area (m^2) is the dependent variable of the hedonic model. The impact of certain outliers in the variable, however, was not insignificant in the pilot test so that they were eliminated to increase the explaining power of the model. The applied rule for the purpose was as follows: those data that are greater than four times the standard deviation from the sample mean were eliminated. Figure-2 shows the distribution of the dependent variable after such a treatment, and, as can be seen, it generally follows the pattern of the normal distribution.

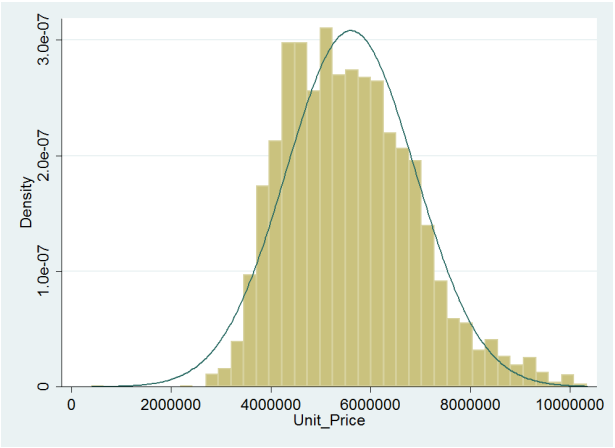

Figure-2. Distribution of apt. prices per unit area (m^2)

3. Methodology and results

3.1 Hedonic model and variables

The hedonic price model is based on the assumption that the value of the heterogeneous goods or services are determined by the sum of the values of all the implicit characteristics of those goods and services (Rosen, 1974). The independent variables of the housing hedonic model should, therefore, well represent the important implicit characteristics of the housing units to be estimated. The study, in this context, carefully selected the independent variables of the model by referring especially the four literatures listed in the reference section which were thought to have the closest relationship to our topic at

hand.

While most of the preceding literature treat the distance from the subway stations as the only transportation variable, this study comprised all the mass transit services including the bus services, i.e., the subway and bus stations that locate within the 500m range from the center of the residential complexes were all included as important variables. For the subway service, the number of stations as well as the number of station entrances were also included. In the case of the bus service, the number of stations, number of routes, interval of services, and accessibility were all taken as independent variables. The accessibility, in particular, were measured by the distance between the centroid of the complex and the station adjusted by the friction factor that include the distance decaying effect. The negative exponential function, first adopt by Jang et al. (2015) were applied here for the purpose. The final list of the independent variables and the formulae to calculate them are summarized in Table-1.

Table-3 List of independent variables

Category		Variable	Unit	Remark
Dependent Variable		Unit of Apartment price	m^2/won	
Apartment Complex Property		Number of the Household	Household	
		Parking lot of the Household	Parking lot/Household	
		Apartment deterioration	Year	
Apartment Condition		Distance from the Park	m	
		Distance from the High School	m	
		Stage of New Town	Dummy	Stage of the 1st, 2nd, 3rd Project
Regional Condition		High School District	Dummy	GangNam, Seocho, Songpa(1), the rest(0)
		Distance from the City Hall	km	From Seoul City Hall to Analysis Target Area
Main Variable (Public Transportation)	Subway	Number of the Subway Station	Unit	$A_t = \sum_j S_j$
		Number of Subway Station Entrance	Unit	$A_t = \sum_j E_j$
	Bus	Number of Bus Stop	Unit	$A_t = \sum_j B_j$
		Number of Bus Route	Unit	$A_t = \sum_{rj} B_{rj}$ (for, $\forall$ r : d_{ij}^{min})
		Service Frequency	Number	$A_t = \sum_{rjw} B_{rjw}$ (for, $\forall$ r : d_{ij}^{min})
		Index of Bus Service Frequency & Accessibility to Bus Stop	-	$A_t = \sum_{rjw} B_{rjw} F_{ij}$ (for, $\forall$ r : d_{ij}^{min}, $F_{ij} = e^{-0.745115(d_{ij})}$)
		여기서, i : Apartment Complex Midpoint, j : Subway Station or Bus Stop, S : Subway Station, E : Subway Station Entrance, B : Number of the Bus Stop, r : Number of Bus Route, w : Each Bus service interval, d_{ij} :Distance between Apartment Complex Midpoint & Bus Stop, F_{ij} Friction of the Passing Function		

3.2 Results

Figure-3 exhibits the distribution of some of the samples with their locations placed at the centroid of the corresponding complexes that each individual sample belongs. The prices are the values obtained by dividing the sales price by their indoor areas (m^2) as aforementioned. In addition, the development stages of the new towns are also marked in the figure. The major outputs from the model run using the entire 9,627 samples are summarized briefly in Table-2. At the significance level of 0.05, all the independent variables have been accepted to have their own significant meanings. The *R*-squared value being 0.49, the model seemed to have a reasonable explaining power as a typical hedonic model for housing research. The major variables with positive influence were: 1) distance from schools (using NEAR function); 2) distance from parks (NEAR); 3) accessibility to the mass transit stations (decaying distance); 4) index of commuting buses (1H); 5) number of subway entrance; 6) number of parking lot per unit; and 7) the development stage of the new town. The variables with negative impacts, on the other hand, have been: 1) the age of the structure; 2) distance from the city hall (air-distance); 3) number of units in the complex; and 4) number of high schools in the vicinity. Particularly, the highest positive impact was seen from the 'school districts' that the

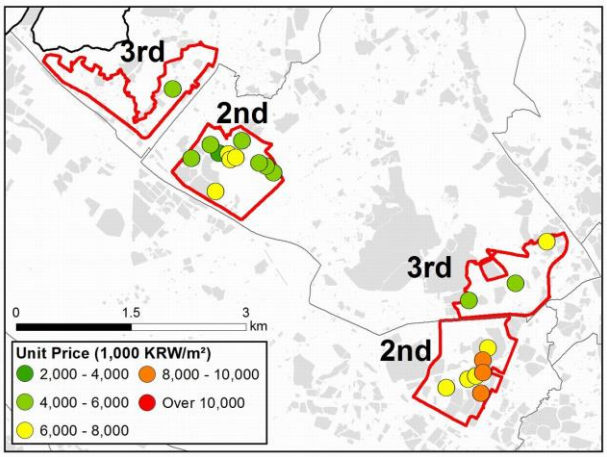

Figure-3. Distribution of typical samples with prices

units belong. The enthusiasm on children's education yet is proven to be overwhelming. The interpretation of the model, as such, seemed generally reasonable, considering the contemporary attributes of the Korean society and housing market.

Table-2 Results of the model run

Variable	Coefficient	t-value	Beta
Household	-275.81	-33.62	-0.29
Number of parking per unit	197,634.50	8.30	0.02
Decreoit	-101,168.70	-55.44	-0.45
Distance from the park	2,659.74	13.99	0.13
Distance from the high school	-745.45	-18.95	-0.18
Stage of the newtown projects	45,793.62	2.26	0.02
School district	1,779,737.00	19.57	0.18
Distance from city hall	-174.72	-33.41	-0.35
Number of subway entrance	28,849.29	7.55	0.07
Index of commuting buses & accessibility to bus stop (1H)	1,147.14	6.31	0.07

* Statistically significant at the level of $\alpha = 0.5$, all the rest are significant at the level of $\alpha = 0.05$, and, for all the variables, VIF ≤ 3.

As all the transportation environment variables, the main focus of this study, have shown the positive impacts, one could conjecture that they are clearly important factors that significantly contribute to the apartment housing prices. To be more specific, when one more subway entrance is added to the existing station, for instance, the price increase of 28,849 KRW per unit area (m^2) takes place in every apartment unit within 500m range from the station.

4. Conclusion

This study tried to use the GIS distance functions to measure the important independent variables for the hedonic model to explain the prices of the apartment housing units that are built in the new towns across Seoul City. Moreover, the raw data used in modelling were mobilized from the City's authentic Big Data Center. Unlike other comparable hedonic studies, this study have placed more emphases on the transportation environment variables than residential environment variables. As such, the study model is seen to have shown clear and substantial impacts of the transportation environment in these renowned new towns of Seoul City.

References

Han, Ji-Won, 2010. A study on house price movements in areas surrounding new town projects. *The Journal of Real Estate Policy*, 3(1), 81~99.

Jang, Jin-Young, Choi, S.T., Lee, H.S., Kim, S. J, Choo, S.H. 2015. A comparison analysis of factors to affect pedestrian volumes by land-use type using Seoul pedestrian survey data. *Korea Institute of Intelligent Transport Systems*, 14(2), 39-46.

Lee, Jae-Myung, Kim, Jin-Yoo, 2014. Negative impact of a subway station on neighboring apartment price: focused on differential effects depending on the structure and function of the station. *Journal of the Korean Association for Housing Policy Studies*, 22(2), 53~75.

Rosen, Sherwin, 1974. Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of Political Economy*, vol. 82, 34-55.

Yang, Seong-Don, Choei, Nae-Young, 2003. The Hedonic Impacts Accrued from the Han-River Civic Park on the Surrounding Residential Areas: The Case of Tuk-Som River Park. *National Territory Planning*, 38(3), 275-285.