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Local Public Expenditure and Housing Prices

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Abstract. This paper develops an econometric specification on the basis of hedonic prices models. These models focus on markets in which a generic commodity can embody varying amounts given a vector of attributes. One issue of interest is determining how the price of a unit varies with the set of attributes it possesses. In the housing set up, and by means of capitalization, we have an instrument to capture how public expenditure influence housing prices and, by extent, how citizens benefit from it. Therefore, we introduce in standard hedonic equations government's expenditure variables in order to measure its effects on housing prices. For the empirical investigation we use individual data (aggregated at a district or neighbourhood level) for dwellings from the City of Barcelona for the period 1998 - 2001. The results show the citizens valuation, in willingness to pay terms, of local public expenditure during the period analyzed.

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Key Words: Hedonic Prices, Housing Prices, Local Public Expenditure.

1. Introduction

In recent years, the American and the European housing markets have experienced an inflationary process experiencing rapid and spectacular increases of the housing prices.[1] In Europe, Spain is an especial case characterized by the magnitude that this process has achieved. The importance of this process in the Spanish case is accentuated if we consider the coincidence of the spectacular increase of housing prices with the relatively good behaviour of the rest of prices collected in the Consumer Price Index (CPI).

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[1] See for instance, "Hot property" in The Economist, September 11th 2003. Recent data indicates that figures for mid-2003 show a slight slow-down in some countries such as America, Britain and Netherlands; however, the prices have accelerated in the rest, especially in Ireland and Spain, see "House of cards" survey by The Economist, May 29th 2003.

Data from the Spanish *Ministerio de Fomento* show that in the period 1998-2001 the price per square metre in Spain increased by 55% for houses of new construction and by 52% for houses already existing in the market (second hand or used houses). This process has been especially dramatic in big cities (and their metropolitan area) such as Barcelona and Madrid where the prices increased from 1998 to 2001 by 60% and 47%, respectively. Table 1 presents data on housing prices for Spanish cities with more than 100,000 habitants. We can observe how the rise in housing prices in Spain has been generalized, but has been especially significant in cities such as Palma de Mallorca (98%), San Sebastian (72%), Pamplona (69.3%), Mataró (66.1%), Logroño (65%), Bilbao (64.2%), Terrassa (63.1%), Baracaldo (61.6%), Málaga (61.4%) or Barcelona (60%). Moreover, we can observe how the most expensive cities in Spain, with respect to the price per square meter are San Sebastian (2,442 euros/m^2), Barcelona (1,918 euros/m^2), Bilbao (1,869 euros/m^2) and Madrid (1,854 euros/m^2).

The evolution of the housing prices has focused the attention of the citizens and political parties in recent times. Housing is considered, in the so-called Welfare State, a basic good. Moreover, the Spanish Constitution explicitly points out housing as a basic right that every Spanish citizen should have guaranteed to them.[2] Therefore, the face of such increase in the housing prices some social groups have been more directly affected, being excluded from the market and, therefore, without the possibility of enjoying decent and adequate housing. This is especially important among the young and the less fortunate individuals in the society.

From a different standpoint, housing can be viewed as an investment good for families and for firms that look for benefits in the housing market. Therefore, the housing sector can help economic growth both directly and indirectly, for instance, inducing the increase of jobs and economic activity in the construction sector, see Eastaway and San Martin (1999) for the influence of the construction sector and the effects of different housing policies on economic growth for the Spanish case.

[2] Art. 47 of the Spanish Constitution states: "All Spaniards have the right to enjoy decent and adequate housing. The public authorities shall promote the conditions necessary and establish the pertinent norms to make this right effective, regulating the use of land in accordance with the general interest to prevent speculation. The community shall share in the increased values generated by urban activities of public bodies."

Table 1. Price of squared meter in Spanish cities with more than 100,000 habitants

Spanish Cities	1998	2001	Cum. Growth	Spanish Cities	1998	2001	Cum. Growth
Andalucía				**Catalunya**			
Algeciras	503.0	605.2	0.203	Badalona	1000.1	1474.3	0.474
Almería	655.7	986.3	0.504	Barcelona	1202.0	1918.4	0.596
Cádiz	726.0	1045.2	0.440	Girona	701.4	1002.5	0.429
Jerez de la Frontera	474.8	622.6	0.311	Hospitalet Llob.	985.7	1518.8	0.541
Córdoba	597.4	832.4	0.393	Lleida	592.0	876.9	0.481
Granada	700.8	1031.9	0.473	Mataró	813.2	1351.1	0.661
Huelva	572.8	905.1	0.580	Sabadell	832.4	1262.1	0.516
Jaén	552.3	756.1	0.369	Sta Coloma Gram.	914.1	1405.2	0.537
Málaga	597.4	964.6	0.615	Tarragona	647.3	947.2	0.463
Sevilla	684.6	1028.3	0.502	Terrasa	735.0	1199.0	0.631
Aragón				**C. Valenciana**			
Huesca	573.4	825.8	0.440	Alicante	557.7	855.2	0.533
Teruel	554.1	755.5	0.363	Castellón	574.6	825.2	0.436
Zaragoza	696.0	1101.7	0.583	Elche	540.9	799.3	0.478
Asturias				Valencia	636.5	873.9	0.373
Gijón	756.7	1115.5	0.474	**Extremadura**			
Oviedo	842.0	1179.8	0.401	Badajoz	492.2	660.5	0.342
Balears				Cáceres	566.8	744.7	0.314
Palma de Mallorca	699.0	1381.1	0.976	**Galicia**			
Canarias				La Coruña	890.7	1075.8	0.208
La Laguna	676.1	997.7	0.476	Lugo	539.7	661.1	0.225
Las Palmas G. C.	801.1	1222.5	0.526	Orense	740.4	893.7	0.207
Sta. C. Tenerife	707.4	1060.8	0.500	Pontevedra	587.2	736.8	0.255
Cantabria				Santiago Comp.	911.7	1055.4	0.158
Santander	912.9	1318.6	0.444	Vigo	689.4	924.4	0.341
Castilla-Mancha				**Madrid**			
Albacete	567.4	762.7	0.344	Alcalá Henares	776.5	1091.4	0.406
Ciudad Real	596.2	793.3	0.331	Alcorcón	893.7	1396.2	0.562
Cuenca	703.8	784.9	0.115	Fuenlabrada	736.8	1098.0	0.490
Guadalajara	664.1	872.1	0.313	Getafe	840.8	1180.4	0.404
Toledo	625.1	888.9	0.422	Leganés	874.5	1215.2	0.390
Castilla y León				Madrid	1256.7	1854.7	0.476
Ávila	775.9	941.2	0.213	Móstoles	757.9	1132.3	0.494
Burgos	1088.4	1551.8	0.426	**Murcia**			
León	795.1	1033.7	0.300	Cartagena	481.4	697.8	0.449
Palencia	775.3	958.0	0.236	Murcia	500.0	696.6	0.393
Salamanca	902.7	1319.8	0.462	**Navarra**			
Segovia	838.4	1074.0	0.281	Pamplona	977.2	1655.2	0.694
Soria	780.7	942.4	0.207	**País Vasco**			
Valladolid	830.0	1172.0	0.412	Baracaldo	897.3	1450.2	0.616
Zamora	634.7	837.2	0.319	Bilbao	1138.3	1869.7	0.643
La Rioja				San Sebastián	1419.6	2442.5	0.721
Logroño	715.2	1180.4	0.650	Vitoria	1194.8	1743.5	0.459

Notes: Data from Spanish *Ministerio de Fomento*. Prices in Euros.

Both the social and the economic importance of housing in developed societies make the topic of the evolution of its prices interesting from different points of view. Moreover, the causes of such evolution become crucial for the policy maker to deal with the social, and by extent economic, problem of high property values. Many can be viewed as the causes of the spectacular rise in the price of property in Spain in recent years, for an excellent survey see Trilla (2002). The author highlights factors such as family composition, migration flows and adaptation of housing to new quality standards as a possible cause of the rise in prices.

We focus our attention on another variable we believe has an impact on housing prices: local government spending. Governments have the task of preventing speculation in the housing markets as wells as in adopting measures directed to guarantee the right to have a home. In fact, we observe how governments adopt property taxes, land laws, public housing and urbanity plans which can directly affect the evolution of the housing market in its different aspects. For instance, Bell and Man (1996) study the capitalization of different local sales taxes on the value of owner occupied housing in the Phoenix metropolitan area, and Manrique and Ojah (2003) point out how the Spanish fiscal policy helps ownership in the face of renting property (for both the main and the secondary housing).[3]

Housing prices can be also affected by other public policies, especially those local policies directed to enhance the quality of life of the inhabitants in, for instance, a city. Haughwout (1997) examines the effects of the provision of infrastructures in central cities combining 1989 microdata on suburban housing values for 30 US metropolitan areas. Moreover, Haughwout (1997) defines that the value of a house in a given jurisdiction within a metropolitan area is determined by factors specific to the house (structural characteristics and its built-in equipment), characteristics of its home jurisdiction, a neighbouring jurisdiction and its metropolitan area. The author concludes that larger public capital stock in the central cities of metropolitan areas have a positive effect on suburban land values.[4]

Although there are various works that deal with the housing market for the Spanish case such as, for instance, Bover (1993) who focuses on the dynamics of housing prices, López-García (1996, 1999) and Bilbao-Terol (2000) who study the impact and

[3] Spain has the second largest share (behind Ireland) of households owning homes, close to 80% in 2003.
[4] Haughwout (1997) also analyses the effect of local fiscal policies on suburban land values.

valuation of certain tax and housing policies, there are no studies dealing with the effect of local government spending on housing prices for the Spanish case.

The aim of this paper is to study the causes of the evolution of the housing prices in the City of Barcelona for the period 1998 - 2001. In particular, we are interested in the effect that local government spending can have on housing prices, expecting *a priori* a positive effect given that a house represents not only a bundle of structural characteristics but also a set of characteristics especific to location. Public policies at a local level are directed to enhance those location characteristics of a particular area and, therefore, the value of houses in that area are affected by local public spending. For this purpose, we use an econometric specification, on the basis of hedonic prices models, and a two-stage procedure to capture how public expenditure influences housing prices using individual data (aggregated at a district, neighbourhood or statistical zone level)[5] for dwellings in the City of Barcelona.

The paper is organised as follows. Section 2 briefly reviews the relevant economic literature and presents a model of housing value determination. Section 3 describes the data base used in the empirical estimation while section 4 present the methodology employed. Section 5 presents the main results obtained. Finally, section 6 concludes.

2. Hedonic Price Models

Despite the existence of previous hedonics studies,[6] it was not until Rosen (1974) that a well-defined and integrated theoretical model that implied the correct interpretation of the estimates was provided. Rosen (1974) presents a treatment of hedonic theory and the demand for and supply of differentiated products. In Rosen terms, differentiated products are assumed to be made up of various characteristics or attributes. These attributes are not explicitly traded on markets, but the implicit marginal prices of these attributes can be revealed by hedonic regressions.

[5] See section 3 for the definitions of locations in the city of Barcelona.
[6] Hedonic techniques were developed by Andrew Court in the 1930s and popularized by the contribution of Griliches (1961) which focused on the automobile sector.

Numerous studies have used the hedonic price framework to analyse the housing sector, for instance Goodman and Kawai (1982), Palmquist (1984), Ihlanfeldt and Martínez-Vázquez, (1986), Linneman and Voith (1989) or Anglin and Gençay (1996). Others studies have focused, by means of capitalization, on the willingness to pay of some neighbourhood amenities such as parks, schools or undergrounds. In this framework, we can emphasize the contributions of Cheshire and Sheppard (1995), Bell and Man (1996), Bilbao-Terol (2000), Bogart and Cromwell (2000), Haider and Miller (2000), Gibbons and Machin (2001), Downes and Zabel (2002) and Tse (2002).

We follow Man and Bell (1996) to develop a model of property value determination. We first assume that all households belong to the same city; however, we specify a strictly quasi-concave utility function identical for all households living in the same location in the city (district, neighbourhood or statistical zone). The utility function takes the following form:

$$U(H, X), \tag{1}$$

where H and X are vectors of housing services and non-housing consumption, respectively. We assume that those services are equal for all households regardless of where they live in the city. Moreover, H refers of services received from the physical characteristics of housing (for instance, squared area, number of bedrooms, heating system, condition or elevator). Households have a budget constraint that in terms of wealth (W) is given by:

$$W = P_X X + P_H H + P_L L, \tag{2}$$

where $P_H H$ + $P_L L$ are the benefits of housing services (B_H), which depend on the services received by the physical characteristics of the house (H) and its valuation (P_H), and on the location of the dwelling in the city (L) and the valuation of the area (P_L). Therefore, normalizing the price of the non-housing good to 1 (P_X=1), the utility can be rewritten as:

$$U(H, W - B_H). \tag{3}$$

This equation implicitly defines de consumers housing function:

$$B_H = B(H, L, P_H, P_L; W), \quad (4)$$

P_H and P_L are the valuations, or willingness to pay by consumer, for the physical characteristics of the dwelling and its location characteristics, respectively. Both can be considered hedonic prices given that are not directly observable but can be revealed from the implicit markets for these characteristics, and are estimated in the empirical section of the paper.

To obtain a specification that can be empirically tested, we define the value of a house, in equilibrium, as the net present value of the benefits of housing, that is:

$$V = \frac{(B_H - \tau V)}{(1+\theta)}, \quad (5)$$

where τ are local taxes (assumed constant in all locations of the city) and θ is the discount rate. The housing price equation derived from equation (5) can be empirically tested with a set of data on housing characteristics and locational attributes. Therefore, the empirical model is specified in the following form:

$$V_{ij} = \frac{1}{1+\theta+\tau} + \sum_k \hat{P}_{H,k} H_{i,j,k} + \hat{P}_{L,j} L_j + u_{ij}, \quad (6)$$

where V_{ij} is the sales price of the i^{th} house in the j^{th} location of the city and $j = 1, 2, \ldots, J$, with J giving the number of districts, neighbourhoods and statistical zones in each regression, $H_{i,j,k}$ is a vector of housing characteristics, L_j are the locational characteristics and u_{ij} is an error term. The property tax, τ, for an individual unit is assumed constant across units and, therefore, it is part of the constant term of equation (6) which is estimated in a first stage in the empirical section, obtaining the effects of housing and location characteristics on housing values (prices).

Moreover, we assume that the valuation of a location is a function of local public spending (G_j) in a given area, j, and other variables (K), for instance, subway, transport facilities, green areas, distance to the city centre, or accessibility. This relation can be stated as follows:

$$\hat{P}_{L,j} = F(G_j, K). \quad (7)$$

The empirical counterpart of equation (7) is:

$$\hat{P}_{L,j} = \delta + \gamma G_j + \mu K + e_j \,, \qquad (8)$$

where δ is a constant term and e_j is an error term. Equation (8) is estimated in a second stage using as dependent variable the results from the first stage.

The effects of local public spending, G_j, on patterns of urban (or metropolitan) development follow a different strand from the literature and there are not many studies that deal with the effect of local budget on housing prices. Apart from the contribution of Haughwout (1997), the effects of local public spending have been analysed from many points of view, see Ingram (1998) for a review, being the effect of public infrastructures on the development of cities the main focus of such strand of the literature. This paper wants to fulfil this gap and pretends to obtain estimates of the effect of local public expenditure on housing prices and, therefore, the citizen’s valuation, in willingness to pay terms, of this type of public expenditure measured from its capitalization on the price of the dwellings in the City of Barcelona.

3. Data

In this section we describe our data base which mainly consists of two groups of variables. First, we use variables concerning the physical characteristics of the dwellings in the City of Barcelona. Second, we collect data of public spending by the City Council. Both sets of regressors are used to study the determinants of housing prices in a two stage econometric approach explained in the next section.

We perform our study for three different levels of geographical aggregation in the City of Barcelona: districts, neighbourhoods, and statistical zones. There are 10 districts which correspond to political and economic divisions of the city. Each district is divided in neighbourhoods; there are 38 neighbourhoods which correspond to the historical divisions of the city. Finally the City Council defined 248 sub-divisions of the city and called them “statistical zones”, each of these zones have approximately 10,000 inhabitants and were defined for statistical purposes.

Data on housing characteristics is defined for dwellings. Data on local public spending is obtained at a district level and we disaggregate it to neighbourhood and statistical zone as explained below. Finally, data on population has been obtained for the three levels of geographical aggregation from the *Instituto Nacional de Estadística* (INE, Spanish National Statistical Institute) and covers the relevant data span.

3.1. Housing Characteristics

The database with information on the physical characteristics of properties in the City of Barcelona is provided by *Tasaciones Inmobiliarias S.A.* (TINSA). It contains information on 11,744 individual dwellings for the period 1998 - 2001. For each dwelling, we have information on price of the square metre, floor area, number of bedrooms, number of bathrooms, availability of elevator, heating system, floor number, condition, antiquity, number of years from the last reform, and a variety of area identifiers (localization indicators). The area identifier indicates the statistical zone at which each observation belongs and, therefore, we can easily group observations by neighbourhood and by district. Individual data is organised as follows: we delete repeated dwellings (dwellings from the same location with exactly the same characteristics) and those for which we do not have the floor number; we have 9,296 dwellings left.

Next, we define the physical variables we include as housing price determinants. Moreover, table 2 presents a summary of these characteristics for dwellings in Barcelona.

(i) Floor area in square metres denotes the surface of the dwelling. We make use of a variety of functional form for the hedonic price function of floor area.[7] We specify the following relationship between the price per square metre (p) and the floor area (S):

$$\ln(p) = \lambda + \beta \cdot \ln \frac{S}{1+S^{\varphi}}, \qquad (9)$$

[7] For other functions of the relation between price of square meter and surface, see Anglin and Gençay (1996).

where λ, φ and β are parameters to estimate. In this specification, the price-elasticity of p with respect to S is:

$$\varepsilon = \frac{dp/p}{dS/S} = \beta \cdot \frac{1+S^{\varphi}\cdot(1-\varphi)}{1+S^{\varphi}} \,. \tag{10}$$

In particular, the logarithmic constant elasticity model appears if $\varphi = 0$ and, therefore, the price-elasticity is the estimated parameter β. On the other hand, any other value of φ lead to a decrease elasticity model of p with respect to S, as S increases. Note that when S tends to infinite, the elasticity tends to zero. Fixing $\varphi = 1$[8] makes easy to interpret the elasticity in equation (10), which is reduced to:

$$\varepsilon = \frac{dp/p}{dS/S} = \beta \cdot \frac{1}{1+S} \approx \frac{\beta}{S} \,. \tag{11}$$

Equation (11) indicates that the elasticity price-floor area, ε, is decreasing, that is, as long as the floor area of a dwelling increases, and given that β is constant, its effect on housing prices, in absolute values, decreases. The sign of this effect corresponds to the sign of β, hence, a positive (negative) estimate indicates that an increase of the floor area increases (decreases) the price of the square meter, but always at a decreasing rate.

(ii) Year of the observation in four dummy variables that correspond to the years in our data span: 1998 – 2001.

(iii) Antiquity of the dwelling. This variable indicates how old each dwelling is in our data base, and it is available for seven categories: new, between 1 to 5 years old, 6 to 10 years old, 11 to 20 years old, 21 to 30 years old, between 31 to 50 years old and more than 50 years old. We expect, a priori, a negative effect of antiquity of the dwelling on its price.

(iv) Availability of elevator is a dummy variable that takes value equal to1 if the dwelling belongs to a building that disposes elevator. We expect the effect of this variable to be positive on housing prices.

[8] We have performed various estimations of equation (9) for different values of φ, obtaining the maximum value of the likelihood function for φ close to 1.

(v) Floor number indicates the position of the dwelling in the building. This variable distinguishes the following five categories: ground floor, first, second, third to six floor, and attic.

(vi) The outside condition of the dwelling refers to the conditions of the front part of the building expecting that buildings with better outside fronts are more valued by buyers.

(vii) The internal condition of the dwelling indicates the general condition of the dwellings. This variable distinguishes among five categories: very bad, bad, normal, good and very good condition. We expect, ceteris paribus, that dwellings in good conditions cost more than those in bad conditions.

(viii) The availability of heating system in the dwelling is an important housing characteristic that can affect, a priori, positively the price of the dwelling.

(ix) Last reform. This variable informs us about the number of years passed from the last reform performed in the house. This variable is divided in four categories: last reform in the last five years, between 6 and 10 years, between 11 and 20 years, and more than 20 years from the last reform. Recent reforms in the dwelling could be reflected in higher housing values.

(x) Area identifiers. The database incorporates for each individual dwelling three area identifiers: district (10), neighbourhood (38) and statistical zones (248). This variable allows us to group variables in the three geographical areas analysed.

Variables from (ii) to (x) are dummy variables. The specification of these dummy variables is linear. Table 2 presents a summary of the variables explained for dwellings in the City of Barcelona. We can observe that, on average, the sample of dwellings have a floor area around 85 squared meters, with an antiquity over 20 years although in good interior and exterior conditions, this could be explained because many dwellings have been reformed in the last five years and the City Council promoted the rehabilitation of the facade parts of houses in Barcelona.

Table 2. Housing Characteristics in Barcelona, 1998-2001.

Variable	1998	1999	2000	2001
Area	86,02	83,97	84,42	85,86
Heating System	0,326	0,353	0,351	0,625
Exterior Condition	0,829	0,855	0,846	0,827
Antiquity				
New	0,032	0,030	0,043	0,034
Between 1 and 6 years	0,026	0,016	0,020	0,026
Between 6 and 10 years	0,020	0,016	0,023	0,013
Between 11 and 20 years	0,171	0,126	0,087	0,073
Between 21 and 30 years	0,327	0,316	0,292	0,260
Between 31 and 50 years	0,208	0,246	0,279	0,294
More than 50 years	0,215	0,249	0,256	0,298
Interior Condition				
Very Bad	0,002	0,170	0,003	0,023
Bad	0,040	0,297	0,052	0,068
Normal	0,613	0,367	0,639	0,614
Good	0,315	0,119	0,276	0,231
Very Good	0,030	0,047	0,031	0,061
Reforms				
Last reform between 0 and 5 years	0.455	0.433	0.415	0.448
Last reform between 6 and 10 years	0,167	0,176	0,173	0,162
Last reform between 11 and 20 years	0,165	0,167	0,173	0,159
Last reform more20 years	0,180	0,194	0,196	0,188
Elevator	0,642	0.605	0.590	0.590
Floor				
Ground	0,046	0,051	0,061	0,070
First	0,133	0,167	0,136	0,147
Second	0,157	0,174	0,177	0,180
Third or Higher	0,607	0,497	0,508	0,545
Attic	0,055	0,109	0,115	0,055

Notes: Own calculations from database provided by TINSA.

3.2. Data on Local Public Spending

Data on local public expenditure for the City of Barcelona is obtained from *Gaseta Municipal*, publication of the City Council. This publication contains information on the composition of the local budget. The time span covers the period 1997 - 2001; this allows us to introduce one lag of this variable in the regression to test the effect of the previous spending on current housing prices.[9]

Budget information on public expenditure is divided into nine types: personnel, purchases of goods and services, payment of interests, current transfers, real investment, capital transfers, variations of financial assets and variations of debt. Data for payment

[9] We consider that public spending needs some periods to be "effective" or perceived by citizens.

of interests, variations of financial assets and variations of debt is not available disaggregated for districts. The remaining types of public spending are provided at a district level, which corresponds to spending realized in each district. In our empirical estimations we make use of two types of local public spending at a district level: purchases of goods and services and real investment.

Table 3 presents data of the budget of the City Council of Barcelona. Spending in districts represents the 12-16% of the overall budget. Purchases of goods and services and real investment represent approximately the 70% of the overall level of resources employed in districts.[10] The reasons of using these two types of spending are the following. First, they constitute two of the biggest shares of public resources employed in districts. Second, we consider that these two types of expenditure are used by the City Council to improve the quality of the district and, therefore, can be considered that directly affect the location characteristics of dwellings, while current and capital transfers are insignificant at a district level and cannot be considered as directed to increase the quality of the district, similar argument applies for spending on personnel.

Table 3. Local Public Spending in Barcelona by Districts and Type of Expenditure.

	1997	%	1998	%	1999	%	2000	%	2001	%
City Council Budget	1385429		1442931		1427097		1372905		1477740	
District Budget	165423	0,12	177799	0,12	194348	0,14	213180	0,16	208235	0,14
Personnel	51296	31,0	53520	30,1	55908	28,8	57693	27,1	58829	28,3
Purchases G. & S.	71133	**43,0**	77120	**43,4**	84387	**43,4**	86852	**40,7**	97228	**46,7**
Current Transfers	4060	2,5	4379	2,5	4459	2,3	4547	2,1	4777	2,3
Real Investment	38934	**23,5**	41879	**23,6**	49274	**25,4**	64088	**30,1**	46863	**22,5**
Capital Transfers	0	0,0	902	0,5	321	0,2	0	0,0	538	0,3

Source: *Gaseta Municipal* (various years). Figures in thousands of euros.

Information from the local budget provides detailed information on what the resources devoted to purchases of goods and services and real investment are used for. Purchases of goods and services refer to programs such as educational services, environmental policies, waste management, street cleaning, public libraries or street lightning, which are services directed to increase the "quality of life" of districts. Real investment is used in programs that can be considered as "productive" for the district.

[10] Note that the remaining part of the local budget is not assigned to any district and, therefore, we cannot establish its correspondence with any geographical area. Moreover, the two types of expenditures analysed obtain their bigger vale, precisely at a district level.

To study the effects of public spending on housing prices we have assigned district data on expenditure to neighbourhood and statistical zone level following two criteria. First, information on real investment is provided disaggregated (at a street level) allowing us to assign this type of expenditure very precisely to each statistical zone and neighbourhood. Data for purchases of goods and services is not detailed at a neighbourhood or statistical zone; therefore, it has been assigned using the benefit approach (see Espasa, 2001). According to the benefit approach the assigning of expenditure depends on where the beneficiary resides. Therefore, the statistical indicator that best represents the beneficiaries of public goods and services is the population living in each neighbourhood and statistical zone.

Finally, we have labelled the variables as follows: $G_{2,t}$ and $G_{6,t}$ represent local public spending in purchases of goods and services and real investment, respectively.[11] $G_{26,t}$ is the aggregate of both types of public spending. Finally, the time subscript *t-1* for these variables indicates that they have been introduced in the regression with one lag value.

4. Methodology

The estimation of the effect of local public spending on housing prices is performed in two stages. In an initial stage, and following equation (6), we estimate a regression model with individual fixed effects of the following type:[12]

$$v_{ij} = \alpha + \sum_k \hat{P}_{H,k} H_{i,j,k} + \hat{P}_{L.j} L_j + u_{ij} \qquad (6')$$

where v_{ij} is the logarithm of the price of the square meter, α is the constant term, $H_{i,j,k}$ represents the vector of *k* physical characteristics of the dwellings, L_j is the location of the dwelling which is considered as an individual fixed effects, and u_{ij} is an error term. The subscript *i* refers to each individual of the sample (dwelling) and subscript *j* stands for the resulting groups from the interaction of the location and year dummies.[13]

[11] The subscript 2 and 6 refers to the order that the City Council of Barcelona present these types of expenditure in its budget.

[12] This specification follows García et al. (2003).

[13] We compute these groups, corresponding to all locations in the four years of our data base, to compute the growth rates of these fixed effects.

Estimating equation (6') we obtain an estimate of $\hat{P}_{H,k}$ which indicates the effects of the physical characteristics of dwellings in its price. Moreover, we obtain the estimate of the individual fixed effects, $\hat{P}_{L,j}$. Adding the constant term to these individual (or locational) fixed effects we can interpret them as the mean of the logarithm price per squared meter in each location and for every year, once we have controlled for the effect of the physical characteristics of the dwellings.

The second stage of the estimation process follows equation (8) and uses the estimated individual fixed effects, $\hat{P}_{L,j}$, to perform the following regression:

$$\dot{\hat{P}}_{L,j} = \delta + \gamma G_j + \mu D_t + e_j \tag{8'}$$

where $\dot{\hat{P}}_{L,j}$ are the annual growth rates of the estimated individual fixed effects for each location and year, G_j is the growth rate of local public spending in each location (districts, neighbourhoods or statistical zones) for every year of our data base, D_t are time dummies and e_j is an error term.

Note that in the second stage we include the time dummies in the regression. The growth rates of the fixed effects obtained in the first stage capture the increase in the prices in a given location assuming constant the physical characteristics of the dwellings in the location. However, those growth rates do not account for the part of the increase in prices due to the overall increase in housing prices in all locations and not only due to the increase in the people's valuation of the location, in part given by the effects of the local public spending in that particular location. In the period 1998 – 2001 there was a generalized "housing boom". Therefore, introducing time dummies we account for that general characteristic of the housing market. Moreover, given that we specify equation (8') in a growth from, the characteristics of each zone (*K*) that can influence its valuation are not introduced in the regression. For instance, the distance to the city centre or the availability of subway in a given location is assumed constant in the period analysed and, therefore, do not change over time.

Once controlled the estimate for the time dummies, we can interpret the estimated parameter for local public spending, γ, as the effect of this variable in the increase in the housing prices once controlled for the physical characteristics of the dwellings and the annual and common increase in prices due to the overall situation of the housing market in the data span analysed in the City of Barcelona.

Finally, the observations in this second stage of the estimation are weighted by its weight in the original sample. In this way, we avoid that locations with one observation (especially in the case of statistical zones) obtain the same weight in the final sample as other locations with more observations per year.

5. Results

We estimate equations (6') and (8') for districts, neighbourhoods and statistical zones. Note that the estimation for statistical zones presents more observations and, therefore, we expect better results. This is why be presents its main results in this section while tables for districts and neighbourhoods are presented in the appendix. The first stage of the estimation, showing the effect of the physical characteristics of the dwellings, is presented in tables 4, 6 and 8. The second stage of the estimation is presented in tables 5, 7 and 9. Moreover, in this second stage, when we estimate the effect of local public spending, we have introduced this variable in different forms obtaining different specifications to be estimated, all of them including time dummies. Model (a) presents the estimates of the effect of current real investment; we add in model (b) spending on purchases of goods and services. Similarly, model (c) and (d) follows the previous specification with lag values of the regressors. Finally, in model (e) we introduce the sum of both types of public spending, while in model (f) the lagged value of this aggregate measure of public spending.

Table 4 presents the results from the first stage estimation for statistical zones. This stage gives us the individual fixed effects used in the second stage but it also gives us interesting information on the effects of physical characteristics of dwellings in Barcelona on the increase in the housing price. This estimation presents an R^2 of 0.38, while 947[14] groups (J) have been created with the zones that contain at least one observation in each year.

Table 4: First-Stage Results for Statistical Zones

Dependent Variable: price of squared meter (log)		
Variable	***Coefficients***	***t-ratio***
Area	-5.408759	-13.36
Antiquity (ref:>50 years)		
New	0.2570758	20.94
Between 1 and 6 years	0.1528858	12.77
Between 6 and 10 years	0.1127149	8.71
Between 11 and 20 years	0.0847753	12.54
Between 21 and 30 years	0.0660095	11.82
Between 31 and 50 years	0.0307907	5.87
Condition (ref: very bad)		
Bad	0.0981496	11.7
Normal	0.1789924	21.38
Good	0.2413142	26.36
Very good	0.2753775	21.71
Heating	0.0215907	5.42
Outside Condition	0.0207141	5.08
Elevator	0.0793082	17.84
Floor (Ref: Ground Floor)		
First	0.0321992	4.3
Second	0.0373886	5.07
Third or Higher	0.046335	6.79
Attic	0.0507372	4.89
*Elevator*Attic*	0.0379262	3.43
Reforms (Ref: >20 years)		
Last Reform between 0 and 5 years	0.0717521	15.93
Last Reform between 6 and 10 years	0.0577991	11
Last reform between 11 and 20 years	0.0379789	7.2
Constant	11.79502	96.76
R^2	0.3811	
σ	0.1335	
N	9297	

Note: all variables are significant at 99% level of significance.

In the first stage of the estimation all the parameters introduced as explanatory of the logarithm of the price of the square meter in Barcelona present the expected signs and are highly significant. The coefficient of the area of the dwelling has a negative sign. The interpretation of this sign and value is related to the functional form of the decreasing elasticity, see equation (11). The price elasticity/area (β/S) implies that the sensibility of prices per square meter of housing to its area decreases in absolute terms if

[14] The number of groups comes from the multiplication of the number of zones and the years available, 248*4 that is 996 zones-year. However, 49 statistical zones have been deleted because there was no observations for one of the years used. For instance, the statistical zone 1 has two groups because it appears with observations in 1998 and 1999 but has no observations for 2000 and 2001

the area increases, that is, although an increase in the area decreases the price per squared meter this effect is inferior for bigger dwellings.[15] For instance, given that the estimated coefficient β for the area is -5.4 this implies that the elasticity price-floor area for a dwelling of 40 squared meters is -0.135, while for a dwelling of 100 squared meters the elasticity is -0.054.

The estimated parameters for antiquity indicate that as long as the dwelling is newer the price of the square metre increases (with respect prices of dwellings with more than 50 years of antiquity). Housing in good conditions increases the price of the squared meter with respect to dwellings in very bad condition. Similarly, the effect of dwellings that have experienced recent reforms (approximated by the number of years since the last reform preformed in the dwelling) on the price of the square metre is positive with respect to dwellings that have not been reformed for 20 years.

The characteristic of some dwellings of having elevator, heating system and a good outside condition of the building, increases the price of the square metre with respect to dwellings that do not have these characteristics. Finally, dwellings located on higher floors have higher prices with respect to dwellings located on the ground floor. This is especially important for attics, which increase the price of dwellings notably and also increase the value of elevators, effect captured by the interaction of both variables.

We obtain very similar results, in sign and significance of the estimates, in the first stage of the estimation for neighbourhoods and districts (see tables 6 and 8 in the appendix). Interestingly, the estimate of the area keeps its negative sign in all the estimations performed, however, its value decreases as the geographical location increases due to less variability when we consider more aggregated locations. Nevertheless, the results are qualitatively identical.

[15] However, the correlation between the price of the squared meter and the surface of the dwelling is positive. This is because we do not control for the rest of explanatory variables: bigger houses are located in more expensive areas and present specific physical characteristics. Therefore, the increase in the dimension of the dwelling implicitly accounts for the effect on its price of the location and the physical characteristics positively related with the dimension. For more details in the case of the City of Barcelona see García et al. (2003).

Table 5 presents the results for the second stage of the estimation process for the statistical zones in Barcelona, similarly tables 7 and 9 (in the appendix) present the same estimations for neighbourhoods and districts. In all the estimations performed in the second stage, the dependent variable is the annual growth rate on the individual fixed effects, previously obtained.

Table 5: Second Stage Results for Statistical Zones

Dependent Variable: growth rate of the per squared meter price						
Variable	***Model (a)***	***Model (b)***	***Model (c)***	***Model (d)***	***Model (e)***	***Model (f)***
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Year (ref:1999)						
2000	-0.07517 (-10.34)	-0.07591 (-10.49)	-0.07637 (-10.55)	-0.07621 (-10.56)	-0.07637 (-10.55)	-0.07537 (-10.49)
2001	-0.09156 (-13.00)	-0.09525 (-13.39)	-0.09333 (-13.27)	-0.09696 (-13.57)	-0.09333 (-13.27)	-0.09654 (-13.52)
Public Spending						
$G_{2,t}$	--.--	0.00231 (2.99)	--.--	--.--	--.--	--.--
$G_{6,t}$	0.00087 (1.71)	0.00061 (1.21)	--.--	--.--	--.--	--.--
$G_{2,t-1}$	--.--	--.--	--.--	0.00230 (2.59)	--.--	--.--
$G_{6,t-1}$	--.--	--.--	0.013426 (2.47)	0.00084 (1.46)	--.--	--.--
$G_{26,t}$	--.--	--.--	--.--	--.--	0.00118 (2.99)	--.--
$G_{26,t-1}$	--.--	--.--	--.--	--.--	--.--	0.00134 (3.37)
Constant	0.24643 (45.21)	0.22539 (25.35)	0.23333 (30.79)	0.226424 (25.93)	0.23331 (30.79)	0.23218 (31.75)
R^2	0.22	0.23	0.23	0.23	0.23	0.23
N	694	694	694	694	694	694

Notes: *t*-ratios in parenthesis.

Before analysing the results for the local public expenditure, we highlight some characteristics of the estimation. First, we lose some observations in the case of statistical zones (947-694=253) because we use growth rates. Moreover, we lose observations that do not present information for one of the years analysed. Second, the R^2 is around 23% in the case of statistical zones but increase as long as we use neighbourhoods (64%) and districts (around 82%). Note that the goodness-of-fit of our model increases with models that present less observations, this can be explained if we consider that with bigger geographical areas considered the variability of the dependent variable remains constant (mainly given by the variability in the general inflation), while the variability of the random errors decreases due to the geographical aggregation.

Third, in all the regressions performed the annual dummy variables introduced (for 2000 and 2001) are negative and significant. We have omitted the dummy for 1999; therefore, the interpretation of these estimates is that 1999 was the year that presented a higher growth in the prices of the squared meters in Barcelona. The price of the squared meter in 2000 and 2001 presents a growth rate around 7.6% and 9.5% lower than in 1999, respectively.

The results for the estimates of the local public spending present positive signs in all the models estimated, and for all the geographical division used (statistical zones, neighbourhoods and districts), therefore it seems that an increase in the local public spending capitalizes in an increase of the value of housing. Therefore, the willingness to pay of an individual owner for an increase in the local public budget is positive because increases the value of housing. The positive sign holds for both the local public expenditure taken as aggregate or both types of spending separately.

The analysis of the effect of real investment (G_{6t}) shows that this variable, introduced alone in the regression in model (a), is only significant for statistical zones, with an elasticity of 0.08%. Moreover, when we also introduce public spending in purchases of good and services (G_{2t}), model (b), G_{6t} loses it not significant while G_{2t} is significant and presents elasticities of 0.23% in the case of statistical zones (table 5), 0.16% for neighbourhoods (table 7) and 0.17% for districts (table 9). These estimates seems to indicate that an additional euro used by the City Council of Barcelona in purchases of goods and services capitalizes in an increase of the price of the square meter of dwellings equal to 0.23% in the case of statistical zones, alternatively, if the additional spending comes from real investment the increase in the price is 0.06%.

We have introduced lagged values of the local public spending in model (c) for real investment and together with purchases of goods and services model (d). The results follow the same pattern as before; however, the point estimates show an increase in the elasticties of G_{6t}, 1.3% for statistical zones, 0.15% for neighbourhoods and 0.3% for districts. Interestingly, the elasticity of real investment decreases as the geographical area studied increases, indicating that the effect of public spending capitalizes in prizes more, or agents value more the public intervention, if we get closer to where it was performed. The lag value of public spending in purchases of goods and services get the same estimates as before, being not significant in the district case. In other words, an increase in one euro of spending in G_{2t} today increases the price of the square meter next year in the statistical zones in 0.23%, for neighbourhoods in 0.15% and for districts in 0.10%. That is, the willingness to pay by individual owners of a given statistical zone for the increase in local public spending in good and services is 0.23% of the price of the square metre of its value, while this percentage is 1.3% for local public spending in real in real investment.

When public spending is introduced aggregated, that is the sum of G_{6t} and G_{2t}, in model (e) the estimates are always significant with elasticities around 0.11% in the three cases analysed. Finally, when public spending is aggregated and introduced in lagged value, model (f), we get positive and significant elasticities with magnitudes of 0.13% (statistical zones), 0.11% (neighbourhoods) and 0.13% (districts). Therefore, the effects of the aggregate measure of public spending are higher when considered in lagged values. This could indicate that public spending needs is more perceived by agents once it has been installed or spent, that is, in the following period.

We observe that public expenditure in purchases of goods and services has a bigger effect on the growth rate of housing prices than spending in real investment, this can be explained because the bigger importance in the total local budget of purchases of goods and services. Nevertheless, real investment, introduced alone in the regressions, has always a positive and significant sign.

The results present a positive effect of local public spending on the housing prices in the City of Barcelona. Although the estimated elasticities have a low magnitude the effect of local public policies cannot be dismissed, especially if local public polices can have an accumulative effect on housing prices, resulting that City Councils can influence the revalorization of specific areas given the policies they perform.

6. Conclusions

This paper has analysed the effect of local public spending on housing prices for the City of Barcelona for the period 1998-2001. First, because this issue has not been addressed before in the Spanish case. Second, because public spending can be a competitive explanation to classical reasons argued to be the cause of the evolution of housing prices, for instance, demographic booms, increases in per capita income or decreases in the interests rates. Therefore, our aim is to study alternative explanations to the spectacular increase of housing prices in the City of Barcelona, and also to identify significant differences among the various geographical zones in which the city is divided (districts, neighbourhoods and statistical zones). A priori, we would expect that increases in local public investment had a positive effect, ceteris paribus, on housing prices

For these purposes, we estimate a two-stage econometric model, based on classical hedonic price models, for the three different geographical divisions in the City of Barcelona. In the first stage of the estimation, we calculate the prices in each location once we control for the effect of the physical (or structural) characteristics of the dwellings. The second stage is devoted to, once we control for the year, study the effect of two types of local public spending on housing prices.

The results show a positive capitalization of local public spending on real investment around 0.08%, higher (0.13%) if this variable is introduced in lagged values. Furthermore, local public spending in goods and services seems to have also a positive effect on housing prizes, 0.23% for statistical zones, and 0.10% for neighbourhoods and 0.10% for districts, that is, lower if the geographical zone under study is bigger. Finally, when we aggregate these two types of public spending in the City of Barcelona, we find a current effect of 0.11% and a lagged effect of 0.13% on the increase of the price of the square meter, significant in both cases.

We have found that local policies directed to enhance the quality of life or the location specific characteristic of the City of Barcelona, such as, street maintenance and cleaning, waste management, building improvements, the creation of sportive and entertainment areas, parks and garden conservation, have an economic impact on housing values.

7. Appendix

7.1 Results for Neighbourhoods

Table 6: First-Stage Results for Neighbourhoods

Dependent Variable: price of squared meter (log)		
Variable	***Coefficients***	***t-ratio***
Area	-3.783695	-9.55
Antiquity (ref:>50 years)		
New	0.2359973	19.76
Between 1 and 6 years	0.1549483	13.24
Between 6 and 10 years	0.1064752	8.53
Between 11 and 20 years	0.0725643	11.02
Between 21 and 30 years	0.0591236	10.93
Between 31 and 50 years	0.0231267	4.53
Condition (ref: very bad)		
Bad	0.0911215	10.92
Normal	0.1716261	20.67
Good	0.2347679	25.8
Very good	0.2782517	22.14
Heating	0.0269085	6.83
Outside Condition	0.0170754	4.17
Elevator	0.0827751	19.42
Floor (Ref: Ground Floor)		
First	0.0371894	4.94
Second	0.0406013	5.5
Third or Higher	0.0515924	7.55
Attic	0.0611303	5.94
*Elevator*Attic*	0.0305497	2.76
Reforms (Ref: >20 years)		
Last Reform between 0 and 5 years	0.0732193	16.15
Last Reform between 6 and 10 years	0.0596351	11.29
Last reform between 11 and 20 years	0.0384772	7.28
Constant	11.82215	979.01
R^2	0.3746	
σ	0.1409	
N	9297	

Note: all variables are significant at 99% level of significance.

Table 7: Second Stage Results for Neighbourhoods

Dependent Variable: growth rate of the per squared meter price						
Variable	***Model (a)***	***Model (b)***	***Model (c)***	***Model (d)***	***Model (e)***	***Model (f)***
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Year (ref:1999)						
2000	-0.07604 (-9.77)	-0.07609 (-9.95)	-0.07551 (-9.95)	-0.07669 (-10.15)	-0.07687 (-10.10)	-0.07649 (-10.17)
2001	-0.09034 (-12.07)	-0.09336 (-12.47)	-0.09402 (-12.47)	-0.09491 (-12.66)	-0.09198 (-12.49)	-0.09505 (-12.73)
Public Spending						
$G_{2,t}$	--.--	0.00165 (2.18)	--.--	--.--	--.--	--.--
$G_{6,t}$	0.00088 (1.14)	0.00037 (0.47)	--.--	--.--	--.--	--.--
$G_{2,t-1}$	--.--	--.--	--.--	0.00153 (1.68)	--.--	--.--
$G_{6,t-1}$	--.--	--.--	0.0015 (2.04)	0.00078 (0.93)	--.--	--.--
$G_{26,t}$	--.--	--.--	--.--	--.--	0.00104 (2.25)	--.--
$G_{26,t-1}$	--.--	--.--	--.--	--.--	--.--	0.00114 (2.62)
Constant	0.24360 (36.24)	0.23014 (25.47)	0.24056 (37.97)	0.23067 (26.70)	0.23238 (26.5)	0.23226 (29.23)
R^2	0.62	0.64	0.63	0.64	0.63	0.64
N	110	110	110	110	110	110

Notes: *t*-ratios in parenthesis.

7.1 Results for Districts

Table 8: First-Stage Results for Districts

Dependent Variable: price of squared meter (log)		
Variable	***Coefficients***	***t-ratio***
Area	-2.953.828	0.414193
Antiquity (ref:>50 years)		
New	0.2040017	0.012566
Between 1 and 6 years	0.1249271	0.012330
Between 6 and 10 years	0.0773823	0.013152
Between 11 and 20 years	0.0500062	0.006809
Between 21 and 30 years	0.0300515	0.005505
Between 31 and 50 years	-0.0004702	0.005252
Condition (ref: very bad)		
Bad	0.0938284	0.008893
Normal	0.1711413	0.008820
Good	0.2387139	0.009668
Very good	0.292284	0.013331
Heating	0.0296056	0.004170
Outside Condition	0.0119267	0.004344
Elevator	0.1003565	0.004353
Floor (Ref: Ground Floor)		
First	0.0517194	0.007988
Second	0.0550394	0.007839
Third or Higher	0.0577624	0.007252
Attic	0.0718932	0.010953
*Elevator*Attic*	0.0349994	0.011808
Reforms (Ref: >20 years)		
Last Reform between 0 and 5 years	0.0712921	0.004834
Last Reform between 6 and 10 years	0.0591783	0.005626
Last reform between 11 and 20 years	0.0375301	0.005632
Constant	11.83585	0.012746
R^2	0.3577	
σ	0.1513	
N	9297	

Note: all variables are significant at 99% level of significance.

Table 9: Second Stage Results for Districts

Dependent Variable: growth rate of the per squared meter price						
Variable	***Model (a)***	***Model (b)***	***Model (c)***	***Model (d)***	***Model (e)***	***Model (f)***
	Coeff.	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*
Year (ref:1999)						
2000	-0.09535 (-7.69)	-0.07602 (-8.01)	-0.09372 (-8.28)	-0.07661 (-8.38)	-0.07752 (-8.38)	-0.07674 (-8.58)
2001	-0.10366 (-8.81)	-0.08809 (-9.57)	-0.11267 (-9.70)	-0.09067 (-9.63)	-0.08648 (-9.69)	-0.09021 (-10.09)
Public Spending						
$G_{2,t}$	--.--	0.00178 (1.85)	--.--	--.--	--.--	--.--
$G_{6,t}$	0.00174 (1.01)	0.00013 (0.09)	--.--	--.--	--.--	--.--
$G_{2,t-1}$	--.--	--.--	--.--	0.00106 (0.69)	--.--	--.--
$G_{6,t-1}$	--.--	--.--	0.00367 (2.15)	0.00174 (0.79)	--.--	--.--
$G_{26,t}$	--.--	--.--	--.--	--.--	0.00118 (1.93)	--.--
$G_{26,t-1}$	--.--	--.--	--.--	--.--	--.--	0.00133 (2.30)
Constant	0.26831 (21.23)	0.22680 (25.47)	0.25849 (21.91)	0.22621 (26.70)	0.22662 (19.98)	0.22598 (22.21)
R^2	0.79	0.82	0.82	0.83	0.82	0.83
N	30	30	30	30	30	30

Notes: *t*-ratios in parenthesis.

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