

Departamento de Economía Aplicada

DOCUMENTOS
DE
TRABAJO



UNIVERSIDAD DE JAÉN

PHYSICAL AND NOT SO PHYSICAL
DISTANCES IN A SIMPLE URBAN
MODEL: AN ANALYSIS

Pablo Brañas Garza¹; Javier Rodero Cosano² and Joan Carles Martori³
WP 9803/Nº 3

Dirección para comentarios y críticas:

Dpto. de Economía Aplicada
Universidad de Jaén
Campus Universidad de Jaén
Paraje de Las Lagunillas s/n
23071 Jaén

¹ Economic Analysis Fundamentals Area. Dpt. Applied Economics. University of Jaén.

² Economic Analysis Fundamentals Area. Dpt. Applied Economics. University of Jaén.

³ Department of Mathematics and Computer Studies. University of Vic.

PHYSICAL AND NOT SO PHYSICAL DISTANCES IN A SIMPLE URBAN MODEL: AN ANALYSIS

Pablo Brañas Garza

Javier Rodero Cosano

Joan Carles Martori

JEL Classification: R21, R15, D12, L85

SUMMARY

This paper introduces the theory of hedonic prices for housing services. The classical approach to this field of urban economics is the monocentric model. This model is often criticized due to the restrictiveness of their assumptions. The most important hypothesis is that the rental value per unit of housing service, declines with the distance from the CBD. We consider some other physical and geographical information in an econometric model for the estimation of housing prices. Two simple forms are analyzed: the linear and log forms. The results seem to indicate that the most significant variables are the physical attributes of the houses and also the existence of North-South differences.

Keywords: housing price, distances models, status reasons, north-south effects, hedonic models

1. INTRODUCTION

In the urban literature, generally, the measurement 'distance' involves the range from the center of the city (CBD)⁴ to any other point of it; in that sense, the distance to the CBD is analyzed like a variable that explains the housing demand, so as we get closer to the CBD the demand and the price of housing, increase.

From this point of view, the disjunctive model (Alonso, 1964; Muth, 1969; Goldstein and Moses, 1973; and others) -also called *monocentric* or *neoclassic*- explains the decision of the agents localization like the choice of the consumer between closeness to the CBD and traveling expenses (also named commuting cost), the called hypothesis of space/access compensation. The basic suppositions of this model are:

- i) No externality in the housing consumption.
- ii) Increase on the commuting cost as we get away from the C.B.D.⁵.
- iii) Constant price elasticity and unitary income elasticity on the housing demand.
- iv) By involvement, that housing and commuting cost be a significant part of the family budget.
- v) Additional supposition, work places are located in the C.B.D.

In a simple way, and accepting that suppositions, the compensation model was explained like a factor of negative exponential density:

$$D(U) = D_0 E^{-\alpha U}$$

where $D(U)$ is the residential density, α the gradient of density, U the distance to the C.B.D., and D_0 is the density next to the C.B.D. The model predicts the fact that when the metropolitan population increases, D_0 also increases, even there is not any prediction for the α value.

Resulting from the simplicity of the model and its too inflexible hypothesis - and not many realistic- there were a large number of attacks from different sectors, either of methodological character or empirical. Firstly, it seems that the inclusion of the first supposition, no externality, causes inconsistency in the model, because the existence of externality in the housing consumption is clear. This is why it seems more logical to include the distance to the center, just like a supplementary exogenous variable of the model, not particular (Wilkinson and Archer, 1973).

Secondly, this model demands a complete possibility of election and perfect competence in the housing market, because there is the suggestion of a housing offer completely elastic in a short term, to try to choose in a free way between center and

⁴ Central Business District: mall of the city.

⁵ The costs are a monothon rising function of the distance.

outskirts, situation that does not appear in the reality (Kanemoto and Nakamura, 1986; Saura, 1995⁶).

Resulting from the critics, the monocentric model begins to be revised, and a range of additional statements is added. Firstly, *the manageable capital stock*, the city is rebuild period by period: it does not exist externality. If the inclusion of this statement is accepted, negative agglomerations of the CBD surroundings, can not be expounded, because if the city has been regenerated in any moment of time, the center has the same conditions of any other zone of recent construction.

Secondly, and in a pretended revision of the disjunctive model, in the Anas' work (1978) and others⁷, we find analysis where the *capital stock is not manageable, and moreover, it lasts a long time*⁸.

This is the way where the reality of a city that offers a growth based in circles is defined: the historical center, the circle of its surroundings, the first enlargement, the second one, etc. Each one responds to a different periods of time, and this is why it offers different services, even it is really probable that they offer the last ones in a better quality than the first ones. The new enlargements can undermine the importance of the CBD as a simple determinant price's force because the new zones has better services than the old ones and they also make good use of the localization demand^{9,10}.

In third place, far from the orthodoxy, an alternative approach that explains the housing price arises from a larger ensemble of variables than the simple distance to the CBD, the called *Tiebóut Model* (1956). Tiebóut exposed that the election of the agents is based on the preferences for determinate zones or surroundings, e.g. the localization demand is defined for the conditions of the surrounding where the housing is placed, this can or can not be influenced by the distance to the CBD¹¹.

This approach relieves the existence of a notable number of factors that can fall in the agents decisions, among them, stands out the followings:

⁶ In his work , explains, as well, that this situation gets worse in the low rent stretches where the range of election possibilities seems much more reduced.

⁷ For a wider revision head for Arnott (1987).

⁸ The reasons for the variation of this statement are obvious: on one hand the housing is a good that intrinsically lasts a long time. On the other hand there is not the capacity by the local authorities to continually regenerate the cities, to try to lessen the damage caused as time goes by.

⁹ In the work of Wilkinson (1974), this situation in the city of Leeds was exposed.

¹⁰ In the last years, as well, the abandon and damage that the center of the cities are suffering, from the consequence of the emigration to zones with better equipments and infrastructures, cause a low inertia to the CBD.

¹¹ This posture involves a large concept of acceibility, keeping in mind other factors that are not contemplated in the classical models. Because of that, in this 'heterox' approach, the model based in the economies of scale, or agglomeration models, heritage from the analysis of the industrial use floor, are integrated.

i) Environmental.

ii) Neighborhood or of the neighborhood's quality (Ball, 1973; Wilkinson, 1974b; Shafer et al., 1975; Kain & Quigley, 1975; and others)

iii) The social Status (Bol  at, 1976)

iv) Other externalities: the closeness to a golf field, to a good school, existence of parking¹², etc..

Under this approach, a major number of variables, those specially related to the quality of the neighborhood, are kept in mind, and they begin to take part of the determinants of the housing price.

Finally, the major critic received from the monocentric model arrived from the reality of a modern city: the decentralization of the cities seems a general phenomenon, even in commercial questions than laboral. In the work of Henderson (1985)¹³, as well, there was the fact that in the big cities there is a decentralization, and α is lower each time, as commercial sub-centers and employment are borning.

It is shown in this line the critic of Turnbull (1990), where it is reveal not only the decentralization of the city but the promotion of others C.B.D: the called *multicentrical structures*. This produces the loose of explanatory capacity of the disjunctive model, because:

i) the C.B.D. is not more the only one, so there is more than one inertia, appeared from the new promoted centers.

ii) in the housing commercial use, the center force gets diffused between the different C.B.D., and

iii) it is not more a desirable place of residence for those ones that prefer the center, if the new ones have better infrastructures than the old one, that means dilapidated.

This critic answers, with much approximation, to the reality of the urban core. In the last years, the growing of the cities and the appearance of new business centers bring up the existence of a major number of inertia or forces more than an only one C.B.D.

¹² In the last years, the ratio number of cars per family, has notably increased, so the existance of place for parking near the residence becomes, more each time, a defendand characteristic (Bra  as and Caridad, 1996). This produces the high prices of parkings.

¹³ Like Hochman and others (1982), where the sapacial analysis of the city already kepted in mind the loose of importance of the C.B.D., e.g. decreased its dimension and its strength in the prices, but in a distances analysis. Despite of this, in this work, the restriction of the center to be the only one, becomes established.

Summarizing, during the last years, a big number of works in the urban economic ambit, which they try to explain the residential localization, have arised, even in a more classical focusing or from a more hetherodox point of view.

The objective of this work is just to contrast a major number of variables in a classical model paying attention to the distances typology, even introducing a variation accepting the existence of rent distances. For this objective, a urban medium-sized nucleus is analyzed, the city of Córdoba, from which we have an extensive database, and where physical variables from more than a thousand sold houses in 1996 are collected.

The work have different parts. The first one collects the materials and methods used for the study realization. In the second one, a serie of questions concerning to the classical urban model are formulated. The questions are the followings: 1- which is the role of the internal distances?. 2- is really determinant the distance to the C.B.D.?. 3- does the north-south differences exist?.

In the third part, the first results are analyzed, and some answers to the questions are offered, attending the stylized facts founded in the available samples. In the fourth part, new questions are done: which are the vagueness causes of the neoclassical model?, and where are the centrifugal and centripetal forces?. In the fifth it concludes.

1. MATERIAL AND METHODS

The information used in the present work, originates from a database that is being accomplishing in the Statistics Department of the University of Córdoba, and some of its projects have already been published. Its collection goes carrying out using surveys, accomplished to Agents of the Real-estate Property, that operate in the city of Córdoba. For the elaboration of these projects it has also been counting on opinions of experts, like the town hall of the city, Management of town planning and the Traffic Department.

With this information it has been able to accomplish indices that represent characteristics sets of the housing, and that bring together the whole information collected in the survey. In this way, from the joint of original variables, are resulting for the analysis the followings:

- Selling price of the housing (P), Surface of the same: useful square meters (S_1), number of dormitories (S_2), number of baths (S_3), number of built-in closets (S_4).
- Distance to the CBD ($DCBD$), and distance of the housing to the center of the zone (DI).
- Installations Index (IFV_1)¹⁴, Conservation Index (IFV_2), Improvements Index (IFV_3), Comfort Index (IFV_4), Convenience Index (IFV_5).

¹⁴ Physical Index of the Housing: index that make exclusive reference to the own state of the housing and attributes of the same.

- Congestion Index (IC), Attributes Index of the building (IAF_1), Construction Age (IAF_2), and Medium Rent Index (R).

To contrast the importance of the different attributes of the housing in its price, we will frame ourselves within the methodology of the hedonic price models. These were introduced by Waugh (1928), Court (1939), Griliches (1961), Lancaster (1966), Chow (1987), etc¹⁵...being their purpose the analysis of the price of a good, in function of its multiple characteristics, by the estimate of the implicit price of each one. The fundamental developments of the hedonic methodology, applied to the analysis of the housing correspond to Rosen (1974) and Witte et al. (1979). In their projects is offered a theoretical and methodological support for this kind of studies.

The hedonic tradition indicates that the function of the implicit prices - that is obtained from the regression of the prices on the characteristics - collects the market price that answers to the citizens demand, and in consequence, to their usefulness function: the set of attributes that maximizes it (Parker et al., 1993; Brown et al., 1982).

From such definition, in this work it is going to accomplish the estimate of the implicit prices equation in the city of Córdoba. The estimate hedonic equations have functional forms not too complex, since the principal objective of this study is not the determination of the housing price, but an analysis of the components that take part in it.

2. QUESTIONS

To order the set of problems we want to outline to the topic, the present paragraph is articulated in questions, trying in this way to systematize the content of the same.

Question 1. Which is the role of the internal distances?

Definition 1. Internal distance ($DI_{f,i}$) is the length of the ratio from the central point of a urban zone f to the point i of such zone f , $i = 0, 1, 2, \dots$, being $i = 0$ \forall central point of the zone (CBD_f). Then $DI_{f,0} = 0 \forall f$.

Proposition 1. If we accept that the distance to the CBD provokes variations in the housing price due to the commercial activity, and if we accept that commercial activity in each f zone exist, then we will also find variations in the internal price of a zone ($p_{f,i}$) in function of the distance of the i point to value in the central zone ($DI_{f,i}$), where the primary commercial transactions of their inhabitants are carried out.

Under this criterion we try to analyze if meaningful differences in the price of the housing exist, according to the location in a central point or other in the neighborhood to which belongs¹⁶, or if, on the contrary, the internal distance does not result meaningful in the attributes demand from the housing. In other words, we try to contrast if there

¹⁵ All of them cited in Brañas (1997).

¹⁶ Since go to the center of the neighborhood to accomplish primary purchases also has medium costs in time and money.

exist other variable distance that the inhabitants of the city could consider in the maximization of the 'price/ratio' distance.

Question 2. Is it determinant the distance to the CBD?

Definition 2. Distance to the CBD ($DCBD_f$) is the length of the ratio from the central point (CBD) of a urban nucleus to the center of the zone f (CBD_f), where $DCBD_{CBD} = 0$.

Proposition 2. Due to the fact that not all the economic activity is concentrated in the CBD and not all the work places are offered in this point, then not all the citizens minimize $DCBD_f$. So, it does not exist a g decreasing function, $p_{f,i} = g(DCBD_f), \forall i \in f$.

According to the disjunctive model, the price of the housing gets maximum in the CBD, since the commercial activity generates a greater housing demand for not residential use and so increases the prices of it.

Attending in exclusive to the maximization of the 'price/distance ratio to the CBD', attributes related to the quality of the neighborhood or of the environment (orthodox approach or of Tiebout), are not outlined as additional variables. In this sense, is the distance to the CBD the only one explanatory variable of the housing price.

If furthermore, we keep in mind that it exist the possibility of working out of the CBD and that, also, in this we find serious congestion problems, noise, begging, etc., then it can not be as place of optimum residence by the citizens.

Question 3. Does differences north-south really exist?

Definition 3. We say that a city is symmetrical (or circularly symmetrical) if $\forall f / DCBD_f = k, P_{f,i} = c, \forall i \in f$.

Proposition 3. If the occupational activity is not concentrated in exclusive in the CBD and this is not the only one, and if it exists some kind of externality related to the geographical location, then the cities are not symmetrical.

3. RESULTS

From the available information, housing data of the city of Córdoba, throughout this paragraph, the stylized facts for this urban nucleus are contrasted. The obtained results are only intended to expose as a case of analysis, and because of that, are not extended as global conclusions.

The obtainment difficulty of this type of samples, hinders by the moment the amplification of the work to other nucleus, and because of this, the results are shown as a particular case in experimental phase.

The model that here is contrasted analyses the price of the housing in function of its attributes (or characteristics), framing us in the hedonic tradition. This is why linear and logarithmic regressions that continue the following specification are accomplished.

$$\hat{P} = \hat{\alpha} + \hat{\beta}_1 z_1 + \hat{\beta}_2 z_2 + \hat{\beta}_3 z_3 + \dots + \hat{\beta}_n z_n + e \quad [1]$$

$$\hat{P} = \hat{\alpha} z_1^{\hat{\beta}_1} z_2^{\hat{\beta}_2} z_3^{\hat{\beta}_3} \dots z_n^{\hat{\beta}_n} e \quad [2]$$

where z_i are the attributes¹⁷ of the housing

$$i = 1, \dots, n$$

The objective that is pursued with such estimates is in the first case, the obtainment of the implicit price of the relevant attribute contents in the hedonic equation. And in the second, the estimate of the attributes elasticity that result meaningful.

The estimate of the equation [1] is accomplished below, where all the coefficients are significantly different from zero for $\alpha= 0.01$ and the coefficient of tight determination $R^2= 77.8\%$. As consequence of the presence of heterocedasticity in the residues, the method of the minimal square weighted (WLS) is used continuing the plan of White.

$$P = -5127.1 + 1179.5 DI + 133.2S_7 + 448.2S_3 + 1532.0R + e \quad [3]$$

(-310.2)¹⁸ (194.5) (747.5) (41.3) (329.2)

The residues of [3] do not continue a Normal distribution (Jarque-Bera=184150.5, $p_{JB}= 0.00$) neither present stability, since surpass widely the bands of the Cusum test.

¹⁷ Understanding by attributes all those characteristics of the housing, already they be those from the zone (or environmental quality, social, ...of the neighborhood, of the property or of the good in itself (surface, quality, antiquity, etc..).

¹⁸ The value of the t-statistic is shown between brackets.

The difference in measure scales of the variables can carry us to biased interpretations of the results, this is why we analyze the coefficient of t-statistics obtained by each one of the variables to interpret the importance of each one of them in the explanation of the price (yet accepting what was commented in the previous paragraph).

- It is observed that S_1 is the one that explains the price in a large way, i.e. unitary increases in the surface in meters of the housing provoke high variations in the price of the housing.
- In the same way, the quality of the neighborhood in rent terms (R), also explains an important part of the variability of the price.
- The internal distance (DI) also seems relevant, though in minor measured, as meaningful variable.
- The variable S_3 does not seem to be an explanatory excess of the price, surface measured in baths, even turns out to be significantly different from zero.
- And finally, that neither the distance to the center ($DCBD$) nor other variables related to the environment of the property neither to the own housing seem to influence the price determination.

The lack of Normality in the disturbances, as well as the need of imposing a WLS method for the estimate, carries us to outline if it has been a wrong specification of the functional form, the one which leads us to all these violations of the linear model suppositions. Already in the projects of Goodman and Kaway (1984) is referred that, frequently, the price of housing is related in a non-linear way to the variables, due to the influence of the interactions between these, since the relationships are given jointly and not through independent productive processes.

Even though the Box-Cox transformation, applied in Brañas (1997)¹⁹, provides better results in term of heterocedasticity, continuing to Freeman (1979) that indicates that the logarithmic form is better adjusted for the price of the housing, was decided to accomplish similar estimates for the case that occupies us.

With this objective the equation [2] was estimated, obtaining the results shown below, where all the coefficients are significantly different from zero for $\alpha=0.01$ and the coefficient of tight determination $R^2 = 78.8 \%$.

$$P = 239.9 DI^{0.03} S_1^{0.89} DBCD^{-0.07} R^{0.04} e \quad [4]$$

(48.9) (9.6) (37.1) (-12.4) (8.2)

¹⁹ Doctoral Thesis. Univ. of Córdoba. In this work, factorial methods are used to reduce the independent variables matrix and estimates in principal components are accomplished, where the price of the housing remains tranformed in the form P^λ , where λ is the optimum value for Box-Cox.

Though in terms of R^2 the model [4] does not offer important variations, we find that its disturbances are homocedastics, of Normal distribution of zero average (Jarque-Bera= 3.51, $p_{JB}=0.17$), and that the estimate parameters are stable, continuing the Cusum test. Summarizing, this specification [2] throws better results than the previous [1].

If we analyze these results we also find important differences that can help us to discover the determinants of the variability of the urban housing price, they are the following.

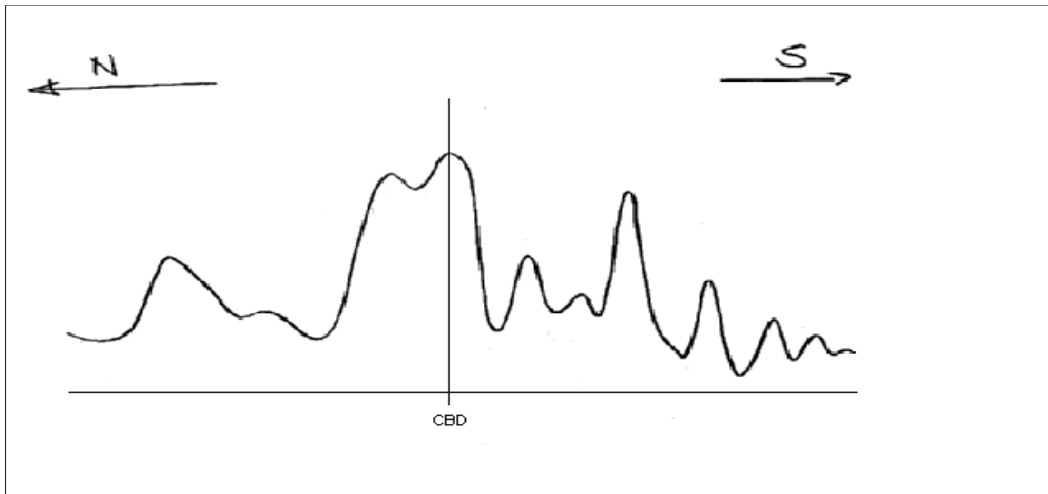
- The distance to the center (*DCBD*) appears as meaningful and the third surface measure S_3 stops being it, and does not take part in the model .
- The rest of the variables contained in [4] continue being significantly different from zero though we find some differences, like the t-statistic of the rent (*R*) is now less than the distance variable *DI*.

Under this logarithmic specification, β offer us information about the elasticities, of the ones we can derive - always keeping in mind that they are no more than particular cases - the following results.

- The elasticity of the surface (S_1) is much more superior than the rest of the variables contained. In this sense, it seems that the surface is the variable that explains the greater percentage of the price variability, and at the same time is the characteristic (or attribute) with higher implicit hedonic price.
- The variable that expresses the classic distance (*DCBD*) has negative sign - so, it is within what could be expected- though it presents a low elasticity, i.e. it does not provoke high variations in the prices.
- In the same way, the quality of the neighborhood in rent terms (*R*) is relevant but it either presents a high elasticity, so it is not really determinant for the variations of the price.
- The internal distance (*DI*) also results meaningful - but with a low elasticity- though already in minor measure as explanatory variable.

From these results, there can not be obtained other conclusions than the followings : it does not exist homogeneity in the housing offer, and the distances are not significantly important for the determinant of the price.

In the third question is outlined the importance of the North and South, and the possible differences they can provide on the set of the market. The first approximation of such differences is found in a graph expression of the medium housing price from North and South to the CBD (where the x-axis represents the distances and the y-axis the prices) that is shown below.



In this table three important facts can be emphasized: in first place, it is not observed that the price of the housing decays exponentially from the CBD toward the extremes. In second place, it is not verified that the topmost prices of the housing stay in the central area, we usually find islands. And finally it is observed a clear lack of North-South symmetry.

Then, does the North-South differences really exist?, and what is most important, where do we find such differences?. To try to contrasting, we divide the sample in two: housings from North and South and we reconsider [2] . These results are shown below.

In the first case, the North, is reached a $R^2 = 85\%$, where all the coefficients are significantly different from zero for $\alpha = 0.01$, and the disturbances continue a Normal average distribution of zero mean and homocedastic variance.

$$\text{NORTH} \quad P = 215.48 \, DI^{0.034} \, S_1^{0.88} \, DBCD^{-0.05} \, R^{0.2} \, e \quad [5]$$

(32.5) (5.8) (24.2) (-6.31) (5.3)

For the South's case, the estimate of [2] throws $R^2 = 80\%$. Also all the coefficients are significantly different from zero for $\alpha = 0.01$, and the residues of [6] are also of Normal average distribution of zero mean and homocedastic variance.

$$\text{SOUTH} \quad P = 248.8 \, DI^{0.03} \, S_1^{0.89} \, DBCD^{-0.06} \, R^{0.04} \, e \quad [6]$$

(43.7) (8.1) (32.8) (-11.6) (8.1)

In a first approximation, meaningful differences between the results of [5], those of [6] and those of [4] are not observed, since seem that they are the same variables those that begin to explain the housing price: surface, distances and rent, without excessive variations in the t-statistic.

However, it is obvious that the elasticity for the quality of neighborhood in rent terms increases substantially in [5], when is compared with [4], and [6]. So, in the North there is a greater sensibility to the variations in the quality of the neighborhood, this seems to be a determinant attribute in the training of the price.

This change in the elasticity of the rent variable can be an indicium to begin understanding why do such variations between North and South exist, since the rest of elasticities, however, do not offer large variations.

As a conclusion of results [4], [5] and [6] we could emphasize the following:

- The surface of the housing continues being the most relevant variable in the whole of the city, in the North and in the South.
- The distance to the CBD is the second more valued attribute in the case of the group and in the South.
- However, the North prefers a good quality in neighborhood terms to the nearness to the CBD.
- The internal distance is interesting to keep in mind, but it does not provide differential results.

What can we answer of what is outlined with precedence?

R.1. The role of the internal distances (*DI*) even in the model group as in the North approach, is limited, it lacks of too value.

R.2. Has relative importance, though it does not show itself in a symmetrical way, i.e. its importance is not equal in the North as in the South.

R.3. Yes, the differences exist: in the valuation of the quality of the neighborhood, as well as in the valuation of the distance to the CBD.

4. OTHER QUESTIONS

Question 4. Which are the inaccuracy causes of the neoclassic model?

Even tough the neoclassic model supposes an adequate departure base, it does not explain in a sufficiently approximated way, the training and real cities growth.

Below we expose the causes that on our understanding makes the hypothesis of the neoclassic model not be fulfilled.

(1) For the neoclassic model, **the housing is a family of identical goods** in all its attributes, unless the characteristic of the EUCLÍDEA distance to the center, that means:

If $X^{(i)}$ is a set of characteristics of a unit housing surface (to assimilate the definition to the neoclassic model we take a surface unit, in reality would be better to use characteristics of the housing, and to include the surface as one more attribute), defined in the space X , by comfort we will call $x_j^{(i)}$ to each j characteristic of the housing i , that is the element j of the x vector. We will suppose without loss of generality, that the first attribute $x_1^{(i)}$, is the distance to the center.

Definition 4: We call that the housing is homogeneous by distances if $\forall i / x_1^{(i)} = k_1$, then $x_j^{(i)} = k_j \forall j = 2, \dots, m$. We also call it homogeneous (unless distances) if $x_j^{(i)} = k_j \forall j = 2, \dots$. This last definition implies if it is fulfilled (as in the case of the typical neoclassic model) that $p^{(i)} = f(x_1^{(i)}, \cdot, a)$, being a a set of parameters and variables detached from the own housing.

Our data clearly contradicts this definition, not only the housings are heterogeneous, but also intrinsic characteristics of the housing that result meaningful in an econometric model of price's determination, like the internal distances or the north-south orientation.

(2) **There exist some attributes that determine the appearance of zones with strict local maximum price**, not only in the CBD, but in some determinate spatial positions, whose genesis is not clear.

Definition 5: We define local CBD, LCBD as such a point that $P_{LCBD} > P_i \forall i / d(i, LCBD) \leq \varepsilon$, for some $\varepsilon > 0$ and $d(i, LCBD) > 0$. LocCBD is the set of points that fulfill those properties, that means $LocCBD = \{y \in X / P_y > P_i \forall i / d(i, y) \leq \varepsilon, \text{ for some } \varepsilon > 0 \text{ and } d(i, y) > 0\}$. For definition $CBD \in LocCBD$. Of course, for the neoclassic model the LocCBD set has an only element that is the CBD.

In the previous table, we can observe the existence of several locals CBD, one of those is the own CBD, that contradicts the neoclassic hypothesis. And, even these points are not symmetrical.

Some hypothesis about the cause of the existence of these LCBD can be formulated, the principal is to suppose that there exist some social attributes (read status) that make very desirable some zones in front of others. However to try to establish the genesis of these LCBD one must to go beyond (the social attributes are created, they do not exist previously), and in *this area the ideas are going stumping*. Some explanations without structure that can emerge are, the difference of intrinsic quality in the zone (neighborhood) as compared to the other, this can be provoked by causes as for example the existence of landscape zones, the establishment of a mall of large dimensions. Or the barriers existence that guarantee that the inhabitants of the zone will have high status (like large surface housings, urban development norms that limit the construction of low quality housings, or high prices in the first promotions of the zone).

We do not explain either the transformation of a normal residential zone in LCBD, that it must be caused by the modification of some characteristic (the most topical case is the own growth of the city, that upon increasing the distances until intolerable terms for the consumer, carries to the creation of intermediate CBD as reduction force of the displacement congestion, being of course the origin of this creation, normally, the local governments)

(3) Linear asymmetry of the city. Even though the linear model supposes circular symmetry of the city (see question 3), it is an empirically contrasted fact that most of the cities present a pronounced North-South asymmetry (curiously similar to other famous economic asymmetry). Most of the cities of the world present a greater concentration of high rent citizens (and high housing prices) in the North extreme of the city, while the lower rents prevail in the South extreme. There exist exceptions to this principle, normally by geographical reasons (the sea or the existence of natural obstacles), but even in this case there exist asymmetry, though of inverse character.

Our data have a technical character problem, upon using flats exclusively as housing unit, to obtain certain normalization level. This is why we do not keep in mind an important source of asymmetry (housings located in the mountain range of the city with high price and status), so the results would have to be more stressed than what is described. However, if we can conclude by fundamental points :

- In the south prevails the economic reasons for the acquisition of a housing, the same as in the general model, the determinant principal of the price will be the surface.
- In the north, the rent results much more meaningful than what is normal, what can indicate that the quality of neighborhood is really important to determine the price that will be paid for a housing. This contradicts the absence externalities hypothesis in the housing good for the neoclassic model. If we look for possible explanations to this anomaly, we need to look back to the history, because in next geographical zones, neighborhoods of very different level emerge (we will go back to this topic in the following question).
- Finally, we need to emphasize an idea, even though we are considering asymmetries, our city is still being linear (just one number is enough to characterize the position in the space of a point). The following logical step would be the introduction of a two-dimensional sketch in which each point would be characterized by two coordinates, our results would possibly be different. Moreover, why not a three-dimensional scale that would permit to homogenize the housings and the blocks.

Question 5. Do the centripetal and centrifugal forces exist?

In their work, Fujita and Thisse (1996) expose that a good urban economy study must analyze the importance of the centrifugal and centripetal forces. We understand *centrifugal* force as the trend to be dispersed, to go out of the urban nucleus; and

centripetal force as the trend to be agglomerated, i.e. the agents must find benefits even for the fact to be agglomerated, than to be dispersed.

Citing Villar, Or. A. (1996) we find that there exist reasons like the pollution, the high prices of the housing in central zones, the traffic, etc. that provoke population to go out of the nucleus. This phenomenon is usually called the *filtered process*, in the urban literature. This process outlines that the highest rent families use to acquire the new²⁰ housings, placed in recently creation zones, and to sell their old housings in deteriorated zones, to families with lower rent. If the *filtered* is associated with the no malleability of the housing, then it results that the families with lower rent, get displaced from the CBD each period of time.

In the Coke and Hamilton work (1984) is outlined a model in which filtered processes are introduced in a nucleus that grows by circles, resulting a location in the periphery for the most favored people, and when they sell their housings to those of lower rent, these ones are located in more central zones.

The force of the process gets increased by the fact that the first ones have higher rent elasticity in the space demand than in transportation cost. That means, transportation costs are not a relevant part of their budget, or at least in a lower proportion that the rest, for they have a higher incentive to go to the periphery, if this offers them the wished conditions.

Then, which centrifugal forces do we find in our analysis?. It seem obvious that even in the North as in the South of the city we find certain displacement from the center.

- In the North we could find a flight from the traffic problems, begging, dirt, noise, etc. of the CBD, since in the north there are only green zones, comfort and high quality of the neighborhood.
- In the south, however, we find a different centrifugal force, following Turnbull (1990), the promotion of two CBD alternative to the initial. In the same way, we find better public infrastructures for the spare time, less congestion problems, and generally greater green environment.

Going back to Villar, O. A. work (1996), we can find as dominant centripetal forces : the existence of scale economies, transportation costs, the workers' mobility, etc. i.e. the inertia that the CBD provokes over the rest of the city. Which determinants do we find?

- Without any doubt, the better commercial and financial services are placed in the CBD. So for the commercial use of the housing this is still being an inevitable reference point.
- Also, the still present denotation of neighborhood's high-quality in the central zones, provokes an increase of the residential location demand in this zone.

²⁰ As the building 'dies', the citizens of higher capacity, leaves.

But, if we have to evaluate, which one of the two forces prevails, we incline ourselves to think that the centrifugal forces begin to limit the influence of the CBD in the training of the prices, and consequently, the explanatory capacity of the neoclassic model.

5. CONCLUSIONS

The Internal Distances (*DI*) are meaningful and with a similar importance to the distance to the center (*DCBD*). In this sense, we say that it should have to be included in the basic model, even its importance being relative.

There exist North-South differences, even in the valuation of housing attributes, than in the influence of the CBD (*centripetal force*). Though in elasticity terms, we do not find important variations.

The perception on the neighborhood's quality seems much greater in the North than in the South of the city. This can be due to the existence of multicentric structures in the South, phenomenon that is not found in the North.

We can also find differences in terms of the good's attributes that lead us to assert it does not exist homogeneity in the housing offer. So, the basic model should include, at least, some particularity of the good in this sense.

6. BIBLIOGRAPHIC REFERENCES

- ALONSO, W. (1964).** Location and Land Use. *Harvard University Press, Cambridge.*
- ANAS, A. (1987).** Dynamics of Urban Residential Growth. *Journal of Urban Economics*, 5: 66-87.
- ARNOTT, R. (1987).** Economic Theory and Housing. In *Handbook of Regional and Urban Economics*, Mills E.S., Vol II, pp 959-998. North-Holland, Amsterdam.
- BALL, M.J. (1973).** Recent empirical works on the determinants of relative houses prices. *Urban Studies* n°22, pag 329-337.
- BOLÉAT, P. (1997).** Housing prices and the housing markets. *Housing Review*, October.
- BRAÑAS, P. (1997).** Modelos econométricos de análisis de la vivienda urbana. *Tesis doctoral, Universidad de Córdoba.*
- BRAÑAS, P.; CARIDAD, J.M. (1997).** Demanda de Características de la vivienda en Córdoba: un modelo de Precios Hedónico. *Revista de Estudios Regionales*, Vol. 3, 2º Año (1997).
- BROWN, J.N. and ROSEN, H.S. (1982).** On the Estimation of Structural Hedonic Price Models. *Econometrica*, vol. 50, n° 3, May.
- FREEMAN, A.M. (1979).** The Hedonic Approach to measuring demand for Neighborhood Characteristics. In *The Economics of Neighborhood*, Academic Press, New York.
- FUJITA AND THISSE (1996).** Economics of Agglomeration. *Journal of the Japanese and International Economics*, 10: pp 339-378.
- GOLDSTEIN, G.S. and MOSES, L.N. (1973).** A Survey of Urban Economics. *Journal of Economic Literature*, vol 11, June.
- GOODMAN AND KAWAY (1984).** Functional form and rental housing markets analysis. *Urban Studies*.
- HENDERSON, J.V. (1985).** Economic Theory and Cities, Academic Press, Orlando.
- HOCHMAN, O. and PINES, D. (1982).** Cost Adjustment and the Spatial Pattern of a Growing Open City. *Econometrica*, vol 50, n° 6, November.
- KAIN, J.F., and QUIGLEY, J.M. (1975).** Housing Markets and Racial Discrimination: A Microeconomic Analysis. *National Bureau of Economic Research*, New York.
- KANEMOTO, Y. and NAKAMURA, R. (1986).** A new Approach to the Estimation of Structural Equations in Hedonic Models. *Journal of Urban Economics*, n° 19, pp. 218-233.
- MUTH, R.F. (1969).** Cities and Housing. *Chicago University Press, Chicago.*
- PARKER, D. and ZILBERMAN, D. (1993).** Hedonic Estimation of Quality Factors Affecting the Farm-Retail Margin. *American J. Agricultural Economics*, n° 75, 458-466.
- ROSEN, S. (1974).** Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *Journal of Political Economy*, n° 82, pp 34-55.
- SAURA GARCIA, P. (1995).** Demanda de características de la vivienda en Murcia, 1995. *Secretariado de Publicaciones de la Universidad, Bibliografía*, p. 153-157, Murcia.

- SCHAFER, R.; HOLSHOUSER, W.; MOORE, K., and SANTER, R. (1975).** Spatial Variations in the Operating Cost of Rental Housing. *Discussion Paper, Department of City and Regional Planning, Harvard University, D75-4.*
- TIEBOUT, C. (1956).** A pure theory of local expenditures, *Journal of Political Economy*, n° 64, 416-424.
- TURBULL, G.K. (1990).** The pure theory of Household, Location: An Axiomatic Approach. *Journal of Regional Science*, vol 30 (4), pp 549-562.
- VILLAR, O.A. (1997).** Configuration of Cities: the effects of congestion cost and government. WP 96-17. *University Carlos III, Madrid.*
- WILKINSON, R.K. and ARCHER, C.A. (1973).** Measuring the Determinants of Relative Houses Prices. *Environment and Planning*, 5, pp 357-367.
- WILKINSON, R.K. (1974 a).** The quality of Housing and the measurement of long term changes in Houses Prices. *Urban Studies*, vol 11.
- WILKINSON, R.K. (1974 b).** The Determinants of Relative house price: a case of academic astigmatism?. *Urban Studies*, vol 11.
- WITTE, A.D.; SUMKA, H.J. and EREKSON, H. (1979).** An estimate of a structural Hedonic Prices Model of the Housing Market: An Application of Rosen's Theory of implicit markets. *Econometrica*, vol. 47, n° 5, September.

WP 9801/Nº 1

PROPUESTA DE UN ANÁLISIS ECONÓMICO PARA EL ESTUDIO DEL
PRECIO DE LA VIVIENDA URBANA

Pablo Brañas Garza; Pablo Fernández-Álvarez; José M^a Caridad y Ocerin

WP 9802/Nº 2

UN ANÁLISIS DEL CRECIMIENTO Y LA CONVERGENCIA DE LA
ECONOMÍA ANDALUZA ENTRE 1985 Y 1995

José García Roa

WP 9803/Nº 3

PHYSICAL AND NOT SO PHYSICAL DISTANCES IN A SIMPLE URBAN
MODEL: AN ANALYSIS

Pablo Brañas Garza; Javier Rodero Cosano; Joan Carles Martori

WP 9804/Nº 4

UNA EVALUACIÓN DEL CAMBIO DE ESTRATEGIA DE LA POLÍTICA
MONETARIA EN ESPAÑA: PERSPECTIVAS DE FUTURO

Antonio Martín Mesa; Francisco Alcalá Olid

WP 9805/Nº 5

URBAN MICROECONOMICS WITHOUT MUTH-MILLS: A NEW
THEORETICAL FRAME (OR THE GREAT WALKOVER)

Javier Rodero Cosano; Pablo Brañas Garza; Inmaculada Fernández Piñar

WP 9806/Nº 6

LAS EXTERNALIDADES URBANAS: ENTRE ALPEROVICH Y FUJITA

Pablo Brañas Garza; Alejandro Lorca Corrons; Javier Rodero Cosano; M^a

Angustias Dávila Vargas-Machuca

WP 9807/Nº 7

LA ECONOMIA ISLÁMICA Y SUS CONTRATOS: UNA PANORÁMICA

Pablo Brañas Garza; Alejandro Lorca Corrons; Javier Rodero Cosano

WP 9808/Nº 8

SIZE, PROFITABILITY AND AGENCY PROBLEMS IN PROFIT LOSS
SHARING IN ISLAMIC

Humayon A. D; David I. Harvey; John R. Presley

WP 9901/Nº9

CAPITAL HUMANO Y CRECIMIENTO EN EL MEDITERRÁNEO:
¿*SPILLOVERS* O DETERMINISMO GEOGRÁFICO

Javier Rodero Cosano, Pablo Brañas Garza, M^a Lucia Cabañes Argudo, Alejandro V. Lorca Corrons

WP 9902/Nº10

SOBRE EL RUIDO Y SU PERCEPCIÓN: UNA APROXIMACIÓN
EXPERIMENTAL

Pablo Brañas Garza; M. D. Alcántara Moral y Javier Rodero Cosano

WP 9903/Nº11

CRECIMIENTO ECONÓMICO ENDÓGENO Y CAPITAL PÚBLICO DESDE
UNA PERSPECTIVA REGIONAL: UNA APROXIMACIÓN

Diego Martínez López

WP 0001/Nº12

DIFFERENT PATHS OF URBAN AGGLOMERATION IN SPANISH
REGIONS: EVIDENCE FROM 1960-1998

Pablo Brañas Garza y Francisco Alcalá Olid

WP 0002/Nº13

IS THERE ANY RELATIONSHIP BETWEEN PUBLIC INVESTMENT AND
ECONOMIC GROWTH IN THE SPANISH REGIONS?

Diego Martínez López

WP 0003/Nº14

CONTRACTS IN THE AGRICULTURAL SECTOR WITH MORAL
HAZARD AND HIDDEN INFORMATION: SPECULATIONS, TRUTHS AND
RISK-SHARING.

Francisca Jiménez Jiménez

WP 0004/Nº15

HOTELLING AND THE OLYMPUS: MODELLING DIFFERENCES IN
RELIGIOUS PRICE

Javier Rodero y Pablo Brañas Garza

WP 0005/Nº16

AN EMPIRICAL MEASUREMENT OF THE EFFECTS OF EXTERNALITIES
ON LOCATION CHOICE

Pablo Brañas Garza y Javier Rodero

WP 0006/Nº17

EL ENDEUDAMIENTO A LARGO PLAZO DE LA HACIENDA PÚBLICA
ANDALUZA: UNA VISIÓN PANORÁMICA

Diego Martínez López