Using Hedonic Pricing Model to Analyze Parameters Affecting Residential Real Estate Value in Artvin City Center

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Key words: Residential real estate, Real estate attributes, Sales price, Hedonic pricing model.

Real estate development; Valuation

SUMMARY

Residential real estates have heterogeneous nature because of their various structural, positional, environmental and socio-economic characteristics, resulting in a different value and pricing of real estates. A realistic prediction of real estate value is of great interest for buyers/sellers and for those who want to invest in real estate. In this context, determining the parameters and their degree of importance affecting the value of residential real estate has recently been the subject of many studies. Herewith, the aim of this study is to determine house characteristics and their contribution degrees to sales prices in the city center of Artvin by using Hedonic Pricing Model (HPM) with semi-logarithmic functional form, one of the most commonly used methods. In this study, correlation and regression analyses were applied for 73 residential real estates (with the data of actual sales value) that were put up for sale in the city center of Artvin in 2015. Before applying regression analysis, it is important to test spatial dependency of data for the nature of the classic statistics relying on the fact that spatial data is independent from each other. For this reason, the sales prices of residential real estates with their known geographical locations were tested with Moran's Index and it was detected that there was no spatial dependency on sales prices. Thus, a hedonic housing valuation model based on non-spatial technique was developed. It was determined that parameters of floor area, age, development level, floor (at ground or below ground level) and Çarşı Neighborhood (proximity to public buildings) were statistically significant and affected the residential real estates sales prices by examining the analyzing results. The coefficients of the variables were also found consistent with the theoretical expectations. Five out of the supposedly effective 22 parameters were able to explain 80% of the variations on price. This figure indicated that the developed model can be used for houses subjected to sales in Artvin city center. In addition, the results revealed that the parameters affected the value of real estate vary according to local and geographical attributes of the city. This result emphasizes the importance and necessity of city-based works.

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1. INTRODUCTION

Real estate services, such as buying and selling, insurance, taxation, expropriation and banking play a significant role in the economy of countries. These services require knowledge of the values of immovable properties (Yılmaz and Demir 2011; Yalpir 2014; Emek and Öztürk 2015). Real estate valuation is defined as determination of possible value of a real estate, a real estate project or rights and benefits of the real estate on the day of its valuation, based on free and objective measures (Yılmaz and Demir 2011; Yavuz Ozalp and Akinci 2017a). In this context, it is a fact that the housing market is a heterogeneous market both for real estate and for buyers/sellers and so every real estate has distinguishing characteristics. The distinguishing character of real estate results in varied values and prices of the real estate (Yayar and Demir 2014).

An exact estimation of real estate value is of great importance both for buyers/sellers and for those who want to invest in property (Bin 2004). However, it is considerably difficult to predict the actual sales price of real estate because of its environmental, spatial, structural, and local characteristics. Moreover, it is not clear how to select and apply the parameters that are effective on predicting the sales price of real estate (Bin 2004). Therefore, determining the parameters and their degree of importance affecting the value of residential real estate has recently been the subject of many studies in the literature (Bin 2004; Yahşi 2007; Ottensmann et al. 2008; Yusof and Ismail 2012; Kördiş et al. 2014; Yalpir 2014; Daşkıran 2015). However, examining these studies reveals that there is no a standard for the selection of parameters and their application. Similarly, there are no standards with regard to the sales prices used in these studies (e.g. interviews with real estate agencies, online sales data, valuation reports data, and the Household Budget Survey data). In this process, with the support of the World Bank in 2008, the Land Registry and Cadastre Modernization Project (LRCMP), the Land Valuation procedure as its fourth component, was initiated by the General Directorate of Land Registry and Cadastre (GDLRC) and in 2011, a report was published focusing on the work aimed at determining the parameters affecting the value of real estates, according to their type and designating specific standards (GDLRC 2014). However, there is no sound basis as yet. The mentioned studies have been continued. At this point, it is very important that these studies are extended throughout the country, since it is well known that the parameters affecting the value of real estates are shaped in line with local features.

In this study, house characteristics and their contribution degrees to sales prices of residential real estates in Artvin city center were determined using Hedonic Pricing Model (HPM) by considering the parameters of real estate for residential purposes specified within the scope of

the LRCMP and the topography and residential features of Artvin Province. The semi-logarithmic functional form of HPM, one of the most preferred methods, was used.

2. MATERIALS AND METHODS

2.1 Study area

This study was conducted in the city center of Artvin, located at the eastern Black Sea region of Turkey (Figure 1). The study area was delimitated with approved zoning plan area, located between 41º 47’ 24” and 41º 50’ 24” East Longitudes and 41º 9’ 36” and 41º 11’ 42” North Latitudes and it covers an area of 768.91 hectares. In the study area, there are seven neighborhoods comprising Balcıoğlu, Çamlık, Çarşı, Çayağzı, Dere, Orta and Yenimahalle. Besides, the south west of the city consists of Kafkasör urban forest with an area of 182.90 hectares. Altitudes in the study area vary from 180 m to 1280 m, making it a hillside city (Yavuz Özalp et al. 2013). Moreover, according to the landslide susceptibility analysis conducted by Akıncı et al. (2015), it is stated that 40% of Artvin city center and 68% of the reconstruction islands has high and very high degree of susceptibility. Handling the population data of 2015 (TurkStat 2017), it can be seen that the population of Artvin city center is 25838.

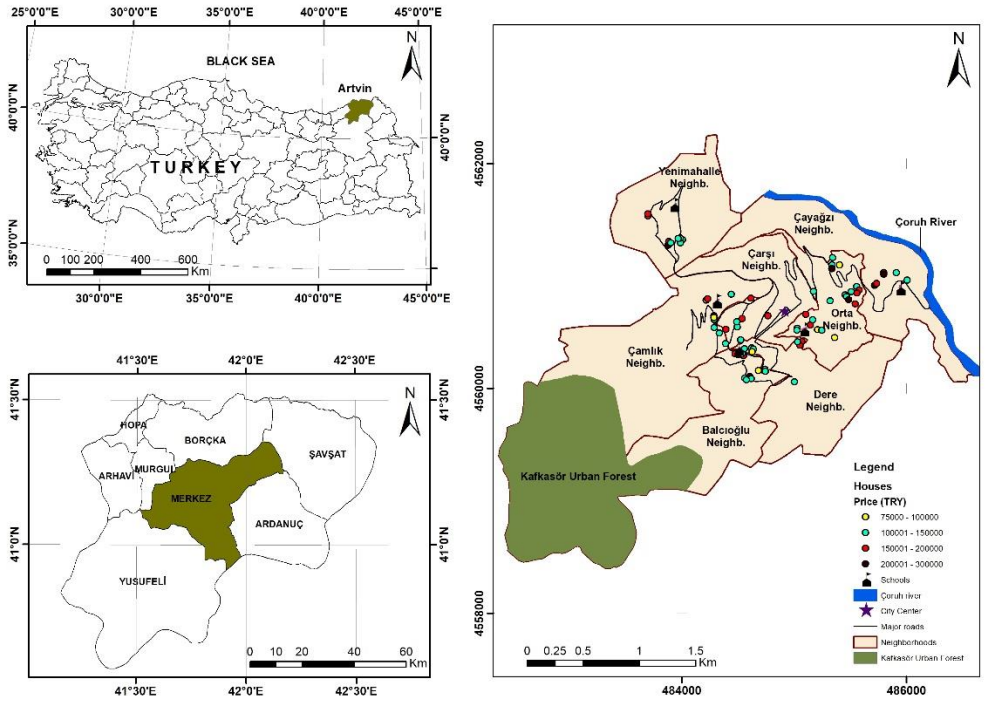

Figure 1. Location of the study area

The material of this study includes some residential real estates (with the data of actual sales value) sold in 2015 on the basis of these seven neighborhoods. The sales data were obtained from Artvin Directorate of Land Registry for the twelve-month period from January 1, 2015 to December 31, 2015. According to this data, total of 584 real estate properties (house, office, land, plot etc.) were sold in the city center in 2015 and that only 298 of them were used for residential purposes. In addition, we selected one residential real estate for each building since some of these residential real estates (298) were located in the same building (especially those that were newly built). Also, because the sales prices registered by Land Registry Directorates are lower than their market value (Yahşi 2007; Türkay 2015; Yavuz Özalp and Akinci 2017a), only the residential real estates that we were able to reach its actual sales prices were preferred. Therefore, a total of 73 residential real estates in proportion to the number of houses sold in each neighborhood were studied in this research. After that, the data on parameters selected for 73 residential real estates was collected from the relevant institutions and organizations.

2.2 Parameters used in the analysis and methodology

In this study, it was aimed to determine the relationship between the sales prices of residential real estates and its characteristics in Artvin city center by using Hedonic Pricing Method. In determining parameters affecting house value, the following sources of data were taken into account; (i) the real estate characteristics commonly used in the literature; (ii) the geographical structures and physical characteristics of Artvin city; and (iii) the list of parameters already determined for residential real estate within "Land Valuation Component" prepared as the 4th component of the LRCMP. Thus, a total of 22 parameters selected were handled in two groups, as continuous and categorical variables (Table 1). While continuous variables include "floor area", "age", "rooms", "balcony", "floor_level", "D_center", "D_school", "D_transport" "façade" and "total_floor", categorical variables consist of "floor", "en-suite bath", "elevator", "parking area", "Çarşı_Neigh.", "environment1", "environment2", "road_type", "position", "physical_poor", "physical_good" and "aspect_south" (Table 1).

Table 1. Parameters used in the analysis and descriptions

Structure of variable		Variables	Description
	Continuous	Price	Actual Sales Price (Turkish lira (TRY))
		Floor area	Usable floor area of a flat (m^2)
		Age	Age of the building at the time of sales
		Floor level	The level on which a flat is located in the apartment
		Rooms	Number of rooms in a flat (including living room)
		Balcony	Number of balconies in a flat
		Facade	Number of sides of a flat
		D_school	Distance to primary school (meter)
		D_transport	Distance to public transportation (bus station) (meter)
		D_center	Distance to the city center (meter)
		Total_floor	Number of floors
	Categorical	Floor	At ground level or below ground level (Characteristic of a flat storey)
		En-suite bath	It shows the presence of an en-suite bathroom
		Elevator	Availability of an elevator (yes=1, no=0)
		Parking area	It shows the presence of parking space (yes=1, no=0)
		Çarşı_Neigh.	If it is Carşı Neighborhood (Centre of the city)=1, the others=0

		Environment1	If development level of environment of the house is good=1, the others=0
		Environment2	If development level of environment of the house is poor=1, the others=0
		Road_type	If the real estate is on the main road =1, on the street=0
		Position	If the position of the flat is on the front= 1; if not, 0
		Physical_poor	If physical condition of the building is neglected=1, the others=0
		Physical_good	If physical condition of the building is very good=1, the others=0
		Aspect_south	If the largest facade of a flat is at the south, south west and south east=1, the others=0

After, the data related to these selected parameters was gathered. In this context, while the numbers of cadastral island, parcel and independent unit were acquired from Artvin Directorate of Land Registry, the actual sales prices were obtained from the face-to-face interview with the buyers/sellers. Next, data about the environmental qualities was obtained from the cadastral and city maps of the study area, accessed from the Artvin Directorate of Cadastre and from the Municipality of Artvin, respectively. The distance of the house to facilities such as city center and school was calculated in meters, considering the existing road network. The structural qualities such as age, floor area, floor level, total_floor and physical condition were obtained from the Occupancy Permits, provided from the Municipality of Artvin and through in situ observations.

Lastly, all the data collected was analyzed by using Hedonic Pricing Method (HPM), one of the most commonly used. In these analyses, SPSS (Statistical Package for the Social Sciences) v.14 software was utilized. Besides, ArcGIS 10.2 GIS software was used for measuring the distance to the facilities, spatial autocorrelation analyses and co-processing of the numeric, verbal and spatial data.

2.3 Hedonic Pricing Method and its application

The hedonic pricing method (HPM) is a model based on Lancaster's consumer theory (Kördiş et al. 2014; Afşar et al. 2017). The value of a heterogeneous product, such as a house and a car, is appraised as the sum of its all attributes. Every attribute has an advantage for the user, and its degree for the user depends on the different attributes contained in the products (Ayan and Erkin 2014). In the HPM, differentiated or heterogeneous goods were defined as the vector of objectively measurable features (Kördiş et al. 2014).

In the housing market, considering heterogeneous nature of the house, the hedonic pricing method has been utilized commonly to analyze the relationship between house features and its prices (Malpezzi 2003; Yahşi 2007; Selim 2008; Corsini 2009; Yusof and Ismail 2012; Makena 2012; Araghi and Nobahar 2013; Kim et al. 2015; Çiçek and Hatırlı 2015; Amca 2016; Randeniya et al. 2017; Yavuz Ozalp and Akinci, 2017b).

In hedonic model based on regression analyze, by establishing the relationship between features of the good and its price, it is aimed to determine the effects of these features on price (Selim 2008; Afşar et al. 2017). The structure of the hedonic model is the same as multiple regression model. However, various functional forms (linear, semi-logarithmic and full-logarithmic) can be used in the hedonic approach (Wen et al. 2005; Selim 2008; Boza 2015; Kangallı Uyar and

Yayla 2016). In this study, semi-logarithmic functional form of HPM, the most common functional form recommended in the literature, was preferred.

Thus, in the analysis, 22 parameters were used as independent variables, while natural logarithm of the actual sales price was treated as dependent variable. With regard to the sales prices and the features of a residential real estate, model was formed as:

$$Ln\,(P_i) = \beta_0 + \sum \beta_i x_i + \varepsilon_i \qquad (1)$$

Where P is the actual sales price of residential real estate (in Turkish lira (TRY)), β is the regression coefficients, x is the features of residential real estate (Table 1) and ε is the error term.

On the other hand, according to the basic hypothesis of the classic statistics, spatial data should be independent from one another. For this reason, before applying regression analysis, it is essential to test spatial dependency (spatial autocorrelation) of the data (Yavuz Ozalp and Akinci 2017b). Spatial autocorrelation can be described as the degree of correlation of the observed variable value in a given location with the value of the same variable in another location (Cellmer 2013; Yavuz Ozalp and Akinci 2017b). If spatial dependency is statistically significant, spatial econometric models (SAR, SEM etc.) should be used. For spatial dependency, the most commonly used method is to perform Moran's Index test (Wilhelmsson 2002; Kangallı Uyar and Yayla 2016; Trojanek and Gluszak 2017; Yavuz Ozalp and Akinci 2017b).

Therefore, in this study, the sales prices of houses with their known geographical location were tested with Moran's Index. The sales prices of 73 spatially-different residential real estates were analyzed with the spatial autocorrelation (Moran's Index) by using ArcGIS 10.2 software. The result of Moran's Index test (Figure 2) showed that there was no spatial dependency on sales prices; thus, the application was conducted by using non-spatial hedonic regression model.

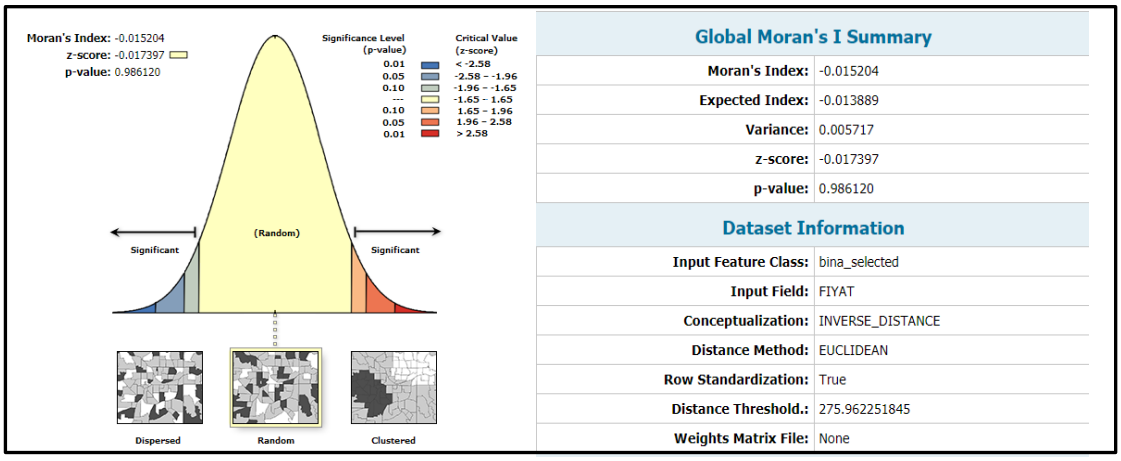

Figure 2. The results of Moran's Index test

The steps of the model application were given below;

i) Data analyses of the continuous variables given in Table 1 were conducted using SPSS software.
ii) Data analysis of the categorical variables according to house sales prices was executed.
iii) Correlation analysis was executed for the continuous variables.
iv) Finally, all variables were subjected to hedonic regression analysis. In this context, by using different methods (such as stepwise, backward, forward and enter) in the SPSS, a large number of models were developed and the most significant one was chosen for this study. The validity of this model was tested using ANOVA.

3. RESULTS AND DISCUSSION

In the analyzing of the continuous variables, the results showed that the house prices varied from TRY 75000 to TRY 300000, the average price of a residential property was TRY 146917.81 and the size of the properties varied from 60 m^2 to 213 m^2 (Table 2). Also the results indicated that while the average age of the buildings sold in 2015 was around seven years, 40 out of 73 residential real estates were newly built. Moreover, while the distance to public transport varied from 5 m to 600 m, the distance to the primary school was between 50 m and 1909 m (Table 2).

Table 2. Data analysis of the continuous variables

Variables	Mean	Range (Min. – Max.)	Standard Deviation
Price (TRY)	146917.81	75000-300000	40512.26
Floor area (m^2)	123.92	60-213	33.22
Age	6.59	0-36	9.47
Floor level	4.93	1-10	2.34
Rooms	3.99	2-7	0.99
Balcony	1.66	0-3	0.63
Facade	2.15	1-4	0.54
D_school (m)	558.22	50-1909	508.92
D_transport (m)	143.78	5-600	149.15
D_center (m)	2057.92	500-3900	765.88
Total_floor	7.19	4-10	1.79

The data analysis of the categorical variables according to house sales price was given in Table 3. Since the majority of the real estate sold in 2015 was newly built, it can be said that the number of residential properties with various modern features such as elevator, physical condition of the building, and parking areas was remarkably high.

Table 3. Data analysis of the categorical variables according to house sales prices

Independent Variables	Groups	N	Mean	Standard Deviation	t	Sig.
Floor	Ground/below ground	7	110714.29	23171.21	-3.98	.002
	The others	66	150757.58	40153.58		

En-suite bath	=>2	26	173307.69	42860.49	4.29	.000
	1	47	132319.15	30969.91		
Elevator	present	54	158722.22	39254.09	6.37	.000
	absent	19	113368.42	20537.80		
Parking area	Present	64	148796.88	40128.04	1.00	.340
	absent	9	133555.56	43142.53		
Çarşı_Neigh.	Çarşı Neighborhood	8	148125.00	27766.56	0.12	.905
	The others	65	146769.23	41974.61		
Environment 1	Development level is good	27	155629.63	43913.51	1.36	.179
	The others	46	141804.35	37941.25		
Environment 2	Development level is poor	16	131875.00	33460.18	-1.92	.064
	The others	57	151140.35	41562.96		
Road_type	Main road	16	142312.50	40036.18	-0.52	.609
	Street	57	148210.53	40903.08		
Physical_poor	Condition is poor	8	98125.00	17715.51	-6.96	.000
	The others	65	152923.08	38442.86		
Physical_good	Condition is good	34	158941.18	38173.40	2.46	.017
	The others	39	136435.90	40026.83		
Aspect_south	S, SW, SE	24	153083.33	47038.30	0.84	.407
	The others	49	143897.96	37058.65		
Position	Front	52	150288.46	42520.44	1.22	.227
	Rear front	21	138571.43	34573.94		

Moreover, when looking at the results of correlation analysis executed in this study, it was found that there was a correlation between the sales price and the parameters of floor area, number of rooms, balcony and floor level (Table 4). However, when the independent variables were handled, it was seen that the parameter of floor area had a strong correlation with the number of rooms (Table 4). In this context, this strong correlation among the independent variables could limit each other by explaining the variant in the dependent variable (Yavuz Ozalp and Akinci 2017b). For this reason, the respective parameter of the number of rooms was not attached to the model.

Table 4. Correlation matrix for the continuous variables

	Price	Area	Age	T_floor	Floor_L	Balcony	Rooms	Facade	D_school	D_center	D_trans
Price	1	.854	-.468	.362	.565	.541	.741	.083	.114	.192	.004
		.000	.000	.002	.000	.000	.000	.485	.338	.104	.976
Area	.854	1	-.402	.342	.565	.571	.864	.069	.151	.238	.097
	.000		.000	.003	.000	.000	.000	.562	.201	.043	.416
Age	-.468	-.402	1	-.567	-.355	-.022	-.139	.093	-.138	-.142	-.008
	.000	.000		.000	.002	.856	.239	.434	.245	.230	.947
T_floor	.362	.342	-.567	1	.656	.010	.158	-.087	-.015	-.076	.171
	.002	.003	.000		.000	.934	.181	.463	.898	.525	.148
Floor_L	.565	.565	-.355	.656	1	.164	.467	.063	.131	.035	.026
	.000	.000	.002	.000		.167	.000	.597	.268	.772	.829
Balcony	.541	.571	-.022	.010	.164	1	.571	.194	.156	.165	.165
	.000	.000	.856	.934	.167		.000	.101	.187	.162	.163
Rooms	.741	.864	-.139	.158	.467	.571	1	.132	.128	.145	.017
	.000	.000	.239	.181	.000	.000		.264	.282	.221	.888
Facade	.083	.069	.093	-.087	.063	.194	.132	1	.175	.236	-.118
	.485	.562	.434	.463	.597	.101	.264		.139	.044	.320
D_school	.114	.151	-.138	-.015	.131	.156	.128	.175	1	.387	-.026
	.338	.201	.245	.898	.268	.187	.282	.139		.001	.830
D_center	.192	.238	-.142	-.076	.035	.165	.145	.236	.387	1	-.035
	.104	.043	.230	.525	.772	.162	.221	.044	.001		.770
D-trans	.004	.097	-.008	.171	.026	.165	.017	-.118	-.026	-.035	1
	.976	.416	.947	.148	.829	.163	.888	.320	.830	.770	

In the next step, parameters effecting the sales price of residential real estates were determined by using regression analysis. In this context, it was found that the parameters of “floor area”, “age”, “development level (Environment1)”, “floor (at ground or below ground level)” and “Çarşı_Neigh. (Center of the city)” were effective on the price. By applying these parameters to the formula (1), the equation (2) was generated:

$$Ln\ P = 11.109 + 0.006^{*}\ (\text{floor area}) - 0.006^{*}\ (\text{age}) + 0.104^{*}\ (\text{development level}) + 0.121^{*}\ (\text{Carsi\_Neigh.}) - 0.123^{*}\ (\text{floor}) \quad (2)$$

The results gathered from the regression analysis were summarized in Table 5. According to this table, while the parameters of floor area, environment1 and Çarşı Neighborhood had a positive effect on the sales price, the parameters of age and floor had a negative impact. Also, when examining the results, it was seen that every additional square-meter in the floor area of

residential real estate increased the sales price of the house at the rate of 0.6%. In addition, being located in the developed environment increased the sales price by 10% while situated in Çarşı Neighborhood raised the sales price by 12%. Nevertheless, being an old property (for each additional year) decreased its sale value at the rate of 0.6%, while located at ground level or below ground level decreased its value by 12%.

Table 5. Coefficients for the model

Functional form	Model	Unstandardized Coefficient		Standardized Coefficient	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
Semi-logarithmic	Constant	11.109	.072		155.298	.000		
	Floor area	.006	.000	.752	12.331	.000	.789	1.268
	Age	-.006	.002	-.196	-3.234	.002	.799	1.251
	Environment1	.104	.031	.189	3.407	.001	.950	1.053
	Çarşı-Neigh.	.121	.047	.142	2.567	.012	.960	1.042
	Floor	-.123	.050	-.136	-2.454	.017	.947	1.056

At the same time, it was seen that the analysis results were in conformity with theoretical expectations. In fact, in this study, it was found that the age of the residential real estate had significantly negative effect on the sales price. There are a number of studies in the literature that have reached the same conclusion (Wilhelmsson 2002; Bin 2004; Yusof and Ismail 2012; Araghi and Nobahar 2013; Kördiş et al. 2014; Kim et al. 2015; Randeniya et al. 2017; Yavuz Ozalp and Akinci 2017b). However, in some studies (Wen et al. 2005; Daşkıran 2015; Yayar and Karaca 2014), there was no relationship found between the price and the age. Moreover, it was observed that the floor area had a highly significant impact on the sales value of real estate as specified in many studies (Wilhelmsson 2002; Mirasyedi 2006; Yahşi 2007; Kryvobokov and Wilhelmsson 2007; Selim 2008; Yusof and Ismail 2012; Kördiş et al. 2014; Ayan and Erkin 2014; Amca 2016; Yavuz Ozalp and Akinci 2017b).

Another parameter that was effective on sales price was the floor, in which the residential real estate was located at ground or below ground level. Similarly, in some researches (Kryvobokov and Wilhelmsson 2007; Ayan and Erkin 2014; Amca 2016), state of being below ground was found negatively effective for the price. However, in some studies (Mirasyedi 2006; Daşkıran 2015), the floor level on which the housing is situated, was found positively impact on the sales price.

Another result of this study was that residential real estate was located at developed and a good environment (the parameter of Environment1) had a positive effect on the sale price. Similarly, Kaklauskas et al. (2007), Selim (2008) and Kördiş et al. (2014) stated that the developed place had positive effect on sales prices. The results showed that if a real estate situated in Çarşı Neighborhood, its value became higher, which can be associated with the fact that most of the government institutions and private business centers are located in this neighborhood. However, unexpectedly, the parameter of D_city center (distance to city center) did not have any effect on sales prices in this study.

At the final step of the study, the validity of produced model was tested. As stated by some researchers (Corsini 2009; Yavuz Ozalp and Akinci 2017b), the R-square value is an important component of regression analysis and it is the measure of the model's foreseeability. In this context, it was seen that both the equation generated in this study and its parameters were significant. There was a strong relationship between the variables and the actual sales price of the houses (R= 0.897) and these variables explained 80% of the variation on sales price (R^2=0.804). Similarly, the explanation ratios of the variation in the sales price varied from 58% to 95% in the literature (Mirasyedi 2006; Yahşi 2007; Yalpir 2014; Yayar and Karaca 2014; Daşkıran 2015; Candas et al. 2015; Yavuz Ozalp and Akinci 2017b). Moreover, the literature (Wen et al. 2005; Kryvobokov and Wilhelmsson 2007; Boza 2015; Yavuz Ozalp and Akinci 2017b) reported that all the VIF values were below 5 and the tolerance scores were bigger than 0.2 (Table 5) showed that there was no problem with multicollinearity among the variables. Therefore, it can be said that this model can be applied.

4. CONCLUSIONS

In this paper, the parameters affecting the sales prices of residential real estates and their impact degree in Artvin city center were determined using hedonic regression analysis. The accuracy and consistency of the valuation studies depend on the accurate establishment of the model and determination of parameters affecting the value. Therefore, in this study, in determining parameters affecting the residential real estate value, the following sources of data were considered; (i) the real estate characteristics commonly used in the literature; (ii) the geographical structures and physical characteristics of Artvin city; and (iii) the list of parameters already determined for residential real estate within the LRCMP. Thus, a total of 22 parameters were handled and a model was generated using the semi-logarithmic functional form. When examining this model, it was found that only five (floor area, age, environment1, floor and Çarşı_Neigh.) out of the supposedly effective 22 parameters were statistically significant and they were able to explain 80% of the variations in sales price. The findings of this study principally overlap with the results of studies conducted in other cities. Moreover, when handling the conformity of the regression analysis with the regression assumptions, it can be said that the produced model is of a satisfactory quality in terms of both the selected parameters and the ratio describing the variations in sales price. Thus, this model can be used as a base for determining the sales price of residential real estate located in the city center of Artvin.

In addition, the results revealed that the parameters affected the value of real estate vary according to local and geographical attributes of the city. This result emphasizes the importance and necessity of city-based works. In conclusion, examining the parameters effecting real estate prices across different regions and time periods should assist to follow the real estate market. Besides, it is quite important to designate urban-based real estate value maps and to serve for all studies requiring this value.

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