Estimating housing market value using regression models.

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ABSTRACT

The aim of this paper is to determinate the contribution of economic, demographic and climatological variables in the Spanish housing market value (both new and second-hand market), with data of the different provinces. Starting from housing dealing prices grouped together by regions, and using regression analysis, we obtain as a result explanatory equations of price with a high determination coefficient. In this work we also estimate other variables such as provincial capital index and inter-provincial dispersal index. This one, uses estimations concerning autonomous regions in order to calculate housing market value in the provinces.

KEY WORDS: Real estate valuation, multiple regression models, market research.

INTRODUCTION

Location is one of the fundamental characteristics in the estimation of the market value of any building, in general, and of the housing, in particular. For that reason, in the econometrics models that try to explain the market value, the location plays a preponderant role in the estimation of the variable to explain.

Nevertheless, the location as quantified variable, can be located in different logical levels. Leaving apart the international scope and focusing on the national level, the housing market can be explained by autonomous regions, provinces, cities and, within each city, by districts.

In a functional way[1]:

$$V = f(x_1, x_2, x_n) \qquad [1]$$

where:
V = Average Value of the house, in absolute value, monetary units by square meter, of a given territorial area.
x_1, x_2, x_n = Explanatory variable located in the same territorial mark.

The most important advantages of the use of the housing market value in the provincial scope, object of the present work, as opposed to the scope of the autonomous regions not only come from the greater subdivision of the information, but that it can also contribute to greater

[1] GALLIMORE (1996)

statistical rigor when increasing the number of data. In the case of the Spanish market, one goes from 17 autonomous regions to 50 provinces, although in the autonomous regions which are composed by only one province, province and autonomous region overlap.

Nevertheless, and indeed as a result of the necessity of a greater number of data, not always available, frequently this subdivision cannot be carried out in its totality, in which case a mixed procedure can be used. On the one hand, if there are sufficient data, of both market values and explanatory variables, the estimation of algebraic expressions will be done to relate them in the provincial scope. However, when the information in the provincial scope is incomplete, regional data in the expressions obtained in the territorial scope of the provinces, or provincial data in the expressions obtained in the scope of the autonomous regions can be used. The availability of a greater number of data (increase of the rows) allows a greater applicability of the multivariant models with the incorporation of a superior number of explanatory variables, as well as of functions not necessarily linear, in contrast with the univariantes and linear models which are used with small data bases.

THE INDEX OF INTERPROVINCIAL DISPERSION.

The main utility of considering the value of housing within the provincial scope, starting from equations estimated with regional data, is based upon the possibility of considering provincial values when deficiency of data exists on the explanatory variables, sufficiently detached, even when accepting in a first approach data that are not recently updated.

For the independent regions with only one province, the two territorial scopes overlap and it is the same to speak of independent region or province. Nevertheless, in the regions with more than one province it is necessary to define an index of interprovincial dispersion that reflects to what extent estimations of autonomic scope can be used to calculate housing market values of provincial scope and whose utility can be justified when it is not possible to detach the value of the housing because of lack of information.

In the transition from the regional scope to the provincial scope it is possible to consider the question of the relation of the values of each one of the provinces with reguard to the average of the own region.

The observation of Table 1 provides information about the behaviour of the provincial market values in relation to the assembly of its autonomous region: this information can be helpful by evaluating the possibility of using regional values for the estimation of provincial values.

Table 1. Value of unitary market of free housig in 2º semestral 1998 (thousands of Pesetas / m^2).

AUTONOMOUS REGION	NEW HOUSING			SECOND-HAND HOUSING		
PROVINCIAS	Capital V_1	Rest V_2	Total V_3	Capital V_4	Rest V_5	Total V_6
Andalucía	**136.2**	**105.2**	**115.5**	**99.8**	**77.2**	**85.3**
Almería	137.1	96.2	110.1	108.2	87.7	94.6
Cádiz	156.6	119.7	124.5	105.8	77.1	80.9
Córdoba	133.3	89.5	107.1	102.8	63.7	79.4
Granada	155.7	88.5	108.9	115.1	72.1	85.2
Huelva	114.7	111.2	112.3	85.2	86.9	86.4
Jaén	110.0	76.5	81.9	85.1	55.6	60.3
Málaga	114.4	143.4	130.4	88.6	97.5	93.5
Sevilla	150.0	97.9	122.1	103.4	77.8	89.7

Table 1. (continuation)

AUTONOMOUS REGION / PROVINCE	NEW HOUSING			SECOND-HAND HOUSING		
	Capital V_1	**Rest** V_2	**Total** V_3	**Capital** V_4	**Rest** V_5	**Total** V_6
Aragón	**150.7**	**99.6**	**128.7**	**106.6**	**64.5**	**88.5**
Huesca	122.8	108.5	111.7	77.5	73.0	74.0
Teruel	139.8	80.7	93.1	84.7	54.2	60.6
Zaragoza	153.3	102.2	138.7	109.9	63.5	96.6
Asturias. Oviedo	**159.8**	**143.5**	**147.2**	**128.4**	**99.6**	**106.2**
Baleares. Palma de Mallorca	**147.1**	**153.2**	**150.6**	**101.3**	**108.6**	**105.5**
Canarias	**151.6**	**128.7**	**136.7**	**123.4**	**118.5**	**120.2**
Las palmas G. C.	157.2	122.4	137.2	127.1	127.0	127.1
S.C. Tenerife	141.8	134.0	136.1	116.7	111.3	112.7
Cantabria. Santander	**178.8**	**130.0**	**147.2**	**144.3**	**99.5**	**115.2**
Castilla– La Mancha	**119.8**	**82.1**	**90.5**	**104.6**	**61.4**	**71.0**
Albacete	114.3	76.9	91.9	95.8	57.5	72.8
Ciudad Real	104.0	77.0	80.3	97.5	53.4	58.9
Cuenca	126.7	70.2	82.4	123.1	49.7	65.6
Guadalajara	140.5	109.0	122.5	118.1	82.5	97.7
Toledo	120.1	88.3	92.3	104.1	70.5	74.8
Castilla – León	**153.2**	**100.9**	**123.6**	**132.9**	**73.2**	**99.2**
Ávila	189.9	88.2	116.5	135.1	78.9	94.6
Burgos	189.3	114.9	149.7	163.5	87.1	122.8
León	140.7	97.6	111.7	119.4	67.7	84.5
Palencia	150.7	104.5	124.6	113.2	67.0	87.2
Salamanca	153.1	104.3	126.3	144.7	73.0	105.3
Segovia	141.3	112.4	123.0	139.4	89.6	107.9
Soria	147.0	90.5	111.0	113.8	70.6	86.3
Valladolid	146.8	110.7	134.3	132.1	75.0	112.4
Zamora	115.2	79.5	90.5	93.1	56.4	67.7
Cataluña	**210.0**	**145.1**	**164.6**	**166.3**	**121.5**	**134.9**
Barcelona	227.1	151.8	176.4	180.8	132.3	148.1
Gerona	135.9	134.9	135.1	106.3	102.1	102.7
Lérida	120.5	107.1	111.3	89.7	71.4	77.2
Tarragona	129.3	129.8	129.7	97.8	92.8	93.9
C. Valenciana	**131.6**	**109.1**	**115.7**	**89.4**	**80.4**	**83.0**
Alicante	111.6	120.6	118.8	84.6	93.5	91.7
Castellón	113.8	98.9	103.3	80.6	88.5	86.2
Valencia	142.1	102.5	116.3	92.7	68.4	76.9
Extremadura	**105.8**	**78.2**	**83.4**	**86.0**	**58.8**	**63.9**
Badajoz	100.4	44.6	81.9	80.9	59.4	63.4
Cáceres	114.4	79.1	85.7	94.0	57.9	64.7
Galicia	**162.6**	**111.4**	**122.0**	**124.5**	**92.0**	**98.7**
La Coruña	189.8	119.4	137.9	144.9	105.3	115.8
Lugo	103.1	87.5	91.2	80.2	66.6	69.8
Orense	157.3	77.6	103.4	121.2	60.1	79.9
Pontevedra	131.7	121.1	121.9	99.7	96.4	96.7
La Rioja; Logroño	**136.1**	**103.6**	**118.8**	**104.5**	**66.6**	**84.3**
Madrid, C.; Madrid	**241.1**	**140.8**	**198.1**	**196.0**	**134.7**	**169.7**
Murcia R.; Murcia	**116.4**	**98.0**	**103.8**	**94.5**	**69.4**	**77.4**
Navarra C.F.; Pamplona	**178.8**	**147.9**	**159.4**	**133.1**	**91.5**	**107.0**
País Vasco	**236.9**	**155.4**	**186.9**	**215.4**	**137.7**	**178.5**
Álava	286.9	119.2	185.4	250.0	92.3	170.8
Guipúzcoa	311.5	153.1	179.2	275.4	137.0	219.2
Vizcaya	202.3	163.1	186.9	173.1	143.8	152.3
Nacional Average	**173.1**	**117.7**	**137.2**	**135.6**	**93.1**	**108.2**

Source: Own processing from data of TINSA, Tasaciones Inmobiliarias, S.A. and of the Basque Government, to 30-9-98.

In the uniprovincial independent regions (Asturias, Baleares, Cantabria, La Rioja, Madrid, Murcia and Navarra), the value of the square meter by independent region and province is the same, obviously. On the contrary, in independent regions as Cataluña coexist provincial values (in province capital, rest of the province and total) as different as those corresponding to Lérida (120'5; 107'1; 111'3 thousands of pesetas by square meter for the new house) with those of Barcelona (227'1; 151'8; 176'4 thousands of pesetas by square meter for the new house). The average values of Cataluña are bad estimators of the provincial values of Lérida.

With the purpose of quantifying this effect, the index of interprovincial dispersion is defined as follows:

$$D_i = \sqrt{\frac{\sum_{1}^{n} (V_i - V_c)^2}{n}} \qquad [2]$$

Where:
V_i = Market value of each province.
V_c = Market value of the autonomous region.
n = number of provinces.

Table 2 shows the coefficients of interprovincial dispersion, both for new housing as for second hand ones, in the pluriprovincial autonomous regions, as well as the percentage with regard to the regional value.

Table 2. Interprovincial dispersion index in thousands of pesetas and in percentage.

AUTONOMOUS REGION	**D1** New housing	**D2** Second-hand housing	% **D1**	**%D2**
Andalucía	14,270	10,329	12,35	12,11
Aragón	23,497	18,746	18,26	21,18
Canarias	0,552	7,206	0,40	6,00
Castilla – León	15,814	16,275	12,79	16,40
Castilla– La Mancha	15,485	13,462	17,11	18,96
Cataluña	35,596	39,438	21,62	29,23
Valencia	7,388	6,407	6,38	7,72
Extremadura	1,942	0,667	2,33	1,04
Galicia	19,669	19,268	16,12	19,52
País Vasco	4,529	28,297	2,42	15,85

Source: own processing.

Table 2 shows that Cataluña and Aragón are the autonomous regions in which there exists greater index of interprovincial dispersion, i.e, where greater difference of values between its provinces can be found. Whereas the independent regions of the Canary Islands and Extremadura present (by square meter) more uniform market values between their provinces.

THE INDEX OF PROVINCIAL CAPITALITY.

Table 1 also shows an additional information referring to the differences between the housing market values in the capital of the province and the rest; tensile differences as much to the new houses as second hand ones.

These differences between the housing value in the capital of the province and the rest of the populations appear as a logical consequence: market values differences come from two assemblies that are easy to distinguish. On the one hand, by the effect of capitality and, on the other hand, because some explanatory variables have the same value in the capital of the province as in the rest of the towns in the same province, whereas others, however, have a very different value. The first is the case of climatological, demographic and some economic variables, whereas in the second case they are most economic variables linked to the wealth.

In order to measure this effect the index of capitality can be defined (e_c) as:

$$e_c \; ? \; \frac{V_c \; ? \; V_r}{V_m} \qquad [3]$$

Where:
V_c = Housing market value in the province capital.
V_r = Housing market value in the other tows.
V_m = Housing market value in the province.

Table 3 represents the index of capitality of the different Spanish provinces and the autonomous regions.

Table 3. Index of provincial capitality for the new house and the second-hand house.

AREA	$\mathbf{e_c}$ new housing	$\mathbf{e_c}$ second-hand housing
Andalucía	0,27	0,26
Almería	0,37	0,22
Cádiz	0,30	0,35
Córdoba	0,41	0,49
Granada	0,62	0,50
Huelva	0,03	-0,02
Jaén	0,41	0,49
Málaga	-0,22	-0,10
Sevilla	0,43	0,29
Aragón	0,40	0,48
Huesca	0,13	0,06
Teruel	0,63	0,50
Zaragoza	0,37	0,48
Asturias	0,11	0,27
Baleares	-0,04	-0,07
Canarias	0,17	0,04
Las palmas G. C.	0,25	0,00
S.C. Tenerife	0,06	0,05
Cantabria	0,33	0,39
Castilla – León	0,42	0,60
Ávila	0,87	0,59
Burgos	0,50	0,62
León	0,39	0,61
Palencia	0,37	0,53
Salamanca	0,39	0,68
Segovia	0,23	0,46
Soria	0,51	0,50
Valladolid	0,27	0,51
Zamora	0,39	0,54
Castilla– La Mancha	0,42	0,61
Albacete	0,41	0,53
Ciudad Real	0,34	0,75
Cuenca	0,69	1,12
Guadalajara	0,26	0,36
Toledo	0,34	0,45

Table 3. (Continuation)

AREA	e_c new housing	e_c second-hand housing
Cataluña	0,39	0,33
Barcelona	0,43	0,33
Gerona	0,01	0,04
Lérida	0,12	0,24
Tarragona	0,00	0,05
Valencia	0,19	0,11
Alicante	-0,08	-0,10
Castellón	0,14	-0,09
Valencia	0,34	0,32
Extremadura	0,33	0,43
Badajoz	0,68	0,34
Cáceres	0,41	0,56
Galicia	0,42	0,33
La Coruña	0,51	0,34
Lugo	0,17	0,19
Orense	0,77	0,76
Pontevedra	0,09	0,03
La Rioja	0,27	0,45
Madrid	0,51	0,36
Murcia	0,18	0,32
Navarra	0,19	0,39
País Vasco	0,44	0,44
Álava	0,90	0,92
Guipúzcoa	0,88	0,63
Vizcaya	0,21	0,19
Total Nacional	**0,40**	**0,40**

Source: own processing.

The coefficient or index of capitality measures, so much per one, the scarcity of the housing in the capital in relation with the rest of the province. According to the previous comments it will be a positive number. Nevertheless in the provinces of great tourist and housing development in residential areas distributed throughout the coasts, this coefficient can be negative. This is the situation in Baleares I., Malaga and Alicante.

The national average index of provincial capitality (0,40) indicates that in Spain the housing values in province capitals are 40% higher than the values in the rest of populations, with the already explained provincial differences (Table 3).

Another possibility of measuring the capitality effect consists on establishing a functional relation between the variables V_1 and V_2 for the new housings and V_4 with V_5 for the second hand ones (see Table 1).

Table 4 gathers the considered equations to calculate the relation between the housing value in the capital and in the rest of the province, with and without independent term, as well as the determination coefficients, whereas Figures 1, 2, 3 and 4 represent these relations.

Table 4. Functional relation between the housing value in the capital and the rest of the province.

New housing	Equation	R^2	Standard error	Figure
With constant in model	$V_1 = 49{,}887 + 0{,}924\ V_2$	0,283	36,738	1
Without constant in model	$V_1 = 1{,}360\ V_2$	0,940*	38,128	2
Second-hand housings				
With constant in model	$V_4 = 34{,}175 + 1{,}02\ V_5$	0,346	32,361	3
Without constant in model	$V_4 = 1{,}400\ V_5$	0,929*	33,352	4

* For the regression through the origin (the model without intersection), R^2 measures the proportion of the variability in the dependent variable through the origin explained by the regression. It is not possible to compare this with the coefficient of determination for the models that include an intersection.

Fig. 1

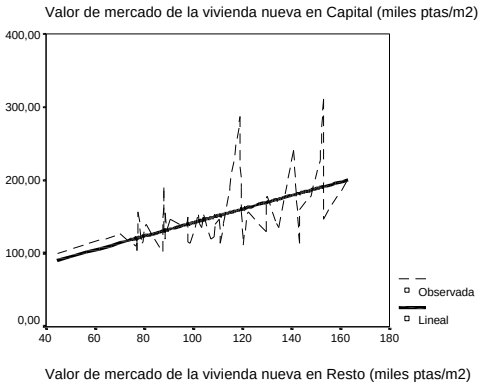


Fig. 2

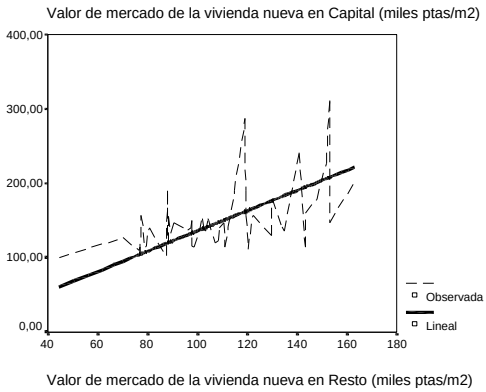


Fig. 3

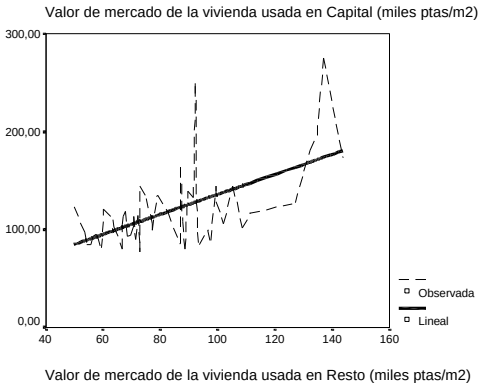


Fig. 4

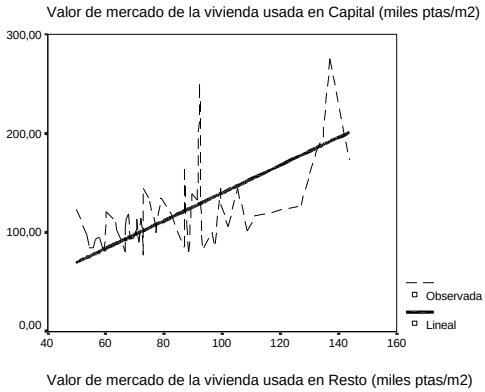


Table 4 indicates that new housings have a similar behaviour in relation with the effect of the capitality index that the second hand houses. Taking the linear function without independent term, the new houses are more expensive in the capital than in the rest of the province in a 36%, approximately, whereas the used houses are 40% more expensive, approximately.

ESTIMATION OF THE VALUE OF MARKET OF THE HOUSE IN THE PROVINCIAL CONTEXT. MULTIVARIANT MODELS.

As already indicated, the best procedure to estimate the housing values in the own scope when sufficient data are available is to obtain, and later use, multivariant, linear or nonlinear equations, from detached provincial data, as much of the variables to be explained (values of market of new housings or second hand housings) as of the explanatory variables available.

Table 5 shows the coefficients of correlation between the variables to be explained (values of the new and used house) by provinces and some of the possible and more probable explanatory variables. 42 explanatory variables have been chosen but, theoretically, this relation is limitless.

Table 5. Coefficients of correlation between the provincial values of the house and 42 possible explanatory variables

	Variables	New housings	Second-hand housings
V_N	Average unitary value of new house (Ptas./ m^2). (1998).	1,000	0,908
V_U	Average unitary value of second-hand housing (Ptas./ m^2).(1998).	0,908	1,000
X_1	Average home expense (Ptas.)	0,774	0,647
X_2	Average employed expense (Ptas.)	0,728	0,603
X_3	Structure of VAApm % Agrario sector.	-0,725	-0,611
X_4	Density of population (Hab./Km^2). (1996).	0,704	0,678
X_5	Employed structure (%). (1996).	-0,631	-0,540
X_6	Extension (Km^2).	-0,627	-0,624
X_7	GIP per inhabitant (average of Spain=100). (1995).	0,613	0,511
X_8	Roads (Km./ 100Km2). (1996).	0,570	0,622
X_9	Employed structure Construccion Sector (%). (1996).	-0,543	-0,504
X_{10}	Hospital beds / 1000 hab. (1995).	0,542	0,481
X_{11}	Structura of VAApm (%) Construccion Sector. (1995).	-0,540	-0,444
X_{12}	Telefone lines / 100 hab. (1996).	0,529	0,420
X_{13}	Disposable Income (average = 100). (1994).	0,525	0,426
X_{14}	Population. Census (1996).	0,498	0,404
X_{15}	Municipality –5000hab (%)	-0,495	-0,447
X_{16}	Hotels room +2 starts (%)	0,457	0,405
X_{17}	Days without cloud.	-0,445	-0,467
X_{18}	Housings with 1 o more bathroom (%)	0,424	0,366
X_{19}	Municipality 100-500 thousand hab. (%)	0,410	0,396
X_{20}	Density of highways (Km/1000 hab.). Año 1996.	-0,406	-0,353
X_{21}	Employment rate (%).	0,390	0,368
X_{22}	Maximum Temperature.	-0,383	-0,403
X_{23}	Municipality +500 mil hab. (%)	0,325	0,197
X_{24}	Precipitation (mm).	0,323	0,371
X_{25}	Migration rate (‰). (1983-1993).	0,257	0,133
X_{26}	VAApm by employed Construccion Sector (Average of Spain=100). (1995).	0,256	0,274
X_{27}	Maritim limit (Km)	0,249	0,184
X_{28}	Municipality 5-20 mil hab. (%)	-0,248	-0,144
X_{29}	Altitude of the capital city (m)	-0,244	-0,191
X_{30}	Municipality 20-100 mil hab. (%)	-0,149	-0,116
X_{31}	Tourism (rooms / 1000 hab.). (1995).	0,146	0,037
X_{32}	Temperature $T ? (\frac{T_{average}}{T_{\max} ? T_{\min}})$	0,136	0,121
X_{34}	Transport expense	0,127	0,042
X_{35}	Minimal Temperature.	0,126	0,096
X_{36}	Average number of person / hauses	0,107	0,146
X_{37}	Energetic Structur, potencia.	0,092	-0,012
X_{38}	Employment rate %	-0,085	-0,045
X_{39}	VAApm / employed Agrary sector	0,066	0,062
X_{40}	Average Temperature.	0,019	-0,033

As it was to be expected, the variables tied to the economy of the province, such as the Average home expense or the Average employed expense, are those that are more correlated with the value of the house. They are followed by another group than includes variables such as the density of population, the GIP per inhabitant, or the density of highways (km/100Km^2) and finally, it appears a group of variables with smaller correlation with the housing market value.

In the models with the market value as variable to be explained with a single explanatory variable the most correlated variable is the one to be chosen. In this case, you must chose whether the variable new house as a function of the used house or viceversa. Secondly, the variable with greater explanatory capacity is in the case of the new housings, the average cost by home, and for the second hand houses, the density of the population.

When models with more than a variable are used, it is necessary, in addition, to consider the coefficient of correlation of the explanatory variables and the variable to explain, as well as to analyse the correlation of the explanatory variables to each other. A procedure to avoid the problem of the multicolineality of the explanatory variables is the grouping of these variables in factors that gather correlated explanatory characteristics to each other[2].

It is helpful to consider two important limitations in the use of these multivariant models of regression or models with several explanatory variables.

The first one refers to the selection of the second variable and successive ones that are introduced in the model. They have to fulfil the condition of not being correlated with the explanatory variables already introduced, because the existence of this autocorrelation can generate statistical results without economic meaning. This it is the case of those variables that in the regression equation present opposite algebraic signs to their economic meaning as a result of which another explanatory variable, already included, has gathered the effect that was expected of the additional variable, closely correlated. In order to avoid this effect, the explanatory variables are gathered together into groups or blocks based on their autocorrelation, by means of the so called factorial analysis, in such a way that all the variables grouped around a factor are correlated to each other and are little correlated with those variables that build the other factors. In order to avoid the problem of autocorrelation in the multivariant models an explanatory variable of each factor is chosen.

The second limitation in the use of the multivariant models is the number of necessary data so that the results are representative. In fact, the reliability of the conclusions and the interpretation of the results are subject to the dimension of the matrix formed by the data. As the number of variables in the equation increases (columns) the data (rows) have to increase, too, and in a non linear relation. For that reason, the equations estimated from a reduced number of data, with several explanatory variables or nonlinear equations like those that will be used in this paper from now on, have to be interpreted with certain caution.

The main advantage in the use of the techniques of factorial analysis to choose the explanatory variables in the models of multivariant regression, is the possibility of starting with a big number of possible explanatory variables without any restriction or distinction (climatologic, demographic, economic), although in the end they are reduced to a few.

Following this procedure, the five variables that appear in Table 6 will be chosen.

[2] CABALLER (1997)

Table 6. New housing market value by provinces, year 1998 (Thousands of Pesetas / m2 constructed) and main explanatory variables.

Provincia	Market value of the new housings V_N	Value of market of the second-hand house V_U	Average Cost by home (in thousands of Ptas.) X_1	Structure of the use in the agrarian sector (%) X_5	Roads (Km./ 100 Km2) X_8	Structure of the employment in the building sector (%) X_9	Altitude of the capital city (m) X_{29}
Almería	110,10	85,30	96,20	24,50	29,50	11,20	16
Cádiz	124,50	94,60	83,60	9,80	28,70	8,90	14
Córdoba	107,10	80,90	81,30	17,10	33,20	8,20	106
Granada	108,90	79,40	88,20	12,00	27,30	11,90	683
Huelva	112,30	85,20	88,70	13,70	20,80	9,60	30
Jaén	81,90	86,40	63,40	18,50	25,90	10,30	568
Málaga	130,40	60,30	99,10	6,10	34,60	11,20	11
Sevilla	122,10	93,50	91,30	7,50	27,50	9,10	11
Huesca	111,70	74,00	76,70	14,80	20,50	11,40	488
Teruel	93,10	60,60	60,90	22,30	20,50	11,70	912
Zaragoza	138,70	96,60	102,10	7,00	22,20	6,70	199
Oviedo	147,20	106,20	109,90	12,10	44,90	9,20	232
P. de Mallorca	150,60	105,50	115,20	2,50	43,90	10,10	15
Las palmas G. C.	137,20	127,10	142,70	6,30	52,00	9,50	13
S.C. Tenerife	136,10	112,70	120,20	9,50	66,50	10,40	5
Santander	147,20	115,20	116,80	11,00	48,40	10,50	11
Albacete	91,90	72,80	72,10	11,00	23,90	14,30	686
Ciudad Real	80,30	58,90	59,90	11,90	20,70	16,30	628
Cuenca	82,40	65,60	67,30	24,60	22,40	12,30	999
Guadalajara	122,50	97,70	99,00	12,90	27,20	12,80	685
Toledo	92,30	74,80	76,20	12,60	23,60	16,40	529
Ávila	116,50	94,60	94,10	19,50	31,60	13,80	1131
Burgos	149,70	122,80	131,90	10,80	34,90	8,50	929
León	111,70	84,50	85,40	15,50	34,90	11,60	838
Palencia	124,60	87,20	88,80	14,30	35,50	9,50	734
Salamanca	126,30	105,30	106,50	17,40	32,10	9,10	800
Segovia	123,00	107,90	109,70	15,60	34,20	10,40	1002
Soria	111,00	86,30	83,00	19,30	31,30	7,90	1063
Valladolid	134,30	112,40	118,00	6,30	37,00	9,70	698
Zamora	90,50	67,70	68,50	24,60	38,30	13,60	649
Barcelona	176,40	148,10	154,50	1,20	50,00	7,50	12
Gerona	135,10	102,70	107,50	5,70	42,80	10,40	70
Lérida	111,30	77,20	79,70	15,10	13,50	10,90	182
Tarragona	129,70	93,90	98,20	11,70	43,20	12,50	69
Alicante	118,80	91,70	94,70	5,90	45,50	9,70	8
Castellón	103,30	86,20	84,40	10,60	33,40	8,00	27
Valencia	116,30	76,90	80,10	6,60	32,80	9,70	13
Badajoz	81,90	63,40	63,80	16,20	21,20	10,30	186
Cáceres	85,70	64,70	65,40	18,00	20,10	15,60	459
La Coruña	137,90	115,80	128,00	19,20	52,30	12,30	26
Lugo	91,20	69,80	62,90	49,40	60,70	6,00	454
Orense	103,40	79,90	83,30	26,60	44,20	10,90	139
Pontevedra	121,90	96,70	100,40	21,90	75,70	10,00	27
Madrid	198,10	169,70	179,80	1,10	41,60	8,50	655
Murcia	103,80	77,40	80,90	10,70	31,60	9,60	39
Navarra	159,40	107,00	121,80	9,10	36,20	8,70	490
Álava	185,40	170,80	268,80	5,30	48,80	6,30	540
Guipúzcoa	179,20	219,20	248,80	2,90	67,70	6,10	12
Vizcaya	186,90	152,30	175,20	1,70	67,50	8,70	6
La Rioja	118,80	84,30	89,10	12,10	35,60	7,50	385

Source: TINSA, INE and Ministerio de Fomento.

The equation that considers the new housing market value is the following one:

$$V_N = 0{,}03152 \cdot X_1 + 1{,}563 \cdot X_5 + 0{,}694 \cdot X_8 + 2{,}824 \cdot X_9 + 0{,}0177 \cdot X_{29} + 67{,}563 \quad [4]$$

Where:
V_N = Market value of the new housings (in thousands of Pesetas / m^2).
X_1 = Average home expense (in thousands of Pesetas). Year 1992.
X_5 = Structure of the use in the agrarian sector (%). Year 1996.
X_8 = Roads (Km./100Km2). Year 1996.
X_9 = Structure of the employment in the building sector (%). Year 1996.
X_{29} = Altitude of the capital city (m).

Also, for the second hand housings the following equation is considered:

$$V_U = 0{,}01978 \cdot X_1 + 1{,}673 \cdot X_5 + 1{,}113 \cdot X_8 + 2{,}736 \cdot X_9 + 0{,}02351 \cdot X_{29} + 51{,}770 \quad [5]$$

Where:
V_U = Value of market of the second-hand house (in thousands of Pesetas / m2).
X_1 = Average home expense (in thousands of Pesetas). Year 1992.
X_5 = Structure of the use in the agrarian sector (%). Year 1996.
X_8 = Roads (Km./100Km2). Year 1996.
X_9 = Structure of the employment in the building sector (%). Year 1996.
X_{29} = Altitude of the capital city (m).

For the case of the new houses a coefficient of determination for this model is 86%.

On the other hand, for the used houses the estimation is inferior. In fact, the determination coefficient is of 75% and the standard error of 16,364 Ptas.

The graphical representation of these results can be seen in Figures 5 and 6.

Fig. 5. Observer value versus estimate value of the new housing.

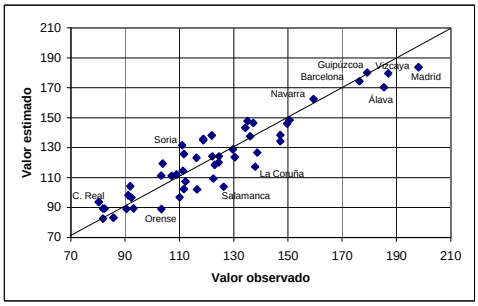
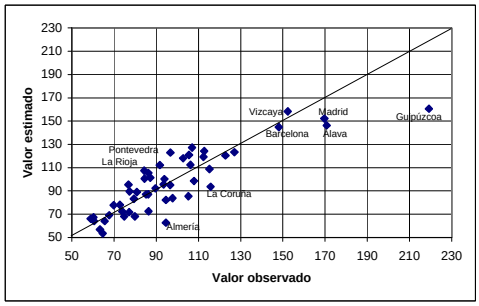


Fig. 6. Observer value versus estimate value of the second-hand housing.



RELATIONS BETWEEN THE PROVINCIAL VALUES OF THE NEW AND SECOND HAND HOUSINGS.

The comparative analysis between the market value of the new and second hand housings can extend to the level of the provincial data, distinguishing, as well, between housings in the capital of province and the rest.

Thus, Table 7 contains the equations corresponding to the functional relation between the market values of the new and second hand housings, including the determination coefficients, whereas Figures 7 to 12 represent them.

Table 7. Functional relation between the value of the new and second-hand house in the capital of province and the rest of the province.

Capital of province	Equation	R^2	Standard Error	Figure
With constant in model	$V_1 = 28{,}081 + 1{,}024\ V_4$	0,891	14,345	7
Without constant in model	$V_1 = 1{,}237\ V_4$	0,988	16,786	8
Rest of the province				
With constant in model	$V_2 = 37{,}409 + 0{,}853\ V_5$	0,606	16,071	9
Without constant in model	$V_2 = 1{,}270\ V_5$	0,971	18,884	10
Total province				
With constant in model	$V_3 = 44{,}752 + 0{,}809\ V_6$	0,774	13,655	11
Without constant in model	$V_3 = 1{,}227\ V_6$	0,977	19,300	12

Fig. 7

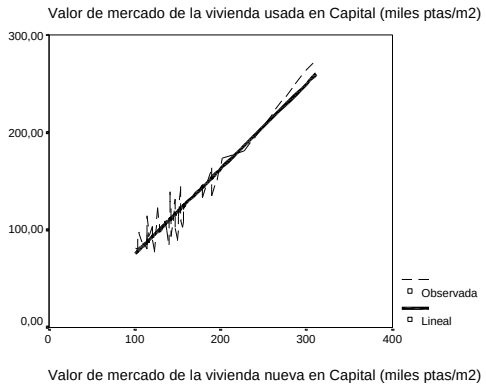


Fig. 8

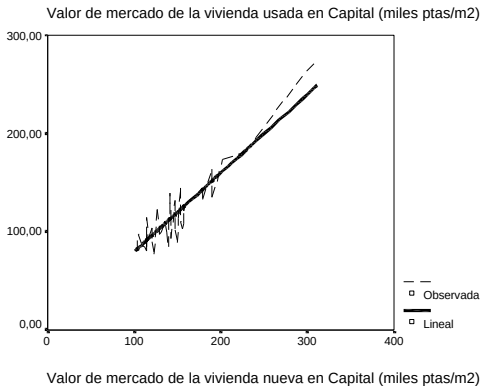


Fig. 9

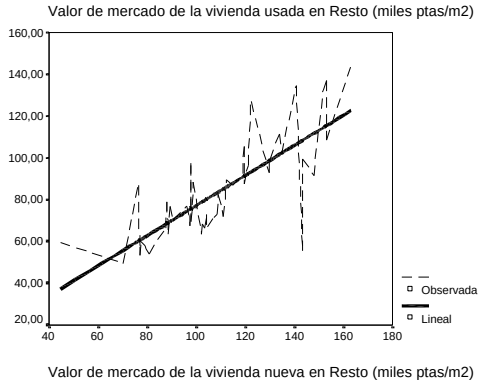


Fig. 10

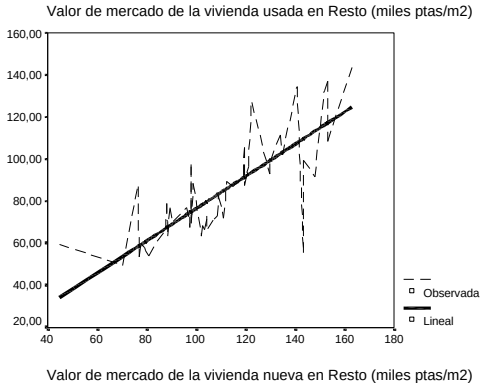


Fig. 11

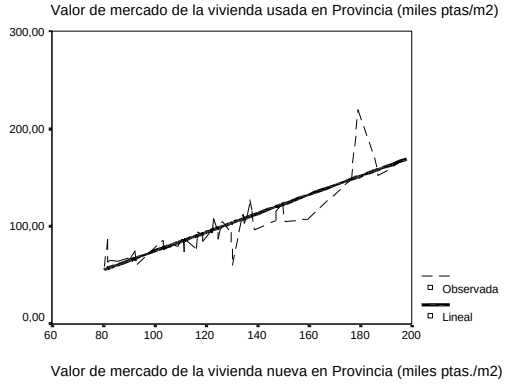
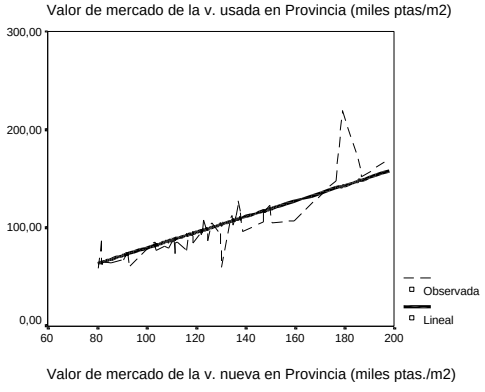


Fig. 12



CONCLUSIONS.

In this paper a study has been made on the housing market value, both for new and second hand houses, using econometric models. For this purpose, it has been used information of economic, demographic, and even, climatological variables, in order to study their contribution to the explanation of the value of the house at the provincial level.

With the segregation of the housing value within the regional scope it is possible to verify that there exist, in some autonomous regions, important interprovincial dispersions, as it is the case of Catalonia with interprovincial differences that can arrive almost until 30% for the market of second hand housings.

In the same line, and distinguishing the housing market values of the capital and of the rest of the province, and being extensive both to new and second hand houses, the coefficient or index of capitality is defined to measure the scarcity of housings in the capital with regard to the rest of the province. The national average index for Spain is positive, with average values of the housings in the province capitals that are 40% higher than the values in the rest of towns, except for some tourist provinces, like Malaga, Balearic Islands, Castellón or Alicante, whose coefficient is negative.

From the study of the 40 possible explanatory variables of the market value of the new and second hand houses, by means of the use of the factorial analysis, a multivariant model is proposed that explains 86% of the variability of the variable to explain: housing market value. The exogenous variables that contribute to this explanation are the average cost by home, the structure of the use in the agrarian sector, the network of highways, the structure of the use in the building sector and the altitude of the capital.

Finally, this comparative analysis is completed with the study of the values of the new and second hand houses, at a provincial level, in the capital and in the other towns of the province, obtaining average provincial differences superior to 20%.

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