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Evaluating the Hedonic Pricing (HP) of Settlement Based on Spatial Econometric -Case study: Tehran-

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Abstract:

Settlement is one of the main needs of human life and affects the individual and social life of human. Settlement is one of the main parts in the economy and so significant. Settlement is accounted as a shelter for households and is a main part of an economy which is in a close relation with services and industry departments and also affects the society occupation. In other words, this section is the engine of economy drive.

The main aim of this study is to determine and classify the effective factors on the settlement's cost in Tehran by using the HP approach. So far, most investigations in this field based on the statistical constraints study the physical and inherent variables of settlement. Since the present study provided the access to the urban planning information (extensive plan information), therefore, this paper by focusing on the urban planning approach studied the effective factors on the settlement price in Tehran. At the end, by using these models, "Ordinary Least Square, spatial regression – self regression and spatial errors' model", evaluations were done.

Key words: HP Method, spatial Autocorrelation, spatial Econometric, Geographic Information System (GIS)

Introduction

Settlement is the most important economical part which has a close relation with the other economical parts. This section, due to these factors, is significant and important as share in the household budget, share in internal gross production, extensive relationship with the other economical sections and also its role in the changes of macro economical indexes as economical growth and occupation of production factors.

Settlement is accounted as a sustainable consumer goods that its features like non tradable, lack of substitute and the others made some problems for the market of this goods. Therefore, settlement possesses capital value as an asset which is not being removed from the market after buying it and this factor is so effective in the costs' fluctuations and its supply and demand gap. Settlement is one of the main needs of human and has a considerable effect on the social and individual life of humans.

Settlement is accounted as one of the main parts of economy and is so significant. Settlement is as a shelter for the households and one of the economy dimensions which is in a close relationship with the industry and services' parts and also affects the occupation of our society. Settlement in other words is the engine of economy. Settlement in the 3rd world countries as the insurance system and social provision do not provide the needs and requirements of the old age times can be as a tool in order to satisfy the future needs and act as a saving.

Also in the inflation conditions, in order to maintain the assets or wealth and prevent the decline of monetary value as a sustainable good, settlement can play a role like an investment good for the households. Based on the social welfare, settlement is the main need of each person in each society and if we provide it, the high level of welfare will be resulted for the individuals of that society.

Settlement is accounted as one of the main parts of our country and economy and also it is one of the principles of private section investment. Settlement has an important role in the occupation of novice and expert workers. Since the

settlement has a close relationship with the industry department, the stagnancy of this part transfers into the industry section and also it falls into the stagnancy domain.

On the other hand, the effect of settlement on the occupation, due to the presence of day workers, is high as firing and compensating the employed workforce is possible simply and the unemployment increases quickly. Also due to the ability of novice, expert and technical workers in the settlement part, its advance decreases the unemployment.

Recognizing the effective factors in the settlement part and the situation of settlement supply and demand and also the households' priorities for the settlement programmers and the optimum allocation of the effective source of a society is so effective. Settlement planning needs the solutions and options in order to synchronize the development plans with the real needs. Based on the obtained statistics, the major investments of Iran are considered in the construction part as most of it is allocated in Tehran. But the shortage of settlement in this city is the main problem of Tehran as the metropolis.

The focus of state offices and large trade companies and ministries, treatment and industrial centers changed Tehran into an immigrant pole and its population increases annually. Based on the above mentioned points, determining the effective factors on the settlement price in Tehran is a main requirement. The method which is being used for this purpose is Hedonic Pricing (HP) method based on Revealed Preferences (RP).

In this article, which is accounted as the research work in the regional sciences, the data possesses a spatial component; therefore, using the econometric methods is not appropriate because among the data which has a spatial element, there will be a spatial Autocorrelation among the observations. But the common econometric ignores this issue because in a case of their existence, the Gauss – Markov hypothesis will be rejected. In other words, at what time of using the collected data which has not fixed variance and mean, focusing on these hypotheses of common econometric won't be possible. For this reason, in this study, the spatial econometric method has been used.

Therefore, the aim of this present paper is to determine the significance extent of effective factors on the settlement price by using the HP model and spatial econometric analyses and also explain the effect of adjunct regions on these features. So the main aim of this paper is to determine the most important effective variables on the settlement price in Tehran.

The importance of this study is that for getting an optimum planning of settlement, in addition to recognizing the current situation, studying the changes of settlement changes and the social, economical, environmental and urban factors on it is necessary. How to rank the different elements of a settlement unit by the consumers is one of the main issues of settlement parts. Therefore, in evaluating the settlement demand, analyzing and determining the Willingness To Pay of applicants for these features is necessary. The new method which has been used in the study is Geographic Information System (GIS).

Also this study is in the field of urban economy. The difference of urban economy from the other field of economy science is in considering the space and time dimension in the related models and analysis. It is clear that by considering the space dimension, the new issues will be defined and analyzed by the other method. The most simple view about direction's change of economical analysis is that the occurrence of an event in a determined time, in order to the effect of previous times, is under the effect of the event's place and in addition, the occurrence of an event in a place is under the effect of other events in the other places.

For example, increasing the land price or a settlement unit in a region of Tehran can be as a function of changes in that region or the near regions or the whole city. Based on some studies which were done in the field of land and its demand consider land as the other assets of household; as the features of land market are different from the other markets and also the related variables in the demand domain are so different.

Land without considering its speculation aspect has inherent features which provide the benefits of consumers from the considered land. In fact, land appears in a function of consumer's optimality as its features and the consumers get

benefits due to these features. The analysis of urban land market by using Lancaster optimality function as a revolution in the field of micro-economy will be possible.

This function of optimality considers the goods' features instead of the goods themselves and for this reason the obtained demand function is a function of goods' features. In this field means demand of land, the factors such as the proximity of land to the recreational centers such as sea, parks, access to the roads and highways, trade routes etc causes the optimality or non optimality. For this reason, we should use the real pattern of land demand which considers the logical behaviors of consumers in the best way. This pattern is HP model which is logic in the demands of settlement units. HP model due to the following unique features has been used in this study:

- ✓ Simple,
- ✓ Clear and without ambiguity, and
- ✓ Its flexibility in order to evaluate the parameters of land demands or settlement units.

Saphores and Li (2012) evaluated the value of urban trees, irrigated grass lands and non-irrigated grass regions by studying the information of 20660 settlement units which were transacted during 2003-2004 in Los Angeles city. The results show that the occupants of this city demand more trees in their place and they do not want to pay more money for them.

Cebula (2009) studied the effect of spatial variables on the settlement price by studying the information of 2888 settlement units transacted during 2004-2005 in Savannah city of Jorjia State. Moaz (2005) in his article in order to study 421 households shows that air pollution has a negative effect on the houses' values. Final willing to pay for each unit shows that the decrease (in the whole concentration) of suspended particles of TSP was about 60$.

Bonnetain (2002) explained the differences in the prices of islands based on the unique features of each of them. The findings show that the island value based on its size and its thermal degree will increase. Therefore, the islands which are in the far regions (based on the geographical view) have more value. Dokmeci, Onder and Yavas (2003) divided Istanbul city

into 18 regions as 12 regions are European and 6 regions are Asian ones.

In this study, HP model was in order to evaluate the settlement demand function. Kim, Phipps and Anselin (1993) measured the final value of air quality improvement in Seoul, South Korea, by combining the spatial econometric method with HP model. In this study, the data of 1121 households related to 22 regions of Seoul in 1993 was used. Zabel and Keil (2000), Batalhone (2002), Keil and Williams (2003), Murty et. al. (2003), Bransington and Hite (2004) and Kiel (2006) studied the effect of air pollution on the value of residential settlement.

Hedonic Pricing model

In this method, the value of a land or residential unit will be considered as a multidimensional good and also studies the effect of each of its features to the price. In this way, the settlement was considered as a multidimensional good and also evaluates the effect of each of the settlement features on its price. The procedure in this method is to determine the price of each of features in the settlement market.

In this way, the main issue in analyzing the settlement demand is how to evaluate the settlement applicants and the basis of this evaluation is that if a settlement unit has more optimum features, therefore, this evaluation will be high and will be reflected in the excess of the above mentioned market value to the other unit. In other words, the main problem in selecting a case from the settlement features in the abovementioned method is that if a case has more optimum features to the other case qualitatively or qualitatively, the consumer will evaluate that case with high price and its high price will be reflected in the settlement market.

In the empirical studies of consumers' evaluation by HP model, it is being said that HP is a criterion which evaluated the significance of each features. The main form of HP function is as the following:

$$P_i = \sum_{i=1}^{n} b_i . z_i + u \quad (1)$$

Where; P_i= price of residential unit, b_i = evaluation coefficients (the implicit price of each feature), z_i= the features in each residential unit, and u=the remainder contains of other variables (other features).

By evaluating each coefficient in the linear regression, it is possible to achieve the significance of each feature in the considered residential unit. These coefficients, in fact, are an evaluation of final willingness to households' payment for each feature of settlement and show the preference of households to each of settlement features.

By using HP, it is possible to determine the effective factors on the land price and residential unit and also the significance of each of them. For evaluating the land demand function or the residential unit, Rosen method (1974) will be used.

This method provides the appropriate framework in order to evaluate the demand for each single good based on the various features. Rosen in a study titled "HP and implicit market" studies a good with ***n*** features ($z_1, z_2, \dots, z_n$). In this market, each good has its price but there is not a price for each feature of that good in the market. In order to access the price of each feature, the function as below will be defined:

$$p(z) = p(z_1, z_2, \dots z_n) \quad (2)$$

And the function links each feature of a good and its market price p(z). In other words, the above function determines the effect of each feature of a considered good in its market price. Rosen assumes that households are the consumers of a set of features. These features are into two distinct groups:

I. Physical features of a residential unit and
II. Environmental features of the above mentioned unit (L)

Therefore, if we show the features with $H(F_1, \dots, F_n, L_1, \dots, L_m)$ and residential unit with p(H) and also the other consuming good with ***x***, it is possible to show the household's optimum function as this:

$$U = U(x, F_1, \dots, F_n, L_1, \dots, L_m) \quad (3)$$

In which $F_1, \dots, F_n, L_1, \dots, L_m$ are the features of a considered good (residential unit) and x refers to the other goods in a market. If the price of other consuming goods is considered due to the ease and the household's income assumes as ***y***, it is possible to write the budget limitation as the following:

$$y = x + p(H) \tag{4}$$

Maximizing the above equation by considering the budget limitation through Lagrange method shows the initial conditions of maximizing the optimality:

$$L = U(x, F_1, \dots, F_n, L_1, \dots, L_m) + \lambda[y - x - p(H)] \tag{5}$$

$$\frac{\partial L}{\partial x} = \frac{\partial U}{\partial x} - \lambda = 0 \Longrightarrow \frac{\partial U}{\partial x} = U_x = \lambda$$
$$\frac{\partial L}{\partial F_i} = \frac{\partial U}{\partial F_i} - \lambda \frac{\partial p(H)}{\partial F_i} = 0 \Longrightarrow \frac{\partial U}{\partial F_i} = \lambda \frac{\partial p(H)}{\partial F_i}$$
$$\frac{\partial L}{\partial L_j} = \frac{\partial U}{\partial L_j} - \lambda \frac{p(H)}{\partial L_j} = 0 \Longrightarrow \frac{\partial U}{\partial L_j} = \lambda \frac{\partial p(H)}{\partial L_j}$$
$$\frac{\partial L}{\partial \lambda} = y - z - p(H) = 0$$

As a result, the initial conditions of optimum maximization will be as the following:

$$\frac{\partial p(H)}{\partial F_i} = P_{F_i} = \frac{U_{F_i}}{U_x} \qquad i = 1,2, \dots, n \tag{6}$$

$$\frac{\partial p(H)}{\partial L_j} = p_{L_j} = \frac{U_{L_j}}{U_x} \qquad j = 1,2, \dots, m \tag{7}$$

In the above relations, U_x= final optimality from other goods' consumption (x), U_{F_i}= optimality from the consumption of ith physical feature of residential unit, U_{L_j}= optimality from the consumption of jth neighboring feature of residential unit, P_{F_i}=final willingness to pay for ith physical feature of residential unit, p_{L_j}= final willingness to pay for jth neighboring feature of residential unit.

Research method

Based on the above mentioned points, the used pattern in this study is Rosen in order to evaluate the HP function of residential units in Tehran, Iran. Therefore, this model is based on the relation of prices and features of residential units. These units are from Tehran city, Iran. In doing the research works, often the researches face data which are from the effect of space and in this case, the space variable must be inserted in this model besides the other variables.

These data are qualitative and they must be changed into the quantitative ones in order to calculate their effect on the data, numerically. The econometric which was used in this field is Spatial Econometric. In this study, two groups of basic information of Tehran were used.

1. Economical, social, population and residential information and in this group, the information of census and settlement of 2006 in all of Iran (which was provided by Iran Statistics' Center) was used.
2. City making information of Tehran and for this purpose, the information of comprehensive and formal plan of Tehran was used. The comprehensive design of Tehran was approved in 2008.

Then, by using the information of 374 regions of Tehran, it is possible to evaluate the model specification. The simple form of this model is presented in the below relation:

$$S\_Price_i = \beta_0 + \beta_1.Distance_i + \beta_2.Bod\_Kh_i + \beta_3.STAF_i + \beta_4.SSABZ_i + \beta_5.Tejari_i + \beta_6.Tj_i + \beta_7.Shabakeh_i + \beta_8.MAyan_i + \beta_9.TarakomF_i \quad (8)$$

The inserted variables in the above model are defined as following:

1. Dependence variable: price of a new residential unit (for each m^2).

2. $Distance_i$ distance of i^{th} region from Tehran market (in which the Tehran market was placed) as the trade center of Tehran, urban traffic and the economical center of Tehran with urban and meta-urban function.

3. Bod_Kh_i: the average dimension of household in ith region which is the substitute variable of social features of households in different regions of Tehran.
4. $STAF_i$: workshop and industrial share from the whole area of ith region.
5. $SSABZ_i$: share of green-lands from the whole area of ith region.
6. $Tejari_i$: trade share from the whole area of ith region.
7. Tj_i: population density in ith region from the ratio of population to the number of households in each region.
8. $Shabakeh_i$: pathway network share from the whole area of ith region which is from the whole ratio of pathways' network of each region (includes of 1 and 2 degree and secondary streets and local access).
9. $MAyan_i$: average meter of residential units located in ith region.
10. $TarakomF_i$: average density of Guideline For Action of Tehran municipality in ith region

But three models were used in order to evaluate the HP model the following:

1. a simple model without spatial variable as below:

$$Ln(HOP_j) = \beta_0 + \sum_{i=1}^{n} \beta_i Ln(X_{ij}) + \varepsilon_j \quad (9)$$

In which (HOP) is a dependence variable as the settlement price. X_{ij} contains physical and environmental variables of a residential unit and ε_j is the model error component. It is being observed that in this model, the space variable was not considered. The results of model's specification which were obtained by using OLS evaluation method were presented in table 1.

2. Regression – spatial self-regression model was defined as following:

$$Ln(HOP_j) = \beta_0 + \rho.W.Ln(HOP_j) + \sum_{i=1}^{n} \beta_i Ln(X_{ij}) + \varepsilon_j \quad (10)$$

In which ρ = coefficient of spatial Autocorrelation variable (HOP) and β = the effect of explanatory variables on the deviation in the dependent variable of HOP. W is the matrix of spatial approximation in which the elements indicate the different regions of Tehran. The method of model's specification by using ML (Maximum Likelihood), based on Table 1, was defined as SAR model.

3. The spatial error model was defined as the following:

$$Ln(HOP_j) = \beta_0 + \sum_{i=1}^{n} \beta_i Ln(X_{ij}) + (\lambda WU_j + \varepsilon_j) \quad (11)$$

These variables are as the same as previous ones but there is a difference among them as λ is the coefficient of spatial Autocorrelation error which is similar to the issue of serial correlation in the time-series models. The evaluation of this model is being done by ML method which was defined as SAR (Spatial Error Model) model in Table 1. Table 1 shows the regressions results of these three models by GeoDa software:

Table 1: results of model evaluation

Variable	OLS	SAR	SEM
Constant	0.507*** (5.72)	0.079 (1.44)	0.85*** (7.69)
Distance	1.313e-005*** (3.585)	5.188e-006** (2.32)	1.04e-005 (1.62)
Bod_Kh	-0.0195** (-2.016)	-0.004* (-2.177)	-0.0068 (-1.23)
STAF	-0.0026 (-1.47)	-0.0007* (-2.719)	0.0014 (1.49)
SSABZ	-0.0002 (-0.132)	0.0016 (1.51)	-0.0013 (-0.93)
Tejari	0.0029 (1.158)	0.0035** (2.36)	0.0052*** (2.86)
Tj	-0.0001 (-0.635)	-4.92e-005*** (-3.86)	-0.0002* (-1.79)
Shabakeh	-0.0099*** (8.605)	-0.0083*** (-10.64)	-0.0083*** (-10.64)
TarakomF	0.0001 (0.294)	0.0001 (0.45)	0.0001 (0.45)

MAyan	0.0058*** (12.058)	0.0003 (0.61)	0.0003 (0.61)
W_S_price	-	0.85*** (7.69)	-
Lambda	-	-	0.91*** (40.62)
R^2	0.599	0.839	0.854
$\overline{R}^2$	0.549	-	-
Log Likelihood	19.5229	176.515	181.089
AIC	-19.0458	-331.03	-342.179
SC	20.1967	-287.864	-302.927

Source: authors' computations

Note: the figures within brackets for OLS model indicate the values of ***t*** statistics and for SAR and SEM models indicate ***z*** statistics.

*, ** and *** denote significance at 10, 5 and 1% level respectively.

The appropriate test in order to study the spatial Autocorrelation among the disorder of a regression model is I Moran statistics. If the spatial weight matrix of W is standard, therefore, it will be equal with:

$$I = \frac{e' W e}{e' e} \quad (12)$$

In this case, e shows the regression remainders (Anselin 1999). Moran statistics equals 78% which shows the high dependency. In fact, there is a serious Spatial Autocorrelation among the different regions of Tehran due to the residential units' price. This dependency was positive as Tehran was divided into two major parts.

Based on Spatial Autocorrelation, it seems that the results of these two models "regression – spatial self-regression" and "spatial error" show the most appropriate regressions. Also in according to the criterions of regressions (R^2 ،AIC ،SC), the results of spatial error are more appropriate than regression – spatial self-regression and we should use the results of this model.

Conclusion

The main aim of this study is to determine the effective factors on the settlement price in Tehran. For this reason, at first, test of Spatial Autocorrelation was done by using Moran statistic which shows the serious Spatial Autocorrelation of settlement price in Tehran.

Then, by using GeoDa software, HP model of settlement in Tehran was evaluated and its results by using SAR model show that the variables like distance of a region from Tehran market, share of green-lands from the whole area of regions, share of trade controls from the whole area of regions, average density of Guideline For Action, and average meter of residential units had positive and significant effect on the price of residential lands in Tehran but the other variables like the average dimension of household, control workshop and industrial share from the whole area regions, pathway network share from the whole area of regions and population density had negative effect on the residential units' price in Tehran.

Also by using SEM model, these variables have significant effect on the residential units' price in Tehran share of trade controls from the whole area of regions, the average dimension of household and pathway network share from the whole area of regions.

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