TITLE: *Housing Market in Malaga: An Application of the Hedonic Methodology*

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Abstract

The aim of this work is to analyze the factors shaping the price of private housing in Spain, concretely in the capital of the “Costa del Sol”, using hedonic methodology. The results obtained enable us to both identify those housing attributes that most influence price and quantify their impact in monetary terms. We found that some structural attributes (e.g., surface area, number of bathrooms, private parking or poor natural light) and certain location attributes (proximity to the seaside or town center and location within a given district) have a determinant effect on the price of dwellings. Furthermore, we found that two characteristics (surface area and number of bathrooms) although show a positive contribution to the price, it is so at a diminishing rate. These results are used to form appropriated valuations of attributes of residential house in Malaga.

Key words: housing prices, hedonic methodology, implicit price, spatial attributes

Introduction

For many different reasons the importance of the housing market has led to an increase in research interest regarding specific house attributes.

From the supply standpoint, the housing market has recently consolidated itself as one of the main driving forces of economic activity in Spain. According to the Spanish National Accounts figures, the weight of construction sector within national production figures has increased in real terms from 4.47% to 5.59% of the total Gross Value Added in the period 1995-2003.

From the perspective of investment, housing is the main asset of Spanish families, and most of their savings are channeled towards this investment. Thus, according to the Spanish Census of Population and Housing (2001), the percentage of owner-occupied housing in Spain, Andalusia, and Malaga in relation to the housing stock is 80.94%, 81.68%, and 81.66% respectively.

Another macroeconomic factor that justifies research interest in this sector is the increasing weight of new dwelling purchases in the Gross Fixed Capital Formation during the last decade. This has increased from 20.34% to 22.62% in 2003, and confirms the significance of this asset as a destination of household savings.

From the standpoint of expenditures, and according to the information provided by the Spanish Central Bank (*Banco de España*), the percentage of mean annual wages used per worker during the first year of a mortgage to pay for the purchase of their house has risen from 36.6% in 1996 to 51.4% in 2003.

From this data we can infer that in the last decade one of the main problems in the Spanish housing market has been the difficulty for most of the population to have purchase a house due to high prices.

Taking the period 1996-2003 as a reference as well as the price per square meter estimated by the Spanish Ministry of Public Works (*Ministerio de Fomento*), there has been a trend toward higher prices for new dwellings. Thus, at the end of 1996, the mean price per square meter of a deregulated dwelling was 674.32 €, and in 2003 this reached 1428.16 €, a growth of 112%. The increase is similar for Andalusia as a whole but within this region the growth of the Malaga market is higher. Thus, the price per square meter of dwellings in Malaga city increased by 157% during the same period, i.e., from 581.65 €/m^2 to 1494.22 €/m^2. These figures show the significance of this market in the area.

In this paper, we analyze house pricing using hedonic methods to study the influence of house attributes on final house prices.

An Overview on the hedonic methodology

The existence of products differentiated by specific attributes is the main reason for the emergence of the hedonic price model. During the first decades of the 20th century some papers were published analyzing the price of a given good by studying variations in the quality of the product as established by the product’s attributes [See Haas (1922), Wallace (1926), Waught (1928 and 1929) and Court (1939)].

These contributions, which were basically empirical and *ad hoc*, were followed by the more formalized work of Griliches (1961), who pointed out "...we are interested in the effect of quality change on measured prices and price indexes, our first job is to find what relationship, if any, there is between the price of a particular commodity and its 'quality'." (Griliches 1961, p. 57).

The first attempts to create a theoretical formulation for this approach were made by Houthakker (1952) and by Tinbergen (1956). However, it was not until the mid-sixties that Lancaster (1966 and 1971) developed the consumer behavior theory oriented toward the demand for heterogeneous commodities with identifiable and objectively valuable attributes. Nevertheless, it was not until the publication of Rosen's works (1974) that hedonic methodology acquired a microeconomic foundation that made it possible to formalize empirical contributions. From this time onwards, the model developed by Rosen has usually been accepted as the paradigm of the hedonic approach.

Rosen established in the hedonic price function the relationship between the price of the differentiated commodity and the quantities and implicit prices of the attributes of the given commodity. This function underlies the relationship between supply and demand for a specific commodity's attributes. In other words, as pointed out by Hulten (2003), the hedonic pricing function establishes a relationship between the demand curves of consumers with heterogeneous tastes for different combinations of attributes within each category of commodities and their corresponding supply functions with different costs of factors and production functions for each attribute.

From an analytical point of view, the application of Rosen's model involves obtaining a pricing function that relates the price of a differentiated good P to its attributes $x_1...x_k$. In other words, $P = f(x_1,...,x_k)$ where the implicit prices of such attributes are given by $\partial P/\partial x_k$ and, depending on the functional form chosen, different values are obtained. Neither Rosen's model nor later contributions offered a criterion for selecting the most suitable functional form to obtain the best results and, thus, this has become an empirical issue.

Traditionally, the most frequently used functional forms were the linear, log-linear and double-log functional forms. In recent years, many different functional forms derived from Box-

Cox transformations have been introduced, although the results obtained have not significantly improved those obtained with traditional functional forms. On the one hand, Box-Cox transformations have considerably hindered later estimations of implicit hedonic prices of independent variables, as pointed out by Goodman (1978), Halvorsen and Pollakowski (1981), and Cassel and Mendelsohn (1985).

The application of this methodology to the housing market began in the 1960s, with the work of Ridker and Henning (1967) being the first to deal with attributes shaping the value of residential properties and making special reference to an environmental factor such as air pollution in the area. However, Freeman (1979) is considered to be the author who provided the first theoretical justification for the application of this methodology to the housing market. Based on the seminal work of Ridker and Henning (1967), the different attributes of a dwelling were grouped into three categories: the structural attributes of the house, location attributes, and neighborhood and environmental attributes. Therefore, according to the hedonic model, housing prices would be explained by the sum of the implicit prices of the dwelling's structural, location, and neighborhood attributes.

Given that dwellings have been considered multiattributed commodities, in recent decades they have been analyzed with the hedonic method by a large number of authors. Table 1 shows some of these works, published by both Spanish authors as well as other nationalities, grouped according to the objective.

TABLE 1

Some contributions to the application of hedonic methodology to the housing market

1. Obtaining the hedonic price of dwellings.	
1.1. Structural Characteristics	Bartik (1987), Brueckner and Colwell (1983), Can (1992), Clapp and Giaccotto (1998), Fletcher et al. (2000), King (1976), Linneman (1980), Mok et al. (1995), Straszheim (1975)
1.2. Location Attributes	Adair et al. (1996), Adair et al. (2000), Benson et al. (1998), Brown (1985), Lipscomb (2003), McMillen (2004), Palmquist (1992), Quigley (1979), So et al. (1996), Wheaton (1979)
1.3. Neighborhood Attributes	Bengochea M. (2003), Cervero and Duncan (2004), Chattopadhyay (1999), Cheshire and Sheppard (1998), Freeman (1979), Goodman and Thibodeau (2003), Harding et al. (2003), Hidano (2002), Kain and Quigley (1975), Li and Brown (1980), Ogwang and Wang (2003), Schafer (1979), Tajima (2003)
2. Obtaining price indexes	Butler (1982), Englund et al (1998), Goodman (1978), Haurin et al (1991), Meese and Wallace (2003), Mills and Simenauer (1996), Palmquist (1980), Straszheim (1975), Wallace (1996)

Despite the theoretical problems derived from the estimation of the model's parameters, these contributions have shown the usefulness of hedonic methodology to identify the factors determining house prices and their quantification.

Data and empirical model

The objective of this study is to analyze the purchase of dwellings (and therefore, it excludes tenancies) without legal restrictions to their sale. For the purpose of this research, this market is considered to be single and homogeneous, and therefore it is implicitly assumed that all the commodities analyzed are effectively interchangeable. In this way, and as indicated earlier, hedonic regression is estimated by assuming that the attributes and prices of the dwellings under analysis are as homogeneous as possible to reduce biases in the estimation of hedonic prices of house attributes.

The housing market chosen was Malaga city. For this analysis, the city was divided into the ten districts established by the local planning authorities. It is of note that the Census of Population and Housing for 2001 recorded a total of 217,079 dwelling units in Malaga city on the 31st of December 2001, thus comprising the houses that potentially would make up the statistical population of our work.

The statistical sources used for this work were:

1. The database of the real estate company UNICASA. This was the main statistical source from which we collected data on the price of dwellings and their structural attributes. This source ensured that the price set for the houses matched the actual purchasing price.
2. The Local Census for 2001. This source, obtained from the Municipal Census Office of Malaga City Hall was used for the socioeconomic and population variables.
3. Additional data was obtained from: the Population and Housing Census 2001 (*Censo de Población y Vivienda 2001*, www.ine.es); the Statistical Bulletin of the Ministry of Public Works (*Boletín Estadístico, Ministerio de Fomento*, www.mfom.es); and the SIMA Database created by the Institute of Statistics of Andalusia (www.juntadeandalucia.es/institutodeestadistica).

We also include some variables derived from other statistical databases which are not original but which should be mentioned due to their special significance:

1. The location variables and those requiring the distribution of dwellings into municipal districts were created from data and city plans facilitated by the Computing Center of Malaga City Council.
2. Finally, the records referring to house orientation were collected *ad hoc* by either locating them in the city plans or by visiting the actual dwellings.

The original sample provided by UNICASA included a large amount of information on 8919 potential or actual sales in the province of Malaga. After applying the criteria indicated to the initial database and deleting incomplete and non-relevant records, the database analyzed included a total of 1996 records. According to the latest official information available from the Population and Housing Census 2001 this figure comprises almost 1% of the housing stock of Malaga city.

Appendix 1 shows the variables included in the original model and a brief descriptive analysis of them. Selected variable definitions are given in appendix 2.

Based on hedonic theory and the available literature, the first step in selecting variables was to choose the final price of houses, expressed in Euros, as the dependent variable.

The process of selecting the independent variables was more complex and is closely related to the functional form chosen. Of the 35 variables taken from the sample, the categorical variables were transformed into dummy variables in such a way that the dummy variable took value 1 when the given attribute was present and zero in any other case.

Subsequently, we performed an exploratory analysis of the variables available by creating a correlation matrix to detect the presence of multicollinearity. In a first stage, the information provided is used to eliminate from the model those variables with clear signs of multicollinearity.

On the other hand, and to eliminate the effect on the future regression of extreme values of the variable price, which can affect the analysis, two intervention variables, dummy variables by definition, were created: "d1" and "d2."

An iterative procedure was followed to obtain the most suitable functional form to carry out the regression analysis by eliminating variables in successive steps using the hedonic simple estimation technique, based on the principle of goodness of fit between the three functional forms most commonly used [linear, log-linear (semilog), double-log].

On the other hand, and given the heteroskedasticity of the error term in the regressions, we decided to apply White's method (1980) to all regressions in this work. In this way, by using the ordinary least squares estimation method, but with a matrix of the estimators' variance and covariance consistent even in the presence of heteroskedasticity, we obtained estimations of the parameters that are not affected by heteroskedastic disturbances.

After performing these steps, and analyzing the results, we found that from the perspective of the goodness of fit, the best results were obtained using the log-linear functional form, which was therefore used to establish the hedonic function of house pricing in this work.

Once the initial model was estimated, the regression obtained was improved by including some variable transformations that improved the goodness of fit as a whole (e.g. surface area squared and number of bathrooms squared).

Results

Table 2 shows the result of the final regression carried out in accordance with the criteria described, i.e. a hedonic model of house purchasing prices in Malaga city for the year 2003.

All the estimated coefficients have the expected signs. Therefore, in the market equilibrium represented by this hedonic price function an additional unit of square meters and bathrooms is assessed positively (but at a diminishing rate as indicated by the coefficients of the same variables when they are squared) as well as more rooms.

It is also positive for the dwelling to be located in either district 2 or 10, close to the center of town and to the seaside, and be a detached house or an attic flat. Similarly, a good state of preservation plus private parking, exterior windows with double glazing, and built-in wardrobes, as well as elevators and a caretaker[1] make the dwellings more attractive to the market. Small dwellings, such as studio flats or apartments, ones that are old or have poor natural light, which are in a building with a large number of floors, located in districts 4, 5, 6 or 7, and which are not well-preserved are the least valued by the market.

Furthermore, all coefficient estimations have statistically significant values with a 95% confidence level or higher, except for the variables: "distance to downtown" with 90.55% confidence level, "attic" with 92.72% and "double glazing" with 71.92%. These variables were kept in the final regression because they provide individual significance to the explanatory capacity of the model. On the other hand, Table 2 also shows the standardized coefficients[2] for independent variables for comparison purposes. These estimations make it possible to indicate the relative importance of each variable in the regression. Thus, it is clear that the variable "surface area" is essential for house pricing, followed by "number of bathrooms".

TABLE 2
Estimation results of hedonic price model

Variables	COEFFICIENTS	T-STATISTIC	PROB. T-STAT	STANDARDIZED COEFFICIENTS
CONSTANT	11.4431	236.8905	0.0000	-
SURFACE AREA	0.0044	14.0600	0.0000	0.7237
(SURFACE AREA)^2	-2.99E-06	-6.4759	0.0000	-0.3530
NUMBER OF ROOMS	0.0235	2.5089	0.0122	0.0506
NUMBER OF BATHROOMS	0.1720	5.8588	0.0000	0.2871
(NUMBER OF BATHROOMS)^2	-0.0141	-2.1521	0.0315	-0.1265
AGE OF THE BUILDING	-0.0025	-3.1471	0.0017	-0.0603
FLOORS	-0.0103	-5.2621	0.0000	-0.0627
DISTRICT2	0.1430	4.6906	0.0000	0.0703
DISTRICT4	-0.0308	-2.1053	0.0354	-0.0221
DISTRICT5	-0.1581	-6.1784	0.0000	-0.0687
DISTRICT6	-0.0462	-3.2302	0.0013	-0.0372
DISTRICT7	-0.0338	-2.0636	0.0392	-0.0233
DISTRICT10	0.0334	1.6728	0.0945	0.0230
DISTANCE TO DOWNTOWN	0.0699	4.6526	0.0000	0.0523
PROXIMITY TO THE SEASIDE	0.1266	7.2538	0.0000	0.0931
APARTMENT/STUDIO	-0.0858	-2.2651	0.0236	-0.0273
DETACHED HOUSE	0.5215	3.0785	0.0021	0.0622
ATTIC FLAT	0.0781	1.7948	0.0728	0.0198
NEW	0.0406	2.5225	0.0117	0.0320
NEEDING REFURBISHING	-0.0948	-6.4510	0.0000	-0.0587
CARETAKER	0.0475	3.2322	0.0012	0.0301
ELEVATOR	0.0469	3.5336	0.0004	0.0466
PRIVATE PARKING	0.1016	7.0954	0.0000	0.0997
POOR NATURAL LIGHT	-0.1777	-12.6367	0.0000	-0.1080
DOUBLE GLAZING	0.0265	1.0787	0.2808	0.0120
BUILT-IN WARDROBES	0.0463	4.7398	0.0000	0.0459
d1	-0.4898	-10.7411	0.0000	-0.1100
d2	0.4145	5.0281	0.0000	0.0931
Dependent Variable	Price (in log)			
Observations	1996			
R^2-adjusted	0.8314			
Regression Standard error	0.2034			
Mean of the dependent variable	12.2233			
S.D. of dependent variable	0.4953			
F Statistic	352.2755			
Prob (F Statistic)	0.0000			
Theil Coefficient	0.0080			

To evaluate the results, the calculation of the coefficients for the variables "surface area squared" and "number of bathrooms squared", were based on the procedure carried out by Lassibille (1994, p.115). On the other hand, the impact of dummy variables on housing prices was calculated by applying the methodology of Halvorsen and Palmquist (1980). Once these procedures were carried out, Table 3 shows the relevance of each variable for the estimated log-linear model, representing the percentage of implicit prices provided by each attribute, and the monetary value of those implicit prices calculated by the expression:

$$implicit\ \ price = \beta_i \cdot e^{\text{mean dependent variable}}$$

These implicit prices indicate marginal variations in housing prices, measured in Euros, when increasing the corresponding continuous independent variable by one unit or when the given attribute is present, in the case of dummy independent variables. The rest remain constant for each case.

TABLE 3
Impact of explanatory variables on housing prices and implicit prices

Variables	IMPACT ON PRICING**	IMPLICIT PRICE
SURFACE AREA*	0.0037	608.41 €
NUMBER OF ROOMS	0.0235	4,790.83 €
NUMBER OF BATHROOMS*	0.1263	16,409.62 €
AGE OF THE BUILDING	-0.0025	- 514.59 €
FLOORS	-0.0103	- 2,093.56 €
DISTRICT2	0.1538	31,284.45 €
DISTRICT4	-0.0304	- 6,180.19 €
DISTRICT5	-0.1463	- 29,759.33 €
DISTRICT6	-0.0452	- 9,191.76 €
DISTRICT7	-0.0332	- 6,757.22 €
DISTRICT10	0.0339	6,902.43 €
DISTANCE TO DOWNTOWN	0.0724	14,736.17 €
PROXIMITY TO THE SEA	0.1350	27,466.94 €
APARTMENT/STUDIO	-0.0822	- 16,728.14 €
DETACHED HOUSE	0.6846	139,304.64 €
ATTIC FLAT	0.0812	16,529.12 €
NEW	0.0414	8,426.22 €
NEEDING REFURBISHING	-0.0904	- 18,399.10 €
CARETAKER	0.0486	9,887.85 €
ELEVATOR	0.0481	9,779.49 €
PRIVATE PARKING	0.1069	21,758.65 €
POOR LIGHT	-0.1628	- 33,122.16 €
DOUBLE GLAZING	0.0269	5,468.36 €
BUILT-IN WARDROBES	0.0474	9,635.37 €
d1	-0.3872	- 78,795.04 €
d2	0.5137	104,519.42 €

* Calculated as in Lassibille (1994), taking the mean value of the attribute
** All dummy variables were calculated according to Halvorsen and Palmquist (1980)

Given that these implicit prices are marginal contributions to the mean housing price, the market very positively values the following attributes: the dwelling is a detached house, which by definition increases the price in a significant way (68.46% or 139,304.64 €), is an attic flat (8.12% or 16,529.12 €), has one extra bathroom (12.63% or 16,409.62 €) or private parking (10.69% or 9,887.85 €). Other attributes or services, such as a caretaker (4.86% or 9,887.85 €) or elevator (4.81% or 9,779.49 €), have less value. It is also worth noting that the market positively values a dwelling in a good condition and ready to move in (4.14% or 8,426.22 €).

The marginal contribution to house pricing of the surface area (0.37% or 608.41 €), as well as the number of bathrooms is conditioned by the fact that, although their contribution to the price is positive, it is so at a diminishing rate since the marginal value of an additional unit of surface area (1 m^2 more) or bathroom (1 extra bathroom) decreases as their number increases. This is shown in Table 4 as the marginal values of the percentage variations in housing prices for different values of the variables analyzed. The rest remains constant.

TABLE 4
Variations in housing prices for different values of surface area and number of bathrooms

Surface area m^2	21	75	125	175	225	300
Effect of the number of m^2 on the housing price.	0.0043	0.0039	0.0036	0.0033	0.0030	0.0026
Number of bathrooms	1	2	3	4	5	6
Effect of number of bathrooms on the housing price.	0.1438	0.1155	0.0872	0.0590	0.0307	0.0024

Note that as the quantity increases (m^2 or bathrooms) the increasing percentage in the housing price decreases.

On the other hand, regarding location attributes, the most valued districts in Malaga city are district 2 (eastern area of the city) (15.38% or 31,284.45 €) with very high socioeconomic conditions and, second, but at a great distance, district 10 which is a growing area (3.32% or 6.902,43 €). Among the attributes negatively valued by the market, the most significant is having little natural light (-16.28% or 33.122,16 €) which considerably lowers the market value of the dwelling. The need for refurbishment due to a generally poor state (-9.04% or 18.399,10 €), or due to the age of the building (-0.25% or 514.59 €), and the fact of being located in a building with many floors (-1.03% or 2.093,56 €), also has negative effect on price. Concerning the type of dwelling, apartments and studio flats are negatively valued by the market due to their small size (-8.22% or 16.728,14 €).

Other attributes significantly valued by the market are proximity of the dwelling to the seaside, less than 750 meters (13.5% or 27.466,94 €) and being no farther than 1500 meters from downtown (7.24% or 14.736,17 €), given that Malaga city is monocentric.

If the dwelling is located in the most socioeconomically depressed district of the city, district 5, the price falls drastically by 14.63%. As shown in Table 3, this fall is less dramatic in other districts, where the fall is around 4%.

Finally, it is of note that, after estimating the elasticity of surface area price by a double log regression with price and surface area variables (see Table 5), where such elasticity is represented by the coefficient of the independent variable of this regression (0.8837), the housing price does not fit perfectly into the variation of surface area, which means that other factors must have an influence on the price increase[3].

TABLE 5
Housing Price Elasticity versus Surface Area

Variables	COEFFICIENTS	STANDARD ERROR	T-STATISTIC	T-STAT PROB.
LOG (SURFACE AREA)	0.8837	0.0185	4.7650	0.0000
C	8.1125	0.0855	9.4820	0.0000
Dependent Variable	Price (in log)			
Observations	1996			
Adjusted R^2	0.6488			
Standard Error of regression	0.2935			
Mean dependent variable	12.2233			
S.D. Dep. variable.	0.4953			
F Statistic	3687.1870			
Prob (F Statistic)	0.0000			
Theil Coefficient	0.0120			

As final point, comparing this work with others is complex because of the variety of functional forms used, the different independent variables included in the models, the types of dwellings analyzed (new or second-hand, owned or rent, for example), the different attributes of the geographical space analyzed or the time which has passed since the research was done.

These difficulties increase due to socioeconomic and cultural factors that make the evaluation of attributes different according to where the study is performed. However, it is worth mentioning that the results obtained in recent works by Bengochea (2003), Bilbao (2000), Bowen et al. (2001), Fletcher et al. (2004), Harding et al. (2003), McMillen (2004) and Tajima (2003) are similar to those obtained in our work.

Conclusions

The complexity of the housing market and the difficulty in obtaining realistic results regarding prices have encouraged the development of methodologies different from the traditional ones. This paper attempts to establish an estimation of both housing prices and the value of housing attributes according to the market. The results were obtained using hedonic methodology.

It is worth highlighting the qualitative jump yielded by the use of this methodology in the analysis of price setting of commodities with objectively measurable and valuable attributes, such as houses. Although, most of the estimated model is based on decisions that were taken according to the information available, given that we used real data from transactions actually carried out, the estimations obtained should be similar to the current expectations of the market. The intrinsic difficulty in obtaining actual housing prices when data comes from official surveys, Land Property records, Fiscal Data, etc., rather than from Real State companies is well known.

The results obtained show that the attributes with the greatest influence on housing prices, measured by standardized coefficients of the estimated hedonic function, are structural factors such as surface area, number of bathrooms, private parking or limited natural light. Given that, currently, there seems to be a serious problem of house availability in Spain due to high housing prices, it seems reasonable to consider that one way to reduce costs is to reduce certain facilities, such as the number of bathrooms, and eliminate others, such as private parking, among others. This possibility should be analyzed not only from the perspective of economic criteria, but also bearing in mind social implications, since access to decent housing is a social target which has yet to be fulfilled.

On the other hand, the housing market gives high importance to some spatial attributes. Although the results obtained for structural variables can be compared to other studies, the location attributes analyzed in this work cannot be compared due to the special attributes of the spatial area investigated. Despite this, the market prefers houses close to the sea, close to downtown or in districts with better social, economic, cultural, or environmental expectations for the citizens (Districts 2 and 10). These results could be of interest to city-planning experts and decision makers. Consumers more value areas close to the seaside and which are capable of fulfilling their preferences for good public and private services, green areas, recreational areas and cultural and leisure infrastructures. On the other hand, the results also show that Malaga citizens prefer to live near the center of town, and so policies to restore and rebuild poorly maintained areas could be beneficial from many points of views.

Finally, according to our results, public administrations should encourage estimation studies of house pricing -- and housing attributes -- in different areas using hedonic methodology. Such research could help to make comparisons over time and between areas on which to base policy-making for the sector.

NOTES

[1] Traditionally, blocks of flats or condominiums in Spain employ a person -the portero- who is the caretaker and cleans the communal areas of the property.

[2] The standardized regression coefficients have been calculated with the expression

$$\beta_i^{st.} = \beta_i \cdot \left(S_i \big/ S_{dep.var.} \right)$$

where, $\beta_i^{st.}$ represents the standardized coefficient of variable i, β_i the non-standardized coefficient, S_i the standard deviation of variable i, and $S_{dep.var}$ the standard deviation of the dependent variable.

[3] The statistical confirmation of this result is done by a significance testing of coefficients, where the null hypothesis means unitary elasticity of the housing price in relation to the surface area. The statistic *t* in such a test should take an absolute value ±1.96, at the 5% significance level. Thus, the null hypothesis is rejected for the presence of unitary elasticity because the value of the statistic *t* is = -6.27 at the 95% confidence level.

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Appendix I

Descriptive statistics for the initial model

Name	Minimum	Maximum	Mean	SD.
Final housing price (in cash) (€)	40 026	2 163 643	235 430.68	171 035.69
Price per surface area (€/m^2)	545.45	6812.90	2029.47	640.36
Surface area (m^2)	21	1,500	118.71	87.37
Number of bathrooms	1	10	1.62	0.83
Number of rooms	2	12	4.16	1.06
Number of floors from ground level	1	17	5.43	3.02
Area of adjacent plot (m^2)	0	250 000	197.93	5609.35
Area of patios (m^2)	0	800	4.39	27.51
Age of the dwelling (years)	1	103	20.30	11.81
Type of Building	0	1	0.24	0.43
House orientation/south or north	0	1	0.17	0.38
Air-conditioning	0	1	0.07	0.26
Private parking included in the price	0	1	0.38	0.49
Most rooms are exterior rooms	0	1	0.83	0.37
Built-in wardrobes	0	1	0.59	0.49
Dressing room off the main bedroom	0	1	0.08	0.27
Access for handicapped people	0	1	0.22	0.42
Caretaker in the property	0	1	0.11	0.31
Private security in the property	0	1	0.07	0.25
Lift	0	1	0.59	0.49
House sold with furniture	0	1	0.12	0.32
Storage room	0	1	0.21	0.40
Type of water heating system in the house	1	4	1.88	0.41
Natural light	1	3	2.26	0.63
Type of House	1	6	1.39	0.77
Type of floor	1	4	1.20	0.49
Finish and state of the house	1	3	1.92	0.54
Municipal District	1	10	5.36	2.83
Distance to the center	1	3	2.27	0.72
Proximity to the seaside	0	1	0.16	0.36
Crime and delinquency reports per 1000 people	26.53	100.02	41.42	24.28
% People Under 20 by district	18.52	27.19	22.00	2.63
% People Over 65 by district	7.81	19.10	14.09	3.26
Mean years of education of residents by district	6.85	10.74	8.54	0.84

N = 1,996

Source: UNICASA. Own preparation

Appendix 2

Variable names and definitions from the regression analysis

Variables	Definitions
SURFACE AREA	In square meters
NUMBER OF ROOMS	Excluding kitchen and baths
NUMBER OF BATHROOMS	All the types of baths
AGE OF THE BUILDING	Antiquity of the dwelling
FLOORS	Number of plants in the block where the dwelling is.
DISTRICT2	Dummy equal to 1if dwelling is in district 2
DISTRICT4	Dummy equal to 1 if dwelling is in district 4
DISTRICT5	Dummy equal to 1 if dwelling is in district 5
DISTRICT6	Dummy equal to 1 if dwelling is in district 6
DISTRICT7	Dummy equal to 1 if dwelling is in district 7
DISTRICT10	Dummy equal to 1 if dwelling is in district 10
DISTANCE TO DOWNTOWN	Dummy equal to 1if the distance to downtown is < to 750 m.
PROXIMITY TO THE SEASIDE	Dummy equal to 1 if the distance to the seaside is < to 1500 m.
APARTMENT/STUDIO	Dummy equal to 1if dwelling is an apartment or studio
DETACHED HOUSE	Dummy equal to 1 if dwelling is a detached house
ATTIC FLAT	Dummy equal to 1 if dwelling is an attic flat
NEW	Dummy equal to 1 if dwelling is a new construction
NEEDING REFURBISHING	Dummy equal to 1 if dwelling needs refurbishing
CARETAKER	Dummy equal to 1if there is caretaker
ELEVATOR	Dummy equal to 1there is elevator
PRIVATE PARKING	Dummy equal to 1there is private parking
POOR NATURAL LIGHT	Dummy equal to 1 if dwelling has poor natural light
DOUBLE GLAZING	Dummy equal to 1 if there is double glazing
BUILT-IN WARDROBES	Dummy equal to 1 if there is built-in wardrobes