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Budget spillovers in a metropolitan area: typology and empirical evidence

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BUDGET SPILLOVERS IN A METROPOLITAN AREA: TYPOLOGY AND EMPIRICAL EVIDENCE [a]

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ABSTRACT: We present a model for measuring spillovers resulting from local expenditure policies. We identify and test for three different types of budget spillovers: (i) benefit spillovers from the production of local public goods, (ii) externalities in crowding, caused by non-resident users of public facilities, and (iii) externalities from expenditure competition effects. In order to account for these types of spillovers, we specify a demand of public goods with interactions among local governments. The model is tested for different expenditure categories with a cross-section of data from municipalities of the metropolitan area of Barcelona. We find positive benefit spillovers in spending in Cultural and Sports facilities, and in Parks and Streets maintenance. Externalities in crowding appear in spending on Police, Cultural and Sports facilities, Parks and Streets maintenance, and Street cleaning, Water delivery and Sanitation. Spending on Social services seems to be affected by competition externalities, while there is no evidence of spillovers in the expenditure on General Administration.

RESUMEN: Presentamos un modelo para medir los desbordamientos en las políticas locales de gasto. Identificamos y contrastamos tres tipos de efectos desbordamiento en el gasto: (i) desbordamiento en los beneficios derivados de la producción de bienes públicos locales, (ii) costes de congestión creados por los residentes en jurisdicciones vecinas, y (iii) externalidades en el gasto derivadas de la competencia fiscal. Con objeto de considerar los distintos tipos de desbordamientos, se especifica una función de demanda de bienes públicos con interacciones entre gobiernos locales. Las predicciones del modelo son constrastadas para seis categorías de gasto diferentes con datos de los municipios pertenecientes al área metropolitana de Barcelona. Los resultados identifican externalidades positivas en los gastos de Cultura y Deporte y en Urbanismo. Los costes de congestión surgen en el gasto de Policía, Cultura y Deporte, Urbanismo, y Bienestar Comunitario. El gasto en Servicios Sociales parece estar influido por la competencia fiscal, mientras que no se obtiene evidencia de efectos desbordamiento en el caso del gasto en Administración General.

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1. INTRODUCTION

Benefit spillovers are a widespread feature of many services provided by local governments. For example, roads, public transportation, and recreation and cultural facilities are visited, and therefore crowded, by residents in nearby jurisdictions. Crime fighting in one jurisdiction could either lower regional crime, or push criminals into neighbouring communities. Air pollution controls and sewage treatment enhance the environmental quality of bordering jurisdictions. Radio and TV broadcasts can be seen away from the local border. Educational and job training expenditures may translate in productivity gains in workplaces outside the community.

Spillovers, or interjurisdictional externalities, have played an important role in the urban economic literature on local government. The significance of spillovers is widely recognized in the fiscal federalism literature, but most of the papers in this tradition simply assume the existence of spillovers and analyse their consequences. See, for example, Brainard and Dolbear [12], Pauly [46], Arnott and Grieson [6] and Gordon [29], for the efficiency consequences of spillovers, and Oates [44], Boskin [11] and Conley and Dix [20] for the implications for the design of optimal federal structures. The general conclusion of this strand of literature is that externalities tent to cause a divergence between private and social costs and benefits, and thus lead to suboptimal decision-making[1]. Some authors have also worried about the equity consequences of spillovers, mainly in the context of the demise of US metropolitan areas (see, e.g., Ladd and Yinger [40]), but also relating to the design of 'needs-based' equalisation grants (Bramley [13]).

[1] The general policy prescribed to deal with positive (negative) spillovers is a matching grant (a tax) provided by a higher layer of government (Dalhby [25]). Other possible methods to internalize spillovers are boundary reforms, assignment of capacity to tax non-residents to the local government, voluntary agreements and the creation of a higher-tier of local government that enforces cooperation among communities (Haughworht [33]).

However, some scepticism remains about the scale and importance of spillovers (Bramley [13]). This may be due to the lack of empirical studies that verify the existence of spillovers in the provision of local public services. Weisbrod [52] and Greene *et al.* [30] are some of the few empirical studies on this topic. The first one estimates the extent to which local school expenditures provide benefits to other communities via the migration of educated population. He finds that school expenditures are lower in states with high rates of outmigration. The second one quantifies the magnitude of benefit spillovers in Washington D.C., confirming the relevance of the problem. There are also some papers dealing with spillovers in crime prevention (Furlog and Mehay [28], Hakim *et al.* [32] and Heikkila and Kantiotou [34]) and recreation (Bramley [13]). These papers provide evidence about the effects of some groups of non-residents on the crime level or on the level of service utilisation in the community.

More recently, some papers have developed specific tests of budget spillovers by looking for interactions among the expenditure levels of neighbouring communities. See, for example, Murdoch *et al.* [43] for a study of local recreation expenditures in the metropolitan area of L.A., and Case *et al.* [18] for an analysis of the full range of expenditure categories of U.S. state governments. The results of these papers confirm the relevance of interactions among expenditure levels of neighbouring governments, but some doubts remain about its meaning. For example, the positive interactions among expenditure levels found in both papers could also be due to competition among jurisdictions for residents or businesses. This seems to be reinforced in the Case *et al.* [18] study by the fact that states seem to react only to expenditure changes of states with similar racial characteristics, and not to adjacent ones. But if spillovers tent to arise as a consequence of some form of mobility or other (e.g., commuting and commercial trips, crime migration or transboundary pollution), the degree of interaction among governments should exhibit distance decay. Also, none of these studies cares about the exact nature of the public services provided. Being these probably congestible, in the presence of some sort of mobility, spillovers would manifest itself not only in the form of expenditure interactions, but also in the form of interactions from the neighbours' demographic variables to own expenditures.

The paper presents a model for measuring spillovers resulting from local expenditure policies. The test of budget spillovers looks, as in the two aforementioned papers, for interactions among expenditure levels, but introduce some improvements in the methodology. First, we identify and test for three different types of budget spillovers: (i) benefit spillovers, derived from the production of local public goods, (ii) externalities in crowding, derived from the crowding of facilities by residents in neighbouring jurisdictions, and (iii) externalities derived from the effects of expenditure competition. Benefit spillovers are accounted for by assuming that the representative resident enjoys the consumption of a local public good both in his community and in the surrounding ones. Externalities in crowding are included by considering that the service outcomes of a locality are influenced by demographic variables of the surrounding localities. These spillovers translate to a demand function with interactions among local governments occurring not only between expenditure levels (benefit spillovers) but also from neighbours' demographic variables to own expenditures (externalities in crowding). Spillovers from expenditure competition effects arise in the special case of expenditure interaction with congestible goods, but without externalities in crowding (that is, the good is congestible but there is only crowding by residents).

Second, we test for spillovers across the full range of expenditure categories of the local governments in our sample, not just one category. Third, we take into account that, partly because of low mobility costs, benefit spillovers are a natural phenomena in large conurbations, where jurisdiction boundaries are unlikely to match natural catchment zones for different types of activity. Small jurisdictions in metropolitan areas are more likely to experience high rates of spillin and central cities are a particular source of some types of spillover. Policy prescriptions to overcome the lack of cooperation among local governments will thus be specially useful in the case of metropolitan areas, as it has been properly illustrated in a recent paper by Haughworth [33]. This leads us to test the model with a cross-section of data from the municipalities belonging to the metropolitan area of Barcelona. In addition to this, the focus on that sample allows us to use a very rich data set, combining census data with data on local government finances coming from a special survey undertook by a higher-tier of local government. Most of the data used to properly account for budget spillovers (e.g., commuters, over-night visitors and employment) is unique to the sample, and is not available for the remaining Spanish local communities.

The remainder of the paper is organised into four sections. In the next section, we present the theoretical framework that allows us to develop a typology of spillovers and derive the empirical predictions. This is followed by a discussion of the estimation procedure and the data set used with this purpose. The results and some concluding remarks are given in the final two sections.

2. BUDGET SPILLOVERS: A TYPOLOGY

Following Conley and Dix [20], we identify two main types of budget spillovers. On the one hand, there are spillovers of local public goods, with no externalities in crowding, occurring when a fraction of the local public good produced in on jurisdiction is experienced by surrounding jurisdictions, and is a perfect substitute for their own provision of public goods. The example of radio or TV broadcasting fits well this category, named 'benefit spillovers' from now on. On the other hand, there are also 'externalities in crowding', that are not consequence from the provision of public goods, but from the crowding of facilities by residents in neighbouring jurisdictions. The crowding of museums and parks by commuters and other visitors is a typical example of this externality. If the good is congestable, both types of spillovers could appear at the same time. In addition to these two categories, it would be worthwhile to include a third one, named spillovers arising from 'expenditure competition effects'. In that case, the externality is prompted by the change in the residence of some groups of population in response to policy differences (e.g., welfare recipients in the case of provision of social services).

In the remaining of this section we will develop some theoretical arguments in order to differentiate the empirical predictions coming from the three different types of spillovers. The concrete specification of each type of spillover is built in a simple model of public good provision, that combines a demand of service provision (the same for each case) with a technology of public good supply (that differs according the type of spillover).

2.1 *Basic demand model*

The decision of the local government on the amount of a good to provide can be modelled as an utility maximisation problem. We shall assume that the local government maximises the utility of a representative resident. This procedure can be justified by invoking the median voter model (see Mueller [42], pp. 64-66) or a welfare maximisation approach (see Wildasin [53], pp. 44). In any case, it should become clear that this procedure is merely instrumental, with the purpose to derive some testable predictions regarding the effect of spillovers. More formally, let the preferences of the representative resident of locality *i* be represented by a strictly increasing, strictly quasi-concave, and twice continuously differentiable function (U_i): $U_i(x_i, o_i)$. Where x_i is the private good and o_i is the level of service or outcome. Let us assume that the level of service or outcome achieved in the locality *i* (o_i) depends on the activity or output provided by the local government (a_i), on the number of users of that service (u_i), and on a variety of exogenous cost drivers (z_i),

$$o_i=f_i(a_i, u_i, z_i) \qquad (1)$$

where $\partial f_i/\partial a_i \geq 0$, $\partial f_i/\partial u_i \leq 0$ and $\partial f_i/\partial z_i \leq 0$. This equation determines the supply technology of the public good and allows for different degrees of publicity of the service provided. If $\partial f_i/\partial u_i = 0$ the service is a pure public good, since the outcome enjoyed does not depend on the number of users, $o_i=f_i(a_i, z_i)$. The pure private good case occurs when $\partial f_i/\partial u_i = - a_i/u_i$, since a proportional variation in the level of output and the number of users keeps unchanged the outcome enjoyed, $o_i=f_i(a_i/u_i, z_i)$.

Let's assume also for simplicity that the output is produced under constant returns to scale technology. In this case, the total cost or expenditure (g_i) is equal to the (constant) per unit cost (c_i) times the level of output (a_i): $g_i=c_i.a_i$. Now, substituting a_i in (1), we are able, by the implicit function theorem, to write the cost function,

$$g_i=h_i(o_i, u_i, z_i, c_i) \quad (2)$$

where $\partial h_i/\partial o_i \geq 0$, $\partial h_i/\partial u_i \geq 0$, $\partial h_i/\partial z_i \geq 0$ and $\partial h_i/\partial c_i \geq 0$. The representative resident must choose the utility maximising level of outcome subject to the cost of supplying public goods (2) and his budget constraint, $y_i = x_i - \tau_i (g_i - s_i)$, where y_i is the income of the representative resident, τ_i is the share of that resident in the tax bill of his locality, and s_i are lump-sum grants and other exogenous revenues received by the local government. Around the point that optimally solves the first order condition, the implicit function theorem allows us to write the reduced-form demand for the public outcome,

$$o_i= o_i(\tau_i \; \partial g_i/\partial o_i \; ; y_i + \tau_i \; s_i) \quad (3)$$

where $\partial o_i/\partial(\tau_i \partial g_i/\partial o_i)$ is composed of an income effect (positive/negative) and a substitution effect (negative) and we generally expect a negative sign. The sign expected for $\partial o_i/\partial(y_i +\tau_i \; s_i)$ is positive in the case of a normal good. Due to the lack of appropriate measures of public outcomes, the model is usually estimated with expenditure data. By substituting $\partial g_i/\partial o_i$ in (3) and the results again in (2) we are able to obtain the reduced form expenditure function,

$$g_i=g_i(u_i, z_i, c_i, \tau_i, y_i + \tau_i \; s_i) \quad (4)$$

where $\partial g_i/\partial(y_i+\tau_i s_i)\geq 0$ and provided that the demand for the outcome is price-inelastic $\partial g_i/\partial u_i\geq 0$, $\partial h_i/\partial z_i\geq 0$ and $\partial h_i/\partial c_i\geq 0$[2]. Since the seminal papers of Borcheding and Deacon [10] and Bergstroom and Goodman [8], many papers have estimated, after choosing appropriate functional forms for equations (1) and (3), demand equations like (4)[3]. This model will serve as a baseline for the spillover-augmented expenditure equations.

2.2 *Benefit spillovers*

Benefit spillovers have been traditionally modelled as arising from public good provision. To illustrate this case we shall assume that the representative resident enjoys the benefits of services provided by his community and a portion (ϕ_i^{-i}) of the benefits of services provided by neighbouring communities (Murdoch *et al.* [43]). The linearity of the benefits in the own and neighbouring communities reflects the perfect substitutability among both types of benefits. The benefits achieved in each community depend on the level of output, users and cost drivers therein. Denoting with *i* and *–i*, the values of the community and its neighbours, we can write the supply technology as,

$$o_i=f_i(a_i, u_i, z_i) + \phi_i^{-i}\bullet f_{-i}(a_{-i}, u_{-i}, z_{-i}) \qquad (5)$$

where $\partial f_i/\partial a_i\geq 0$, $\partial f_i/\partial u_i\leq 0$ and $\partial f_i/\partial z_i\leq 0$. In the case of a positive spillover, $\partial f_{-i}/\partial a_{-i}\geq 0$, $\partial f_{-i}/\partial u_{-i}\leq 0$ and $\partial f_{-i}/\partial z_{-i}\leq 0$; and, in the case of a negative spillover, $\partial f_{-i}/\partial a_{-i}\leq 0$, $\partial f_{-i}/\partial u_{-i}\geq 0$ and $\partial f_{-i}/\partial z_{-i}\geq 0$. Recalling that $g_i=c_i.a_i$ and $g_{-i}=c_{-i}.a_{-i}$, and substituting a_i and a_{-i} in (5), we are able to write the cost function,

$$g_i=h_i(o_i, u_i, z_i, c_i; g_{-i}, u_{-i}, z_{-i}, c_{-i}) \qquad (6)$$

[2]The signs of $\partial g_i/\partial u_i\geq 0$ and $\partial h_i/\partial z_i\geq 0$ can be reversed if there is a high degree of substitutability between x_i and o_i. However, the concrete functional forms chosen to estimate demand equations do not allow for complementary/substitutability effects among public and private goods. But, since the sign obtained in these studies for $\partial g_i/\partial u_i$ and $\partial h_i/\partial z_i$ tend to be the positive and the demand is price-inelastic, it seems that the substitutability effect does not empirically dominate the direct cost effect.

[3] Other examples are Schwab and Zampelli [50], Ladd and Yinger [40] and Duncombe [26].

where $\partial h_i/\partial o_i \geq 0$, $\partial h_i/\partial u_i \geq 0$, $\partial h_i/\partial z_i \geq 0$ and $\partial h_i/\partial c_i \geq 0$. If the spillover is positive, $\partial h_i/\partial g_{-i} \leq 0$, $\partial h_i/\partial u_{-i} \geq 0$ and $\partial h_i/\partial z_{-i} \geq 0$; and if the spillover is negative, $\partial h_i/\partial g_{-i} \geq 0$, $\partial h_i/\partial u_{-i} \leq 0$ and $\partial h_i/\partial z_{-i} \leq 0$.

The direct estimation of equation (6) would provide evidence on benefit spillovers. However, due to lack of outcome data, the usual procedure is to estimate a reduced form expenditure function. The derivation of the expenditure function is similar to the previous case, but an important difference has to be noted. Given the interjurisdictional public good characteristics of the cost function (6), an assumption must be made about the behaviour of each local government vis-à-vis the other local governments. It is common in this case to assume that each local community behaves Nash; that is, considers as fixed the supply of public goods by other jurisdictions. Although there could be other possible behaviours, the Nash assumption has been widely used in the literature on public goods provision (see, e.g., Cornes and Sandler [21]). Thus, after following the same steps than in section 2.1, and assuming Nash behaviour, we obtain an expenditure function comparable to (4),

$$g_i = g_i(u_i, z_i, c_i, \tau_i, y_i + \tau_i s_i,; g_{-i}, u_{-i}, z_{-i}, c_{-i},) \qquad (7)$$

where, provided that demand is price inelastic, $\partial g_i/\partial g_{-i} \leq 0$, $\partial g_i/\partial u_{-i} \geq 0$, $\partial g_i/\partial z_{-i} \geq 0$ and $\partial g_i/\partial c_{-i} \geq 0$, if the spillover is positive; and $\partial g_i/\partial g_{-i} \geq 0$, $\partial g_i/\partial u_{-i} \leq 0$, $\partial g_i/\partial z_{-i} \leq 0$ and $\partial g_i/\partial c_{-i} \leq 0$, if the spillover is negative. In the case of a positive spillover, $\partial g_i/\partial g_{-i} \leq 0$ reflects the classical free-riding effect, while in the of case of a negative spillover, $\partial g_i/\partial g_{-i} \geq 0$ reflects the need to compensate the adverse effects of neighbours' policies[4]. Equation (7) will be estimated in section 3 after choosing an appropriate functional form for the supply technology relation (5).

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[4]The sign of $\partial g_i/\partial g_{-i}$ could also be reversed if there is a high degree of substitutability between x_i and o_i. However, note that if this is the case, also the signs of $\partial g_i/\partial u_{-i}$ and $\partial g_i/\partial z_{-i}$ should also be reversed. Thus, if (provided that the demand is price-inelastic) we check that these variables have the same sign as in the cost equation (in general, we expect them to be positive cost drivers), the sign of $\partial g_i/\partial g_{-i}$ will be the one expected (negative/positive for a positive/negative spillover).

2.3 *Crowding externalities*

These externalities occur when non-residents come to the locality and use the services provided therein. If the good is congestable, the use by non-residents reduces the outcome experienced by residents. In this case, we shall assume that the number of users of the service (u_i) depend on the size of some socio-demographic groups in the community (n_i) and in the surrounding communities (n_{-i}), $u_i=u_i(n_i,n_{-i})$, where $\partial u_i/\partial n_i \geq 0$ and $\partial u_i/\partial n_{-i} \geq 0$. That is, the populations living in the vicinity tend to travel to the community *i* (e.g., to work, study or shop) and make some use of the public services provided therein. We shall further assume that the decisions of the commuters to use public services in the workplace is simply a matter of opportunity and is, thus, exogenous. In this case the outcome provided can be expressed as,

$$o_i=f_i(a_i, n_i, n_{-i}, z_i) \tag{8}$$

where $\partial f_i/\partial a_i \geq 0$, $\partial f_i/\partial n_i \leq 0$, $\partial f_i/\partial n_i \leq 0$ and $\partial f_i/\partial z_i \leq 0$. After following the same steps than in section 2.1, we obtain an expenditure function comparable to (4),

$$g_i=g_i(n_i, n_{-i}, z_i, c_i, \tau_i, y_i + \tau_i s_i) \tag{9}$$

where, provided the demand is price-inelastic, $\partial g_i/\partial n_i \geq 0$ and $\partial g_i/\partial n_{-i} \geq 0$, and the remaining coefficients show the same results than in section 2.1. Equation (9) will be estimated in section 3 after choosing an appropriate functional form for the supply technology relation (8).

The models represented by expenditure equations (5) and (9) are by no means incompatible. Except in the case of no-congestion (i.e., $\partial o_i/\partial u_i=\partial o_{-i}/\partial u_{-i}=0$ in (5)), benefit spillovers and crowding externalities may appear simultaneously. In fact, if residents crowd public services ($\partial o_i/\partial u_i \geq 0$) and there are benefit spillovers ($\phi_i^{-i} \neq 0$), why should not non-residents also crowd public services?. Thus, the equation to be estimated in section (3) allows for the possibility that both kinds of spillovers appear at the same time.

2.4 *Competition effects*

Fiscal competition constitutes in itself a potential alternative explanation of interactions among expenditure policies of local governments. For example, local governments may fear that low relative levels of productive expenditure will drive out business, or that high relative levels of social expenditure will attract welfare recipients. In this case, they will match the spending increases of neighbour communities with own spending increases. This is in fact the prediction of the model of capital tax competition developed by Wildasin [54] and tested by Buettner [17]. This author finds a positive interaction among capital tax rates of Western Germany neighbouring communities. Empirical analysis of welfare competition also tent to find a positive interaction between benefit levels of neighbouring communities, although the theory gives no a priori prediction for the sign of the reaction (see, e.g., Saavedra [49]).

The interaction among expenditure levels could also arise as a result of 'yardstick competition' (Besley and Case [9]). This happens when voters evaluate the performance of local incumbents relative to the performance achieved by local governments in comparable communities. If this is the case, incumbents may choose not to deviate from the policies undertook by neighbours in order to remain in office. Spending increases/ decreases by a local government will tent to be followed by local governments in the neighbourhood[5].

Thus, both fiscal competition and 'yardstick competition' theories generate a positive pattern of interactions among expenditure levels. In order to disentangle benefit spillovers from competition effects we have to make a more subtle argument, based on the public good characteristics of the service analysed. In the congestable good case, it is not likely that benefit spillovers come independently from crowding externalities. Thus, when the service analysed is not a pure public good, the absence of crowding externalities will indicate that

[5] Some recent papers have found evidence of mimicking behaviour in local tax setting, see Ladd [39] and Besley and Case [9].

competition effects are a plausible explanation for interactions. If the service is a pure public good, both competition effects and benefit spillovers may provide the explanation needed to justify expenditure interactions.

3. EMPIRICAL INVESTIGATION

3.1 *Specification of the expenditure equation*

The estimated expenditure equation is obtained after posing specific functional forms for the supply technology of public goods and the outcome demand function. The functional forms chosen are in the vein of the classical papers of Borcheding and Deacon [10] and Bergstrom and Goodman [8] and, thus, the demand equation proposed can be considered as an augmented version of these classical approaches. The concrete parameterisation of the model has the advantage of allowing precise testing of different hypothesis, from the degree of publicity to the nature of spillovers.

Let's assume a very general supply technology, that encompasses all possible budget spillovers identified in section 2,

$$\hat{o}_i = (\hat{a}_i - \varepsilon.\hat{u}_i - \sigma.\hat{z}_i) + \phi(\mathrm{W}\hat{a}_i - \varepsilon.\mathrm{W}\hat{u}_i - \sigma.\mathrm{W}\hat{z}_i) \qquad (10)$$

Where (^) indicates that the variables are taken in logs, and W indicates that the variable has been calculated as a weighted average of all the communities to the exception of community *i*. The weights in W indicate the degree of connectivity or relationship among two communities and are (in general, although not necessarily) related to the geographic distance between them. We postpone a more detailed explanation of the specification of W to the next section. The parameters ε and σ quantify the impact of users and other cost drivers, respectively, on the level of service or outcome achieved. The coefficient ε is known in the literature as the 'congestion parameter' and measures the degree of publicness of the service provided (i.e., ε=0 identifies a pure public good while ε=1 identifies a private good)[6,7].

Most studies of local public good congestion concentrate on the effect of the overall population of the level of outcome achieved. However, as (Wildasin [53], pp. 33) points out, the extent of crowding by different population groups may not be the same. In addition to that, being the purpose to estimate crowding externalities, non-residents must be included among the groups of users. We shall also assume that there are different groups of potential users of the service. For simplicity, let's write the number of users of i as a weighted sum of the general population (n_i) and other socio-specific demographic groups ($n_{k,i}$), and some groups of non-residents visitors (e_i , e.g., commuters, over-night visitors, and commercial employment). That is, the number of users may be written as $u_i=n_i+\gamma.n_{k,i}+\delta.e_i$. Using the fact that $\ln(1+a)\cong a$ when a is small, we obtain $\hat{u}_i = \hat{n}_i + \gamma.(n_{k,i} / n_i) + \delta.(e_i / n_i)$.

Thus, this simple specification of u_i accounts for the presence of crowding externalities. However, the non-resident variables included may not account for all possible forms of mobility. They do not pick, for example, the effects of mobility derived from leisure or crime behaviour. A more general specification of u_i will thus be used, adding the population and various socio-demographic groups of the neighbour communities, ($W\hat{n}_i$ and $Wn_{k,i}$),

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6 Most of the empirical studies (see Reiter *et al.* [47] for a review) have found most local services to be quasi-private. As these authors discusse, there may be various flaws in the specifications that account for this result, but some of them derive from the omission of variables included in the equation estimated in this paper (e.g., higher responsibilities of big cities, crowding by non-residents).

7 The specific functional form used to account for congestion has been criticised on the grounds that it exhibits constant marginal congestion, and not increasing marginal congestion (Brueckner [14] and Craig [23]), as Buchanan's club theory specifies (Buchanan [15]). However, functional forms consistent with increasing marginal congestion are non-linear and not amenable to the econometric techniques used in the paper; also, on empirical grounds, the superiority of this non-linear specification has been questioned by some papers (Means and Mehay [41]).

$$\hat{u}_i = \hat{n}_i + \gamma.(n_{k,i} / n_i) + \delta.(e_i / n_i) + \eta.\mathrm{W}\hat{n}_i + \mu(\mathrm{W}n_{k,i}/\mathrm{W}n_i) \quad (11)$$

Finally, we shall pose a log-linear demand function for the level of outcome,

$$\hat{o}_i = \hat{a} + \alpha.\hat{n}_i - \alpha.\ln(\partial g_i / \partial o_i) + \beta.\ln(y_i + \theta(s_i / n_i)) \quad (12)$$

Where θ allows for the possibility that lump-sum grants have degree of fungibility different from that of personal income and shows the presence of fiscal illusion[8]. Substituting (11) in (10) and using $\hat{g}_i = \hat{c}_i + \hat{a}_i$ and $\mathrm{W}\hat{g}_i = \mathrm{W}\hat{c}_i + \mathrm{W}\hat{a}_i$ we may obtain the cost function that, combined with (12), will yield the following reduced form expenditure function:

$$\begin{aligned}
&(\hat{g}_i - \hat{n}_i) = \\
&a_0 + a_1\hat{n}_i + a_2(n_{k,i} / n_i) + a_3(e_i / n_i) + a_4\mathrm{W}\hat{n}_i + a_5(\mathrm{W}n_{k,i} / \mathrm{W}n_i) \\
&+ a_6\hat{z}_i + a_7\hat{c}_i + a_8\hat{y}_i + a_9(s_i / y_i) \\
&+ a_{10}(\mathrm{W}e_i / \mathrm{W}n_i) + a_{11}\mathrm{W}\hat{n}_{-i} + a_{12}(\mathrm{W}n_{k,-i} / \mathrm{W}n_{-i}) + a_{13}\mathrm{W}\hat{z}_i \\
&+ a_{14}\mathrm{W}\hat{c}_i + a_{15}(\mathrm{W}\hat{g}_i - \mathrm{W}\hat{n}_i)
\end{aligned} \quad (13)$$

Where $(\hat{g}_i - \hat{n}_i)$ and $(\mathrm{W}\hat{g}_i - \mathrm{W}\hat{n}_i)$ are the logs of per capita expenditures of the community *i* and its neighbours, respectively. This is a spillover-augmented version of the more traditional demand or expenditure equations of Borcheding and Deacon [10] or Bergstrom and Goodman [8]. To obtain the basic expenditure equation the coefficients a_4 and a_5, and a_{10} to a_{15} must be set to zero.

Equation (13) provides the general specification that will be used in order to test for the different types of spillovers. Note that the different spillover models presented in Section 2 are embodied in equation (13). The model with 'externalities from crowding' is obtained when a_3, a_4 or a_5 are different from zero, and when a_{10} to a_{15} are zero. In addition to that, for the model of crowding externalities to have economic sense, the congestion parameter has to

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[8] See Turnbull [51] for an empirical test based on this non-linear specification; Courant *et al.* [22] and Oates [45] are classical papers on the 'flypaper effect', and Bailey and Connoly [7] provide a survey of the literature.

be different from zero (ε>0). This condition can be checked from the coefficients a_1 and a_7, since $\varepsilon=(a_1/a_7)+1$.

The model with 'benefit spillovers' (but no crowding externalities) is obtained when the coefficients a_{10} to a_{15} are different from zero, when a_2 and a_4 are zero, and when the good is not congestible (ε=0). If all these conditions hold but the good is congestible, competition externalities may be present. If a_{10} to a_{15} and a_3, a_4 or a_5 are different from zero, benefit spillovers and crowding externalities are present at the same time. The model is also capable to identify the sign of the benefit spillover. When the demand is price-inelastic (α<1), benefit spillovers are positive/negative if a_{15} is negative/positive and a_9 to a_{14} are negative/positive. The signs are reversed when the demand is price-elastic (α>1). However, in any case, it is possible to ascertain the sign of the spillover; the reason is that the spillover (ϕ) parameter, the price elasticity (α) and the other parameters of the model) are completely identified (see Annex 1).

3.2 *Econometric approach*

Equation (13) indicates that the local choices of expenditure levels are interdependent. This implies that the expenditure per capita in a given community depends on the expenditure per capita in a set of alternative communities. In addition to that, expenditure per capita also depends on demographic variables and cost drivers in this set of alternative communities. These variables enter equation (13) multiplied by W; as we stated at the beginning of section 3.1, this operator indicates that the variable has been calculated as a weighted average of all the communities to the exception of community *i*. For example, in the case of $\hat{g}_i$,

$$W\hat{g}_i = \sum_{j\neq i} \omega_{ij}\hat{g}_j \qquad \text{and} \qquad \omega_{ij} = w_{ij} / \sum_{j\neq i} w_{ij} \tag{14}$$

Where ω_{ij} is the weight of community *j* in the set of alternative communities of *i*. For technical reasons these weights tent to be standardised (Anselin [2]) and, thus, add to one. For empirical testing of the model it is imperative to be more concrete about which communities most likely engage in spillover interactions. Admittedly, as (Anselin [2]) points out, the selection of weights in this kind of analysis is somewhat arbitrary. As we have stated previously, budget spillovers tent to arise as a result of some form of mobility between local communities. Therefore, the scope of that mobility will define the connectivity among communities and the weights used in (14). In the case of local services in a metropolitan area, the distances travelled for most relevant forms of mobility (e.g., commuting, and leisure and commercial travelling[9]) are quite short. For example, the median commuting distance in the municipalities of the sample is about 15 km[10]. Therefore, there is a fundamental theoretical justification to expect that geographical proximity matter in our case.

We will define four different sets of weights. The first two sets of weights are based on pure proximity criteria. Binary weights are defined as $w_{ij}=1$ if radial distance between two communities is lower than 15 km and $w_{ij}=0$ otherwise[11]. Inverse of squared distance weights are defined as $w_{ij}=1/d_{ij}^2$ where d_{ij} is the radial distance between two communities. There are two other sets of weights that combine proximity with the size of surrounding communities. Population binary weights are defined as $w_{ij}=n_j$ if radial distance between two communities is lower than 15 km and $w_{ij}=0$ otherwise, where n_j is the resident population of community j. Finally, population inverse of squared distance weights are defined as $w_{ij}=n_j/d_{ij}^2$. These weights reflect the asymmetric impact of an expenditure change in big and small communities over the level of spillovers experienced by the rest of the metropolitan area[12].

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[9] Recall that all these forms of mobility are included among the variables accounting for non-resident user groups in equation (13).

[10] This distance has been calculated using a commuting matrix for all the municipalities in the sample; data on commuting comes from the 1996 census.

[11] Binary weights with higher distances (20 and 30 km) did not perform as well as this one in the empirical analysis.

[12] That is, for example, if a big community increases the level of per capita expenditure, a huge number of residents in the rest of the metro area (that, for example, work in that community) will

As we have previously stressed, equation (13) embodies different budget spillover models. The 'crowding externalities' model can be obtained by setting the coefficients a_{10} to a_{15} to zero. In this case, the only variables from surrounding communities that are included in the equation are the neighbours' demographic variables $(W\hat{n}_i$ and $Wn_{k,i} / Wn_i)$. The coefficients of these variables, jointly with those of the variables included in e_i (e.g., commuters, over-night visitors and commercial employment) will identify the externalities from crowding. The inclusion in equation (13) of these neighbours' demographic variables does not pose any econometric problem. Therefore, if this is the suitable specification of budget spillovers, we will be able to consistently estimate all the parameters by ordinary least squares (OLS).

The 'benefit spillovers' model expands the previous model to include all the neighbours' variables. Of special interest in this case is the parameter of the neighbours' expenditure $(W\hat{g}_i - W\hat{n}_i)$.The inclusion of this variable introduces a specific simultaneity problem, which is well established in the spatial econometrics literature (Anselin [2]). This specification is known in the econometrics literature as the spatial lag model and; since $(W\hat{g}_i - W\hat{n}_i)$ is correlated with the residuals, can not be consistently estimated using OLS. The maximum likelihood estimation (ML) of the spatial lag model will provide consistent estimates of the unknown parameters (see Anselin [2])[13]. A standard test of spatial lag dependence is the Anselin [3] test based on the Lagrange Multiplier principle (LM_{ϕ}), that can be computed from OLS residuals of the 'crowding externalities' model.

But both the 'crowding externalities' and the 'benefit spillovers' models may suffer from an additional econometric problem. It may happen that the expenditure policies of adjacent local

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experience the increased level of provision. Also, if use is endogenous, an expenditure decrease in a big city will push off a big number of users. These effects have been recognised in recent papers dealing with asymmetric tax competition (see Kanbur and Keen [36] and Hoyt [35]).

[13]This is the most common procedure to estimate equation (13). Alternatively, equation (13) may be estimated by instrumental variables (see Anselin [2], ch. vii, and Kelejian and Prucha [38]).

governments may be affected by common shocks. If this is the case, the error term (ζ) may exhibit spatial autocorrelation (i.e, $\zeta=\lambda.\zeta+\xi$, where ξ is a well behaved error term). This model is known in the econometrics literature as the spatial error model. The OLS estimation of the model is no longer efficient and ML estimation has to be used again. The presence of spatial error autocorrelation can be tested by using a Lagrange Multiplier test (LM_{λ}) that can also be computed from the OLS residuals (see Burridge [16]). In practice, the OLS residuals of the 'crowding externalities' model may exhibit both kinds of misspecification. In this case, the standard LM_{ϕ} and LM_{λ} tests of Anselin [3] and Burridge [16] loose power. Instead, the robust LM_{ϕ}^{*} and LM_{λ}^{*} developed by Anselin *et al.* [4] should be used.

In case of presence of both kinds of spatial dependence an additional problem arises, since the maximum likelihood function suffers from identification problems (Anselin [2] and Anselin *et al.* [4]). The approach used in the paper to overcome this problem is to separately estimate both models by ML when the LM_{ϕ}^{*} and LM_{λ}^{*} tests suggest so, and to perform some additional tests using the ML results. These tests are a Likelihood Ratio test on the spatial autorregresive coeficient, both for the spatial lag and spatial error models, and a test on the 'common factor hypothesis' (Anselin [2] and Burridge [16]) that indicates whether the spatial lag or the spatial error model is appropriate[14].

3.3 *Variables and data*

The empirical implementation of the model has been carried out with a cross-section of data from the municipalities belonging to the metropolitan area of Barcelona for the year 1996. The sample includes 104 municipalities ranging from 5.000 to 250.000 inhabitants[15]. All of

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[14] Alternative approaches are the estimation of the joint model imposing some restrictions, as in Case *et al.* [19], or to use the GMM estimation approach of Kelejian and Prucha [39].

[15] Note that the central city, Barcelona, as been excluded from the sample, on the grounds of the very specificity of its status. However, the city has been included into the set of neighbour's of its surrounding localities.

them are located to less that 80 km of the central city, Barcelona. Different kinds of mobility are widespread in the area, and problems related with spillovers are folk wisdom and a source of political concern. Also an early experience of a general metropolitan government existed in the area during the 80's, but political conflict with the regional government prompted its demise. By now, metropolitan co-operation is restricted to the fields of transportation and water delivery, but a proposal to extend it to other fields still exists.

Six different expenditure equations have been estimated: (i) General administration, (ii) Police, (iii) Social services, (iv) Cultural and Sports facilities, (v) Housing, Town building, and Parks and Streets maintenance, and (vi) Street cleaning, Water delivery and Sanitation. These categories cover the full range of expenditure categories that are responsibility of Spanish local governments and represent more than a 90% of total operating expenditure[16]. These categories are also representative of the responsibilities that municipalities use to have elsewhere, to the notable exception of the lack of education expenditure.

To estimate the model motivated by equation (13) we need measures of g_i, n_i, $n_{k,i}$, e_i, z_i, c_i, y_i , s_i and some other variables that control for economic, institutional and political influences on local expenditure not included in (13). The information used comes from various sources, mainly from the 1996 census but also from municipal budgets and other administrative sources. The dependent variable (g_i) is measured as operating expenditure outlays for the year 1996 (i.e., wages, supplies and transfers), excluding thus the more volatile capital expenditure. The source of budgeting information is a special survey conducted each year by a higher-tier local government (Diputación de Barcelona).

[16] The weights of these categories in the total operating expenditure of local governments are: (i)=29.28, (ii) 10.46, (iii)=13.25, (iv)=9.78, (v)=15.15 and (vi)=14.55. The remaining 8% correspond to small categories excluded because some of the municipalities of the sample do not have expenditure responsibilities in these areas.

The size of the resident population (n_i) and other demographic variables ($n_{k,i}$) are taken from the 1996 Census. These variables include: population under age 18, over age 65 and aged 18-40, number of graduates, number of old houses (i.e., build before 1950). Poverty or deprivation has been measured by two indices, the Index of Economic Deprivation and the Index of Social Deprivation. These indices have been constructed by carrying a factor analysis over a set of variables that pick up various dimensions of poverty[17]. The Index of Economic Deprivation includes (with the same weights): the number of unemployed, the number of illiterate people and the number of welfare recipients. The Index of Social Deprivation includes (with the same weights): the number of taxpayers under a given level of taxable income, the number of lone-parent families and the number of immigrants. The variables are from the 1996 Census to the exception of welfare recipients (Dep. of Social Welfare of the Regional government) and taxpayers by income level (Tax Administration).

The variables picking up the size of various groups of non-resident users (e_i) are: number of commuters, number of over-night visitors and employment in the commercial retail sector. Information on commuters and employment come from the 1996 Census while the over-night visitors are own estimates of the Dep. of Regional Planning of the Regional government. It has to be emphasised that this information is not available for most of the remaining Spanish municipalities. The reason is that questions relating the origin and destination of jobs are only included in the Census for the municipalities belonging to big metropolis.

Cost drivers (z_i) must include all the influences on the cost of providing public outputs related to fixed characteristics of the territory served (e.g., climate, building styles, travel costs, settlement patterns, etc.). The effect of settlement patterns of the costs of providing public goods has been well documented, but the characterisation in just one variable is difficult (see Ellis-Williams [27] and Bramley [13]). We have included in this category three variables that

[17] See Chapman [19] for a similar approach applied to English local governments.

attempt to measure the settlement pattern of the population: developed area per capita, dispersed population (i.e., living outside the main urban centre of the municipality), and isolated population (i.e., living in non-urbanised areas). The information come also from the 1996 Census and, in the case of developed area, from the Dep. of Regional Planning of the Regional government. The cost of providing one unit of output (c_i) is measured as a Divisia-type index of input costs (Schwab and Zampelli [50]). Problems of data preclude the inclusion of factor costs other than wages in the index.

Differences in economic resources across communities are accounted for by including in the equation the income per capita of the municipality (y_i), as estimated from income tax information by Arcarons *et al.* [5], and unconditional grants received by the municipality from the central and the regional government (s_i). This information comes from the same budgetary source as local expenditure. However, we believe that these variables do not pick up accurately all the possibilities of raising revenue by Spanish municipalities. More than a half of municipal revenues come from tax sources. But municipal taxes[18] are not only related to the income of residents in the municipality, but also to the economic activity therein. Commuting and commercial trips mean that there may be a substantial degree of tax-exporting. And, as the extent of tax-exporting and the level of budget spillovers are probably correlated, it is necessary to control for tax-exporting in the expenditure equation (13) in order to avoid biases in the spillover-related coefficients. Since data availability have precluded the direct quantification of tax-exporting (as, for example, in Ladd and Yinger [39]), we have employed a simpler procedure. We have included a variable, called potential revenues (p_i), in an expanded definition of the revenue resources of local governments: $y_i[1+\theta.(s_i/y_i)+\varphi.(p_i/y_i)]$ where θ and φ are coefficients. Potential revenues are obtained by multiplying the average effective tax rates in the sample for each figure by its tax base in each community and adding

[18] The main municipal taxes are a residential and business property tax, a business tax, a vehicle tax and taxes on building activity.

up for the different taxes. The information needed to calculate this index comes from the same budgetary source as local expenditure.

Table 1*: Descriptive statistics, 1996 Cross-Section (n=104).*

	Mean	*Std. Dev.*	*Max.*	*Min.*
Expenditure per capita (i) (pta.)	13,940	6,046	41,072	4,227
Expenditure per capita (ii) (pta.)	5,442	2,716	20,174	6,187
Expenditure per capita (iii) (pta.)	8,227	4,719	25,486	1,254
Expenditure per capita (iv) (pta.)	6,648	2,974	14,810	2,655
Expenditure per capita (v) (pta.)	10,435	5,315	26,741	1,120
Expenditure per capita (vi) (pta.)	9,012	5,657	43,239	2,265
Population	27,544	41,952	255,050	4,937
Prop. Population under age 18 (%)	24.280	2.500	30.282	12.700
Prop. Population above age 65 (%)	13.406	3.600	24.449	5.818
I. of Economic Deprivation (Index)	0.905	0.171	1.438	0.383
I. of Social Deprivation (Index)	1.041	0.410	3.958	0.546
Prop. Commuters (%)	15.230	6.546	76.224	2.032
Prop. Overnight visitors (%)	10.354	22.702	129.451	0.000
Prop. Commercial employ. (%)	1.699	0.464	3.734	0.574
Input cost (Index)	1.000	0.179	1.560	0.470
Dev. Area per capita (m^2)	2.355	2.408	4.130	1.138
Prop. Dispersed Population (%)	1.776	1.627	8.677	0.000
Prop. Isolated Population (%)	1.994	3.030	20.769	0.000
Prop. Population Growth (%)	11.300	18.147	51.226	0.000
Income per capita (pta.)	1,649,987	409,661	3,597,764	1,138,891
Lump-Sump grants per capita (pta.)	17,943	3,300	34,260	8,519
Potential revenue per capita (pta.)	40,684	13,046	116,992	15,780
Index Ideology of Gov.	-0.099	0.499	0.771	-0.750
Index Divided Gov.	0.307	0.348	1.000	0.000

Other variables have been included to control for institutional and political factors that influence local expenditures. We include the amount of specific grants per capita received by the local government and, when available, the direct expenditure of other layers of government in the municipality. Data on specific grants come from the aforementioned budgetary sources and has the drawback of not being available by spending category. We also control for the fact that some municipalities have some additional spending responsibilities. For example, big municipalities have more responsibilities in social services and public transport systems, and we control for this fact by including the number of specialised rooms in social services and the number of km of bus service in categories (iii) and (v), respectively. Data on these factors come from different Regional government departmental sources.

Finally, we include two political variables. The first one is and index of ideology of the members of the local government. This index is calculated, following Gross and Sigelman [31] and Cusack [24] as the product of the share of each political party in the local council by and index of political ideology of this party, that takes values from –1 for left wing parties to +1 for right wing parties. We include also an index of political fragmentation of the local government, similar to that of Roubini and Sachs [48][19].

4. EMPIRICAL RESULTS

The results of the 'Crowding externalities model' are presented in Table 2. In this model the only spatially lagged variables included are those corresponding to socio-economic factors; they are assumed to be picking up the effects of crowding by non-residents. Note that the sets of cost variables named 'Crowding by residents' and 'Crowding by non-residents: lagged variables' include the same list of variables. Note also that these sets do not include the same variables in the different expenditure categories, but they reflect the most important factors in

[19] The index is 0 in the case of a majority government, 1/3 in the case of a two party coalition, 2/3 if the coalition has more than two parties and 1 in the case of a minority government.

each one. The results with the complete set of variables included in all the equations is shown in Table A.1 in the Annex 2 (i.e., 'Basic demand model'). Since there are not enough theoretical criteria to guide the selection of own cost variables, the ones with high standard errors in Table A.1 have not been included in the estimated equations of Table 2. Note, however, that control variables, to the exception of those reflecting institutional factors, remain in the equation regardless of statistical criteria. This is because these variables have been included in the equations on clear theoretical grounds.

[Table 2 about here]

The results of Table A.1 also help us to decide which weight matrix to use to compute the spatially lagged variables. This table includes the robust LM tests suggested by Anselin *et al.* [4] to check the presence of spatial autocorrelation. The calculations have been performed for the four weights matrices presented in section 3.2: W_I=binary weights, W_{II}=inverse of square distance weights, W_{III}=binary weighted by population, W_{IV}=inverse of square distance weighted by population. The results suggests that the matrices W_{II} and W_{IV} perform better that the other ones. Since weighting by population seems less appropriate for 'Crowding externalities' that for 'Benefit spillovers', we compute the lagged variables included in all the equations of Table 2 with W_{II}. However, we also include in Table 2 the robust LM tests computed with both sets of weights, W_{II} and W_{IV}.

The results of Table 2 are able to identify various sources of 'Crowding externalities'. Some of these congestion effects are identified through own variables: commuters create congestion in four expenditure categories, (ii) and (iv) to (vi), commercial employment in three categories, (ii), (iv) and (vi), and overnight visitors in two, (ii) and (vi). But also lagged variables are statistically significant in some categories: measures of deprivation in categories (ii) and (v), and total population or population subgroups in categories (ii) and (iv). However, the robust tests of spatial dependence included at the bottom of Table 2 indicate that all of these equations are misspecified: the problem seems to be spatial error dependence in categories (i) and (vi), and spatial lag dependence in categories (iii) and (v), while either spatial error or spatial lag dependence could be present in categories (ii) and (iv).

The results of the ‘Benefit spillovers model’ are presented in Table 3. The coefficients included for each category correspond to the ML estimation of the most appropriate specification, either the spatial error or the spatial lag model. Recall that in the spatial lag model, expenditure per capita and cost drivers of the neighbour communities are included in the equation. These are included in Table 3 in the group of variables (v), named ‘Budget spillovers’. Note that these are included in italics when the coefficients do not belong to the best model (i.e., when the results of the spatial error model have been presented). This group of variables includes also the estimated coefficient of spatial error correlation; the coefficient appears in italics when the remaining of coefficients belong to the spatial lag model.

[Table 3 about here]

The bottom of Table 3 shows the results of the ML tests performed in order to identify the source of spatial dependence in the data. The LR tests on spatial error and lag dependence show the same pattern than the robust LM tests of Table 2. The remaining doubts according the source of spatial dependence in categories (ii) and (iv) are solved with the help of the LR test on the common factor hypothesis. This tests indicates that spatial error dependence is the main misspecification in the category (ii), while spatial lag dependence is the main problem in category (iv).

The results of Table 3 confirm the expectations about the relevance of crowding externalities in the different expenditure categories. Expenditures in police (ii) are higher in communities with a lot of commuters, overnight visitors and commercial employment, but also in communities surrounded by big neighbours and deprived populations. Expenditures in Culture and Sports (iv) are higher in communities with commuters and commercial employment, but also in communities surrounded by young and educated populations. Expenditures in Housing, Town building, and Parks and Streets maintenance (v) are higher in communities with commuters surrounded by deprived populations. Finally, expenditures on Street cleaning, Water delivery and Sanitation (vi) are higher in communities with commuters, overnight visitors and commercial employment. Note that only the services in categories (i) General Administration and (iii) Social Services are not congested by non-residents. These results are similar to those obtained in the literature (see Hakim *et al.* [32] in the case of Police expenditures and Bramley [13] in the case of Culture and Sports).

The results of Table 3 also allow us to conclude that interactions among expenditure levels of neighbouring communities are present at least in three categories: (iii) Social Services, (iv) Culture and Sports, and (v) Housing, Town building, and Parks and Streets maintenance. Shocks common to nearby communities are present in the remaining four communities, including category (ii) Police. We believe that these interactions indicate the presence of 'Benefit spillovers' only in the last two categories, while in the case of Social Services interactions may be related to 'Expenditure competition'. We reach this conclusion by joining various pieces of evidence. First, note that the results of the model show that Social Services is a publicly provided private good (i.e., the level of population is not statistically significant). Second, although expenditure on this service is higher in communities with high proportions of young, old and deprived populations, to be surrounded by communities with high proportions of these population groups do not have any impact on expenditures. It is difficult to believe that there could be benefit spillovers in a private good without crowding externalities occurring at the same time. The only remaining explanation for expenditure interactions is 'Expenditure competition', arising because local governments worry about the possibility of attracting deprived population groups when increasing service quality. Third, once the spatial lag model has been estimated, most of the population groups of nearby communities appear with a negative sign (and some of them are statistically significant).

Given that the coefficient of lagged expenditure per capita is positive, this may indicate that expenditure per capita increases/decreases when the quality of service increases/decreases in nearby communities, both because an increase/decrease in expenditures or because a decrease/increase in the size of client groups and cost drivers.

The results regarding expenditure interactions can be compared to those found in the U.S. literature. The magnitude of the spatial lag coefficient in the case of Social Services (iii) is 0.316, rather similar to the values estimated by Saavedra [49] in the case of AFDC benefit competition and by Case *et al.* [18] in related expenditure categories. The sign of the spatial lag coefficient is negative in the case of Culture and Sports (iv), and Housing, Town building, and Parks and Streets maintenance (v), but its magnitude is similar: –0.353 and –0.364, respectively. This negative sign can be interpreted as evidence of a classical free-riding effect (i.e., as the increase in expenditure by nearby governments provide benefits to the residents, there is no need to provide the same level of service than before), suggesting the existence of a positive benefit spillover[20]. To our knowledge, this result can not be found in the other papers in the literature, that use to found positive interaction effects (see Case *et al.* [18] and Murdoch *et al.* [43]). Moreover, the interpretation of this results as a positive benefit spillover is consistent with the crowding externalities found in these expenditure categories.

One may wonder if the results regarding budget spillovers are robust or, instead, are the result of some omitted variable that accounts for relevant aspects of local budgeting. However, note that the results have been obtained by specifying the spillovers model as embedded in a classical demand equation. The coherence of the results regarding the main parameters of

[20] Of course, this prediction only hold in the theoretical model if some assumptions are made (i.e., inelastic demand and low degree of substitutability among public and private goods), but the results of the equations presented in Table 3 suggest that this is so in practice: the coefficient of the Input cost variable is positive and so the price-elasticity of demand (one minus this coefficient, see Annex 1) is less than unity, and the coefficients of the other cost drivers (e.g., population subgroups, non-residents, geographical cost factors) have the expected positive sign.

interest of this equation should provide evidence of good specification of the complete model. Note, for example, that both price and income elasticities are lower than unitiy, as is common in this kind of analysis. The different cost drivers (aside those that mesure spillover effects) that are statistically significant in the different equations are also consonant with the expectations.

The effect of lump-sum grants on expenditure is very high. The estimated coefficient for *s* is around 19; dividing this coefficient by the income elasticity we obtain the θ parameter, that shows the degree of fiscal illusion. The value of this coefficient is thus around 31. This indicates that an increase in income per capita of 30 peseta has the same effect than an increase of grants of one peseta. Thus, the flypaper effect is very big in the Spanish case. This result is consistent with those of some other studies (Turnbull [51] and Bailey and Connolly [7]). The effect of potential revenues is also very high. The estimated coefficient for *f* is around 11. After dividing this coefficient by the income elasticity we obtain the φ parameter. The value of φ is around 18. Thus, and increase in income per capita of 18 peseta has the same effect than an increase of potential revenues of one peseta.

The results identify economies of scale in consumption only in three spending categories, General Administration (i), Culture and Sports (iv) and Housing, Town building, and Parks and Streets maintenance (v), although in categories (i) and (v) the pure private good hypothesis only can be rejected at the 85 and 90% confidence level, respectively[21]. This limited evidence of economies of scale in consumption is consistent with the results shown in some recent surveys on the topic (see, e.g., Reiter *et al.* [47]).

The equations presented in Table 3 also control for political and institutional details deemed important for our analysis. Note that, as expected, higher responsibilities, that concentrate in

[21] The confidence interval for the crowding parameter ε depends on the standard error of the population coefficient but also on the standard error of the input cost variable, quite high in general.

categories (iii) and (v), imply higher expenditure per capita. In a similar fashion, higher expenditure in the community by other layers of government allow the municipality to reduce its expenditure in categories (iii), (v) and (vi), and Specific grants provide an important source of finance in the case of Social Services (iii). The ideology of government is also important in some services: left wing governments seem to spend more on General Administration (i) and (v) Housing, Town building, and Parks and Streets maintenance, while right wing governments spend more on Culture and Sports (iv).

Thus, the results provided in the paper are robust to the consideration of many of the facts that define the financing and decision-making systems of Spanish local governments. This allows us to reinforce the previous conclusion that the different types of budget spillovers analysed in the paper are relevant to fully understand local public finance in metropolitan areas. Moreover, spillovers are not only relevant, but also quantitatively important, a fact that can be checked by having a look at the percentage of per capita expenditure variance explained by the different groups of variables included in Table 3. The results of this analysis are presented in Table 4 for each of the expenditure categories and for total expenditure.

[Table 4 about here]

Spillover-related variables explain a non-negligible share of the variance in per capita expenditure. This share is around 20% in the case of total expenditure, but it is higher for some expenditure categories: around 50% in the case of Culture and Sports (iv), and near 35% in the cases of Police (ii) and Housing, Town building, and Parks and Streets maintenance (v). On average, only the variables that measure fiscal capacity (e.g., per capita income, grants and potential revenues) have a higher explanatory capacity that spillover-related ones (i.e., around 40%). Half of the explanatory power of spillover-related variables is due, on average, to own variables and half to spatially lagged variables, confirming not only the need to account for crowding but also the need to use spatial analysis to properly measure these effects.

5. CONCLUSION

This paper has presented a model for measuring spillovers resulting from local expenditure policies. We have identified and tested for three different types of budget spillovers: (i) benefit spillovers, derived from the production of local public goods, (ii) externalities in crowding, derived from the crowding of facilities by residents in neighbouring jurisdictions, and (iii) externalities derived from expenditure competition effects. Benefit spillovers have been accounted for by assuming that the representative resident enjoys the consumption of a local public good both in his community and in the surrounding ones. Externalities in crowding are included by considering that the service outcomes of a locality are influenced by demographic variables of the surrounding localities. The empirical approach of the paper has consisted in specifying a classical demand function but expanded to take into account interactions among local expenditure levels and interactions from neighbours' demographic variables to own expenditures.

The model has been tested for six different expenditure categories with a cross-section of data from the municipalities belonging to the metropolitan area of Barcelona. The results are able to identify externalities in crowding in spending on Police, Cultural and Sports facilities, Parks and Streets maintenance, and Street cleaning, Water delivery and Sanitation. Positive benefit spillovers appear in spending in Cultural and Sports facilities, and Parks and Streets maintenance, providing evidence on free-rider behaviour on these kind of services. Spending on Social services seems to be affected by competition externalities, while there is no evidence of spillovers in the case of spending in General Administration. In general, thus, the results support the inclusion of interjurisdictional spillovers in demand equations, tough its type and quantitative influence differs according the kind of service analysed.

The results are robust to the inclusion of many political and institutional controls that account for specific details of Spanish local governments. Moreover, in some of the categories the explanatory capacity of spillover-related variables is quite substantial. Of course it is not clear that the results obtained can be extended to other countries or even to other metropolitan areas in Spain. First, it has to be noted that local governments in Spain are really fragmented; this reality manifests both in very small municipalities that are below any reasonable size and in metropolitan areas where sometimes a different local government cares of each side of the street. Second, this problem is even worse in the case of Barcelona, since its borders (to the difference, for example, of the capital, Madrid) only cover the very central business district and the regional government covers much more than the metropolitan area. Also, attempts to achieve co-operation through a metropolitan government have failed historically. Thus, the fact that there seem not to be institutions fighting the spillover problem may have helped us to find evidence on its strength.

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Annex 1: *Identification of the supply technology coefficients*

The coefficients a_0 to a_{13} that appear in the expenditure equation (13) are related to the ones in the supply technology of public goods in the following manner,

$$a_0 = \hat{a}', a_1 = (\varepsilon - 1)(\alpha + 1),$$
$$a_2 = (\varepsilon.\gamma)(\alpha + 1),\ a_3 = (\varepsilon.\delta)(\alpha + 1),$$
$$a_{4=}(\eta + \phi.(\varepsilon - 1))(\alpha + 1),\ a_5 = (\mu + \phi.\varepsilon)(\alpha + 1),$$
$$a_6 = \sigma(\alpha + 1),\ a_7 = (\alpha + 1),$$
$$a_8 = \beta,\ a_9 = \beta.\theta,$$
$$a_{10} = (\phi.\varepsilon.\gamma)(\alpha + 1),\ a_{11} = (\phi.\eta)(\alpha + 1),$$
$$a_{12} = (\phi.\mu)(\alpha + 1),\ a_{13} = (\phi.\sigma)(\alpha + 1),$$
$$a_{14=}\ \phi(\alpha + 1),\ a_{15=}\ \text{-}\ \phi.(\alpha + 1)$$

Therefore, the coefficients of the technology of public goods can be obtained as follow,

$$\varepsilon = (a_1 / a_7) + 1, \quad \gamma = a_2 / (a_1 + a_7),$$
$$\delta = a_3 / (a_1 + a_7), \quad \eta = a_3 - (a_{14}.a_1 / a_7)$$
$$\mu = a_5 / a_7, \quad \sigma = a_6 / a_7,$$
$$\alpha = a_7 - 1, \quad \beta = a_8, \ \theta = a_9 / a_8,$$
$$\phi = a_{14} / a_6 = -a_{15} / a_7 = a_{11} / a_5 = a_{12} / a_6,$$

Annex 2: *Results for the Basic demand model*

Table A.1: *Basic demand model. Cross-Section OLS estimation for 1996 (n=104).Dependent variable: Ln Expenditure per capita*

Explanatory variables	*Coefficient estimates*[1] *by expenditure category* [2]					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
i) Crowding by residents						
Ln Population	-0.092	-0.024	0.043	-0.084	-0.058	-0.001
	(-1.991)**	(-0.302)	(0.313)	(-2.644)**	(-1.583)	(-0.015)
Prop. Population under age 18	0.007	0.014	0.056	0.053	0.025	-0.033
	(0.475)	(0.309)	(2.926)**	(3.321)**	(0.406)	(-0.099)
Prop. Population above age 65	0.010	-0.006	0.062	0.007	0.002	-0.061
	(0.331)	(-0.156)	(3.543)**	(0.445)	(0.001)	(-0.125)
Index of Economic Deprivation	-0.010	0.066	0.082	0.174	0.132	0.062
	(-0.065)	(1.355)	(2.102)**	(1.923)*	(3.429)**	(0.551)
Index of Social Deprivation	-0.026	0.055	0.109	-0.045	0.033	-0.024
	(-0.135)	(1.892)*	(1.779)*	(-0.352)	(1.884)*	(-0.058)
Prop. Population aged 18-40	--.--	--.--	--.--	--.--	0.012	--.--
					(1.434)	
Prop. Old Housing	--.--	--.--	--.--	--.--	0.300	--.--
					(2.958)**	
Prop. Grad. Population	--.--	--.--	--.--	0.025	--.--	--.--
				(1.894)*		
ii) Crowding by non-residents						
Prop. Commuters	-0.014	0.561	-0.114	1.324	0.994	0.321
	(-0.025)	(1.772)*	(-0.058)	(3.784)**	(3.553)**	(1.214)
Prop. Overnight visitors	0.105	0.270	-0.028	-0.039	0.096	0.383
	(0.421)	(1.793)*	(-0.096)	(-0.041)	(0.763)	(2.245)**
Prop. Commercial employ.	-0.005	9.235	0.254	10.005	0.047	13.121
	(-0.058)	(1.921)*	(0.368)	(1.784)*	(0.499)	(2.114)**
iii) Cost drivers						
Ln Input cost	0.191	0.213	0.337	0.266	0.190	0.374
	(1.650)*	(2.311)**	(1.789)*	(1.668)*	(1.675)*	(1.763)*
Ln Dev. Area per capita	0.018	0.016	0.027	-0.158	-0.031	0.019
	(1.775)*	(1.505)	(1.530)	(-0.295)	(-0.126)	(2.430)**
Prop. Dispersed Population	0.025	-0.005	0.025	-0.012	0.012	-0.014
	(1.909)*	(-0.054)	(2.960)**	(-0.497)	(0.269)	(-0.023)
Prop. Isolated Population	0.001	-0.001	-0.004	-0.167	-0.056	0.014
	(0.021)	(-0.129)	(-0.222)	(-0.541)	(-0.011)	(1.664)*
Prop. Population Growth	0.012	-0.096	-0.021	-0.023	0.021	-0.031
	(2.016)**	(-0.885)	(-0.196)	(-0.321)	(0.048)	(-3.671)**
iv) Control variables						
Ln Income per capita	0.680	0.531	0.348	0.512	0.624	0.656
	(18.318)**	(21.543) **	(4.687)**	(14.976)**	(24.785)*	(10.903)**
Prop. Lump-Sump grants	27.101	15.814	17.919	24.109	25.364	27.001
	(2.063)**	(1.849)*	(1.785)*	(2.521)**	(1.784)*	(1.025)
Prop. Potential revenue	9.254	14.004	11.372	15.860	14.656	13.553
	(3.210)**	(2.255)**	(4.023)**	(3.226)**	(1.995)*	(4.181)**
Ln Specific grants per capita	0.286	0.233	0.202	0.030	0.064	0.475
	(0.548)	(0.355)	(4.771)**	(0.194)	(0.336)	(0.459)
Ln Higher Resp. Expend. per capita	--.--	--.--	0.877	--.--	0.865	--.--
			(1.654)*		(2.631)**	
Ln Other Layers Expend. per capita	--.--	--.--	-0.421	-0.041	-0.037	-0.165
			(-1.687)*	(-0.465)	(-1.774)*	(-1.667)*
Index Ideology of Gov.	-0.062	-0.233	0.034	0.115	-0.019	0.192
	(-1.617)*	(-0.355)	(0.335)	(2.146)**	(-1.845)*	(2.313)**
Index Divided Gov.	0.009	0.007	-0.029	-0.072	0.021	0.015
	(1.267)	(0.284)	(-0.774)	(-3.067)**	(0.011)	(0.382)

Table A.1: *(continued)*

Explanatory variables	*Expenditure category* [(2)]					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
R^2	0.588	0.520	0.623	0.637	0.599	0.621
F test ($c_j=0$, $\forall j$)	9.039**	7.595**	6.093**	8.089**	7.768**	6.154**
Breusch-Pagan (Heterosked.)	11.034	11.227	9.944	5.649	11.235	5.102
Kiefer Salmon (Normality)	1.679	2.952	3.659	1.419	1.756	3.024
Robust tests of Spatial Dependence						
LM Test of Spatial Lag. Depen. (W_I)[(3)]	2.018	3.584*	1.395	4.021**	0.748	0.021
LM Test of Spatial Error Depen. (W_I)	0.078	6.181**	0.015	3.664**	0.231	3.741*
LM Test of Spatial Lag. Depen. (W_{II})	2.220	3.451*	4.562**	4.266**	3.662**	0.521
LM Test of Spatial Error Depen. (W_{II})	0.256	6.258**	0.523	3.558**	0.540	3.834**
LM Test of Spatial Lag. Depen. (W_{III})	2.359	4.102*	2.136	4.446**	0.442	0.033
LM Test of Spatial Error Depen. (W_{III})	0.224	7.036**	0.024	3.845**	0.013	4.201**
LM Test of Spatial Lag. Depen. (W_{IV})	2.474	4.221*	2.774*	4.511**	3.844**	0.666
LM Test of Spatial Error Depen. (W_{IV})	3.821*	7.651**	0.601	3.955**	0.009	4.658**

Notes: (1) *t* statistics are shown in brackets; * & **=significantly different from zero at the 90 and 95% levels.
(2) Expenditure categories: (i) Administration, (ii) Police, (iii) Social services, (iv) Culture and Sports, (v) Housing, Town building, Parks and Streets maintenance, (vi) Street cleaning, Water delivery and Sanitation.
(3) Refers to the robust LM tests of Anselin *et al.* (1996); W is the matrix used to weight neighbours' values of each variable; W_I=binary weights, W_{II}=inverse of square distance weights, W_{III}=binary weighted by population, W_{IV}=inverse of square distance weighted by population.

Table 2: *Crowding externalities. Cross-Section OLS estimation for 1996 (n=104).Dependent variable: Ln Expenditure per capita*

Explanatory variables	*Coefficient estimates*[1] *by expenditure category* [2]					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
i) Crowding by residents						
Ln Population	-0.073 (-1.998)**	--.--	--.--	-0.088 (-2.645)**	-0.063 (-1.786)*	--.--
Prop. Population under age 18	--.--	--.--	0.054 (2.344)**	0.044 (2.577)**	--.--	--.--
Prop. Population above age 65	--.--	--.--	0.056 (2.772)**	--.--	--.--	--.--
Index of Economic Deprivation	--.--	0.056 (2.081)**	0.081 (2.120)**	0.139 (1.391)	0.111 (2.663)**	--.--
Index of Social Deprivation	--.--	0.069 (1.987)**	0.121 (1.705)*	--.--	0.042 (1.956)**	--.--
Prop. Population aged 18-40	--.--	--.--	--.--	--.--	0.011 (1.474)	--.--
Prop. Old Housing	--.--	--.--	--.--	--.--	0.132 (3.061)**	--.--
Prop. Grad. Population	--.--	--.--	--.--	0.021 (1.844)*	--.--	--.--
ii) Crowding by non-residents: own variables						
Prop. Commuters	--.--	0.544 (1.997)**	--.--	1.123 (3.590)**	0.928 (3.893)**	0.178 (1.898)*
Prop. Overnight visitors	--.--	0.255 (1.862)*	--.--	--.--	0.114 (0.863)	0.389 (2.445)**
Prop. Commercial employ.	--.--	18.826 (3.648)**	--.--	6.805 (3.590)**	--.--	11.003 (2.449)**
iii) Crowding by non-residents: lagged variables						
W x Population [3]	0.002 (0.315)	0.020 (2.024)**	0.010 (0.301)	0.112 (0.206)	0.003 (0.049)	0.034 (0.236)
W x Prop. Population under 18	--.--	--.--	-0.019 (-1.325)	0.026 (3.731)**	--.--	--.--
W x Prop. Population over 65	--.--	--.--	-0.011 (-1.208)	--.--	--.--	--.--
W x I. of Economic Deprivation	--.--	0.068 (2.834)**	-0.021 (-0.421)	0.027 (0.108)	0.063 (2.258)**	--.--
W x I. of Social Deprivation	--.--	0.095 (2.224)**	-0.136 (-1.509)	--.--	0.029 (1.151)	--.--
W x Prop. Population aged 18-40	--.--	--.--	--.--	--.--	-0.028 (-0.618)	--.--
W x Prop. Old Housing	--.--	--.--	--.--	--.--	0.008 (0.145)	--.--
W x Prop. Grad. Population	--.--	--.--	--.--	0.074 (1.743)*	--.--	--.--
iv) Cost drivers						
Ln Input cost	0.199 (1.867)*	0.216 (2.353)**	0.258 (1.336)	0.241 (1.442)	0.181 (1.901)*	0.344 (1.867)*
Ln Dev. Area per capita	0.017 (1.746)*	0.0225 (2.333)**	0.020 (1.836)*	--.--	--.--	0.020 (2.373)**
Prop. Dispersed Population	0.027 (1.934)*	--.--	0.027 (2.100)**	--.--	--.--	--.--
Prop. Isolated Population	--.--	--.--	--.--	--.--	--.--	0.013 (1.764)*
Prop. Population Growth	0.010 (2.002)**	--.--	--.--	--.--	--.--	-0.030 (-3.887)**

Table 2*: (continued)*

Explanatory variables	*Coefficient estimates*[1] *by expenditure category* [2]					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
			v) Control variables			
Ln Income per capita	0.669 (21.572)*	0.504 (25.224)**	0.389 (6.354)**	0.606 (12.867)**	0.687 (14.958)**	0.667 (11.261)**
Prop. Lump-Sump grants	21.362 (2.073)**	18.122 (2.234)**	20.269 (1.651)*	20.521 (1.566)	20.211 (1.741)*	29.286 (1.120)
Prop. Potential revenue	11.125 (3.750)**	12.010 (2.444)**	8.423 (4.210)**	15.022 (3.024)**	11.835 (1.663)*	15.989 (4.225)**
Ln Specific grants per capita	--.--	--.--	0.274 (4.010)**	--.--	--.--	--.--
Ln Higher Resp. Expend. per capita	--.--	--.--	0.861 (1.864)*	--.--	0.921 (2.123)**	--.--
Ln Other Layers Expend. per capita	--.--	--.--	-0.551 (-1.234)	--.--	-0.033 (-1.780)*	-0.382 (-1.782)*
Index Ideology of Gov.	-0.062 (1.698)**	--.--	--.--	0.109 (1.834)*	-0.023 (-2.311)	0.191 (2.354)**
Index Divided Gov.	0.010 (1.299)	--.--	--.--	-0.066 (-2.171)**	--.--	--.--
R^2	0.578	0.611	0.631	0.621	0.645	0.640
F test (cj=0, ∀j)	12.346**	16.217**	9.890**	6.539**	13.709**	6.320**
Breusch-Pagan (Heterosked.)	5.954	9.935	11.219	9.981	2.854	5.857
Kiefer Salmon (Normality)	2.109	2.935	4.051	0.859	0.234	4.364
			Robust tests of Spatial Dependence			
LM Test of Spatial Lag. Depen.(W_{II})[4]	1.509	3.198*	4.529**	4.638**	4.885**	0.116
LM Test of Spatial Error Depen. (W_{II})	2.556	5.442**	0.168	4.561**	0.001	2.334
LM Test of Spatial Lag. Depen.(W_{IV})	2.214	3.265*	3.709*	5.871**	4.125**	0.294
LM Test of Spatial Error Depen. (W_{IV})	3.728*	6.550**	0.102	5.633**	0.001	3.814*

Notes: (1) *t* statistics are shown in brackets; * & **=significantly different from zero at the 90 and 95% levels.
(2) Expenditure categories: (i) Administration, (ii) Police, (iii) Social services, (iv) Culture and Sports, (v) Housing, Town building, Parks and Streets maintenance, (vi) Street cleaning, Water delivery and Sanitation.
(3) W is the matrix used to weight neighbours' values of each variable; the matrix used is W_{II}=inverse of square distance weights.
(4) Refers to the robust LM tests of Anselin *et al.* (1996); W is the matrix used to weight neighbours' values of each variable; W_{II}=inverse of square distance weights, W_{IV}=inverse of square distance weighted by population.

Table 3*: Benefit spillovers, Cross-Section ML estimation for 1996 (n=104).Dependent variable: Ln Expenditure per capita*

Explanatory variables	*Coefficient estimates[1] by expenditure category [2]*					
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	ML-Error[4]	*ML-Error*	*ML-Lag*	*ML-Lag*	*ML-Lag*	*ML-Error*
i) Crowding by residents						
Ln Population	-0.071 (-2.045)**	--.--	--.--	-0.060 (-3.328)**	-0.073 (-2.279)**	--.--
Prop. Population under age 18	--.--	--.--	0.065 (2.616)**	0.043 (2.870)**	--.--	--.--
Prop. Population above age 65	--.--	--.--	0.078 (3.550)**	--.--	--.--	--.--
Index of Economic Deprivation	--.--	0.061 (2.201)**	0.094 (2.321)**	0.138 (1.672)*	0.107 (2.898)**	--.--
Index of Social Deprivation	--.--	0.047 (1.996)**	0.109 (1.928)*	--.--	0.075 (1.136)	--.--
Prop. Population aged 18-40	--.--	--.--	--.--	--.--	0.012 (1.687)*	--.--
Prop. Old Housing	--.--	--.--	--.--	--.--	0.143 (3.484)**	--.--
Prop. Grad. Population	--.--	--.--	--.--	0.026 (1.742)*	--.--	--.--
ii) Crowding by non-residents: own variables						
Prop. Commuters	--.--	0.546 (2.622)**	--.--	1.135 (4.034)**	0.959 (4.289)**	0.332 (2.286)**
Prop. Overnight visitors	--.--	0.159 (1.695)*	--.--	--.--	0.125 (1.295)	0.288 (2.101)**
Prop. Commercial employ.	--.--	17.356 (4.049)**	--.--	10.554 (1.993)**	--.--	13.310 (2.636)**
iii) Crowding by non-residents: lagged variables						
W x Population [3]	0.002 (0.274)	0.018 (2.345)**	0.012 (0.355)	0.101 (0.233)	0.004 (0.110)	0.035 (0.230)
W x Prop. Population under 18	--.--	--.--	-0.031 (-2.131)**	0.014 (3.400)**	--.--	--.--
W x Prop. Population over 65	--.--	--.--	-0.034 (-1.783)**	--.--	--.--	--.--
W x I. of Economic Deprivation	--.--	0.046 (2.206)**	-0.022 (-0.621)	0.033 (0.308)	0.099 (2.331)**	--.--
W x I. of Social Deprivation	--.--	0.087 (2.207)**	-0.054 (-1.735)*	--.--	0.105 (1.153)	--.--
W x Prop. Population aged 18-40	--.--	--.--	--.--	--.--	-0.025 (-0.306)	--.--
W x Prop. Old Housing	--.--	--.--	--.--	--.--	0.009 (0.161)	--.--
W x Prop. Grad. Population	--.--	--.--	--.--	0.013 (3.251)*	--.--	--.--
iv) Cost drivers						
Ln Input cost	0.211 (1.855)*	0.174 (2.080)**	0.274 (1.694)*	0.307 (1.898)*	0.198 (1.862)*	0.445 (1.999)**
Ln Dev. Area per capita	0.018 (1.779)*	0.020 (2.164)**	0.018 (1.996)*	--.--	--.--	0.021 (2.064)**
Prop. Dispersed Population	0.030 (1.900)*	--.--	0.028 (2.616)**	--.--	--.--	--.--
Prop. Isolated Population	--.--	--.--	--.--	--.--	--.--	0.012 (1.664)*
Prop. Population Growth	0.012 (1.985)**	--.--	--.--	--.--	--.--	-0.011 (-3.064)**

Table 3*: (continued)*

Explanatory variables	*ML Coefficient estimates*[1], *Expenditure category* [2]					
	ML-Error[4] (i)	*ML-Error* (ii)	*ML-Lag* (iii)	*ML-Lag* (iv)	*ML-Lag* (v)	*ML-Error* (vi)
v) Benefit spillovers[5]						
W x Ln Expenditure per capita	*0.014* *(0.586)*	*0.226* *(2.889)***	0.316 (2.427)**	-0.353 (-4.022)**	-0.364 (-2.089)**	*0.022* *(0.899)*
W x Prop. Commuters	--.--	*-0.501* *(-1.764)**	--.--	0.523 (1.783)*	0.900 (1.893)*	*-0.025* *(-0.486)*
W x Prop. Overnight visitors	--.--	*-0.130* *(-1.599)*	--.--	--.--	0.202 (1.309)	*-0.015* *(-0.413)*
W x Prop. Commercial employ.	--.--	*-9.411* *(-3.004)***	--.--	9.910 (1.435)	--.--	*-5.610* *(-0.413)*
W x Ln Input cost	*-0.021* *(-0.235)*	*-0.158* *(-1.998)***	-0.265 (-1.450)	0.250 (0.896)	0.345 (1.550)	*-0.017* *(-1.987)***
W x Ln Dev. Area per capita	*-0.004* *(-0.339)*	*-0.045* *(-1.524)*	-0.001 (-1.675)*	--.--	--.--	*-0.028* *(-1.689)**
W x Prop. Dispersed Population	*-0.001* *(-0.458)*	--.--	-0.038 (-1.754)*	--.--	--.--	--.--
W x Prop. Isolated Population	--.--	--.--	--.--	--.--	--.--	*-0.039* *(-1.256)*
W x Prop. Population Growth	*-0.001* *(0.697)*	--.--	--.--	--.--	--.--	*0.047* *(1.112)*
W x Error	0.051 (1.874)*	0.482 (4.994)**	*-0.267* *(-0.880)*	*-0.687* *(-3.354)***	*0.117* *(0.095)*	0.063 (1.995)**
vi) Control variables						
Ln Income per capita	0.650 (17.336)**	0.503 (26.737)**	0.455 (6.673)**	0.646 (14.936)**	0.682 (15.809)**	0.650 (17.012)**
Prop. Lump-Sump grants	20.339 (2.001)**	17.529 (2.461)**	17.011 (1.661)*	17.654 (1.854)*	22.441 (1.852)*	20.223 (1.675)*
Prop. Potential revenue	11.065 (3.263)**	12.519 (2.154)**	11.465 (4.565)**	11.539 (2.741)**	10.346 (1.846)*	10.201 (3.009)**
Ln Specific grants per capita	--.--	--.--	0.322 (4.014)**	--.--	--.--	--.--
Ln Higher Resp. Expend. per capita	--.--	--.--	0.862 (3.401)**	--.--	0.820 (2.443)**	--.--
Ln Other Layers Expend. per capita	--.--	--.--	-0.455 (-1.387)	--.--	-0.033 (-1.881)*	-0.471 (-2.138)**
Index Ideology of Gov.	-0.057 (1.677)**	--.--	--.--	0.116 (2.249)**	-0.021 (-2.425)	0.079 (2.012)**
Index Divided Gov.	0.009 (1.255)	--.--	--.--	-0.071 (-2.678)**	--.--	--.--
R^2	0.579	0.628	0.669	0.659	0.647	0.649
Log L	15.175	26.530	48.191	7.313	8.624	27.798
Breusch-Pagan (Heterosked.)	5.378	7.669	8.875	12.421	2.851	4.861
Kiefer Salmon (Normality)	2.234	2.775	4.231	0.541	0.229	4.054
ML Tests of Spatial Dependence						
LR Test of Spatial Lag. Depen.(W[4])	2.792	7.458**	5.890**	10.021**	4.789**	0.785
LR Test of Spatial Error Depen. (W)	3.951*	10.086**	0.443	9.665**	0.005	3.920**
Common Factor Test						
LR Test on Common Factor Hyp. (W)	10.024	12.386	39.593**	24.892**	19.332**	12.048

Notes: (1) & (2): see Table 2; (4) The matrix used in this case is W_{II}=inverse of square distance weights., in categories (iii) and (v), and W_{IV}=inverse of square distance weighted by population, in categories (i), (ii), (iv) and (vi). (5) The coefficient estimates correspond to the selected specification for each category, either the Spatial Lag Model (ML-Lag) or the Spatial Error Model (ML-Error); (5) The coefficients in italics correspond to the alternative specification.

Table 4: *Contribution (%) to per capita expenditure variance explanation of different groups of variables*

Expenditure Categories / *Variables*	(i)	(ii)	(iii)	(iv)	(v)	(vi)	Total[1]
Spillover-related variables	--.--	33.679	17.946	50.524	35.927	20.802	20.897
- Crowding by non-residents	--.--	33.679	--.--	33.572	22.230	20.802	14.272
- Own variables (ii)	--.--	25.351	--.--	26.237	12.922	20.802	11.029
- Lagged variables (iii)	--.--	8.328	--.--	7.335	9.308	--.--	3.243
- Benefit spillovers (v)	--.--	--.--	17.946	16.952	13.697	--.--	6.607
Crowding by residents (i)	15.447	7.224	47.714	18.034	24.893	--.--	18.529
Cost drivers (iv)	21.338	10.678	6.246	6.042	4.642	19.305	13.297
Control variables (vi)	63.214	48.419	27.134	25.398	34.537	59.275	47.192
- Revenues [2]	60.696	48.419	21.714	16.103	23.367	42.503	40.025
- Other [3]	2.518	--.--	6.430	9.295	11.170	16.772	7.167
TOTAL	100	100	100	100	100	100	100

Notes: (1) Computed as a weighted average of the different expenditure categories, using as weights its share in total operating expenditure: (i) General Administration=0.317, (ii) Police=0.113, (iii) Social services=0.143, (iv) Culture and Sports=0.106, (v) Housing, Town building, Parks and Streets maintenance=0.164, (vi) Street cleaning, Water delivery and Sanitation=0.157.
(2) Includes income per capita, grants and potential revenues.
(3) Includes political and institutional factors.