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Estimation of the Hedonic Pricing Function for Housing Units (A Case Study of Hashtgerd New Town, Iran)

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Abstract: The price of a housing unit, as a heterogeneous and multidimensional commodity, is a function of the physical, environmental and locational characteristics. In this regard, this research was conducted to study the factors that influence the price of residential properties in Hashtgerd New Town (35° 34'48''N, 50° 26'24''E). The information required for this study was gathered from 416 households in Hashtgerd New Town. The housing pricing function was estimated by applying the Hedonic Pricing Model based on Ordinary Least Squares (OLS) method. The findings suggest that the most significant features of a housing unit include gross floor area, type of housing unit, stone facade, land area, number of rooms, number of floors and unit's distance from down town and park. Among these variables, gross floor area, type of housing unit (in terms of being a villa or an apartment) and stone facade with 0.60, 0.42 and 0.25 rates of elasticity, respectively have had the greatest positive impact on setting the price of a housing unit.

Key words: Hedonic, price, housing, OLS, physical, residential property

INTRODUCTION

Housing has always been considered to be a fundamental need in the economy of every society. Hence, the development of the housing sector has largely influenced other divisions of the economy. The role housing market played in the recent financial crisis in Europe and USA clearly indicates such reality (Gholizadeh, 2000).

The word hedonic is derived from the Greek Hedonikos, meaning delight. In welfare economics literature, hedonic means favorability of goods or services or satisfaction of consumer with them. The Hedonic Method was first applied by Griliches (1961) to analyze the demand in housing market and environmental economics and was popularized by the researches of Lancaster (1966) and Rosen (1974). In the Hedonic Demand Model, several dimensions are assumed for a product. Regarding that it applies to housing as well, i.e., a residential unit like any composite commodity has various features, it is therefore, appropriate to apply Hedonic Model to demand in housing market. The base for hedonic pricing function for the payments a household makes to get its demanded residential unit emanates from factors characterizing the housing unit (Hill, 2011).

Several studies have been done in the area of home pricing by using Hedonic Model. The research performed by Arimah (1992) on the structure of home pricing in the Nigerian city of Abidjan is one of those studies. In this research, the researcher initially estimated the hedonic pricing function by utilizing logarithmic form and then applied hedonic function to approximate the implicit prices. Afterwards, he employed implicit prices to extract the housing demand function (Arimah, 1992).

Dokmeci *et al.* (2002) used a Hedonic Model to estimate the housing demand function in Istanbul. The results of this study showed that the average price boosted \$191 per extra m^2. In addition, increase in the number of rooms had positive impact on home price. Moreover, while the age and the type of residential building did not have statistically meaningful influence on buildings prices, construction permits and legal title did. Furthermore, heating system variable had an effect on house prices.

When a product already has a market, the supply and demand conditions can provide valuable information about the benefits and values of commodities and services. In contrast, non-market products require information about the demand. Housing is a non-market commodity whose demand information is not directly available and requires using the existing methods for estimating its price. Therefore, this research was performed to estimate the effects of physical, environmental and locational factors on home price and also to determine the aspects that particularly influence home prices in Hashtgerd New Town.

MATERIALS AND METHODS

To estimate the demand for home in Hashtgerd New Town, the present study applied Hedonic Pricing Method

based on OLS technique. Since, housing is a multidimensional and heterogeneous commodity, Hedonic Pricing Method can be used to determine the impact of each housing features on the demand for home (Hill, 2011; Shihomi, 2007). In regard to purchasing a house or a housing unit, the Hedonic Pricing Method considers a collection of residential unit's characteristics that influence utility and quality of life. In other words, the taste and priorities of an applicant regarding a residential unit will be manifested in the price, they will pay for it (Hill, 2011).

Hashtgerd New Town in Alborz province is located on the Southern slopes of Alborz mountains and on the Northern edge of central desert of Iran. In 1989, the Higher Council of Urbanism and Architecture of Iran approved the construction of the city and its location. Hashtgerd New Town which covers an area of 4800 ha is one of the four cities surrounding Tehran and is 65 km West of Tehran metropolis and 24 km West of Karaj. The overall structure of the town is composed of two parts: The first part is a residential site that covers an area of 4312 ha in the North side of Tehran-Qazvin freeway. The second part is a 350 ha industrial site (industrial town) in the Southern part of Tehran-Qazvin freeway. The area between these two sections is covered by an afforested space and Tehran-Qazvin freeway (Anonymous, 2007).

An interview questionnaire with 95.2% validity has been used as data collection instrument. In this research, Hashtgerd New Town is considered as an infinite population and its residential units are taken as the research's statistical units. Since, the standard deviation for the population was not clear, the number of samples (416) was calculated with respect to the number of population and based on Morgan technique at a confidence level of 99% and margin of error of 0.01 (Krejcie and Morgan, 1970). Besides, Multistage Sampling Method was applied. The samples were selected based on the detailed plan of Hashtgerd New Town and in regard to each of the urban phases (1-3) and garden city.

The followings were taken as independent variables in order to estimate the hedonic pricing function: Land Area in square meter (LA); Elevator (EL; EA = 1: if available or EL = 0: if not available); Gross Floor Area of Residential Unit in square meter (GFARU); Type of the Structure (TS; TS = 1: for steel frame and TS = 0: for concrete frame); the Distance to the Nearest Medical Center in meter (DNMC); the Distance to the Nearest Educational center in meter (DNE); the Distance to the First Main Street in meter (DFMS); the Distance to Downtown in meter (DD); the Distance to the Nearest Park in meter (DNP); the Material of Kitchen Cabinets (MKC; MKC = 1: for wooden or MDF Kitchen Cabinet and MKC = 0: for metal and other types of kitchen cabinets); Type of Floor Covering (TFC; TFC = 1: for ceramic and parquet coverings and TFC = 0: for carpet and other types of coverings); Brick Facade (BF; BF = 1: for Brick Facade and BF = 0: for other types of facade); Stone Facade (SF; SF = 1: for Stone Facade and SF = 0: for other types of facade); the Age of the Building or Residential Unit in years (ABRU); the Floor the Unit is Located on (FUL); Number of Rooms (NR); Number of the Floors of the Building (NFB) and the Type of Residential Unit (TRU; TRU = 1: for villas and TRU = 0: for apartments). The estimation of hedonic pricing function was carried out based on OLS and using EViews software.

RESULTS AND DISCUSSION

The results of the estimation of hedonic function for the residential units in Hashtgerd New Town were obtained using OLS and the findings are presented in the Table 1. In this study, Double-log Model was used since it possessed such characteristics as reducing the influence of outlying observations, reducting the intensity of collinearity and simplicity of changing the parameters. Arimah (1992), Gholizadeh (2000) and Askari and Ghaderi (2002) have also used Double-Log Model. However, Tiwari and Parikh (1998) and McDougall (1976) applied linear form to estimate the hedonic home price, Lodhi and Pasha (1991) have employed Box-Cox Model. According to Arimah (1992), double-log form has superiority over other forms because of its explanatory power (R^2), diagnosis ability, stability of the hedonic coefficients, application in setting the implicit prices of the characteristics, downward trend in final prices and dependencies between housing's characteristics. The model's assumptions including phenomenon of autocorrelation of errors were studied before performing statistical analysis. The value of Durbin-Watson (DW) statistics showed that there was no autocorrelation between the errors and a hedonic function could be fitted using ordinary least squares for residential units in Hashtgerd New Town (Table 1).

The findings revealed that ten out of 18 variables had significant impacts on setting the home prices. Hence, those coefficients that were not meaningful in initial estimation at 5% error level were removed from the original model and then the final pattern was re-estimated using the ten variables with significant coefficients. The variables Land Area in square meter (LA), Elevator (EL), Gross Floor Area of Residential Unit in square meter (GFARU), the Distance to Downtown in meter (DD), the Distance to the Nearest Park in meter (DNP), Brick Facade (BF), Stone Facade (SF), Number of Rooms (NR), Number

Table 1: Estimation of the hedonic pricing function for housing units in Hashtgerd New Town

Variables	Coefficients of function's parameters	Excepted sign	Initial model		Final model	
			Coefficient	t-statistic	Coefficient	t-statistic
Intercept	a_0	Unknown	4.8140	13.83**	4.767	13.98**
LA	a_1	Positive	-0.1140	-3.70*	-0.108	-3.73**
EL	a_2	Positive	0.0840	2.83*	0.088	3.05**
GFARU	a_3	Positive	0.6110	10.72**	0.602	10.76**
TS	a_4	Positive	0.0110	0.50^{NS}	-	-
DNMC	a_5	Negative	-0.0100	-0.79^{NS}	-	-
DNE	a_6	Negative	0.0020	0.17^{NS}	-	-
DFMS	a_7	Negative	0.0070	0.78^{NS}	-	-
DD	a_8	Negative	-0.0950	-5.36**	-0.103	-7.26**
DNP	a_9	Negative	-0.0320	-3.85**	-0.026	-3.36**
MKC	a_{10}	Positive	0.0080	0.34^{NS}	-	-
TFC	a_{11}	Positive	0.0330	1.38^{NS}	-	-
BF	a_{12}	Positive	0.0750	2.34*	0.069	2.18*
SF	a_{13}	Positive	0.2250	6.20**	0.248	7.28**
ABRU	a_{14}	Negative	-0.0259	-1.23^{NS}	-	-
FUL	a_{15}	Negative	-0.0300	-1.35^{NS}	-	-
NR	a_{16}	Positive	0.1660	3.14*	0.186	3.59**
NFB	a_{17}	Negative	-0.0890	-2.39**	-0.103	-2.87**
TRU	a_{18}	Positive	0.4190	9.29**	0.424	9.60**
Statistic of model						
R-squared (R^2)	-	-	0.8100	-	0.800	-
Adjusted R-squared (R^2)	-	-	0.8000	-	0.800	-
Durbin-Watson stat	-	-	1.7500	-	1.770	-
F-statistic	-	-	91.6400	-	164.610	-
Included observations (n)	-	-	416.0000	-	416.000	-

NS: Non Significant; *, **: Significant at 5 and 1% levels of probability, respectively

of the Floors of the Building (NFB) and the Type of Residential Unit (TRU) were included in the final pricing model and were considered to be the most influential variable and factors in setting the price (Table 1).

The final estimate of the optimal form of the function in this study was obtained as follows:

$$\begin{aligned}&LOG(PRICE) = a_0 + a_1LOG(LA) + a_2LOG(EL) + \\ &a_3LOG(GFARU) + a_8LOG(DD) + a_9LOG(DNP) + \\ &a_{12}LOG(BF) + a_{13}LOG(SF) + a_{16}LOG(NR) + a_{17} \\ &LOG(NFB) + a_{18}LOG(TRU) + U\end{aligned}$$

Where:

a_0-a_{18} = Coefficients of the function's parameters
U = Residuals predicate

Coefficient of determination of the model (R^2) was high and equal to 0.80. This shows that 80% of changes in the values of residential units are related to the housing characteristics included in the final model and 20% of those modifications are explained by other factors (Table1).

With respect to the results obtained from the Hedonic Pricing Model estimation in Hashtgerd New Town, among the studied variables, factors such as gross floor area, type of residential unit (i.e., villa or apartment) and stone facade with 0.6, 0.42 and 0.25 rates of elasticity have had the highest influence on the price of housing units. The number of rooms with 0.19 rates of elasticity, distance to downtown and the number of floors of the building with −0.103 rates of elasticity hold the following ranks. In addition, all independent variables apart from land area of the residential unit have expected mark (Table 1). As a reason, it can be stated that based on the detailed plan of Hashtgerd New Town, the further the ground area increases with residential occupancy, the number of units approved for construction will increase (Anonymous, 2007). However, the improvements rate in the culture of living in apartments, welfare services, social conditions and neighborhood relationships do not keep pace with the increase in the number of residential units. The mentioned reasons explain why applicants expect lower payments for buildings with more number of units. All of the mentioned earlier reasons express the inverse relationship between the price of a housing unit and land area. Being equipped with elevator and having brick facade with 0.08 and 0.07 rates of elasticity has lesser impact on the value of residential unit. Among the influencing locational and environmental characteristics, the coefficients of variables distance from downtown and distance from park are significant in a way that 1% change in distance from downtown and park alters residential unit's value about −0.103 and −0.03%, respectively (Table 1). In other words, the farther the distance to residential unit, the more the value of residential unit.

Chris and Wallace (2002), Arimah (1992), Tiwari and Parikh (1998), Gholizadeh (2000) and Askari and Ghaderi (2002), hedonic techniques have also been used to estimate the implicit prices associated with the attributes of housing products.

As the estimation of the coefficients of the hedonic pricing function in Hashtgerd New Town has been performed in the form of a logarithmic function, the obtained coefficients then account for the elasticity. Each of these elasticity values contains valuable information for constructors in terms of cost-benefit, awareness of buyers and sellers of residential units, policymakers and planners in housing sector. For example, an increase of 1% in the gross floor area of residential units in Hashtgerd New Town has raised housing unit price 0.60 on average. Moreover, each of the estimated coefficients can be interpreted similarly.

CONCLUSION

Accordingly, by using the results obtained from the quantitative analysis and having the implicit price which actually is the marginal propensity of households to pay for each feature, a practical guidance can be provided in order to plan for production and supply of housing. It is so because by determining the tendency to pay, the priorities of households are, in fact, recognized. Therefore, those factors for which there is the highest tendency for payment can be considered in designing and planning of housing.

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