On the relationship between local authority size and expenditure: lessons for the design of intergovernmental transfers in Spain

Albert Solé-Ollé[†] and Núria Bosch

Universitat de Barcelona and IEB (Insitut d'Economia de Barcelona)

Unconditional transfers to local governments in Spain are distributed mainly according to weighted population, with weights rising with population size in order to account for the higher expenditure responsibilities and needs of bigger municipalities. In this paper we evaluate the appropriateness of these weights and derive some implications for the design of unconditional transfers. With this aim we estimate an expenditure equation with data from a unique data set, covering more than 3.000 Spanish municipalities during the period 1995-99. The use of a piecewise linear function allows us to account for the possible non-linear relationship between expenditure and population size. The equation includes control variables in order to avoid confounding population size effects with influences coming from other factors (i.e., transfers received, fiscal capacity). The results identify important scale economies for the smaller local authorities and growing per head expenditures for higher population sizes. However, in this case the growth in per head expenditure is much lower than the one implicit in the weights used in the distribution of unconditional transfers.

[†]Corresponding address: Facultad de Ciencias Económicas (UB)
Avda. Diagonal, 690, Torre 4, Planta 3ª
08034-Barcelona (SPAIN)
Tel: 93 4035919 Fax: 93 402 18 13
email: asole@eco.ub.es

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1. Introduction

Unconditional transfers to local governments in Spain are distributed mainly according to weighted population, with weights rising with population size in order to account for the higher expenditure responsibilities and needs of bigger municipalities. In this paper we evaluate the appropriateness of these weights and derive some implications for the design of unconditional transfers. With this aim we estimate an expenditure equation with data from a unique data set, covering more than 3.000 Spanish municipalities during the period 1995-99. The use of a piecewise linear function allows us to account for the possible non-linear relationship between expenditure and population size. The equation includes control variables in order to avoid confounding population size effects with influences coming from other factors (i.e., transfers received, fiscal capacity). The results identify important scale economies for the smaller local authorities and growing per head expenditures for higher population sizes. However, in this case the growth in per head expenditure is much lower than the one implicit in the weights used in the distribution of unconditional transfers.

There are few papers analysing the relationship between population size and local spending. The literature on the estimation of the degree "publicness" should, of course, be mentioned (see, Reiter and Weichenrieder, 1997, for a survey). However, the approach is quite different, since we do not focus only on scale economies in consumption, but on the broad spectrum of cost and need factors than can be related to population size. Perhaps the paper by Ladd (1992) is the one that most resembles to ours; in that paper a flexible relationship between density and local spending is estimated. But as the Spanish unconditional grant uses population ins-tead of density this will be our focus too[1]. The results of this last paper are quite encouraging too, since spending per head is found to be quite high at low and high densities, and low at medium densities.

There are also few papers analyzing spending decisions by local governments in Spain. The papers by Monasterio and Suárez (1989), Bosch and Suárez (1993) and Solé-Ollé (2001b) are exceptions to this rule. But Solé-Ollé (2001a) is the only paper analyzing the impact of cost and need factors on municipal spending. This author estimates an expenditure equation with a 1996 cross-section of data of municipalities belonging to the region surrounding Barcelona. The results of the paper identify various need variables, from the impact of commuters and tourists to the effects of density and other measures of urban settlement. Regarding population

[1] However, analysing size and density may be more or less the same thing. After all, there is a high correlation between both variables (roughly a 60% in our sample).

size, the paper did not found significant effects in most of the analysed spending categories. The data used was, however, not well suited to analyse this problem. Municipalities with population lower than 5,000 and so was Barcelona. Therefore, there were few big municipalities and all of them from a unique Spanish region. We feel the data base available for the current analysis is better suited to analyse the relationship between spending and population size, since it includes all Spanish municipalities with more than 20,000 inhabitants.

The paper is organised as follows. In the second section we present a brief outline of the workings of transfers to local governments in Spain and present the basic facts that motivate our analysis. In the third section we discuss various arguments that are used to justify that costs may bear some relationship with population size. In section fourth we discuss the methodology used to perform the econometric analysis and discuss the results obtained. Finally, section fifth presents the main conclusions of the paper and its implications for the design of transfers.

2. Transfers to local governments in Spain

Nearly 40% of total non-financial revenues of Spanish municipalities come in the form of transfers made by higher layers of government. More than 70% of these grants are unconditional grants for current spending,. The great bulk of the remaining transfers are grants earmarked to specific investments projects. Although there are also some specific current grants, its share of the budget quite small.

Municipal revenue-sharing ("Participación de los Municipios en los Ingresos del Estado") is the main unconditional grant received by Spanish municipalities. The name given to this grant may be misleading, since it is not a sharing on revenues on a derivation basis, but an unconditional grant distributed among municipalities by a formula that takes into account specific variables. The objective of this grant is to guarantee the principles of sufficiency and equalization. Nevertheless, as it has been recognised by different authors, this last principle is not well addressed by the formulation of this grant (see, e.g., Castells *et al*., 2002).

The overall amount of resources to be distributed among municipalities is determined every five years by law, and is updated yearly during the five-year period in accordance with certain criteria that are applied automatically. More specifically, the general rule of evolution is the growth rate of nominal GDP, with a minimum guarantee set by the inflation rate. These resources are distributed among municipalities[2] in accordance with the following criteria:

[2] Madrid and Barcelona receive a special treatment: their grant is determined outside the general fund.

- 75% depending on weighted population, with weights growing with population size. These weights are shown in column (a) of Table 1.

[Insert Table 1]

- 14% depending on the average tax effort of each municipality, weighted according to the population in each municipality. The purpose of this variable is to provide incentives to raise local tax rates. However, it has proven very ineffective in this aspect, since municipalities do not take into account the future gain in transfers associated with a tax increase. Moreover, since the computation of this variable is flawed by many problems, some authors have proposed its exclusion from the formula (see, Suárez and Pedraja, 1999).

- 8.5% depending on the inverse of fiscal capacity. However, this variable is calculated very incorrectly, with the result that its does not pick up real differences in fiscal capacity. There is a wide consensus in that the actual design of the grant does not have any tax equalizing effect and that a reform is needed in this aspect (see, e.g., Suárez and Pedraja, 1999, and Castells *et al*., 2002).

- The remaining 2.5% depending on the number public school units (primary, secondary and special), existing in each municipality. This variable aim to account for specific local spending needs. However, its inclusion in the formula has also been questioned because education has a very small weight in local budgets[3] and there are many others needs variables that could be included in the formula[4].

Population size is, therefore, the most important determinant of unconditional transfers per head received by Spanish municipalities. The effect of the other variables included in the formulation is not substantial and, in any case, its main effects are felt inside population strata. This can be checked from Figure 1, which plots transfers per head against population size; we also have included in the figure a fitted polynomial function. From the figure it can be checked that transfers per capita tent to follow the same pattern than population weights used in the formula. Column (b) of Table1 displays data on the actual transfers per head by population strata expressed also in relative terms with the smallest municipalities as the base category. Note that these values may differ from those of column (a) because there are other variables in

[3] The main responsibilities in the field of education are in the hands of regional governments. The only local responsibilities in this field are to provide lots for school construction and pay for its maintenance.

the formula (weighting 25%) and because minimum guaranteed transfers operate in some cases. In this case the coefficients are a little bit more flat; however, they continue to grow with population size. This pattern is justified in theory by the higher responsibilities and costs of bigger municipalities[5]. The purpose of the paper will be precisely to find empirical evidence to discuss if this assumption is or not appropriate.

[Insert Figure 1]

One justification often invoked to justify this weighting scheme is that local spending responsibilities differ by population size, bigger municipalities having more responsibilities than smaller ones. The responsibilities assigned to local governments in Spain are regulated by the Local Government Act of 1985[6], which establishes a minimum list of services to be provided by municipalities. These are the so-called "compulsory services". Bigger local governments are assumed to be more able in service delivery, so the list of "compulsory services" increases with population size. Table 2 provides the list of responsibilities by population size. There are, however, several caveats to this argument.

[Insert Table 2]

First, note that the population strata of Table 2 do not fully coincide with those of Table 1: municipalities assume more responsibilities and get more resources at the 5,000 and 20,000 thresholds. At the 50,000 threshold, municipalities assume more responsibilities but do not get more unconditional funds[7]. At the 100,000 and 500,000 thresholds, municipalities receive more funds without additional responsibilities. Furthermore, it should be made clear that in most cases, the municipalities intervene voluntarily in the provision of services even if they have not the population size required[8]. Therefore, there should be other arguments that justify transfers per head that increase with population size. The next section discusses these arguments and the rest of the paper try to estimate its effect on spending per capita.

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[4] As for example, the additional needs created by commuters and tourists, or the higher costs that face sparsely populated municipalities.

[5] These factors are also responsible for the high dispersion of transfers per head in Figure 1, especially at low population sizes

[6] The Spanish constitution provides for the division of powers between the central government and the regions (Autonomous Communities), but does not make any reference to the responsibilities assigned to local governments.

[7] They do receive, however, funds earmarked to transportation spending.

[8] Moreover, they tent to intervene also in the provision of services that are responsibility of other levels of government. It has been estimated that in the municipalities of the province of Barcelona the expenditure of the non-obligatory services represent 27% of the total expenditure.

3. Population size and local expenditures

There are many arguments that can be used to justify a relationship between spending needs and local authority size. In this section we review shortly some of them:

(a) *Shared use of facilities*.

Assume that each local service is provided by facilities whose sizes are fixed in the short run. Examples of such facilities will include, for example, refuse collection trucks, water treatment plants, or sports and cultural facilities. Some of these services are impure public goods or "club goods". Adding an additional user to the facility reduces to some extent the benefits enjoyed by a typical user, and this effect will be higher the more crowded is the facility. That is, average congestion costs will rise with the number of users. The literature on "club goods" (see, e.g., Buchanan, 1965, King and Ma, 2000) tells us that these congestion cost should be balanced against production costs in order to determine the optimal number of users of the facility.

If there are fixed costs in the production of the service, then the average production cost will be U-shaped. Combining increasing average congestion costs and U-shaped production costs will also give a U-shaped average cost function for a facility of a given size. When we change the size of the facility we obtain a family of average cost functions. There will be one facility size (number of users) that will minimize costs: once this facility size is reached scale economies will be exhausted. This is why it is commonly expected that spending per head will be higher for the smallest municipalities; that is, for those where the number of users is lower than the facility size that minimizes average costs.

Therefore, the basic question here is: which is this minimum efficient size? It is interesting to review empirical evidence here. On the one hand, the literature on the estimation of the degree of "publicness" of local services (see, Reiter and Weichenreiter, 1997) finds that most of them are like "private goods". One the other, the classical work by Hirsch (1965 and 1973) suggests that production economies of scale are exhausted at low population levels, specially in horizontally integrated services. Moreover, as local governments become more enablers than producers scale economies may experienced through contracting-out or privatization of services. Therefore, it may be possible that the minimum efficient size is a very small municipality; therefore, the number of municipalities facing higher than average costs because of inefficient size may be quite small[9].

[9] However, nearly 90% of Spanish municipalities have populations lower than 5,000 inhabitants.

(b) *Administration costs*

Some administration costs are fixed in nature: a local government may build a minimum administrative capacity to be able to operate efficiently in the job and credit markets, or to collect revenues. However, most of them may be exhausted at reasonable population sizes. Moreover, beyond a given authority size, administration costs may increase because of higher coordination costs, or because unions become more powerful and are able to obtain higher wage increases (Inman, 1997). Of course, this type of costs is difficult to disentangle from pure X-inefficiency.

(c) *Density*.

Big cities tent to be display higher densities than small localities. While the correlation among these variables is not perfect it is non-negligible (i.e., roughly a 60% in our sample). Therefore, an empirical relationship between spending per head and population size may simply mask the effects of costs associated with high or low densities. There are two different views one the effects of density on costs (see, Ladd, 1992 for a review). First, the so-called engineering view, tells us that high-density planned development reduce the costs of producing direct outputs. This happens because fewer facilities are needed to serve a given number of users, or because a decrease in the number of trips needed to serve the population from a fixed facilities (Bennet, 1980, cap. II).

Second, the results arising from econometric studies, that tent to show that costs tent to rise with density (see, e.g., Bradbury *et al*., 1984, Ladd and Yinger, 1989, and Ladd, 1992). The two views can be reconciled: the higher costs in densely populated areas arise because more output units are needed to achieve a given outcome or service level. That is, more density increases accessibility and saves in transport costs but is also associated with a harsher environment (see, e.g., Bradford *et al*., 1969). For example, increased density may require more traffic lights and traffic control officers to achieve a given level of traffic safety or traffic flow. Similarly, higher density may raise the social costs of inappropriately disposed waste and, therefore, require more waste collection. And higher density may require more police services to achieve a given level of protection from crime. The final effect of density on spending may be non-linear: at low densities the first effect may dominate while the most important effect at high densities may be the second one. If density and population size are correlated, there may also appear a non-linear relationship between spending and population size.

(d) *Input costs*.

An additional effect of density and/or population size operates thorough the unit costs of inputs. It is well know that both wages and rents are higher in big cities. Therefore, the wage a local government will have to pay to recruit a standard quality worker will be higher in those places. Something similar can be said about rents for public offices or about the price of land used to build public facilities[10].

(e) *Spillovers*

Bigger cities tent to be located at the centre of large conurbations with many more communities in the neighbourhood. In these areas, populations tent to travel from one locality to another to work, shop or study and, therefore, crowds out the facilities provided our of the locality of residence. This effect may also push up the costs of the localities that provide services for non-resident user groups[11].

(f) *Responsibilities*

In many countries, bigger local governments have more spending responsibilities than smaller ones. But, at least in Spain, this does not translate into different spending levels because local government tent to provide the service even without responsibility. It is ultimately citizen's demand (and lack of intervention by other layers off government) that helps to explain why a service is provided.

The combination of factors (a) to (f) may produce any kind of spending-to-population profile. It is necessary to an empirical analysis to obtain a precise conclusion. And a partial analysis, performed by looking at the plot of spending per head on population size will not help at all (shown in Figure 2). This occurs because, in addition of factors (a) to (f), spending may differ among localities because, for example, the biggest one receive more transfers or the smallest ones are able to collect more taxes per head. In fact, if we look at the plots in Figure 2, we must conclude that there is no relationship between both variables[12].

[Insert Figure 2]

[10] Those higher input costs are taken into account in the calculation of transfers to local and regional governments in some countries, as England (Department of the Environment, 1999) and Australia (Commowealth Grants Commission, 2001).

[11] As in the case of density, this correlation may not be complete. There may be, for example, big suburbs that are cost exporters and rural cities without substantial suburbs that are not cost importers.

[12] Look at the fitted line; we begun with a six-order polynomial, which order was reduced in search of some explanatory power, ending always with a straight line with and R^2 of zero.

4. Econometric analysis

4.1 *Empirical framework*

The best way to disentangle the effects of population size on local costs from the effect of other factors is to embed these variables in a fully specified model of local public spending. The model used in this paper is similar to the one used in the large literature on local public spending in which the desired level of per head spending is specified as a function of the demand for public services and their costs[13]. Letting g represent per head spending in a given municipality, the model has the following general form:

$$g = f(\text{cost factors; intergovernmental transfers, revenue capacity; demand variables})$$

Cost factors may include different groups of variables: those that account for the higher costs of producing public outputs like, for example, population size or density; variables accounting for the costs of transforming public outputs into outcomes, like poverty, crime and other socioeconomic factors; variables that measure the unit cost of inputs used in the production process, as the wage rate; variables accounting for the higher expenditure responsibilities of some governments. Unfortunately, the data base available to carry out our analysis does not allow for the measurement of most of these cost factors. One of the few variables we can use is population size. However, this suffices for our main purpose: to determine the effect of population size on costs. Of course, the coefficient on population will embed all those effects, from (a) to (d). As we explained in the previous section, all those factors may be correlated with population size: scale economies may mean that costs decline with population, but poverty, crime and wages may rise with city size. Therefore, the overall shape of the expenditure-population relationship will be probably non-linear. We will take this into account in the estimation of the expenditure equation. An obvious drawback of this procedure is that we will not be able to disentangle the different cost effects related to population size. As we explain below, by exploiting the panel nature of the data base we will be able to ascertain the relevance of higher responsibilities (d) in local expenditure.

Although the data base is scarce in variables accounting for cost factors, it contains some variables measuring intergovernmental transfers and the revenue capacity of local govern-

[13] See Borcheding and Deacon (1972) or Bergrstrom and Goodman (1973) for the seminal papers in this literature. Ladd and Yinger (1989) and Bradbury *et al.* (1984) provide more insight into the role of cost variables in this model. A previous attempt to estimate such a model with Spanish data can be found in Solé-Ollé (2001).

ments. Therefore, we will be able to control for these factors[14]. This is necessary, since although we accept that the population effect will embed a mixture of different cost effects, we must be sure that it does not pick up fiscal capacity effects. The exclusion of revenue variables from the equation will bias the population coefficient, that will include now two different types of effects. The concern with this bias is justified because we know from section two that per head unconditional transfers to municipalities in Spain grow with population size. At the end, by confusing high cost with high transfers we would conclude that the municipalities most in need of additional aid are those that are now receiving higher per head transfers!

According to traditional analysis, the main demand variables to be included in the expenditure equation are: the private income and the tax-price of the representative resident and demographic variables accounting for differential tastes or preferences. Our data base only provides information on the first variable and for only one of the years. The estimation of the equation with a cross-section of data for that year will allow to check the effects of excluding private income from the analysis. However, nothing can be done to avoid the exclusion of the tax-price perceived by the representative voter (i.e., the share of any increase in local spending that he expects to finance with taxes). The main problem caused by the exclusion of this variable is one of identification of the effects of population on costs. For theoretical precision, the coefficient of population only identifies its effects on expenditure: its effects on costs plus the effects of those higher costs on the desired level of public services that operates through the tax-price term. That is, the estimates should be adjusted by a price elasticity of demand. However, this adjustment would be probably small given the low elasticity estimated in the literature[15].

4.2 *Regression equation*

The relationship between population and local spending will be estimated with data covering more than 3.000 Spanish municipalities during the period 1995-99. The panel nature of the data will help us to control for heterogeneity and some omitted determinants of local spending, and also to disentangle the effects of higher expenditure responsibilities form other population-related cost factors. The regression equation used in the panel estimation may be written as:

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[14] However, some of the variables accounting for revenue capacity will only be available for one single year. Because of this we will complement the basic panel estimates with a cross-section equation for that year.

[15] These elasticities are often below one (see, e.g., Ladd and Yinger, 1989). In the case of Spanish municipalities Solé-Ollé (2001) provide an average estimate of 0.7 (ranging from 0.4 to 0.9 for different local services).

$$g_{it} = e_{it}^{c}(p_{it}) + e_{it}^{a}(p_{it}) + \sum_{k=1}\gamma^{k} \times x_{it}^{k} + f_i + f_t + \varepsilon_{it} \quad (1)$$

Where g_{it} is local government expenditure per head, e_{it}^{c} are local cost factors that have some impact on services that are the responsibility of all local governments, e_{it}^{a} are local cost factors that have impact only on services related to additional responsibilities, x_{it}^{k} is one of the k control variables picking up the effects of intergovernmental transfers and revenue capa-city, f_i and f_t are individual and time effects, and ε_{it} is an error term with the habitual properties. Individual effects are included to control for demand variables not included in the equation and that are assumed to stay relatively constant during the period analysed as, for example, political factors.

Note that both e_{it}^{c} and e_{it}^{a} depend on population size (p_{it}). The term e_{it}^{c} is related to population size because scale economies, environmental cost factors, and rising wages. The term e_{it}^{a} rises with population because additional local spending responsibilities in Spain appear as population size exceed given population thresholds. Costs may depend on other factors, but as we are interested only in the effects of population, this is the only variable we will use in the analysis. However, careful modelling of the non-linear relationship between g_{it} and p_{it} and the availability of panel data will allow us to identify e_{it}^{c} and e_{it}^{a}.

In the case of e_{it}^{c}, we will use the technique of spline regression. With this approach, the statistical relationship between population and per capita spending, controlling for other variables, is estimated in the form of a series of linear, connected segments as shown in Figure 3. The estimated regression coefficients for the four population intervals $p<p^0$ to $p>p^2$ are labelled β^0 to β^3. The first coefficient, β^0, is an estimate of the slope of the first segment, while the other coefficients show the change in the slope of spline function from on segment to the other. Therefore, the slope of the second segment is just the sum of coefficients β^0 and β^1. The slope of the other segments is computed similarly. Our main interest, however, is not the slope of this function but the height of the curve at each of the segment points, labelled δ^0 to δ^3. This will require a simulation strategy, consisting on fixing the height for a base category (e.g., δ^1) and then computing step by step the height of the other ones. We will give more detail on the simulation method in section four.

[Insert Figure 3]

The algebraic formulation of the spline function can be expressed as follows (see Greene, 1999, Ch.8):

$$e_{it}^{c} = \alpha^{0} + \beta^{0} \times p_{it} + \sum_{j=1} \beta^{j} \times d_{it}^{j} \times (p_{it} - p_{j}) \qquad (2)$$

Where α^0 is a constant, β^0 is the slope of the base category, β^j is the change in the slope of the function in the *j* segment with respect to the preceding one, d_{it}^{j} is a dummy variable equal to one if the population of a municipality belongs to the *j* segment, pit is the population of the muncipality *i* the year *t*, and p_j is the of the lower bound of the *j* population segment.

In the case of e_{it}^{a}, we will assume that the effect of higher spending responsibilities provokes a jump in per capita spending just when the municipality exceeds one of the population thresholds considered by the law (5,000, 20,000 and 50,000 inhabitants). Therefore, e_{it}^{a} can be expressed as:

$$e_{it}^{a} = \sum_{l=1} \beta^{l} \times d_{it}^{l} \qquad (3)$$

Where β^l per capita spending due to additional responsibilities when exceeding the population threshold *l*, and d_{it}^{l} is a dummy variable equal to one if the population of municipality *i* is higher than the population threshold *l*. The shape of this function is shown in Figure 4. We are not interested only in the steps (i.e., β^l), but in the height of the function at different population sizes (i.e., δ^{l}). To do this calculation we will need also an estimate of the height of a base category (e.g., δ^1). The details of this simulation will be explained later.

[Insert Figure 4]

With a cross-section of data it will be very difficult to identify these threshold effects, since the jump at given population levels may be confused with the changing slope show in Figure 2. However, the panel nature of the data allows disentangling these effects.The inclusions of individual fixed effects in the expenditure equation means that we will identify the effects of population on spending only from time variation. In that case, β^l will be identified only from the subset of data that includes the municipalities that jump from a population interval to another during the period. If all the municipalities stay all the years in the same interval it will not be possible to estimate this effect[16] because all cross-section variation will be picked up by the individual effects.

After substituting expressions (2) and (3) in (1) we obtain the following regression equation:

$$g_{it} = \beta^0 \times p_{it} + \sum_{j=1} \beta^j \times d_{it}^j \times (p_{it} - p_j) + \sum_{l=1} \beta^l \times d_{it}^l + \sum_{k=1} \gamma^k \times x_{it}^k + f_i + f_t + \varepsilon_{it} \qquad (4)$$

Note that the only variables used in the estimation are the ones related to population (i.e., higher responsibility dummies, and population levels interacted with the dummies indicating population intervals), control variables and individual effects. An important question here is how to define the *j* population intervals. Given that we aim to compare the results with the coefficients used actually in the computation of unconditional grants, we must use the same thresholds than that of the grant. Recall from section two that the bounds of those thresholds are 5,000, 20,000, 100,000 and 500,000 inhabitants. In addition to that, and in order to allow a smoother adjustment of the spline function we introduce four additional thresholds: 1,000, 10,000, 50,000 and 250,000 inhabitants[17,18].

4.3 *Data and statistical sources*

Equation (4) will be estimated with data on 3.722 municipalities for the period 1995-1999. The budget data used comes from a survey on municipal finances undertook by the Ministry of Economy each year. Most municipalities with population higher than 20.000 are included in the survey; for municipalities below this population threshold, the survey selects a representative sample.

Population data come from estimates carried out by the National Institute of Statistics (INE). Local spending has been computed from data on municipal outlays coming from the afore-

[16] The share of municipalities changing population interval during the period, and therefore gaining newer expenditure responsibilities is not large, although non-negligible. For example, 56 of the municipalities with less than 5.000 inhabitants in 1996, surpassed that threshold during the period 1996-2001; 46 of the municipalities within 5.000 and 20.000 inhabitants and 23 within 20.000 and 50.000 inhabitants surpassed the 20.000 and 50,000 thresholds in the same period.

[17] We have also tried a finer subdivision but the results did not improve much the adjustment of the spline function to the data.

[18] Note also that some of these thresholds coincide with the ones used to determine the effects of increased expenditure responsibilities. However, this does not pose any problem because, as we explained above, the source of variation that identifies these two effects is different. However, in order to check the robustness of the results we repeated the analysis after changing the thresholds levels in (2) that coincide with those in (3) (i.e., using 4.000 instead of 5.000, 15.000 instead of 20.000 and 35.000 instead of 50.000). The results obtained where qualitatively unchanged.

mentioned survey on municipal finances (Ministry of Economics). We estimate equation (4) both with data on current expenditures and with data on total expenditures (i.e., current + capital). The results for total spending must be interpreted with care because capital expenditures are simply the investment outlays in the year they occur and do not reflect the annual user cost of capital. Therefore these results should not be interpreted as indicating the effects of population size on the annual cost of capital; instead they simply provide information on how population size affects investment spending. However, even accepting this caveat we consider important to extent the analysis to capital spending, because municipal expenditure needs are determined by cost factors affecting all types of inputs, current or capital.

Among the control variables we include two variables measuring the amount of intergovernmental transfers per head received by the municipality. The first one measures current transfers received, including the main unconditional transfer received from the central government ("Participación en los Ingresos del Estado") and other minor transfers. The other measures the capital transfers received. We expect current transfers to affect both current and total spending and capital transfers to affect basically capital spending (although some effects on current spending can not be a priori discarded).

We also include some variables that control the local capacity to obtain revenues through the property tax. This is the main local tax in Spain, accounting for nearly half of tax revenues. Previous empirical analysis have shown that assessed property value per head are useful in explaining both the variation in local spending per head (Solé-Ollé, 2001) and in property tax rates (Solé-Ollé, 2002).The inclusion of this variable in the empirical framework depicted before can also be justified theoretically. For example, Solé-Ollé (2001) obtains a an specification where the size of local tax bases allows to control for tax-exporting effects. It can also be argued that property value per head is a proxy for the resident's private income; as we previously said, our data base does not provide information on this last variable.

Assessed property value per head is, because of property reassessments delays, a very rough proxy of property tax revenue capacity[19]. This means that assessed values per head in two municipalities will only be strictly comparable if reassessment has been carried out the same

[19] In Spain, property tax assessments are the responsibility of a central agency ("Centro de Gestion Catastral y Cooperación Tributaria"), so in principle reassessment delays do not occur because of lack of coordination among local governments. However, because the huge amount of municipalities (near 8,000) and the popular opposition to generalised reassessment campaigns at the beginning of the 90's it is not unusual to observe delays of ten years or more in some municipalities. In addition to this, even without differential delays, reassessments are not carried out the same year for all the municipalities, so assessed values for reassessed and non-reassessed municipalities are never strictly comparable.

year[20]. Therefore, two municipalities, one accumulating a reassessment delay and the other recently reassessed may obtain the same revenue: one with a high base and a low rate, and the other with a low base and a high rate. To control for this fact we include in the regression equation both assessed property value per head and interactions among this variable and a set of dummies indicating the number of years since the last reassessment. We use three of these dummies, that take the value of one if the assessment lag higher than two years, higher than five years, and higher than ten years. Assessed property and number of years since reassessment come from a publication by the central assessment office for various years ("Impuesto sobre Bienes Inmuebles. Bienes de Naturaleza Urbana").

However, although it is the main local tax in Spain, the property tax is not the only tax available to municipalities. The local business tax and the local motor vehicle tax are also relevant revenue sources, accounting for 20% and 15% of tax revenues each. However, the panel data set presented above does not provide any variable regarding these tax bases. Because of this we have decided to re-estimate equation (4) with a cross-section of data for 1999. The new variables added to the equation are only available for municipalities with a population higher than 3.000 inhabitants. This means that we will loose the lower tail of the distribution in the analysis and that we will not be able to derive any conclusion regarding scale economies at low population levels. Because of that the number of municipalities in the cross-section is only of 2,632. This number is lower that in the panel analysis, but the reduction of observations is concentrated in the lower segment, so the data set is equally representative of the rest of Spanish municipalities.

The main difference with the panel specification is that the additional responsibility dummies (d_{it}^{l}) are not included in the regression. As we have yet explained it would not be practical to try to identify these effects jointly with the spline coefficients β^{j} only with cross-section variation. The other difference is that we will not be able to control for heterogeneity by including individual and time effects in the equation. However, we feel that this drawback may

[20] In fact, casual observation reveals that nominal property tax rates tent to drop suddenly after a reassessment (although effective rates tent to rise) and then is raised again to keep revenues growing. After some time it becomes difficult to raise the tax rates again and a new reassessment is needed. There have been many attempts in the literature to explain this fact. Some authors attribute consider voter fiscal illusion may give an explanation (Bloom and Ladd, 1982, and Ladd, 1991) but others (Strumpf, 2001) have argued that this behaviour may be purely rational. In this paper, however, we are less interested in the theoretical foundations of this specification than in its ability to fit the data.

be partly compensated with the inclusion of a richer set of control variables. First, we include as proxies for the revenue capacity in the business tax and the vehicle tax the number of firms per head and the number of cars per head. This information comes from a study made by a financial institution ("Anuario Económico de España", La Caixa). We also include in the equation two additional variables coming from the same source: resident income per head[21] and the number of tourist per head[22].

4.4 *Results*

The results of the estimation of equation (4) with panel data are shown in Table 3. Columns (3.a) to (3.c) show the results for current spending, while columns (3.d) to (3.f) show the results for total spending. In all the cases, the results shown correspond to the within-groups estimation. The *F* statistic on the joint significance of the individual effects shows that the null hypothesis that the constants are equal for all municipalities can be rejected. The Hausman test at the bottom of the table shows that the individual effects are correlated with the variables included in the equation and that, therefore, a fixed effects specification is more appropriate than a random effects one. The Breusch-Pagan test shows that there is no heteros-cedasticity in the data. The explanatory capacity of the model including all the variables is substantial, with adjusted R^2 higher than 60%. Columns (3.a) and (3.d) show, for current and total spending, the results when only the population spline function and the time effects are included. Note that the adjusted R^2 is around 30%, and much lower than in the other equations. Moreover, *F* statistics for the joint significance of the spline and the time effects (not shown in the table) are 7.304 and 15.226, respectively; although this result tells us that both are statistically significant at the 95% level, it also suggest that the explanatory capacity of population size alone is quite low. We delay the interpretation on population coefficients and go now for the control variables.

[Insert Table 3]

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[21] Municipal income is an estimate from basic economic activity indicators, as number of telephones, number of bank offices, number of cars,…This estimate is the so-called *market-share* ("Cuota de Mercado") and is presented as a share over the Spanish total; we have divided this number by the population share of each municipality and derive an income per head index, with an average equal to one. For ease of comparison, the rest of variables added to the cross-section regression are also expressed as an index.

[22] The sign of this variable is uncertain, since tourism has an impact both on the revenue side and on the spending side. On the revenue side, there are some minor taxes (i.e., taxes on building activities and taxes on lot transactions) and user charges not accounted for in the tax capacity variables than may be especially relevant in tourist resorts. On the spending size, tourist may increase the need for spending on refuse collection, water supply, traffic control and safety, among other services.

Columns (3.b) and (3.c) show the results obtained when adding the set of controls. The coefficients of current and capital transfers and of assessed property are positive and highly significant, with extremely high *t*-values. There are three main results that merit some attention. First, one additional euro received in the form of current transfer increases current expenditure by nearly half an euro and total spending by nearly ¾ of an euro. This means that not all the transfers received are transformed into increased spending, but some are used to reduce taxes[23]. However, the existence of fiscal illusion (see, Turnbull, 1998) can not be completely discarded, since we do not know the response to an equivalent increase in resident income. Second, one euro in capital transfers increases total spending by 0.85 euro but current spending only by 0.05 euro. This result is also consistent with expectations, since those transfers are earmarked for capital projects. Third, an increase in assessed property value of 1,000 euro prompts additional current spending of 6.5 euro for assessment delays lower than two years and higher than ten, and of 7.8 euro for delays higher than two years but lower than ten. As we explained in the previous section, a possible interpretation of this fact is that municipalities tent to compensate stagnating assessed values with increases in the property tax rate in order to keep property tax revenues growing. However, after some years (ten as suggested by the results) it becomes quite difficult to increase tax rates again and a new reassessment process is needed[24].

[Insert Table 4]

The set of controls included in the regressions shown in Table 3 is not very large. As panel estimation allows controlling for omitted heterogeneity through the inclusion of individual effect, this may not be a very serious problem. However, in order to check the robustness of the results we have repeated the estimation of the expenditure equation with a cross-section of data for the year 1999. The results are presented in Table 4. The explanatory capacity of the model is also quite high, with adjusted R^2 higher than 60%; this is remarkable with cross-section data. The results for the control variables are similar to the ones in the panel regre-

[23] Previous analysis by Solé-Ollé (1998), controlling for residents' income and tax-price, found that the full amount of current transfers is translated to spending increases.

[24] This interpretation should be interpreted as tentative. The purpose of this specification was only to account for an empirical fact of Spanish local finance and ensure a better fit of the model to the data. However, the results obtained may be theoretically justified. For example, in a recent paper Strumpf (2001) proposes a political economy model of property taxation and reassessment timing to generate a time pattern of revenues similar to the only we have found in the data.

ssions. Current and capital transfers and assessed property value have a high explanatory power. The coefficients are similar to those obtained in the panel regressions; however, the coefficients on current transfers seem too high, especially in the total spending equations, where they are (statistically) higher than one. Given that most of these grants are unconditional, it is hard to believe that an increase in one euro of transfers foster spending by more than one euro. The results for assessed property are similar but the interaction with the second dummy is not statistically significant. The new control variables appear also with the expected sign and have are highly significant, except resident income per head; this last result may be due to multicollinearity since (at least in this cross-section) income shows a high correlation with assessed property, cars and tourists.

Summing up, the results of the control variables, both in the panel and in the cross-section regression, suggest that the model has substantial predictive capacity and its coherent with the previous literature. This increases the confidence in the results of the main variable of interest: population size. As we noted above, the explanatory capacity of the spline function is not very high. However, joint significant of the coefficients can not be rejected in any of the specifications (see the *F* statistics at the bottom of Tables 3 and 4). The introduction of the control variables in Table 2 (columns 3.b. and 3.e) provoke changes in some of the coefficients: both in magnitude and in statistical significance. The introduction of dummies for additional spending responsibilities (columns 3.c and 3.f) provoke also some smaller changes in the coefficients. Something similar happens in Table 4 with the introduction of the full set of controls. For this reason we will focus in the results of columns (c) and (f) of both tables.

It is quite cumbersome to interpret the results of the spline function estimates from the results of Tables 3 and 4. As we explained in the previous section, these coefficients only identify the change in the slope of the function from the previous segment. In Table 5 we present the estimated slopes for each segment. The first two columns present the results derived from the panel estimates, first for current spending and second for total spending. The last two columns present the results obtained from the cross-section estimates. Let’s go first for the panel estimates. Note that in the first two segments the slope is negative meaning that for municipalities with less than 5,000 inhabitants increasing population reduces spending per head. For the three following segments the slope is positive, meaning that spending per head increases with population. Note also that for populations above 50,000 the slope can not be statistically distinguished from zero. This pattern suggests that there are important scale economies at low levels of population, but that they are exhausted at low population levels (around 5,000). Above this population size other factors are more relevant than scale economies: increasing administrative and congestion costs, or higher wages. Spending per head stops increasing at relatively low population levels (around 50,000). The cross-section results show a similar pattern. Here the slope of the first segment (from 3,000 to 5,000 inhabitants) is negative but not statistically different from zero. Note, however, that this segment is different than the one used in the panel regression (from 1,000 to 5,000 inhabi-tants). The slopes of the segments that follow are also positive, as in the panel estimates. In this case, however, the spline function flattens near the 20,000 level; the slope of the 20,000 to 50,000 segment is quite low for current spending and null for total spending.

[Insert Table 5]

Thus, the panel and the cross-section results are similar. However, we have some preference for the panel estimates, for three reasons. First, because the results regarding some control variables (e.g., current transfers) are more coherent in the panel regressions. Second, because they cover they full population spectrum. And third, because they provide information on spending due to additional responsibilities[25]. Therefore, we have decided to use the panel results to perform a simulation of the height of the spline function at various population sizes. The first step of the simulation is to fix a base category; as minimum spending per head is reached just before the 5,000 threshold, our base category will be a municipality with 4,999 inhabitants. The second step is to compute the spending per head of this municipality in the event it has the average values for the control variables; to perform this calculation we take the average 1999 spending per head in the sample and subtracts the effect of the control variables (i.e., the product of the estimated coefficient and the average sample value of each variable). After this procedure, we obtain current spending and total spending per head of 290 and 490 euro. The final step is to add to these values the spending increases implicit in the spline function slopes and the coefficients of the additional responsibility dummies. The results of this simulation, expressed as indexes relative the base category (equal to one) are shown in Table 6.

[25] Columns 3.c and 3.f show that the assumption of new responsibilities has possitive effects on per capita expenditure; this is true for the 5,000 and 20,000 thresholds in the case of current spending, and also for the 50,000 threshold in the case of total spending Most of these coefficients, however, are statistically significant at the 90% level; only the 5,000 coefficient in the total spending equation is statistically significant at the 95% level.

[Insert Table 6]

The first three columns of Table 6 correspond to current spending. There are other three columns for total spending. For each spending category, the first column shows the heights of the spline function, the second column shows the increase in per capita spending due to additional responsibilities, and the third column is simply the sum of the two previous ones. We include also, in the last column of Table 6, the weights given to population in the computation of the unconditional transfer received by Spanish municipalities. Note that the simula-ted values can also be interpreted as normative population weights. By comparing simulated with actual weights we will be able to assess the appropriateness of the actual formulation. The ease interpretation, the results shown in Table 6 are also displayed in Figures 5 and 6.

[Insert Figures 5 and 6]

Both the data in Table 6 and the profiles show in the figures give clear messages. First, per capita spending needs are higher both in very small localities and in big cities; the profile relating population and per capita expenditure has a U-shape. For example, if we look at the total spending population weights, per capita expenditure needs in a municipality with 1,000 inhabitants is a 23% higher than in the base municipality of 4,999 inhabitants. Per capita expenditure in a municipality with 50,000 inhabitants is a 97% higher than in the base case; of this differential, a 74% is due to extra costs in common responsibilities and the remaining 23% to expenditure derived from additional responsibilities[26]. Second, per capita spending needs stop growing at 50,000 inhabitants. This behaviour is very different than the one displayed by the weights used actually in the formulation of the transfer. Note that, actually, the weights rise again slightly at 100,000 and are multiplied by a factor of two at 250,000. Our empirical results do not provide any evidence on such an abrupt change at high population sizes. In fact, above 50,000 the estimated profiles are flat: the statistical tests performed on the coefficients of Table 3 are conclusive in this respect. Third, relative per capita spending needs at high population levels (50,000 and above) are, however, substantial. Moreover, the estimated weights are also very high at intermediate population sizes. Figures 5 and 6 show the curve rises very fast above the 5,000 threshold. Note also that the estimated profile is much above the one depicted by actual weights.

[26] Of this 23%, 7% correspond to responsibilities assumed after exceeding the 5,000 threshold, 10% to the 20,000 threshold, and 13% to the 50,000 threshold.

6. Conclusions

This paper has analysed the relationship between spending per head and population size. The main purpose of the paper is to evaluate the actual weights given to population in the formulation of the main unconditional transfer given to local governments in Spain. With this aim we estimate an expenditure equation with data from a unique data set, covering more than 3.000 Spanish municipalities during the period 1995-99. We use a piecewise linear function to account for the possible non-linear relationship between expenditure and population size and include control variables in the regression in order to avoid confounding population size effects with influences coming from other factors (i.e., transfers received, fiscal capacity). The simulated expenditure-population profile is very different than the one implicit in the population weights used in the formulation of the transfer. The empirical evidence suggest that there are important scale economies for municipalities below 5,000 inhabitants, that is the population size where spending per head is minimized. Similarly, spending per head rises steeply above the 5,000 inhabitants, but stops increasing at 50,000. The actual profile is quite different: it does not recognize those higher costs at lower population sizes, the cost differences accepted for municipalities from 5,000 to 50,000 are much lower than those suggested by our simulations, and transfers per head for big municipalities (above 250,000) are really high.

The results suggest that big cities do not bear the high cost that are supposed to bear, and that costs in small towns are much higher than currently accepted. The policy implications of these results are profound, and the reform in the formulation of the unconditional transfer may be not politically feasible. This is the first results on very hot topic; the evidence need to be complemented by any other means to ensure robustness. Moreover, there may be weaknesses associated in our procedure; for example, while the number of observations available to identify the first strata is huge (i.e., there are more than two thousand municipalities below 5,000 inhabitants in the sample), it lower in the higher population strata (i.e., there are 35 municipalities with more than 50,000 inhabitants, and even lower in the top segments)[27].

However, we feel the results are not unrealistic. Other empirical analysis have found similar U-shapped patterns (see, e.g., Ladd, 1992). And different arguments can be used to reconcile the empirical results with the reality. First, the fact that costs are higher in small localities does not necessarily justify that these costs have to be compensated by transfers. If municipalities have an inefficient size it would be better to provide some incentives to promote contracting-out or

[27] Note however that the spline function is flat above 50,000; the number of observation used to identify this zero slope is very high (near 200 municipalities by 5 five years of data).

municipal consolidation in order to better exploit scale economies (King and Ma, 2000). Or politicians may be considering that this subsidy to high cost areas entails efficiency costs because it reduces the amount of money to be distributed to other parts of the country and induces people to locate in too expensive areas (see, e.g., Dixon *et al*., 1993)[28].

Second, high transfers per head to big cities may well be the result of its higher political weight. For example, a non-negligible part of politicians now in the regional or central government were recruited from big municipalities. Also, local electoral results in Spanish big cities are a good indicator of central government's prospects in next general elections. Third, high cost in big cities may be the result of expenditure spillovers, arising from commuters and other non-residents that came to central cities and consume its public services (see Solé-Ollé and Viladecans, 2002a and 2002b, for evidence). It may well happen that these spillovers are imperfectly related to population size, because in some big cities boundaries are far more broad than in others. But note that if this is true, transfers must not be higher simply according to population size: they must be tailored to solve the spillover problems of specific areas.

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[28] Although this argument is often used to justify not to fully subsidize high cost small localities, note that the same argument can be used to ban subsidies for high cost big cities. For a discussion of this argument. see, e.g., Fenge and Meier, 2000.

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Table 1:
Population weights implicit in the Spanish municipal unconditional transfer

Population	*Population weights*	*Actual transfer per head*
< 5,000	1.00	1.00
Between 5,000 and 20,000	1.15	1.08
Between 20,000 and 100,000	1.30	1.19
Between 100,000 and 500,000	1.50	1.49
> 500,000	2.80	2.14

Source: Local Government Financing Act, 1988 ("Ley Reguladora de las Haciendas Locales") & own elaboration from data provided by the Ministry of Economics on Municipal Revenue Sharing by municipality

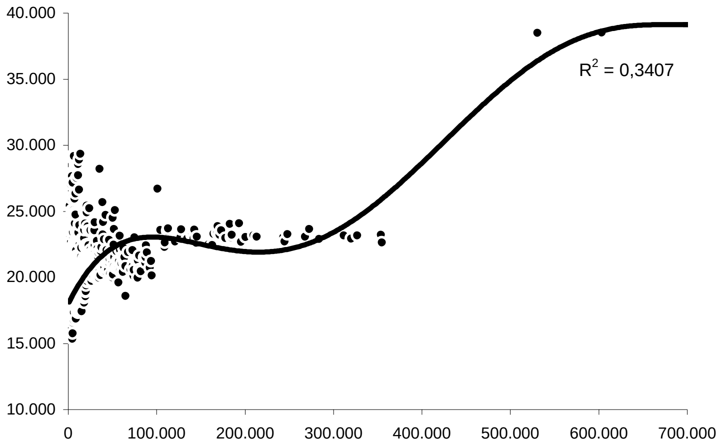
Table 2: *Spending responsibilities in Spanish municipalities.*

	Responsibilities
All municipalities:	Public lighting,
	Street cleaning,
	Refuse collection,
	Water supply,
	Paving of local roads,
	Food and drink control
Municipalities with:	
- *Population* > 5,000	Parks,
	Libraries,
	Market place,
	Solid waste treatment
- *Population* > 20,000	Fire protection & Emergencies
	Social services,
	Sport facilities,
	Slaughterhouse
- *Population* > 50,000	Urban passenger transport,
	Environmental protection

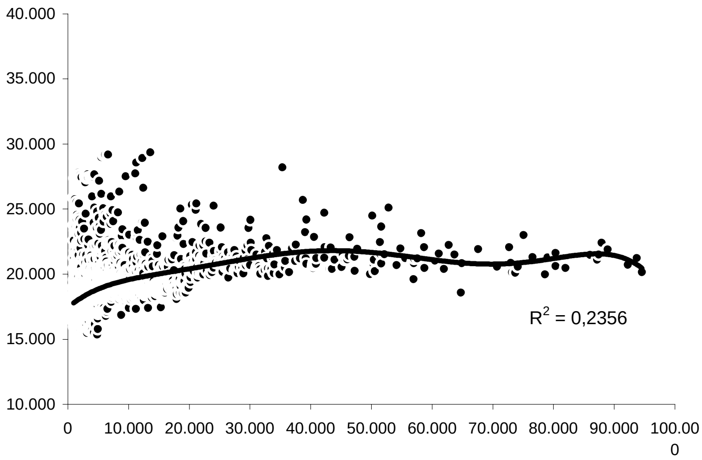
Source: Local Government Act, 1985 ("Ley Reguladora de Bases de Régimen Local")

Figure 1: *Unconditional grant per head vs. population size*

Panel a: *full sample*



Panel b: *population lower than 100,000*



Panel c: *population higher than 100,000*

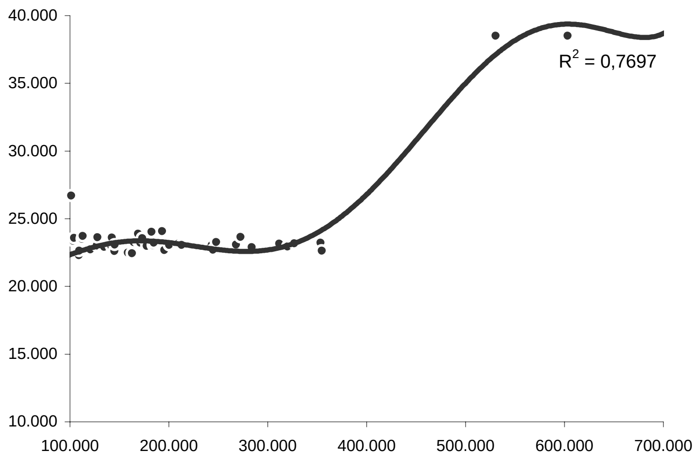
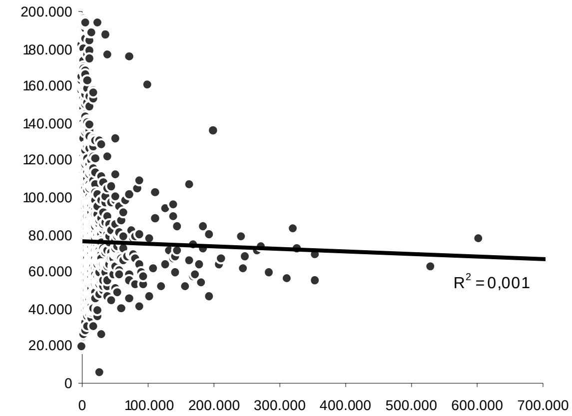


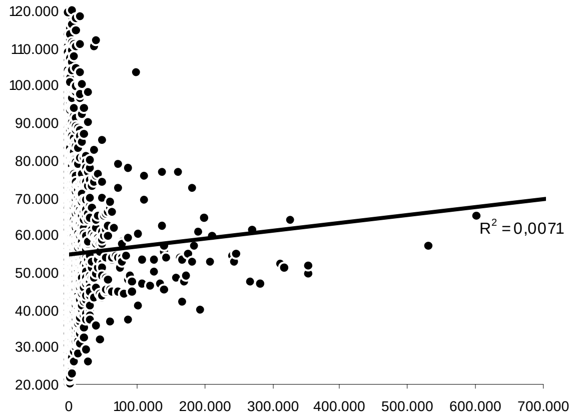
Figure 2: *Total and current spending per head vs. population size*

Panel a: *full sample*

a.1 *Total spending*

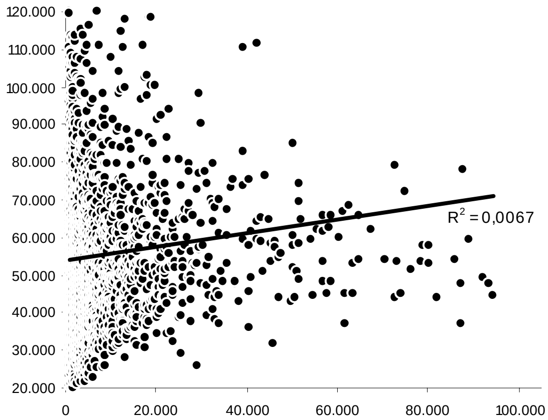


a.2 *Current spending*

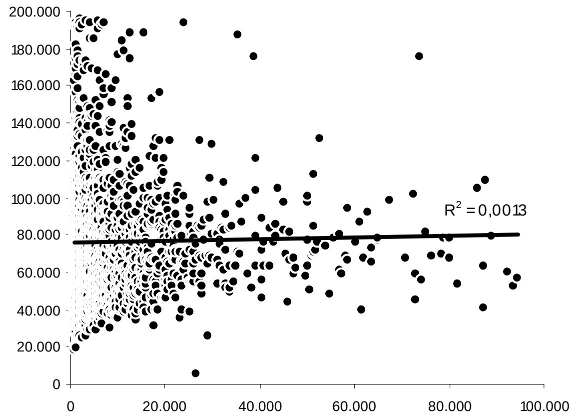


Panel b: *population lower than 100,000*

b.1 *Total spending*

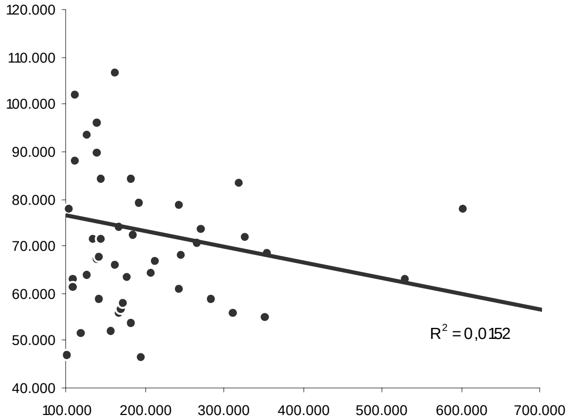


b.2 *Current spending*



Panel c: *population higher than 100,000*

c.1 *Total spending*



c.2 *Current spending*

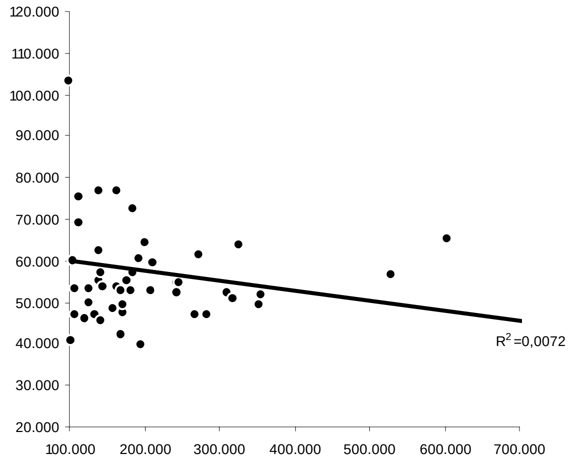


Figure 3. *Spline function*

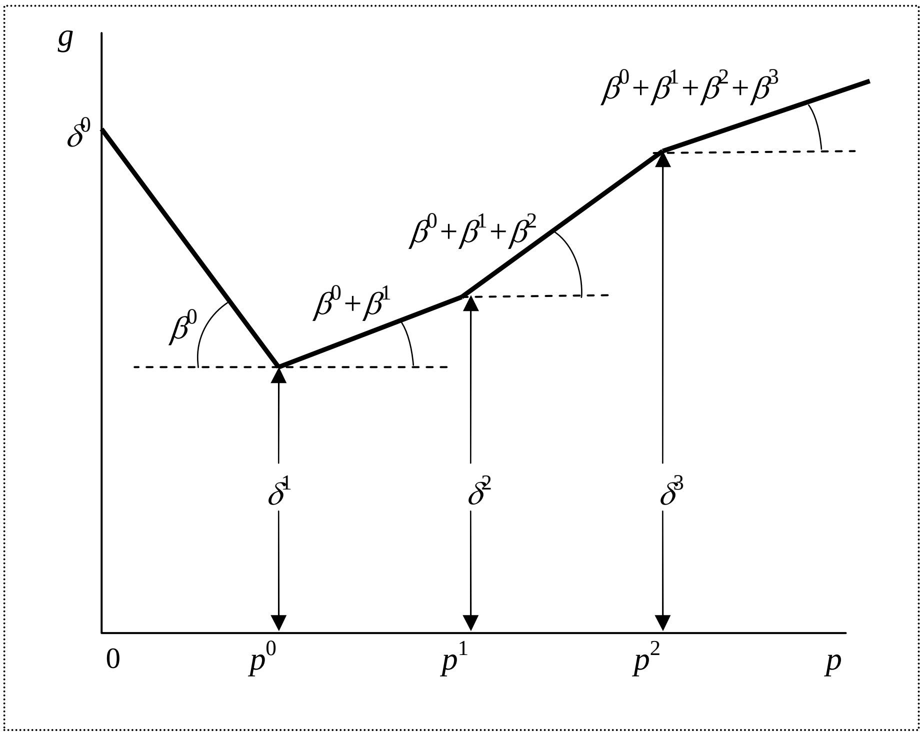


Figure 4. *Step function*

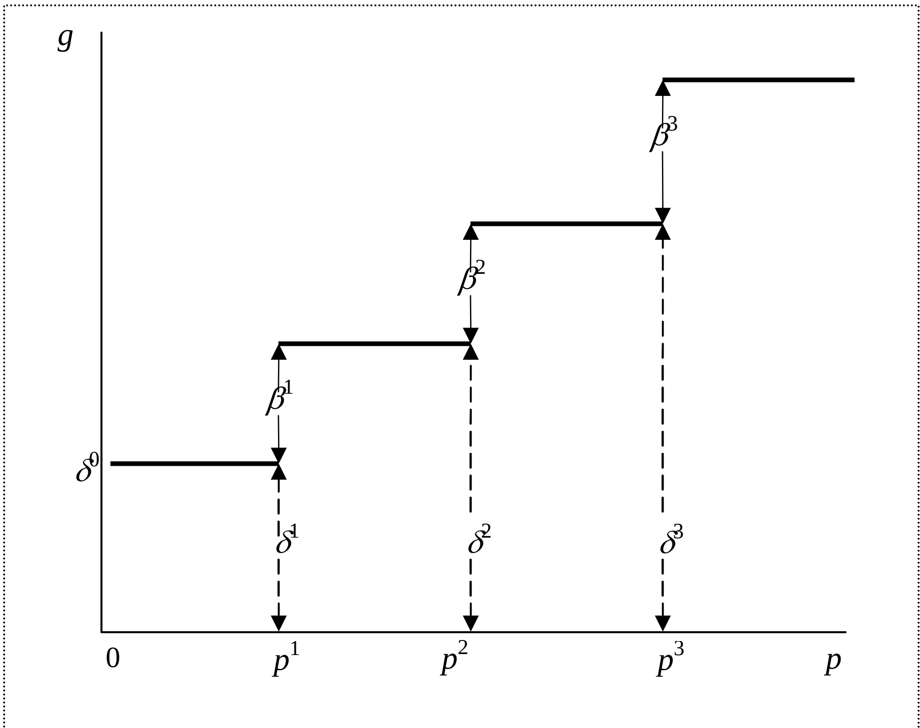


Table 3

Effects of population size on local government spending in Spain. Basic results.
Panel for the period 1995-1999. *Sample* of 3,722 *municipalities* (Obs.=18,610)

	Current spending (g^c)			*Total spending* (g^t)		
	(2.a)	(2.b)	(2.c)	(2.d)	(2.e)	(2.f)
			i.- *Common spending responsibilities* (e^c)			
population (*p*)	-171.41 (-30.787)**	-61.997 (-13.409)**	-62.012 (-13.411)**	-233.07 (-17.878)**	-71.593 (-7.184)**	-71.715 (-7.196)**
p - 1,000	161.57 (27.999)**	57.334 (12.038)**	57.088 (11.971)**	223.55 (16.544)**	69.272 (6.747)**	68.681 (6.683)**
p - 5,000	10.518 (6.248)**	5.333 (3.961)**	5.461 (4.038)**	12.600 (3.197)**	6.841 (2.357)**	7.205 (2.473)**
p - 10,000	0.638 (1.541)	0.200 (1.712)*	0.454 (2.167)**	-1.144 (-1.414)	-2.411 (-2.187)**	-1.858 (-2.388)*
p - 20,000	-1.120 (-1.689)*	-0.730 (-1.797)*	-0.824 (-1.810)*	-0.867 (-1.525)	-0.728 (-1.699)*	-1.140 (-1.898)*
p - 50,000	-0.234 (-1.416)	-0.243 (-1.539)	-0.268 (-1.692)*	-0.207 (-1.611)	-0.293 (-1.921)*	-0.239 (-1.859)*
p - 100,000	-0.573 (-1.061)	-0.038 (-0.088)	-0.041 (-0.093)	-0.491 (-0.705)	-0.130 (-0.677)	-0.074 (-0.037)
p - 250,000	0.217 (0.455)	0.209 (0.547)	0.209 (0.548)	-0.078 (-0.070)	0.039 (0.041)	0.030 (0.037)
p -500,000	0.316 (1.026)	-0.080 (-0.327)	-0.080 (-0.325)	0.632 (0.876)	0.111 (0.209)	0.113 (0.213)
			ii.- *Additional spending responsibilities* (e^a)			
d(*p*>5,000)	--.--	--.--	2,119.59 (1.701)*	--.--	--.--	5,755.30 (2.178)**
d(*p*>20,000)	--.--	--.--	1,426.86 (1.690)*	--.--	--.--	2,079.60 (1.810)*
d(*p*>50,000)	--.--	--.--	154.13 (0.147)	--.--	--.--	11,194.33 (1.743)*
			iii.- *Revenue availability and other controls* (x^k)			
Current Transfers p.h.	--.--	0.528 (52.832)**	0.527 (54.852)**	--.--	0.745 (34.625)**	0.745 (34.592)**
Capital Transfers p.h.	--.--	0.049 (12.601)**	0.049 (12.602)**	--.--	0.859 (101.230)**	0.858 (101.238)**
Assessed property p.h. ($\times 10^{-2}$)	--.--	0.649 (48.004)**	0.648 (47.941)**	--.--	0.646 (22.183)**	0.644 (22.104)**
Ass.prop. p.h. × *Ass.lag* (>2)		0.167 (15.382)**	0.167 (15.371)**		0.156 (8.909)**	0.156 (8.902)**
Ass.prop. p.h. × *Ass.lag* (>5)	--.--	0.183 (20.582)**	0.184 (20.600)**	--.--	0.178 (9.275)**	0.178 (9.296)**
Ass.prop. p.h. × *Ass.lag* (>10)	--.--	0.008 (0.891)	0.009 (0.891)	--.--	0.037 (1.676)*	0.037 (1.684)*
R^2-*adj.*	0.322	0.638	0.668	0.237	0.601	0.623
B.P. (*heteroskedasticity*)	3.224	3.018	2.847	1.336	1.558	1.360
F-stat. (f_i=*f*)	25.478**	43.355**	42.323**	42.766**	38.442**	38.433**
χ^2-*Hausman* (*fixed* vs. *random*)	945.160**	948.210**	840.932**	251.810**	182.590**	181.360**
F-stat. (f_t=*f*)	15.226**	13.142**	14.024**	12.334**	14.240**	13.224**
F-stat. (*spline*)	7.304**	7.574**	7.998**	8.334**	8.102**	8.304**
F-stat. (*additional resp.*)	--.--	--.--	3.014**	--.--	--.--	5.014**
F-stat. (*controls.*)	--.--	25.247**	27.155**	--.--	23.309**	22.145**

Notes: (1) *t* statistics are show in brackets; *, significantly different from zero at the 90% level and **, Significantly different form zero at the 95% level, (2) Individual effects included in all specifications.

Table 4

Effects of population size on local government spending in Spain, Cross section for the year 1999, *Sample* of 2,632 *municipalities* (Obs.=2,632)

	Current spending (g^c)			*Total spending* (g^t)		
	(2.a)	(2.b)	(2.c)	(2.d)	(2.e)	(2.f)
i.- *Common spending responsibilities* (e^c)						
population (*p*)	-0,145 (-0,329)	-0,104 (-1,048)	-0.022 (-1,282)	-1,000 (-1,521)	-0,153 (-0,369)	-0,014 (-0,034)
p - 5,000	0,796 (1,804)*	0,396 (1,785)*	0.646 (2.282)**	1,717 (1,719)*	0,787 (1,664)*	0,628 (1,784)*
p - 10,000	-0,753 (-1,601)	-0,314 (-1,733)*	-0,364 (-2,274)**	-0,831 (-1,497)	-0,706 (-1,490)	-0,427 (-1,639)*
p - 20,000	0,144 (0,357)	-0,043 (-1,176)	-0,226 (-1,871)*	0,276 (0,458)	0,075 (0,200)	-0,242 (2,114)**
p - 50,000	-0,307 (-1,196)	-0,055 (-1,169)	-0,035 (-1,523)	-0,230 (-0,588)	-0,003 (-0,152)	-0,006 (-0,024)
p - 100,000	0,085 (0,445)	0,052 (0,441)	0,021 (0,183)	0,005 (0,018)	-0,027 (-0,152)	-0,049 (-0,287)
p - 250,000	0,068 (0,585)	0,001 (0,009)	0,002 (0,029)	0,079 (0,455)	-0,015 (-0,138)	-0,019 (-0,185)
p -500,000	-0,031 (-0,462)	0,009 (0,210)	0,011 (0,279)	-0,014 (-0,013)	0,034 (0,535)	0,039 (0,621)
ii.- *Revenue availability and other controls* (x^k)						
Current Transfers p.h.	--.--	0.754 (26.393)**	0.792 (27.712)**	--.--	1.048 (24.242)**	1.129 (25.841)**
Capital Transfers p.h.	--.--	0.089 (3.854)**	0.111 (4.848)**	--.--	0.854 (24.228)**	0.887 (25.056)**
Assessed property p.h. ($\times 10^{-2}$)	--.--	0.649 (31.379)**	0.552 (24.617)**	--.--	0.843 (26.975)**	0.763 (22.263)**
Ass.property p.h. × *Ass.lag* (>2)	--.--	0.077 (0.323)	0.048 (0.539)	--.--	0.011 (0.336)	0.277 (0.800)
Ass.property p.h. × *Ass.lag* (>5)	--.--	0.330 (14.461)**	0.266 (11.730)**	--.--	0.349 (10.124)**	0.293 (8.417)**
Ass.property p.h. × *Ass.lag* (>10)	--.--	0.076 (1.997)**	0.054 (1.480)	--.--	0.224 (3.845)**	0.087 (0.246)
Income p.h. (*index av.*=100)	--.--	--.--	0.271 (1.163)	--.--	--.--	0.336 (1.330)
Firms p.h. (*index av.*=100)	--.--	--.--	0.432 (7.638)**	--.--	--.--	0.674 (7.722)**
Cars p.h.(*index av.*=100)	--.--	--.--	0.289 (3.249)**	--.--	--.--	0.660 (5.022)**
Tourists p.h. (*index av.*=100),	--.--	--.--	0.033 (4.717)**	--.--	--.--	0.041 (1.705)*
R^2*-adj.*	0.076	0.609	0.692	0.053	0.616	0.687
B.P. (*heteroskedast,*)	3.059	4.012	3.260	3.102	4.200	4.056
F-stat. (*zero slopes*)	6.160**	295.60**	244.98**	5.021*	280.45**	214.24**
F-stat. (*spline*)	--.--	8.664**	9.245**	--.--	8.664**	7.742**
F-stat. (*controls.*)	--.--	210.31**	226.47**	--.--	189.62**	193.54**
F-stat. (*additional controls.*)	--.--	--.--	10.541**	--.--	--.--	9.612**

Notes: (1) *t* statistics are show in brackets; *, significantly different from zero at the 90% level and **, significantly different form zero at the 95% level.

Table 5

Estimated slope at each segment of the spline function (1)

Population	*Panel*(2)		*Cross-section*	
	Current spending	*Total Spending*	*Current spending*	*Total Spending*
<1,000	-62.012 (-13.411)**	-71.715 (-7.196)**	--.--	--.--
1,000-5,000 (or 3,000-5,000) (3)	-4.924 (-12.331)**	-4.034 (-6.992)**	-0.022 (-1.282)	-0.014 (-0.034)
5,000-10,000	0.537 (6.557)**	3.171 (4.422)**	0.624 (2.003) **	0.614 (1.779)*
10,000-20,000	0.991 (2.424)**	1.313 (2.774)**	0.260 (2.124) **	0.187 (1.754)*
20,000-50,000	0.167 (2.047)**	0.137 (1.947)*	0.034 (1.865) *	-0.055 (-1.005)
50,000-100,000	-0.100 (-0.865)	-0.100 (-1.023)	-0.001 (-1.587)	-0.061 (-0.354)
100,000-250,000	-0.106 (-0.211)	-0.104 (-0.699)	0.020 (0.574)	-0.110 (-0.311)
250,000-500,000	0.100 (0.368)	-0.101 (-0.148)	0.022 (0.334)	-0.129 (-0.258)
>500,000	0.020 (0.311)	0.010 (0.251)	0.033 (0.325)	-0.091 (-0.598)

Notes: (1) The slopes are computed as the sum of the estimated coefficient for all the previous segments (e.g., $\beta^0+\beta^1+...$); *t* statistics for the slope coefficients (shown in brackets) have been computed by dividing the value of the slope by its standard error (see, Greene, 2001, Ch. 6.5); *, significantly different from zero at the 90% level and **, significantly different form zero at the 95% level. (2) Panel=the slope are computed from the panel estimates of Table 2; Cross-section=the slope are computed from the cross-section estimates of Table 3. (3) The segment 1,000-5,000 is used in the panel estimation while the segment 3,000-5,000 is the first segment of the cross-section estimation.

Table 6

Population weights obtained from the econometric analysis compared with those implicit in the actual formula

Population	*Current spending*			*Total Spending*			*Actual Grant*
	(a) *Common resp.(e^c)*	(b) *Additional resp.(e^a)*	(c) *Total* (a+b)	(a) *Common resp.(e^c)*	(b) *Additional resp.(e^a)*	(c) *Total* (a+b)	*Total*
<1,000	1.51	--.--	1.51	1.23	--.--	1.23	1
1,000-5,000	1.00	0.04	1.04	1.00	0.07	1.07	1.15
5,000-10,000	1.11	0.04	1.15	1.37	0.07	1.43	1.15
10,000-20,000	1.52	0.07	1.59	1.65	0.10	1.75	1.3
20,000-50,000	1.70	0.07	1.77	1.74	0.23	1.97	1.3
50,000-100,000	1.70	0.07	1.77	1.74	0.23	1.97	1.5
100,000-250,000	1.70	0.07	1.77	1.74	0.23	1.97	1.5
250,000-500,000	1.70	0.07	1.77	1.74	0.23	1.97	2.8
>500,000	1.70	0.07	1.77	1.74	0.23	1.97	2.8

Notes: (1) Weights computed from the results of the panel estimation of Table 2. (2) A municipality with 4,999 inhabitants has been taken as the base category; base category spending computed as the 1999 spending per head of such a municipality in the event it has average values of the control variables (i.e., 290 and 490 euro p.h. for current and total spending). (3) The weights are for a municipality with a population equal to the upper bound of the segment. (4) Common responsibilities=weights arising from the spline function coefficients; Additional responsibilities=weights arising from the dummies picking up the municipalities getting additional competences during the period.

Figure 5. *Current spending estimated population weights vs. actual weights.*

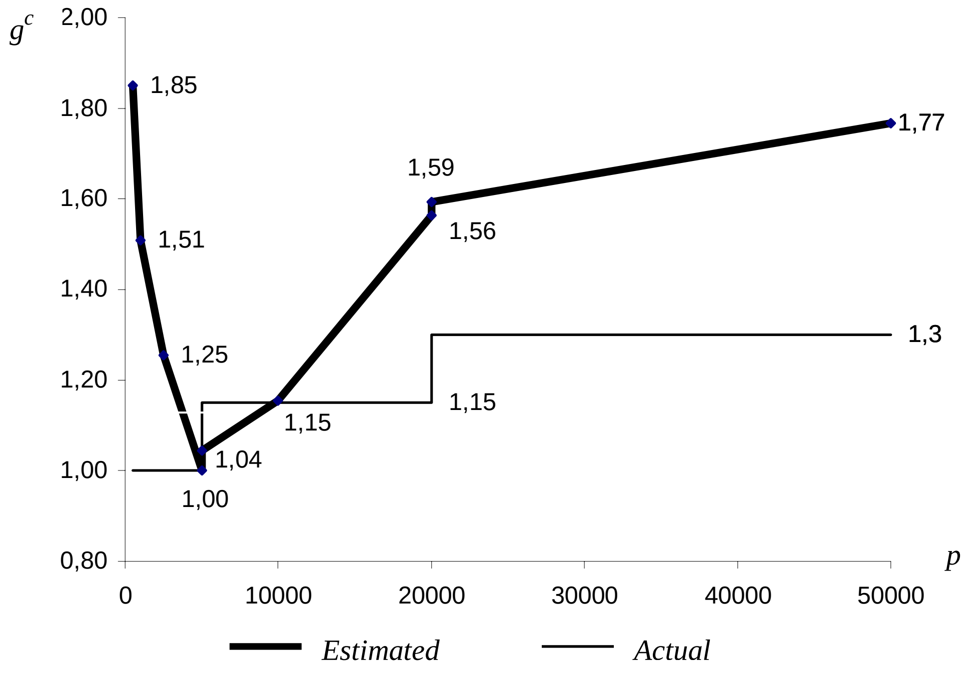


Figure 6. *Total spending estimated population weights vs. actual weights.*