ESTUDIOS SOBRE LA ECONOMÍA ESPAÑOLA

Geographic Heterogeneity in Housing. Evidence from Spain

Raquel Arévalo Tomé
José María Chamorro Rivas

EEE 203

March 2005

FEDEA
Fundación de Estudios de Economía Aplicada

http://www.fedea.es/hojas/publicado.html

ISSN 1696-6384

Geographic Heterogeneity in Housing. Evidence from Spain[1]

Raquel Arévalo Tomé[2] and José María Chamorro Rivas[3]
University of Vigo

Abstract

This article offers an empirical analysis of geographical differences in the characteristics of housing in the different provinces of Spain. The study employs multiple correspondence analysis to derive a housing index, in line with Arévalo (1999). While Arévalo used only structural variables, this research also includes proxy variables for access to services derived from the location of the living unit. A readily interpretable index is thus created, which measures the level of internal and external services that a living unit (house or apartment) provides for its occupiers. The results confirm that characteristics derived from location are complementary to structural characteristics of the living unit itself (housing services). Moreover, with the addition of location variables, the new housing index shows: (i) increased correlation with observed rental and house prices, and (ii) a more realistic view of geographical differences in the level of services of Spanish housing. The study contributes new housing indicators that are easily applicable, for example, in studies on household quality of life, social exclusion, and poverty.

Keyword: Housing index; Access; Multiple Correspondence Analysis
JEL: R10, R20

---

[1] The authors acknowledge the financial support of the Spanish Ministry of Science and Technology and European Regional Development Fund, through DGICYT grant BEC2002-04102-C02-01, and the Xunta de Galicia, through grant PGIDIT03PXIC30002PN.

[2] Departamento de Organización de Empresas y Marketing, Facultad de Ciencias Económicas y Empresariales, Universidad de Vigo, Campus Lagoas-Marcosende, 36200 Vigo. E-mail: arevalo@uvigo.es. Phone: +34 986 813540. Fax: +34 986 812401

[3] Departamento de Economía Aplicada, Facultad de Ciencias Empresariales, Universidad de Vigo, Campus Sur, 32004 Ourense. E-mail: chamorro@uvigo.es. Phone: +34 988 368763. Fax: +34 988 368923.

1 Introduction

On buying or renting housing, households value several characteristics, such as living space, bathroom facilities, number of rooms, lifts or elevators, the neighbourhood, access to services including schools, motorways, etc., in terms of the utility that these characteristics (or services) render to the household (*housing value*). The objective of this work is twofold. First, we propose an ordinal measure of housing value (which we have called *level of housing services*) for owner and tenant occupied houses in Spain, and second, we apply this measure to analyse geographic differences in housing services in the different provinces of Spain.

House prices (or rental prices) are the most straightforward indicators for housing value in competitive markets.[4] However, the Spanish housing market is extremely complex and far from competitive,[5] so observed prices are not optimal reflections of the services rendered by houses to their occupiers.[6] An analysis of heterogeneity in housing requires an adequate measure of the level of services, and the large numbers of categorical variables that characterise a house create the problem of how to synthesise them to a more manageable number.

Several studies have used multivariate analysis techniques to construct composite quality variables. For example, Kain and Quigley (1970) estimate the market value of services consumed by urban households and use factor analysis to derive a set of quality

---

[4] Traditionally, hedonic regression has been used to estimate the relationship between house price and housing characteristics. For example, Rosen (1974) derives the microeconomic fundamentals of this technique; Diewert (2003) shows an interesting theoretical discussion; Maurer *et al*. (2004) have derived house price indexes using this technique; and Arévalo and Ruiz-Castillo (2004) or Silver and Heravi (2004) propose the use of hedonic imputation indexes for the proper measurement of inflation, for product areas which have a high turnover of differentiated models.

[5] Housing is described as a durable asset which is bought for residential and/or investment purposes, occasionally with a speculative purpose, under strong governmental intervention. See, for example, López (1992) and López (1997).

[6] For example, Börsch-Supan (1986), using data from German and USA householders, proves via empirical estimations that length of tenure has a significant negative effect on rental prices. Börsch-Supan identifies this discount, called tenure discount, as a generalised phenomenon in the housing rental market which is independent of government interventions; Arévalo (2001) estimates the effect of tenure discount in Spain; and Miron (1990) and Hubert (1995) explain tenure discount as a problem of asymmetric information.

indexes from 39 variables, which are used in the regressions reported in their article. More recently, by using Multiple Correspondence Analysis (MCA), Arévalo (1999) obtained a housing quality index with information on 8 structural characteristics of Spanish houses for the years 1980 and 1990, which indicated an improvement of housing quality in this period.

In accord with Arévalo (1999), our main concern in this article is to construct a more complete index to measure the level of housing services for housing in Spain. While the structural attributes of a living unit are an important determinant of internal services, several studies have claimed that housing value depends on other, external services derived from location.[7] We therefore include two new variables in MCA: the size of the municipality, or township, (an administrative unit of local government) where the house is located, and access to external services.[8] Data on structural characteristics and municipality size are obtained from the *Encuesta Básica de Presupuestos Familiares* (EBPF), a representative sample of housing units in Spain. The variable for access to external services (which we will henceforth call the *access variable*) was derived from data on road journey times between provincial capitals.

When location variables are included together with structural variables in MCA, the results show that: (i) both types of variables are strongly correlated, (ii) the external services component complements internal services (structural characteristics) and improves the measurement of the level of housing services, and (iii) explanatory capacity for purchase and rental prices is enhanced.

With MCA we obtain a housing index that integrates two concepts that are closely related to housing value: the living unit's internal services (derived from structural characteristics) and external services, which are located in the home's surroundings and are accessible from it. An analysis of the distribution of this index in different provinces in Spain confirms the geographically unequal structure shown in several studies that use other socio-economic variables.[9] Houses with the highest level of services are

---

[7] See, for example, Shinnick (1997) and Wolverton and Senteza (2000).
[8] The access of households to external services is defined as a function of the population of the closest main cities and the distance to them.
[9] See, for example, LA CAIXA (2003).

concentrated in those few provinces that have traditionally shown high levels of economic development and economic activity. Thus, the present paper derives a new, easily manageable index that contributes a new aspect to the discussion of the lack of distributive equity in Spain.

In the rest of the paper, Section 2 will derive a housing index for housing in Spain. Section 3 applies the index to analyse geographical differences in the different provinces of Spain. Section 4 puts forth the conclusions of the study.

2 Empirical analysis of housing services in Spain

2.1 Data and variables

The population under examination comprises occupied housing in Spain. Two types of variables can be used to measure the level of services that a housing unit (house or apartment) provides for its occupants: structural variables (proxy for internal services) and location variables (proxy for external services that are available in the vicinity).

Structural housing attributes were obtained from a representative sample of Spanish housing, the *Encuesta Básica de Presupuestos Familiares* (EBPF), reported by the *Instituto Nacional de Estadística* (INE) for the period 1990-91.[10]The sample size is 19,733 housing units, which represent a total 10,657,822 houses distributed among 47 Spanish provinces.[11]

For external services, we used the variable “township size”, expressed in number of inhabitants according to EPBF. In addition, we constructed another variable for each living unit, called the *access variable,* which reflects the possibility of using services

[10] The EBPF survey is carried out once every ten years to adjust the basket of goods and services which is the basis for the Spanish consumer price index. From 1980-81 and 1990-91, EPBF includes information about characteristics of occupied housing. The EBPF for 1990-91 is the most recent detailed information available for Spain. The data are available on www.eco.uc3m.es/data/epf/epf90-91.pdf.

[11] The present paper analyses mainland Spain, excluding the Canaries, Balearic Islands, Ceuta and Melilla. Mainland Spain comprises 47 provinces, organised as 15 Autonomous Communities. The capital city of each province is the centre for administration and social and cultural life.

located in the capital cities of the provinces, which surround the location of the house. The intensity of these urban amenities can reasonably be measured by using the capital city's population weighted by the distance.

The access variable, A_r, is defined as follows. Let r be the province where a house is located, and let S_r be the set of provinces that surrounds province r, thus

$$A_r = P_r + \sum_{i \in S_r} d_{ri} P_i$$

where P_i is the population of province capital i and d_{ri} is the distance between province capital r and province capital i. This distance is defined, in mean terms for each province, as the minimum time t_{ri} that a family takes to go by road from province capital r to province capital i. We consider that the effect of access attributes is limited to a circle with radius $t_{\max}$ minutes. Therefore, the distance is defined as $d_{ri} = (t_{\max} - t_{ri}) / t_{\max}$. For the purpose of this study we have considered $t_{\max} = 90$.[12]

Table 1 outlines the categorical variables that refer to structural characteristics and location characteristics used in this paper. The first set of variables contains 18 structural characteristics, with a total of 61 categories. In the second set, the variables indicating township size and access to services contain 5 and 4 categories, respectively. The first column of Table 1 shows the observed frequency of categories.

2.2 Methodology

The method used to synthesise the set of variables is multiple correspondence analysis (MCA)[13]. MCA originated in the work of Benzécri (1964) and has been used extensively in several empirical and theoretical studies. Greenacre (2002) gives an explanation of this technique and applies it to a study related to the Spanish National Health Survey. In a theoretical context, Greenacre (1991) reviews the practical aspects

---

[12] The second column of Table 3 shows the values for the access variable.

[13] MCA is a specific version of the more popular Principal Component Analysis (PCA). MCA is used with categorical variables while PCA uses cardinal variables. Appendix I shows the analytical fundamentals for MCA.

of interpreting MCA, and Tenenhaus and Young (1985) discuss a variety of methods for quantifying categorical multivariate data.

The objective of MCA is to reduce the dimensionality of a set of categorical variables and capture the relationships between the different variables. As far as the variables are correlated, MCA can define a smaller number of new variables (called *factors*) which are linear combinations of the original variables. Thus, when correlation is increased, dimensionality is reduced as fewer new variables are obtained. The factors are intercorrelated and their combination allows full characterisation of the analysed individuals. Each isolated factor synthesises an independent aspect of the relationship between the original variables, and the combination of factors explains the total observed variance. Furthermore, we can interpret each factor in terms of: (i) its *relative importance* (the percentage of the total variance explained by the factor), (ii) the *influence of each variable on the construction of the factor* (the correlation between the factor and the original variables), and (iii) the *contribution (or weight) of categories of variables in the definition of the factor* (the sign and magnitude of the coefficients in the linear combination that defines the factor).

An interesting property of factors is that they are ordinal variables that give a value to each individual in function of the weights assigned to the categories of the original variables. This fact allows us to make comparisons between individuals as well as between a particular individual and the sample mean, which, by construction, we will take to be zero.

2.3 Application of MCA to housing in Spain

In this section, we discuss the results obtained by applying MCA to two different sets of variables: (a) structural variables, and (b) structural, township size and access variables among owner and renter occupied houses represented in EBPF for the period 1990-91.[14]

---

[14] The analysis was run using SAS software (Windows version 8). The MCA results can be requested from arevalo@uvigo.es.

We have called the analysis of the first set of variables[15] *S-analysis,* and the analysis of the second set *SL-analysis*. Table 2 shows the number of factors and their relative importance obtained through S-analysis and SL-analysis. [16]

Results show that the factor with the greatest relative importance explains approximately 67% of variability of the original variables in both analyses. The factor with second greatest relative importance explains 17% of variability in S-analysis, and 15% in SL-analysis. Significant simplification is obtained when the original variables are replaced with these two first factors. The remaining factors, which together explain less than 20% of total variability, have low relative importance. They merely capture unimportant aspects of data that are not considered in the two first factors, and their interpretation is only marginally interesting.

The next section will focus on the interpretation of the first and second factors in terms of the original variables.

Influence of the original variables on the first two factors

Columns 2 and 4 of Table 1 show the correlations between the original variables and the first factor in the S-analysis and the SL analysis, respectively.

First, if we focus on the factor with the greatest relative importance provided by MCA, we can conclude that the structural variables exhibit similar behaviour in both analyses. The analysis shows that the most influential variables for this factor are type of fuel used to heat water, fuel used for central heating, type of building, lift / elevator, central heating, and other community services. In an intermediate position, we find variables such as bathroom facilities, telephone, age of the building and garage facilities. Finally, the variables that show the lowest correlation with the first factor are the existence of a swimming pool, sports area, air conditioning, garden and electric power. These last variables exhibit the highest divergence between frequencies in their categories.

---

[15] While Arévalo (1999) used 8 structural variables, in the present paper the sample is extended to 18 structural variables.
[16] Following Greenacre's (1991) recommendation, we applied Benzécri's transformation to infer the true representation of each factor (Benzécri, 1979).

In SL-analysis, location variables do not change the behaviour of structural variables, and show considerable correlation with the first factor, close to 0.6 for township size and 0.43 for access. This fact appears to indicate that, far from being independent of structural variables, location variables are complementary to structural variables for the interpretation of the first factor.

Further, we observe that in both analyses, the most represented variables in the second-ranking factor in relative importance are fuel for water and heating, running water, bathroom facilities, and central heating.

The contribution of categories to the definition of each factor

The weights assigned to the categories of original variables in the first two factors for the S-analysis and SL-analysis are shown in Table 1. This table presents the observed frequencies of each category.

Regarding the categories represented in the first two factors, we observe a very frequent phenomenon, known as the Guttman effect,[17] which enormously simplifies the interpretation of these factors. The Guttman effect indicates that whereas the first factor summarises the order structure of categories for each variable, the second factor only shows the opposition between extreme categories of a variable (categories with a lower frequency) and average categories (with a higher frequency). That is, the second factor simply displays the relationship between categories and the observed frequency.

In view of the low relevance of the second factor, we will focus on analysing the first factor in the S-analysis and SL-analysis.

From the results obtained in the S-analysis, we can observe that the categories that most penalise the first factor are: the lack of running water (with a weight of -10), no bathroom facilities (-8.27) and not having electric power (-8.21). All three indicate the lack of essential facilities for a housing unit. Conversely, categories with the highest

---

[17] For an explanation of this phenomenon see, for example, Greenacre (1991).

positive contribution to the first factor are the existence of a sports area (5.73) and swimming pool (5.43). However, the lack of these services (which is the most frequent case) hardly penalises the value of the first factor (-0.06 and -0.07 respectively). The results show that the most frequent categories approximate the value of the factor to the average house, which, by construction, takes zero value.

The separate study of each structural variable in the S-analysis shows that the order of its categories assigns a negative weight to the worst category, a positive sign to the highest category, and gradation in accordance with meaning when the variable has more than two categories. This result and the contribution of variables to the definition of the first factor allow us to interpret this factor as an index of structural housing variables (proxy of the level of internal services of housing). We will define this index as *S-index*.

The SL-analysis shows that structural variables exhibit the same behaviour for the first factor as in the S-analysis. Additionally, the township size variable penalises this factor when the house is located in a city with fewer than 50,000 inhabitants. On the contrary, township size gradually assigns a positive weight as the township increases its population. The access variable penalises (favours) the first factor when the house is situated in a location with a low (high) access rank. We will give the name of *SL-index* to the first factor obtained from SL-analysis.

2.4 Interpretation and characteristics of the S-index and the SL-index

The S-index and the SL-index are ordinal measures of the utility level that a housing unit offers its occupiers. Their interpretation is limited by the variables that take part in the analyses. Whereas the S-index only synthesises the internal services of housing units, the SL-index provides a more complete approach. By including location variables in the analysis, the SL-index confirms the role of structural variables in the interpretation of the level of internal services and incorporates a new aspect (access to external services) that reinforces and completes this interpretation.

The main advantage of the derived indices is their excellent capacity for synthesis. By using the S-index (SL-index), we consider altogether 18 (20) variables and 61 (70) categories. Furthermore, their ordinal character allows for making comparisons between different housing units, as well as between a particular housing unit and the average. By construction, both indices take zero value in the average housing unit.[18]

The average housing unit is characterised by the following variables. It is a flat or apartment located in a two-storey building, without a lift, built 20 to 30 years ago and situated in a township between 10,000 and 50,000 inhabitants. It measures between 60 and 90 sq.m. and has one bathroom with individual hot water, moveable electrical heating appliances, a telephone and a garage. It does not have air conditioning, a garden, a swimming pool or other communal services. Butane (bottled) gas is the main fuel used to heat water and cook.

In order to enhance the relationship between index values and original variables, Table 3 shows the distribution of the characteristics associated to each quartile of the S-index and SL-index distributions.[19] As expected, partition I (partition IV) of each index concentrates the greatest proportion of attributes identified with the lowest (highest) level of service. Partitions II and III occupy intermediate positions. This information is adapted to a classification in four types of living units, and links to the original variables to compare S-index and SL-index distributions in different groups of living units in EPBF.

3 Geographic comparison of housing services in the different provinces of Spain

Once each house in the EPBF has been assigned a level of services by means of the S-index and the SL-index, this section will discuss their geographical distribution. First,

[18] Consequently, if the index for a particular house is negative (positive), it will be indicative that its level of services is inferior (superior) than that of the average house.

[19] Four partitions are defined from the quartiles (position values Q1, Q2, or median, and Q3) for the distribution of the S-index and SL-index. Partitions I, II, III and IV comprise the 25% of housing units whose index value is (respectively) lower than Q1, between Q1 and Q2, between Q2 and Q3, and higher than Q3.

we examine average values for each province with the S-index and the SL-index. Table 4 displays the 47 Spanish provinces according to average S-index value, from highest to lowest value.[20]

Only one-third of the provinces show a higher level than the reference level for services in the average home (zero value on both indexes). Both indexes show that the best provinces are Madrid and the provinces of North-east Spain. The provinces with lowest average values are Ourense, Lugo, Badajoz, Almería and Cáceres. These results suggest a positive relationship between the indicators and an area's level of economic development, which is coherent with expectations for this type of indicators and speaks for the indicators' ability to synthesise. We should now attempt to establish what the SL-index adds to the S-index.

Once the role of the original variables in the interpretation of both indexes has been identified, only the effect of location-related variables (township size and access) remains to explain differences in the relative positions of homes in the two indexes. A comparison of the maps in Figure 1 will illustrate the main differences province by province. First, we note that only the provinces of Barcelona and Valencia improve their situation, mainly thanks to the access variable[21]. After the capital city, Madrid, the province capitals with the largest population are Barcelona and Valencia,[22] and this means a higher external service level for living units located in their provinces.

The township size variable has a negative effect on the SL-index in provinces such as Teruel, Cuenca and Huesca, with 100% of homes located in townships with less than 50,000 inhabitants, and Palencia or Navarra, with 60% and 66% of homes also located in small townships. Other provinces, such as Guadalajara, do not show a negative effect although 62% of living units are in small townships. The reason is that Guadalajara is very close to Madrid (and is indeed known as Madrid's "bedroom city", because of the large commuter population). This gives Guadalajara access to services in Madrid, and

---

[20] The first column shows the percentage of houses in each province. Column 6 shows the corresponding normalised mean indices. Figure 1 shows the classification of provinces according to the average level of the indices.
[21] Table 4 shows how the ranking for Madrid province improves when the SL-index is used. Madrid ranks first with the SL-index, and second with the S-index. This is not shown on the map.
[22] The 1991 Census shows that the most populated province capitals are Madrid (3,010,492 inhabitants), Barcelona (1,643,542) and Valencia (752,909).

the SL-index reflects this through the access variable, compensating for the negative effect of the township size variable. This simple analysis of average values clearly indicates that the SL-index has a broader perspective than the S-index, derived from the use of location variables.

To complete the comparison of services to living units in the different provinces, Table 4 shows the proportion per province of homes from each of the four types of living units (partitions I, II, III and IV), shown in Table 3. The proportions per province would only be similar to proportions in Spain as a whole (25% per partition) if index distribution were homogeneous in all the provinces. This is not valid in Spain. For instance, for structural characteristics, five provinces (Navarra, Álava, Madrid, Vizcaya and Barcelona) have more than 70% of living units in partitions III and IV. At the opposite end of the scale, in the provinces of Zamora, Cádiz, Huelva, Cáceres, Lugo, Ourense, Almería and Badajoz, more than 75% of living units are in partitions I and II. More than 80% of living units with structural services below the median value for the S-index are actually in Almería and Badajoz, which are extreme cases.

As expected, the location variables in the SL-index have a strong positive (negative) effect, derived from how near (or far) the living unit is from the great Spanish areas of influence. If we compare the distribution per province according to the S-index with the distribution per province according to the SL-index, the only provinces that show an increase in the percentage of living units in partitions III and IV are the "7-G" (the 7 most highly populated Spanish provinces)[23] and Guadalajara, for the reasons explained above.

Figure 2 shows geographic distribution for the S-index and the SL-index at the Autonomous Community level (Autonomous Communities are larger, regional divisions, formed by groups of provinces). At this level, both indexes show strong differences between less developed Autonomous Communities (Extremadura and Galicia) and traditionally more active Communities (Madrid, País Vasco, Navarra and

[23] The 7-G provinces are Madrid (with 13.54% of 36,545,131 inhabitants in 1991), Barcelona (12.74%), Valencia (5.5%), Sevilla (4.4%), Málaga (3.18%), Vizcaya (3.16%) and Zaragoza (2.26%). Further information on the effects of the 7-G as areas of influence in Spain is available on http://campus.uab.es/iermb/papers/Papers27/2.pdf.

Cataluña). The rest occupy intermediate positions, with Autonomous Communities such as Andalucía, Castilla la Mancha, Murcia, Asturias and Castilla-León closer to the first group, and La Rioja, Aragón and Valencia closer to the second group.

To summarise, results are consistent whit the interpretation of the indices. The relative positions of provinces and Autonomous Communities, according to average values and distribution, is coincidental with positions established by other socio-economic indicators from studies unrelated to the present paper.[24] This coherence of results is a guarantee for the usefulness of the indexes. As well as being new indicators with great synthetic capabilities, they are shown to detect geographical differences in external and internal services in homes in Spain.

As regards the relationship of the S-index and the SL-index, we observed that, while the S-index basically reproduces geographic distribution of internal services, the SL-index shows a broader aspect of services in living units, in terms of location. The S-index shows no difference in value between a home in the capital city, Madrid, and an equivalent home, with the same structural characteristics, in a 200-inhabitant village in Badajoz province. Obviously, the monetary value (price) will differ considerably, and the SL-index also expresses this difference.

We will now examine the explanatory capacity of the two indexes for diversity in housing prices. Table 4 shows two sets of mean prices per square metre of living space, according to province: (i) purchase price, according to the Ministerio de Fomento (the Spanish government body in charge of housing) in 1991, and (ii) monthly rental price according to EBPF in 1991 for rented living units. Rental prices (not purchase prices) are referred to the same group of living units (rented homes according to EPBF) used to calculate a SL-index value and an S-index value. This could explain the correlation between indexes and prices shown in Table 5. The indexes are highly explanatory for purchase price (a 36% determination coefficient with S-index, and 45% with SL-index), and even higher for rental price (42% and 56%). The evidence suggests that the SL-

[24] See, for example, the indicators "Activity rate," "Percentage of homes with computers, internet access, mobile telephones," etc., analysed by Fundación "LA CAIXA" (2003).

index is more valuable than the S- index to explain house prices[25], and that the SL-index complements the S-index. This enhances the value of the SL-index, as a single variable is shown to be able to capture (at least partially) the effect of location on price, which the structural index does not show.

These indexes show a valuation of the level of "housing value" for the occupiers of the living unit, which is more objective than prices.[26] Such indexes could have special relevance for work on inequality or social wellbeing in countries (like Spain) where large segments of the population have great difficulty to buy or rent a home. [27]

4. Conclusions

The main goal of this paper is to illustrate the lack of distributive equity that affects the characteristics of Spanish homes, as shown by the Encuesta Básica de Presupuestos Familiares (EBPF). Correspondence analysis was used to construct the ordinal variable S-index, an index for living units that synthesises 18 categorical structural variables, which are proxy for internal services of the living unit. Additionally, a second index, the SL-index, was created by adding two location variables, which are proxy for access to external services available in the living unit's surroundings.

The difference between the SL-index and the S-index is that the SL-index integrates both types of services (internal and external), and shows their complementary nature. The SL-index includes a positive (or negative) component derived from the distance between the living unit and a large city, which will give the home's occupants more (or less) access to the large city's services. Naturally, the SL-index shows a broader concept of services than the S-index, originating increased correlation with prices. Though the

[25] This does not necessarily mean that the SL-index should be used, rather than the S-index, for a hedonic price regression. In fact, if we need to estimate the cost due to location, location should be considered independently from structural variables. This strategy will be more explanatory for prices of homes.
[26] Other variables which also affect observed prices can be, for example, tenure discount (see Börsch-Supan, 1986, and Arévalo, 2001), discounts on the price of protected housing for poorer families or tax incentives for first-time buyers.
[27] The Spanish housing market is characterised by one of the weakest rental markets in Europe, a high percentage of unoccupied living units and rampant speculation on land. Government has made repeated attempts to increase control of the market, but a report on the influence of government policies on housing, on behalf of the European Institute for Comparative Urban Research, showed how "the problem with housing in Spain is not housing but access" (Nel-lo, 1997, p. 42)

S-index is highly explanatory for housing prices in a hedonic regression (it explains 36% of observed variability in purchase price, and 42% of variability in rents), the SL-index performs even better, with 45% and 56%.

A limitation of the ordinal character of variables (S-index and SL-index) is that comparison is only possible between living units that were in the analysis. From a geographical perspective, there are important differences in the distribution of services for Spanish living units, as assessed with the S-index and the SL-index in each province. Only one-third of the provinces have a higher level than the average for all the homes analysed. The provinces with the highest percentages of best valued homes are in Madrid and the north-east. The provinces with the worst level of services are mostly in the south and south-west. Geographical heterogeneity according to the S-index and the SL-index is notably similar to heterogeneity shown by the main socio-economic indicators in Spain, and this reinforces our assessment of the value of the indexes.

The SL-index shows two main differences with the S-index: (1) it assigns a better relative position to the provinces near the main areas of influence, especially Madrid and Barcelona, and (2) it assigns a lower relative position to provinces with a majority of small townships, for example, Teruel, Cuenca and Huesca. In other provinces, such as Guadalajara, where more than 62% of homes are located in townships with less than 50,000 inhabitants, this effect is cancelled out, as Guadalajara is a "bedroom city" for Madrid.

The main contribution of this article is to make new indicators available for the study of inequality in Spanish housing. The indicators can be used for work on quality of life in families, social exclusion, or poverty. Both indexes could also be used as explanatory variables for the observed price diversity. Replacing the original variables with these indicators in a hedonic regression has three principal advantages: the degrees of freedom are considerably increased, problems of multi-co-linearity for this type of variables are reduced, and the estimation of crossed effects with other variables is made easier.

Appendix I

Multiple Correspondence Analysis (MCA)[28] is a statistical technique used to analyze categorical data (data on a set of qualitative variables, each with several categories). From a contingency table of a set of individuals, MCA finds linear-independent factors, each constructed as linear combinations of categories. These factors define orthogonal dimensions of a perceptual map, where the categories are represented by points projected onto the map. Factors can be ordered with respect to the percentage of variability that they explain so that all of them explain the total variability in the data.[29] The centre of the map can be interpreted as an "average individual", characterized by being associated with the most frequently observed categories.

Next, we explain in detail this technique. MCA applies to Q qualitative variables, possibly correlated, for N individuals, often as a result of a questionnaire survey. The objective of MCA is to obtain a set of K uncorrelated variables ($K < Q$) which are linear combinations of the Q variables analyzed. These K variables will help us to interpret the collected data.

Notation

Suppose we have data on Q qualitative variables from N individuals. Let Z be the matrix of data ($N \times J$) where J is the total number of categories of the Q variables. Let J_q be the number of categories of variable q ($q = 1, 2, \ldots, Q$).[30] The element z_{ij} of matrix Z takes the value one when individual i gives the response corresponding to category j and zero otherwise, $i = 1, 2, \ldots, N$, $j = 1, 2, \ldots, J$, where $N >> J$. Note that since each individual only responds to one category of the J_q categories of variable q, the row

---

[28] MCA is a generalization of the Simple Correspondence Analysis where a two-variable contingency matrix is used.

[29] Arévalo (1999) applies this technique to Spanish housing and finds that 88% of variability is explained considering just one factor.

[30] For example, in a context of housing quality a typical variable is the number of square metres of constructed surface which we will assume with four categories: less than 61 square metres, between 61 and 90 square metres, between 91 and 130, and more than 130 square metres.

sums for Z must be equal to Q, and that the sum of elements in column j of matrix Z is the absolute frequency of category j (frequency denoted by N_j).

For each variable q, we have that $N = \sum_{j \in I_q} \sum_{i=1}^{N} z_{ij}$, where I_q is the set of categories for variable q. Therefore, $NQ = \sum_{j=1}^{J} \sum_{i=1}^{N} z_{ij}$ is simply the grand total of Z.

The relative frequency matrix is $F = (1/NQ)Z$. From this matrix i´s row profile can be defined as the ith row of F. Analogously j's column profile can be defined. The vector of average column profile is the vector $r = F1_J$ with $r_i = 1/N$, and the vector of average row profile is the vector $c = F^T 1_N$ where each element is equal to $c_j = N_j / NQ$. The diagonal matrices of these masses are denoted by D_r and D_c respectively.

In this context, the similarities between two profiles are measured through the χ^2-distance. This is the standard Euclidian distance with metric defined by D_r^{-1} for the column profiles and D_c^{-1} for the row profiles.

Let now define the matrix

$$E = D_r^{-1/2} \left(F - rc^T \right) D_c^{-1/2} . \tag{1}$$

The element $e_j^T e_j$ in the diagonal of matrix $E^T E$ is the χ^2-distance between the ith column profile and the average column profile r, weighted by its relative frequency (c_j). Analogously the element $e_j e_j^T$ of matrix EE^T for the rows can be interpreted. The sum of these elements for matrix $E^T E$ is called the total inertia (TI). This is a concept used in the literature of correspondences, and it is associated with the notion of weighted variance.

Procedure

MCA computes the singular value decomposition of *E*, say $UD_{\alpha}V^{T}$, *U* and *V* being orthogonal matrices. This matrix has $J-Q$ non-zero eigenvalues. In practice, since $N >> J$, it is more convenient to compute the eigenvalue-eigenvector decomposition of the $(J \times J)$ symmetrical matrix $E^{T}E$, say $E^{T}E = \Gamma D_{\lambda}\Gamma^{T}$, where $D_{\lambda} = D_{\alpha}^{2}$. The eigenvalues in the diagonal matrix D_{λ} quantify the inertia projected through each of the associated eigenvectors (columns of Γ). These eigenvectors represent orthogonal directions of projection of centered column profiles. The direction of the first eigenvector (that associated with the greatest of all eigenvalues) is the optimal projection; say, it is the linear orientation that collects the maximum disparity between individuals according to the *Q* variables. The second eigenvector is orthogonal to the first one and represents the linear orientation that captures the maximum residual disparity, that is, the disparity not taken into account by the first axis of projection, and successively we can interpret all eigenvectors until the total inertia is in *K* orthogonal axes with $K \leq J-Q$. In geometric terms, we are changing the original space of profiles which has dimension $J-Q$ to another reduced space with dimension *K*.

The coordinates used for plotting the column points in the reduced space are contained in the following matrix

$$M = D_{c}^{-1/2}\Gamma D_{\lambda}^{1/2} \quad (2)$$

where the generic element is m_{ij}. The *K* indicator variables w_{k} ($k = 1, 2, \ldots, K$) are defined through linear combinations of all categories, and they are the columns of matrix

$$W = ZM \quad (3)$$

The element m_{jk} of matrix *M* shows the contribution of the *j*th category in the new variable w_{k}, and z_{ij} takes the value one (alternatively, zero) if individual *i* has (alternatively, does not have) the *j*th category. By construction, it can be proved that the average individual satisfies that $w_{k} = 0$.

Since inertia λ_k represents a percentage of the total inertia, it is possible to calculate the percentage of inertia collected by each indicator or axis. Therefore the ability to explain the information in matrix *E* can be measured, and therefore, the ability to summarize MCA.

In MCA, in contrast with Simple Correspondence Analysis ($Q = 2$),[31] these percentages are always small and show a pessimistic idea of the proportion of the projected inertia (Greenecre, 1990). To know the real representative of axis, Benzécri (1979) proposes considering solely the relevant *P* axis, that is, the axis associated with those eigenvalues with $\lambda_p > 1/Q$, $p = 1, 2, \ldots, P$ and $P \leq K$. Analogously, he proposes correcting the eigenvectors with the transformation

$$\lambda_p^c = \left[Q/(Q-1)\right]^2 \left[\lambda_p - 1/Q\right]^2 \qquad (4)$$

and show the proportion of inertia explained related to $\sum_{p=1}^{P} \lambda_p^c$. The dimensionality of the original matrix is reduced from $J - Q$ categories to *P* relevant indicator variables losing a small quantity of information.

Once the importance of each indicator is evaluated, we have to interpret it in relation with (a) its correlation with all initial variables, and (b) the weights of initial variables on the indicator.

References

Arévalo, R., (1999), "Construcción de un índice de calidad de la vivienda", *Investigaciones Económicas*, 23(2), pp. 267-280.

Arévalo, R., (2001), *El mercado de la vivienda en España*, Ph-thesis. Universidad Complutense de Madrid.

[31] For the special case $Q = 2$, TI is known to be equal to $(J/Q) - 1$.

Arévalo, R. and Ruiz-Castillo, J. (2004), "The rental equivalence approach to non-rental housing in the Consumer Price Index. Evidence from Spain", Working Paper 04-17, Economic Series 04, Universidad Carlos III, Madrid, available in http://docubib.uc3m.es/WORKINGPAPERS/WE/we041704.pdf.

Benzécri, J., (1964), "Sur l'analyse factorielle des proximités". Institut de Statistiques de l'Université Pierre et Marie, Paris, France.

Benzécri, J., (1979), "Sur le calcul des taux d'inertie dans l'analyse d'un questionnaire. Addendum et erratum", Cahiers de l'Analyse des Données, 4, pp. 377-378.

Börsch-Supan, A., (1986), "On West German tenants protection legislation", Journal of Institutional and Theoretical Economies, 142 (2), pp. 380-404.

Diewert, E., (2003), "Hedonic regressions: A consumer theory approach", Scanner Data and Price Indexes, National Bureau of Economic Research, Studies in Income and Wealth, 61, Chicago: University of Chicago Press, pp. 317-348.

Greenacre, M., (1991) "Interpreting multiple correspondence analysis", Applied Stochastic Models and Data Analysis", vol. 7, pp. 195-210.

Greenacre, M., (2002), "Correspondence analysis of the Spanish National Health Survey", Gaceta Sanitaria, 16(2), pp. 160-170.

Hubert, F. (1995). "Contracting with costly tenents", *Regional Science and Urban Economics* 25, 631-654.

Kain, J. F. and Quigley, J. M., (1970), "Measuring the value of housing quality", Journal of the American Statistical Association, 65(330), pp. 532-548.

LA CAIXA, (2003), "Anuario Económico de España 2003", Servicios de Estudios e Instituto Lawrence R. Klein. Barcelona. (See: http://www.anuarieco2003.lacaixa.comunicacions.com/java/X?cgi=caixa.anuari99.util.ChangeLanguage&lang=es).

López, M.A., (1992), "El Informe del Comité de Expertos sobre la vivienda: una valoración tentativa", Hacienda Pública Española, 122, pp. 161-194.

López, M.A., (1997). "La fiscalidad y la política de la vivienda en España", Hacienda Pública Española, 141/142, pp. 287-334.

Maurer, R., Pitzez, M. and Sebastian, E. (2004). "Hedonic price indices for the Paris housing market", *Allgemeines Statistisches Archiv* 88, 303-326. http://www.finance.uni-frankfurt.de/wp/42.pdf.

Miron, J.R. (1990). "Segurity of tenure, costil tenants and rent regulation", *Urban Studies*, 27, Nº2, 167-184.

Nel-lo, O., (1997). "Las grandes ciudades españolas: dinámicas urbanas e incidencias de las políticas estatales" Papers. Regió Metropolitana de Barcelona, 27, pp. 9-70.

Rosen, S., (1974), "Hedonic prices and implicit markets: Product differentiation in pure competition", Journal of Political Economy, 82(1), pp. 34-55.

Shinnick, E., (1997), "Measuring Irish housing quality", Journal of Economics Studies, 24(1/2), pp. 95-119.

Silver, M. and Heravi, S., (2004), "The difference between hedonic imputation indexes and dummy hedonic indexes for desktop PCs", Working Paper 02, Centre for Applied Economic Research, University of New South Wales.

Tenenhaus, M. and Young, F., (1985), "An analysis and synthesis of multiple correspondence analysis, optimal scaling, dual scaling, homogeneity analysis and other methods for quantifying categorical multivariate data", Psychometrica, 50(1), pp. 91-119.

Wolverton, M. and Senteza, J., (2000), "Hedonic Estimates of Regional Constant Quality House Prices", Journal of Real Estate Research, 19(3), pp. 235-253.

Table 1. Relation between the original variables and factors 1 and 2 obtained from Multiple Correspondence Analysis (MCA).

	Frequency	Type of MCA according to variable considered			
		Structural		Structural-Location	
		Factor 1	Factor 2	Factor 1	Factor 2
		(Corr.)	(Corr.)	(Corr.)	(Corr.)
VARIABLES AND CATEGORIES	Observed	Weight	Weight	Weight	Weight
Type of building		(0.62)	(0.29)	(0.69)	(0.36)
Fixed lodgings or non-residential building	0.28	-4,66	2,93	-4,67	2,63
Single-family home	35.30	-2,67	0,61	-3,17	0,99
Two-family home	4.52	-1,63	-0,53	-1,88	-0,5
Three-family home	59.86	1,72	-0,33	2,03	-0,56
Age of Building		(0.38)	(0.30)	(0.33)	(0.36)
Over 50 years old	12.46	-2,65	0,81	-2,59	0,8
31 to 50 years old	12.85	-1,28	-0,05	-1,14	-0,43
21 to 30 years old	23.88	-0,15	-0,9	0,17	-1,38
11 to 20 years old	32.98	1,11	-0,21	1,06	0,03
Under 10 years old	17.83	0,94	0,93	0,45	1,53
Area in square metres		(0.21)	(0.27)	(0.16)	(0.37)
Under 60 sq.m.	9.29	-2,13	0,23	-1,6	-0,46
61 to 90 sq.m.	38.05	-0,03	-0,67	0,24	-1,09
91 to 130 sq.m.	37.19	0,54	0,22	0,33	0,49
Over 130 sq.m.	15.47	0,07	0,98	-0,43	1,78
Bathroom services		(0.57)	(0.59)	(0.51)	(0.55)
None	1.77	-8,27	7,14	-8,36	7,18
Shares with other living units	0.15	-5,24	2,64	-4,06	1,23
One or two toilets with washbasin, or one or two toilet	3.14	-4,26	1,8	-4,13	1,43
One bathroom, or one toilet and one or two toilets with washbasi	70.46	-0,49	-0,6	-0,4	-0,83
One bathroom and one or two toilets with washbasin, or one bathroom and one toil	5.83	1,49	0,43	1,3	0,89
One bathroom, one toilet and one toilet with washbasin, or two bathrooms and one or more toilets or toilets with washbas	17.25	2,8	0,98	2,5	1,69
Two or more bathrooms, one or more toilets and one or more toilets with washbas	1.39	4,58	3,12	4,16	4,73
Water facilities		(0.61)	(0.68)	(0.56)	(0.58)
None	0.38	-10	10	-10	10
Cold water only	4.88	-6,8	4,63	-6,72	4,34
Individual hot and cold wate	87.61	0,03	-0,51	0,04	-0,58
Centralised hot and cold wate	7.13	4,89	2,53	4,61	3,61
Electric power		(0.10)	(0.16)	(0.09)	(0.12)
None	0.17	-8,21	8,2	-8,38	8,34
Electric power	99.83	0,01	-0,01	0,01	-0,01
Heating		(0.67)	(0.62)	(0.63)	(0.62)
None	7.86	-4,3	2,9	-4,47	2,93
Mobile heating appliances	63.88	-0,84	-0,89	-0,76	-1,2
Individual heating	19.45	2,07	0,67	1,92	1,24
Collective heating	8.81	5,39	2,38	5,29	3,36
Fixed telephone		(0.49)	(0.18)	(0.50)	(0.14)
None	22.98	-3,07	0,72	-3,32	0,69
Fixed telephone	77.02	0,92	-0,21	0,99	-0,2
Garage		(0.33)	(0.21)	(0.26)	(0.31)
None	72.45	-0,7	-0,27	-0,58	-0,53
Garage	27.55	1,84	0,72	1,52	1,39
Air conditioning		(0.13)	(0.06)	(0.13)	(0.08)
None	97.6	-0,07	-0,01	-0,07	-0,02
Private system	2.22	2,58	0,41	2,64	0,67
Collective system	0.18	4,88	2,16	4,9	3,11
Lift / elevator		(0.68)	(0.15)	(0.68)	(0.16)
None	69.96	-1,52	-0,22	-1,62	-0,28
Lift/elevator	30.04	3,53	0,51	3,76	0,66
Garden		(0.06)	(0.20)	(0.01)	(0.27)
None	85.41	-0,08	-0,18	-0,02	-0,31
Garden	14.59	0,46	1,04	0,11	1,8
Swimming pool		(0.18)	(0.20)	(0.15)	(0.24)
None	98.79	-0,07	-0,05	-0,06	-0,07
Swimming pool	1.21	5,43	3,91	4,88	5,94
Sports area		(0.17)	(0.16)	(0.15)	(0.18)
None	98.96	-0,06	-0,03	-0,06	-0,05
Sports area	1.04	5,73	3,3	5,34	4,93
Other community services		(0.66)	(0.08)	(0.71)	(0.11)
None	52.35	-2,16	0,17	-2,44	0,28
Other community services	47.65	2,37	-0,18	2,68	-0,31
Fuel or power to heat water		(0.78)	(0.73)	(0.76)	(0.64)
None, or only cold water	5.28	-7,03	5,03	-6,96	4,75
Solid Fuel: coal, logs or others	2.37	-0,53	1,73	-0,91	2,52
Butane gas	59.94	-0,8	-0,84	-0,85	-0,97
Electric power	15.57	0,19	-0,74	0,14	-0,94
Others: town gas, natural gas, propane gas, fuel oi	16.84	4,96	1,85	5,2	2,47
Fuel or power for heating		(0.71)	(0.68)	(0.69)	(0.71)
None	7.85	-4,3	2,91	-4,47	2,93
Solid fuel: coal, logs or others	20.31	-1,97	0,45	-2,47	0,95
Butane gas	13.14	-0,94	-1,07	-0,62	-1,6
Electric power	42.05	0,25	-1,21	0,49	-1,67
Others: city gas, natural gas, propane gas, fuel oi	16.65	4,55	1,99	4,39	2,94
Fuel or power for cooking		(0.61)	(0.41)	(0.64)	(0.39)
Solid fuel: coal, logs or others	3.60	-4,88	3,37	-5,42	3,94
Butane gas	76.19	-0,79	-0,43	-0,84	-0,53
Electric power	6.98	2,9	0,56	2,82	0,86
Others: city gas, natural gas, propane gas, fuel oi	13.23	4,32	1,26	4,84	1,53
Municipality or township size				(0.61)	(0.24)
Fewer than 10,000 inhabitants	26.55			-3,02	1,08
10,000 to 50,000 inhabitants	22.09			-0,91	-0,21
50,000 to 100,000 inhabitants	9.00			0,83	-0,34
100,000 to 500,000 inhabitants	21.71			1,53	-0,36
More than 500,000 inhabitants	20.65			2,88	-0,64
Accessibility (90 minutes)				(0.43)	(0.24)
Fewer than 100,000 inhabitants	5.15			-2,08	1,74
100,000 to 500,000 inhabitants	42.10			-1,32	0,58
500,000 to 1,000,000	24.65			-0,04	-0,76
More than 1,000,000 inhabitants	28.10			2,33	-0,41

Table 2. The importance of indicator obtained in the Multiple Correspondence Analysis (MCA).

Breakdown of the explained variability	Type of MCA according to the variables considered			
	Structural		Structural-Location	
	Variance	%	Variance	%
First factor	0,0433	66	0,0437	66
Second factor	0,0113	17	0,0097	15
Third factor	0,0051	8	0,0063	10
Rest of factors	0,0054	8	0,0062	9
Total of variance	**0,0652**	100	**0,0658**	100

* Variance collected in each indicator (with the Bencecri correction, 1979) and the total that it represents in the total.

Table 3. Distribution of categories in each partition of Structural and Structural-Location indexes.

VARIABLES AND CATEGORIES	Structural Index				Structural and Location Index			
	I	II	III	IV	I	II	III	IV
Type of building								
Fixed lodgings or non-residential buildings	0,84	0,24	0,08	0,02	0,85	0,31	0,06	0,02
Single-family home	**80,65**	**49,89**	13,01	3,37	**86,23**	**56,11**	9,51	1,96
Two-family home	6,45	8,18	3,12	0,74	5,61	9,99	3,09	0,55
Three-family home	12,06	41,68	**83,79**	**95,87**	7,31	33,58	**87,35**	**97,48**
Age of Building								
Over 50 years old	**30,02**	11,84	5,78	4	**28,06**	12,48	7,44	4,67
31 to 50 years old	20,23	15,24	9,68	7,17	18,02	16,41	10,61	7,92
21 to 30 years old	18,65	26,58	31,7	17,85	16,63	23,63	33,4	20,83
11 to 20 years old	17,02	**29,11**	**38,59**	**45,36**	19,37	**28,41**	**36**	**44,77**
Under 10 years old	14,07	17,23	14,25	25,62	17,91	19,06	12,54	21,81
Area in square metres								
Under 60 sq.m.	17,26	10,63	7,17	2,93	13,98	8,83	10,97	4,29
61 to 90 sq.m.	32,06	35,61	**50,76**	32,49	29,12	33,39	**50,34**	37,33
91 to 130 sq.m.	**32,35**	**36,07**	32,63	**47,5**	**35,04**	**38,61**	30,62	**44,02**
Over 130 sq.m.	18,33	17,69	9,44	17,07	21,86	19,18	8,07	14,35
Bathroom services								
None	7,48	0,06	0	0,06	7,63	0,15	0,03	0,06
Shares with other living units	0,61	0,03	0	0,01	0,45	0,21	0	0,01
One or two toilets with washbasin, or one or two toilets	10,16	2,29	0,56	0,27	9,67	2,1	1,36	0,45
One bathroom, or one toilet and one or two toilets with washbasin	**77,15**	**81,68**	**77,49**	**46,2**	**75,99**	**77,17**	**78,85**	**52,53**
One bathroom and one or two toilets with washbasin, or one bathroom and one toilet	2,06	5,58	5,92	9,42	2,69	6,18	5,16	8,7
One bathroom, one toilet and one toilet with washbasin, or two bathrooms and one or more toilets or toilets with washbasin	2,47	10,03	15,09	39,95	3,53	13,58	13,58	34,78
Two or more bathrooms, one or more toilets and one or more toilets with washbasin	0,07	0,33	0,95	4,08	0,05	0,62	1,02	3,47
Water facilities								
None	1,66	0	0	0	1,73	0	0	0
Cold water only	20,67	0,22	0,02	0,02	20,78	0,75	0,14	0
Individual hot and cold water	**76,74**	**97,42**	**96,82**	**78,45**	**76,26**	**96,6**	**97,08**	**80,33**
Centralised hot and cold water	0,93	2,36	3,16	21,53	1,23	2,65	2,78	19,67
Electric power								
None	0,67	0,03	0,01	0	0,67	0,06	0,01	0
Electric power	**99,33**	**99,97**	**99,99**	**100**	**99,33**	**99,94**	**99,99**	**100**
Heating								
None	27,33	3,62	1,92	0,36	26,72	4,88	2,25	0,49
Mobile heating appliances	**69,24**	**81,55**	**75,42**	29,94	**68,92**	**76**	**77,5**	**36,94**
Individual heating	3,44	14,53	21,14	**37,03**	4,33	18,78	18,71	32,86
Collective heating	0	0,3	1,52	32,68	0,03	0,34	1,54	29,72
Fixed telephone								
None	**62,58**	21,8	8,59	3,05	**61,8**	23,45	11,28	2,56
Fixed telephone	37,42	**78,2**	**91,41**	**96,95**	38,2	**76,55**	**88,72**	**97,44**
Garage								
None	**90,47**	**74,9**	**74,26**	**51,75**	**86,02**	**72,43**	**77,97**	**56,34**
Garage	9,53	25,1	25,74	48,25	13,98	27,57	22,03	43,66
Air conditioning								
None	**99,72**	**98,72**	**97,28**	**94,92**	**99,65**	**98,83**	**97,41**	**95,13**
Private system	0,28	1,17	2,65	4,54	0,35	1,12	2,48	4,38
Collective system	0	0,1	0,06	0,54	0	0,05	0,12	0,49
Lift / elevator								
None	**99,41**	**97,46**	**68,51**	18,28	**99,59**	**97,95**	**75,21**	18,29
Lift/elevator	0,59	2,54	31,49	**81,72**	0,41	2,05	24,79	**81,71**
Garden								
None	**85,72**	**84,14**	**88,94**	**82,6**	**83,41**	**82,17**	**91,59**	**83,76**
Garden	14,28	15,86	11,06	17,4	16,59	17,83	8,41	16,24
Swimming pool								
None	**99,94**	**99,67**	**99,43**	**96,22**	**99,94**	**99,5**	**99,16**	**96,94**
Swimming pool	0,06	0,33	0,57	3,78	0,06	0,5	0,84	3,06
Sports area								
None	**100**	**99,96**	**99,6**	**96,38**	**100**	**99,92**	**99,47**	**96,85**
Sports area	0	0,04	0,4	3,62	0	0,08	0,53	3,15
Other community services								
None	**97,43**	**82,39**	27,78	8,31	**98,69**	**88,01**	29,28	7,97
Other community services	2,57	17,61	**72,22**	**91,69**	1,31	11,99	**70,72**	**92,03**
Fuel or power to heat water								
None, or only cold water	22,33	0,22	0,02	0,02	22,51	0,75	0,14	0
Solid Fuel: coal, logs or others	3,88	1,76	1,23	2,85	4,31	1,94	0,93	2,61
Butane gas	**64,18**	**80,07**	**73,26**	22,76	**64,47**	**77,71**	**75,18**	27,24
Electric power	9,33	17,38	21,04	13,77	8,44	19,01	20,46	13,8
Others: town gas, natural gas, propane gas, fuel oil	0,28	0,57	4,45	**60,6**	0,27	0,59	3,29	**56,35**
Fuel or power for heating								
None	27,33	3,62	1,91	0,36	26,72	4,88	2,24	0,49
Solid fuel: coal, logs or others	**40,96**	27,82	7,32	7,93	**47,97**	27,23	4,81	7,22
Butane gas	14,04	19,09	15,02	4,65	11,04	18,02	17,73	6,45
Electric power	17,31	**47,07**	**66,71**	33,88	13,83	**45,26**	**66,24**	39,01
Others: city gas, natural gas, propane gas, fuel oil	0,35	2,4	9,04	**53,18**	0,44	4,6	8,98	**46,82**
Fuel or power for cooking								
Solid fuel: coal, logs or others	13,36	1,25	0,52	0,15	14,02	1,25	0,43	0,16
Butane gas	**85,67**	**95,36**	**86,3**	38,54	**85,17**	**95,43**	**89,1**	40,94
Electric power	0,72	2,56	7,96	15,9	0,62	3,03	7,13	15,18
Others: city gas, natural gas, propane gas, fuel oil	0,25	0,83	5,21	**45,41**	0,19	0,29	3,34	**43,72**
Municipality or township size								
Fewer than 10,000 inhabitants					**65,33**	**35,27**	11,04	3,09
10,000 to 50,000 inhabitants					23,32	33,71	22,75	10,97
50,000 to 100,000 inhabitants					4,37	9,11	11,32	10,41
100,000 to 500,000 inhabitants					4,93	16,62	**28,76**	32,62
More than 500,000 inhabitants					2,05	5,3	26,14	**42,9**
Accessibility (90 minutes)								
Fewer than 100,000 inhabitants					6,01	3,15	1,13	1,29
100,000 to 500,000 inhabitants					**68,9**	**53,3**	**35,86**	25,98
500,000 to 1,000,000					20,61	28,42	27,76	21,84
More than 1,000,000 inhabitants					4,48	15,13	35,25	**50,89**

Table 4. Information at a province level on the accessibility, mean prizes of squared meter and Structural index (S-I) and Structural-Location index (SL-I)

	Distribution	Accessibility	Price in euros		Indexes		Quartile distribution of S-I and SL-I			
			Owner	Rental	S-I /SL-I	Mean	I	II	III	IV
SPAIN	(in %)	(population)	751,53	1,93		0	25	25	25	25
					S-I	8,69	6,86	13,52	25,53	54,1
Álava	0,74	545.747	591,75	2,25	SL-I	7,26	6,72	15,09	24,68	53,51
					S-I	6,97	8,46	16,04	26,3	49,2
Navarra	1,37	357.223	1052,9	2,18	SL-I	3,89	11,63	23,12	24,39	40,87
					S-I	6,57	4,3	19,15	33,37	43,18
Madrid	13,31	3.087.182	1267,47	3,66	SL-I	8,01	2,16	10,12	37,69	50,04
					S-I	4,83	9,39	19,09	30,18	41,34
Barcelona	13	1.707.278	1113,8	2,49	SL-I	6,08	4,54	18,5	29,85	47,1
					S-I	4,78	18,07	16,43	25,03	40,47
Zaragoza	2,55	614.514	593,7	1,53	SL-I	4,46	19,87	12,81	22,98	44,34
					S-I	4,78	17,72	19,94	20,5	41,84
La Rioja	0,71	264.091	786,9	1,8	SL-I	2,47	20,14	24,22	19,01	36,62
					S-I	3,88	18,56	20,2	23,9	37,34
Valladolid	1,36	490.463	735,46	1,79	SL-I	2,14	23,32	16,39	27,05	33,23
					S-I	3,8	7,44	20,37	42,07	30,12
Vizcaya	3,12	656.623	838,33	2,51	SL-I	3,48	6,13	21,71	41,88	30,28
					S-I	2,81	14,65	28,2	24,19	32,97
Lleida	1	154.694	501,91	1,15	SL-I	0,26	21,82	33,7	19,1	25,38
					S-I	2,65	26,57	17,31	18,79	37,33
Burgos	1,06	335.618	819,31	1,96	SL-I	0,73	30,87	18,14	16,39	34,6
					S-I	2,51	8,5	29,08	38,48	23,94
Guipúzcoa	1,87	475.135	1204,93	2,69	SL-I	1,36	6,99	39,5	34,8	18,72
					S-I	0,95	20,24	30,75	20,77	28,24
Huesca	0,6	323.663	391,07	1,19	SL-I	-1,53	33,49	29,44	14,65	22,41
					S-I	0,28	24,34	28,65	20,28	26,74
Guadalajara	0,44	1.537.862	630	1,37	SL-I	0,49	19,26	33,16	21,27	26,31
					S-I	0,05	34,56	20,67	15,28	29,49
Palencia	0,53	393.164	573,14	1,46	SL-I	-1,93	40,83	20,55	14,64	23,98
					S-I	-0,01	19,72	25,46	34,32	20,5
Valencia	5,93	826.072	477,31	1,15	SL-I	0,15	17,91	26,89	35,75	19,46
					S-I	-0,49	22,94	31,62	24,2	21,24
Tarragona	1,53	770.902	532,15	1,36	SL-I	-1,18	22,54	37,47	20,93	19,06
					S-I	-0,65	33,2	22,48	16,91	27,41
Soria	0,3	55.452	529,65	1,47	SL-I	-3,58	42,44	23,26	16,68	17,61
					S-I	-0,74	32,95	17,22	22,3	27,53
Asturias	3,19	232.856	791,62	1,74	SL-I	-1,28	31,67	20,24	22,37	25,73
					S-I	-0,77	26,34	26,18	23,28	24,2
Cantabria	1,42	359.561	654,3	2,15	SL-I	-1,62	28,89	25,98	27,09	18,03
					S-I	-0,82	20,73	34,8	29,55	14,91
Girona	1,42	598.242	570,22	1,48	SL-I	-1,95	20,35	47,38	19,92	12,35
					S-I	-0,9	29,07	31,81	17,52	21,61
Segovia	0,45	907.179	653,37	1,53	SL-I	-2,17	34,83	34,17	11,97	19,03
					S-I	-1,41	19,52	32,68	34,29	13,51
Alicante	3,44	407.650	477,55	1,37	SL-I	-1,94	19	40,17	33,56	7,27
					S-I	-2,02	31,45	32,52	18,98	17,06
León	1,5	201.760	780,41	1,52	SL-I	-3,58	39,17	31,41	14,15	15,28
					S-I	-2,3	36,11	23,81	20,6	19,48
Albacete	1,03	162.833	413,3	0,85	SL-I	-3,42	41,64	24,13	19,28	14,95
					S-I	-2,97	43,65	20,25	11,62	24,47
Salamanca	1,09	289.344	750,68	1,46	SL-I	-3,85	50,47	14,55	13,65	21,33
					S-I	-3,09	29,04	38,06	21,08	11,82
Toledo	1,35	1.270.846	581,92	1,07	SL-I	-2,7	24,04	46,16	18,42	11,38
					S-I	-3,21	33,93	33,53	19,68	12,86
Sevilla	3,88	820.143	652,74	1,82	SL-I	-2,37	29,5	35,14	20,8	14,56
					S-I	-3,33	37,44	29,93	15,55	17,08
Granada	2,17	420.700	505,56	1,35	SL-I	-4,17	41,95	28,07	17,99	11,99
					S-I	-3,56	33,97	37,24	19,29	9,5
Teruel	0,45	70.315	406,13	1,06	SL-I	-5,89	54,33	30	9,79	5,88
					S-I	-3,88	34,13	30,44	24,18	11,24
Málaga	3,13	584.493	531,88	1,81	SL-I	-2,64	27,7	32,65	28,48	11,17
					S-I	-3,91	31,69	28,71	28,26	11,34
Castellón	1,33	535.764	403,17	1,01	SL-I	-3,62	30,2	31,53	28,9	9,36
					S-I	-4,05	42,27	21,42	16,85	19,45
Pontevedra	2,17	156.516	557,38	1,45	SL-I	-4,59	42,57	25,6	14,6	17,23
					S-I	-4,17	47,7	27,62	8,06	16,62
Cuenca	0,64	42.817	566,99	1,06	SL-I	-6,45	61,71	18,6	7,42	12,28
					S-I	-4,21	41,13	31,11	12,91	14,85
Ciudad Real	1,35	63.675	474,14	1,01	SL-I	-5,89	53,27	25,03	8,91	12,79
					S-I	-4,47	41,06	24,58	20,56	13,8
La Coruña	2,77	300.631	777,91	1,64	SL-I	-4,9	43,8	23,9	21,25	11,05
					S-I	-4,53	35,13	39,68	18,8	6,4
Córdoba	1,94	436.202	474,1	1,45	SL-I	-4,81	40,33	36,62	18,21	4,84
					S-I	-4,63	34,66	39,21	17,71	8,42
Murcia	2,66	456.141	462,7	1,24	SL-I	-4,54	32,66	44,66	16,81	5,88
					S-I	-5,08	45,99	26,54	13,28	14,19
Ávila	0,56	611.447	558,54	1,11	SL-I	-5,96	51,32	27,66	11,08	9,94
					S-I	-5,82	46,22	28,37	19,51	5,9
Jaen	1,72	233.768	356,85	1,02	SL-I	-6,24	49,46	29,06	17,37	4,11
					S-I	-6,12	46,19	30,15	10,01	13,65
Zamora	0,7	243.056	547,11	1,18	SL-I	-7,11	57,33	22,82	7,81	12,04
					S-I	-6,36	46,05	31,7	16,33	5,91
Cádiz	2,41	306.131	567,6	1,75	SL-I	-5,6	40,96	39,7	15,24	4,09
					S-I	-6,58	45,98	30,87	15,54	7,61
Huelva	1,15	377.812	436,33	1,48	SL-I	-6,69	46,89	33,21	16,59	3,31
					S-I	-6,63	45,72	31,6	16,71	5,97
Cáceres	1,2	101.750	503,82	1,18	SL-I	-7,57	59,18	24,14	11,57	5,12
					S-I	-7,49	49,65	31,16	13,2	5,98
Almería	1,2	155.120	470,49	1,25	SL-I	-7,32	49,98	33,56	12,63	3,83
					S-I	-8,78	63,69	23,84	6,88	5,58
Badajoz	1,89	138.800	396,51	0,97	SL-I	-8,88	68,05	20,7	6,99	4,26
					S-I	-9,74	62,55	14,78	10,35	12,32
Lugo	1,11	222.685	503,49	0,91	SL-I	-10	63,82	19,07	7,37	9,73
					S-I	-10	61,13	15,71	11,71	11,45
Ourense	1,27	145.870	595,34	1,12	SL-I	-9,99	63,25	18,42	8,71	9,61

Figure 1. Classification of provinces by the mean value of Structural and Structural-Location Indexes

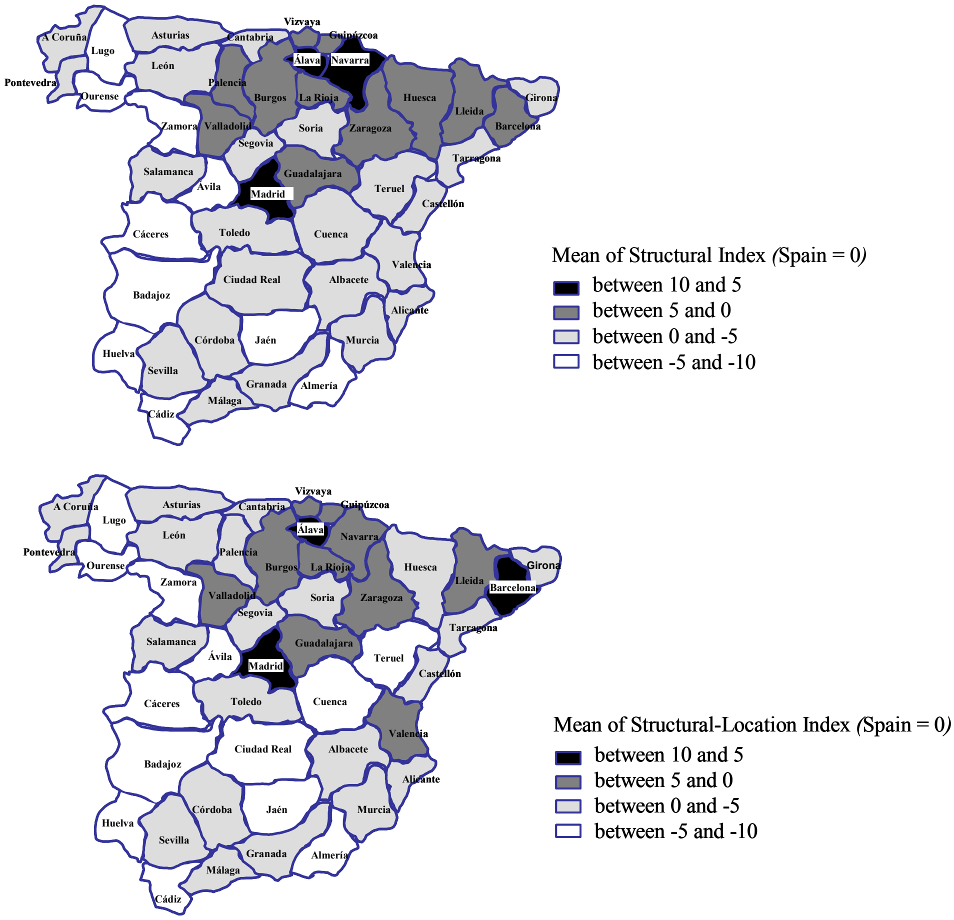

Figure 2. Distribution of Structural Index by Autonomous Comunities

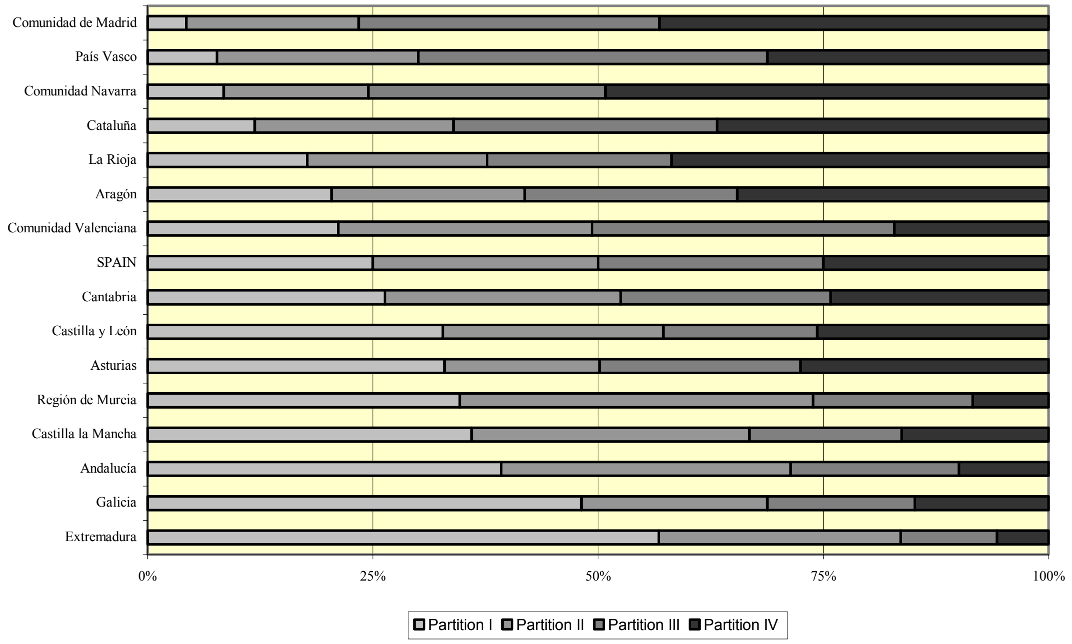

Figure 3. Distribution of Structural-Location Index by Autonomous Comunities