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Strategic Interaction in Local Fiscal Policy: Evidence from Portuguese Municipalities

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Abstract: This paper aims at testing the degree of interaction between Portuguese municipalities' expenditure levels by estimating a dynamic panel model, based on jurisdictional reaction functions. The analysis is performed for all 278 Portuguese mainland municipalities from 1986 to 2006, using alternative ways to measure neighbourhood. Results indicate that local governments' spending decisions are significantly influenced by the actions of neighbouring municipalities. For total expenditures, there is evidence that a 10% increase in nearby municipalities' expenditures boosts expenditures in a given municipality by around 3.8%.

JEL: C23, H7, R1

Keywords: spending interactions, local government, spatial econometrics, dynamic panel data

1. Introduction

Strategic interaction among governments has been a significant matter in public finance and regional science for quite a long time. However, most of the empirical studies[1] estimate reaction functions for taxes, and the lack of studies focusing on local expenditures interaction is striking. This paper builds on this literature by investigating if Portuguese local governments' spending decisions influence each other. This is a major issue to understand the distribution of expenditures across municipalities, and the impact of budget decentralization policies.

To our knowledge, interactions between Portuguese local governments have never been investigated. Veiga and Veiga (2007) found strong evidence of strategic manipulation of expenditures' levels and composition by mayors, as more is spent in election years on items that are highly visible to the electorate. They control for transfers received from the central government and for the demographic and political characteristics of the municipalities. However, they did not take into account that the actions of a local government may affect the policy decisions of its neighbours. An important finding of the present paper is that an increase in a municipality's neighbours' expenditures increases its own expenditures, and that this is particularly relevant for investment decisions.

Portugal is an interesting case study because municipalities are all subject to the same rules and legislation, have the same policy instruments and resources at their disposal, and local politicians have some discretionary power over them. Additionally, a large and detailed data set is available (all mainland municipalities from 1986 to 2006), allowing the analysis of spending in specific categories. We find that for total, current and capital expenditures, and particularly for investment, spending in other municipalities matters significantly. On investment components, *Transportation Material*, *Machinery and Equipment*; and *Rural Roads* seem to be particularly relevant. Furthermore, in mainland Portugal there is only one level of local government and, therefore, the estimated magnitude

[1] See Brueckner (2003) and Revelli (2005) for surveys.

of municipalities' fiscal interaction cannot be attributed to vertical externalities among different levels of authorities, as may occur in many countries that have a multi-tier structure of government.

The paper is organized as follows. The next section presents a brief review of the literature, and section 3 describes the Portuguese institutional framework. In section 4, the empirical methodology is laid out, and in section 5 the empirical results are presented. Finally, section 6 concludes the paper.

2. Literature Review

Since the early 1990s, interest in spatial interaction between economic agents has grown remarkably. Although several theoretical studies on how and why actions taken by a local government may affect other local governments appeared earlier,[2] analyses using spatial econometric methods only then started to emerge and are still rather scarce.[3]

Interjurisdictional interaction is largely acknowledged in the fiscal federalism literature[4] and its consequences in terms of policy choices and efficiency have been broadly studied. The traditional theory of fiscal federalism (Musgrave, 1959; Stigler, 1957; and Oates, 1972) presents a framework in which the central government is responsible for the macroeconomic stabilization function, income redistribution, and the supply of a number of national public goods; and the lower levels of government are in charge of another part of the allocation function, which implies differentiated provision of goods and services whose consumption is limited to their own jurisdiction. However, the decentralization theorem (Oates, 1972), which establishes this provision system on the basis of economic efficiency, holds only if there are no interjurisdictional externalities. In the context of benefit spillovers between jurisdictions it is required that the Pigouvian rationale of subsidies is applied to

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[2] See Wilson (1999) for a survey on tax competition literature.

[3] Brueckner (2003) and Revelli (2005) survey the empirical research on strategic interaction among local governments.

[4] See Oates (1999) for a survey.

intergovernmental grants: the government ought to provide matching grants so that the policy-makers and the electorate internalize such benefits (Oates 2005). Other possible solutions are the reassignment of boundaries, voluntary agreements, or the enforcement of cooperation through the creation of a higher level of government (Haughaut 1999). The consequences of expenditure spillovers, in terms of efficiency and the design of federal structures, have been broadly discussed in the literature by authors such as Williams (1966), Oates (1972 and 2005), Wellisch (1993) and Conley and Dix (1999).

The empirical literature on strategic interaction between decentralised levels of government is typically divided into three categories: tax and welfare competition, benefit spillovers, and yardstick competition. The first includes models where a jurisdiction is affected by the choices of other jurisdictions as a result of the existence of a particular resource that they share: the tax-competition literature studies how taxes are chosen strategically when they are levied by governments on a mobile tax base, and that on welfare competition analyses the strategic choices of governments regarding welfare benefit levels, as a result of the mobility of the poor. Examples of the latter include Brueckner (1998), Saavedra (2000), Fiva and Rattso (2006). Research on benefit spillovers in local public expenditures investigates if some expenditures of a jurisdiction derive benefits to similarly situated ones, and assesses how they induce interactions between neighbourhood jurisdictions' decisions as to a particular variable (usually expenditures). Empirical literature examining the size of these spillovers is fairly thin. Finally, yardstick competition models, often considered to fit the benefit spillover framework, assess how voters, in an asymmetric information setting, use neighbouring jurisdictions' public services and taxes to judge their own government's performance. Not having complete information on the cost of public goods and services, they compare the expenditures and tax levels they face with those most easily observable – those of nearby jurisdictions. Besley and Case (1995) presented the first theoretical framework of yardstick competition and empirical evidence using US state data.

Since the main purpose of this paper is to analyse the extent to which municipalities' spending is influenced by the spending of neighbouring municipalities, we will focus our attention on empirical studies of benefit spillovers. The pioneering work of Case, Rosen and Hines (1993) formalises a model for the United States, in which a jurisdiction's welfare is assumed to depend, among others, on the public spending in neighbourhood jurisdictions. Neighbour is defined not only in terms of geographic proximity, but also in terms of economic and demographic similarities. Their results provide strong evidence that states' expenditures are significantly influenced by those of their neighbours, in line with theoretical models of benefit spillovers among jurisdictions.

Since Case, Rosen and Hines (1993), several studies have improved our understanding of how and to what extent spillovers result from local expenditure policies. Among others, Revelli (2003) builds up a theoretical framework with horizontal and vertical fiscal externalities in a multi-tier structure of government, in order to assess the source of spatial dependence between English local governments' expenditures. He concludes that, when vertical interaction is accounted for, the magnitude of the horizontal interactions significantly decreases. Baicker (2005) uses exogenous shocks to state medical spending in the US to examine the effect of that spending on neighbouring states. She finds substantial spillover effects, and concludes that states are most influenced by neighbouring states from or to which their citizens are most likely to move. Finally, Solé-Ollé (2006) presents a framework to analyse and test for two types of expenditure spillovers: benefit spillovers and crowding spillovers, which arise from the crowding of facilities by residents in neighbouring jurisdictions. Estimations of expenditure reaction functions for Spanish local governments reveal that spillovers are stronger in urban areas than in the rest of the country, and that both kinds of spillovers occur in the suburbs, while for the city centres only crowding spillovers are relevant.

All the above mentioned studies used maximum-likelihood or instrumental variables to address the problem of endogeneity of the expenditure interaction variable, since expenditure in one jurisdiction depends on expenditure in another jurisdiction, but the reverse is also true. Recently, a growing body of research has started to implement the Generalized Method of Moments (GMM) in the context of spatial interaction. Using a dynamic panel of European Union countries, Redoano (2007) finds evidence of strategic behaviour by central governments on taxes and expenditures. She concludes that: (1) for corporate taxes, European countries follow large countries, while for income and public expenditures, fiscal interactions are driven by yardstick competition; (2) interdependency decreases when countries join the EU. Foucault, Madies and Paty (2008) test the existence of public spending interactions between French municipalities in a dynamic panel data model. Their results suggest the existence of spending interactions in investment and primary expenditures between neighbouring municipalities and between cities whose mayors have the same partisan affiliation. They find evidence of opportunistic behaviour in pre-electoral periods (Rogoff and Sibert, 1988), but not of yardstick competition.

3. Portuguese Institutional Framework

According to the Portuguese Constitution, there are three types of local governments: parishes (*freguesias*), municipalities, and administrative regions. However, administrative regions have not yet been implemented in mainland Portugal, due to the rejection of the proposal to institute them in a national referendum, in 1998; there are only two autonomous regions: Azores and Madeira. In the mainland there are currently 278 municipalities,[5] and in the autonomous regions 30. Our data set does not include these 30 overseas municipalities, given the differences in the territorial organization, the fact that inhabitants of the islands may have different needs from those living in continental Europe, and that the status of ultra-peripheral regions allows them to receive additional European Union's funds. We focus our attention on municipalities because *freguesias*, which are the lowest administrative unit in Portugal, have a very limited scope of functions.

Local governments in Portugal have their own property and finances, and are all subject to the same laws and regulations. Since the reestablishment of democracy in Portugal, in April 1974, there has been a progressive decentralization of competencies from

[5] Three municipalities were created in 1998: Trofa, Odivelas and Vizela.

the Central Government to local authorities. Nevertheless, Portugal is still among the most centralized countries in the European Union (EU). The Local Power Law of 1977 (Law 79/77) defined the competencies of municipalities and the division of power among their organs of sovereignty,[6] emphasising infrastructural interventions, such as the improvement of accessibilities, sewage, and the distribution of water and electricity. In 1984, new legislation (Decree-Law 77/84) was approved enlarging municipalities' competencies to areas such as rural and urban equipment, culture, leisure and sports, transportation and communication, education, and health care. When Portugal joined the European Economic Community, in 1986, the financial situation of municipalities improved considerably, as they started receiving European structural and cohesion funds. Increased resources allowed municipalities to implement several measures that had been delayed due to lack of funds, and to devote greater care to other activities, such as the promotion of culture. Furthermore, more attention was paid to territorial organization and to the establishment of networks with foreign municipalities, namely Spanish jurisdictions near the border. A new law was enacted in 1999 (Law 159/99), which extended municipalities' attributions regarding the provision of social and cultural services, urban rehabilitation, protection of the environment, consumer protection, promotion of touristic activities, territorial planning and urbanism, external cooperation, and the attraction of corporate activities. Finally, the current Local Finance Law (Law 2/2007) assigned new responsibilities to municipalities in the areas of education and healthcare, among others.

Municipalities account for the bulk of consolidated expenditures of the local administrations. Municipal public expenditures are divided into capital and current expenditures. The former include investment, their main component, capital transfers to parishes, financial assets and liabilities, and other capital expenditures. Until 2001, investment expenditures included miscellaneous constructions (and subcomponents), acquisition of land, housing, transportation material, machinery and equipment, other

[6] Legislative power in municipalities belongs to the Municipal Assembly, while the executive power rests with the Town Council, where the mayor has a prominent role.

buildings (and subcomponents), and other investments.[7] As for current expenditures, their sub-components are expenditures on goods and services, financial expenditures, human resources, current transfers to parishes, and other current expenditures.

Municipalities have little capacity to influence the amount of revenues they receive, since transfers from the Central Government[8] represent their main source of revenue, and local revenues are constrained by law. They have more autonomy to establish their expenditure levels and composition. Therefore, this paper focuses on expenditures to test for interactions between neighbouring municipalities. It is important to note that mayors have greater control over investment expenditures than over current expenditures, since items such as salaries are quite rigid. Furthermore, investment expenditures can be used by local decision makers to attract corporate activity and households, and to gain votes in municipal elections.

4. Empirical Framework and Econometric Procedure

The purpose of this paper is to test for strategic interaction in *per capita* expenditure levels in Portuguese municipalities, in a dynamic panel framework. If there is interaction, jurisdiction *i*'s spending levels depend not only on their own economic and demographic characteristics, but also on the spending levels chosen by nearby municipalities. There can be either positive or negative correlation in local public expenditure levels, depending on the effect that the neighbour jurisdictions' expenditures have on the marginal utility of a given municipality's public spending. They will have a positive effect if public goods or services supplied by these neighbours are complements of the municipality's own goods, and a negative effect if they are substitutes. Municipality *i*'s reaction function can be described as:

[7] In 2002, investment accounts were reorganized into the following categories: acquisition of land, buildings and other constructions (and subcomponents), transportation material, machinery and equipment and, finally, others.
[8] For a revision of the laws regulating transfers from the Central Government to municipalities, and an analysis of the impact of political forces in the allocation of intergovernmental grants, see Veiga and Pinho (2007).

$$G_{it} = \beta_1 + \alpha WG_{it} + \beta_2 mun_{it} + \varepsilon_{it} \quad (1)$$

where G_{it} is real *per capita* expenditure in jurisdiction *i* at time *t;* WG_{it} is a weighted average of neighbouring municipality's real *per capita* expenditures (*W* is a geographical weighted matrix), that is, $WG_{it} = \sum_{j \neq i} w_{ijt} G_{jt}$; mun_{it} is a vector of economic and demographic variables for each jurisdiction, affecting their fiscal choices, and ε_{it} is an error term.

The rationale behind this is that citizens may derive benefits from public goods and services provided by their own municipality and by neighbouring municipalities. Thus, a welfare maximizing government will maximize the following objective function:

$$F(G_{it}, WG_{it}; mun_{it}) \quad (2)$$

Solving the first order condition, a given municipality *i* will choose G_{it} according to the reaction function $G_{it} = R(WG_{it}; mun_{it})$, which consists of its best response to the decisions of other municipalities, taking into account its own characteristics. If there are no spillovers regarding public expenditures, then WG_{it} does not enter the reaction function – the coefficient α in equation (1) will be zero.

In a regression framework the dependent variable is the logarithm of real *per capita* expenditures. Several items of expenditure are considered alternatively: total expenditures, capital expenditures, current expenditures, and investment expenditures and its main components.

4.1. Specification of the weight matrix

It is highly important to properly select a criterion to define neighbours, given that a misspecification of the weight matrix may lead to inconsistent estimates and affect the coefficients' interpretation (Anselin, 1988). Several approaches have been followed to specify the elements of the weight matrix, and no consensus has been achieved on which is better suited for spatial econometric analysis. The matrix has to be specified according to a criterion that reflects previous expectations about the spatial pattern of interaction. It has zero diagonal values, which means municipalities are not considered its own neighbours.

A commonly used method is to assign weights based on contiguity.[9] One way to apply this scheme is to assign values of 0 and 1 to the structure of neighbours – binary contiguity. This would imply $w_{ij} = 1/m_i$ for municipalities *j* that share a border with municipality *i*, and $w_{ij} = 0$ otherwise; where m_i is the number of municipalities contiguous to i. Such matrix (W^0), was created for our sample and later used in the estimation for total expenditures, as a robustness test. However, as discussed by Anselin (1988), this method does not supply a full representation of the degree of spatial interaction present in the data. It is frequent, after Cliff and Ord (1981), to assign different weights to the neighbours, according to the degree to which they affect municipality *i*, so that $\sum_j w_{ij} = 1$.[10] Different weights may be assigned according to geographical distance, or other variables affecting interactions, namely demographic or economic variables.

Following several papers in the literature, we also defined neighbours according to the Euclidean distance between the centres of the municipalities, and constructed the weights as the inverse of this measure. Firstly, and given that Portugal is a relatively small country, all municipalities were considered neighbours (W^T). Secondly, and in order to investigate the robustness of the results, we limited the municipalities that are considered neighbours to those that distance *x* or less kilometres (W^x), with *x* = 50 and 100 km. This is because benefits are more likely to be internalized by municipalities that are closer. In all the specifications the effect of neighbours is smaller the further away they are. The choice of 100km was based on the fact that the maximum frequency of distances between Portuguese municipalities is for 100km, and that of 50km was based on the limits generally used in empirical literature on spillovers between local governments. Additionally, 50km is the distance from which a journey is considered medium or long distance.

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[9] See Besley and Case (1995).

[10] See, for example, Case, Rosen and Hines (1993).

Hence, municipality *i*'s expenditures are assumed to be affected by the expenditures of all its neighbours, in inverse proportion to their distances to *i* and are normalized afterwards, so that $\sum_j w_{ij} = 1$. Thus, w_{ij} is defined as:

$$w_{ij} = \frac{\frac{1}{dist_{ij}}}{\sum_j \frac{1}{dist_{ij}}} \qquad \text{or} \qquad w_{ij} = \begin{cases} \frac{1/dist_{ij}}{\sum_j 1/dist_{ij}} & \text{if } 0 < d_{ij} \leq xkm \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

for the first (W^T) and second (W^x) specifications, respectively. Hence, each observation G_{it} is associated to its spatially lagged counterpart, $WG_{it} = \sum_{j \neq i} w_{ijt} G_{jt}$, which is a linear combination of the observations for all *i*'s neighbours.

As a result, four matrices were created: one based on geographical contiguity and three distance decay matrices. Each *W* is, therefore, a 275x275 matrix for the period 1986-1998, and a 278x278 matrix, for the period 1999-2006, with zero diagonal elements.[11]

We chose the geographical criterion to compute the weight matrix because benefit spillovers depend on the mobility of the population, which, in turn, depends on the distance between municipalities. Other possibilities, such as matrices based on political, demographic or economic similarities, are usually applied to other behavioural models, but were not considered in the current analysis.

4.2. Econometric issues

According to the model, municipality *i*'s expenditures in year *t* depend on municipality *j*'s expenditures, and municipality's *j*'s expenditures also depend on those of *i*. If municipalities react to each other's spending decisions contemporaneously, then WG_{jt} is endogenous in model (1) and correlated with the contemporaneous error term:

[11] Three municipalities were created in 1998: Trofa, Odivelas and Vizela.

$$\mathrm{E}\{\varepsilon_{it} W G_{it}\} \neq 0 \quad (4)$$

In this situation, the OLS estimator is biased and inconsistent and there are two possible solutions: Maximum Likelihood and Instrumental Variables. The first solution consists in inverting the system, in order to eliminate the dependent variables from the right-hand side of the estimating equation, and using a non-linear optimization routine to estimate the spatial coefficient. Examples of papers using this approach are Case *et al.* (1993), Besley and Case (1995), Brueckner (1998) and Foucault *et al.* (2008). However, this procedure is computationally demanding, especially with a large dataset with panel observations.

Another possible solution for this problem would be an instrumental variable two-stage least squares (2SLS) procedure, using as instruments the neighbours' variables (mun_{jt}) that influence their fiscal decisions and are not correlated with the error term. Thus, in line with numerous empirical studies, these would be all considered strictly exogenous and would be weighted by W. Several papers have used this method successfully, such as Kelejian and Robinson (1993), Revelli (2002) and Solé-Ollé (2006).

Another empirical problem concerning the estimation of a spatial model is that there may be spatial dependence in the error term, given by:

$$\varepsilon_{it} = \lambda W \varepsilon_{it} + \mu_{it} \quad (5)$$

where μ_{it} is a white noise error term, uncorrelated between municipalities. If this error correlation is ignored, false evidence of strategic interaction may be provided by the estimation. ML solves this by incorporating this error structure, and IV generates consistent estimates of α even in the presence of spatial error correlation (Kelejian and Prucha 1998).

Due to the fact that we are dealing with panel data, we have to consider unobserved heterogeneity. Thus, we augmented equation (1) with an individual municipality effect. Additionally, we included time effects, with year specific intercepts, in order to control for macroeconomic variables that affect all municipalities at the same time. As noted by Case *et* *al.* (1993), these are particularly important so that spending correlations between jurisdictions caused by common national level shocks are not given spatial significance.

Finally, according to Veiga and Veiga (2007), Portuguese municipalities' level of *per capita* real expenditures exhibits a high level of persistency. Hence, we also included a lag of the dependent variable, G_{t-1}. The model to be tested can, then, be specified as follows:

$$G_{it} = \beta_1 + \gamma G_{it-1} + \alpha WG_{it} + \beta_2 mun_{it} + \eta_i + \rho_t + \varepsilon_{it} \quad (6)$$

where η_i is the individual effect and ρ_t are time effects.

Because G_{t-1} was included, by construction it will be correlated with the individual effect, η_i. In order to solve this problem, and following Arellano and Bond (1991), we can take first-differences of equation (6) to eliminate η_i and use as instruments for ΔG_{it-1} lagged levels of the dependent variable from two or more periods before – which are not correlated with the residuals in differences, assuming no serial correlation in ε_{it}. The neighbouring variable, being endogenous, can be instrumented in a similar way. Thus, the estimation may be conducted with instrumental variables, more specifically by the Generalized Method of Moments (as discussed in Arellano and Bond, 1991) – GMM – which combines the instruments efficiently. It does so by estimating the model parameters directly from the moment conditions.

However, since we suspect high persistence in expenditures, the use of the System GMM estimation (Arellano and Bover, 1995, and Blundell and Bond, 1998) might be the appropriate solution. This extended estimator combines the moment conditions for the model in first differences and for the model in levels, and is especially suitable when there is a high level of persistency in the dependent variable – it is less biased and more precise. It also allows correcting for econometric problems such as weak instruments and measurement errors. Given its properties, we will consider this solution throughout our empirical analysis, comparing it, where appropriate, with the OLS, fixed-effects (FE) and GMM applied to first-differences (GMM-Dif) alternatives.

The validity of the instruments later used in our estimations will be checked using the Hansen test for overidentifying restrictions. We will specifically address the presence of heteroskedasticity in our data. Additionally, in each regression, following Arellano and Bond (1991), we will investigate whether the residuals are serially correlated.

Several estimation procedures have been proposed for spatial models, but the only method that incorporates spatial dependence, temporal lags and other endogenous variables is the system GMM estimator (GMM-Sys).[12] Recently, Kukenova and Monteiro (2008), by performing a Monte Carlo Investigation, found the extended GMM to be suitable to estimate dynamic spatial lag models, especially when N and/or T are large.

4.3. Data and empirical model

The empirical model consists of an equation where municipality *i*'s real *per capita* expenditure in year *t* (G_{it}), depends on its lagged value, its own characteristics and on the real *per capita* expenditures of the neighbouring municipalities (G_{jt}) in the same year. The following variables are used to capture municipalities' resources and needs:

- $grant_{it}$ is total real *per capita* transfers from the central government. Since grants represent the main source of municipalities' revenues, a positive and large coefficient is expected. Cap_grant_{it} and $curr\_grant_{it}$ are, respectively, capital grants and current grants. They are included, instead of total grants, in the regressions having as a dependent variable capital, investment and its components, and current expenditures.

- $taxes_{it}$, the *per capita* real municipal taxes, are included with the same purpose, and a positive, but smaller, coefficient is expected.

- $popdens_{it}$ represents the population density, in jurisdiction *i* at time *t*. It proxies for the level of urbanisation and allow us to test for congestion effects or scale economies in the provision of local public goods and services.

[12] For a description of estimators dealing with spatial and time dependence in panel datasets see Kukenova and Monteiro (2008).

- In order to pick up differences in population needs, we consider the dependency ratio (*depend*$_{it}$), which is the proportion of population in the municipality that is under 15 years old and over 65. These groups of the population demand specific services that are provided by local authorities, such as elementary education and facilities for the elderly.

All variables are expressed in logarithm, except for the population density and the percentage of dependent population, so the results can be interpreted as elasticities.

The data set contains annual data on all Portuguese mainland municipalities, for the years 1986 to 2006. Given that three municipalities[13] were only created in 1998, from 1986 to 1998 there are only data for 275 municipalities. Data on municipalities' local accounts were obtained from the *Direcção Geral das Autarquias Locais*'s (DGAL) annual publication *Finanças Municipais* (Municipal Finances). That on population and consumer price indexes was collected from *Marktest's Sales Index* (SI) and the proportions of population under 15 and over 65 were collected from the Regional Statistical Yearbook, of the Portuguese Institute of Statistics (INE). Descriptive statistics are presented in Table 1. Portuguese municipalities have an average of 540.28 euros *per capita* for total expenditures in the period in analysis, with a standard deviation of 317.4. Current expenditures account for around 51% of total expenditures, with capital expenditures representing the other 49%. Of the latter, about 81% are investment expenditures.

[Table 1 about here]

5. Results

Empirical results are presented in Tables 2 to 4. Our key estimates are discussed in Section 5.1, Table 2, where we estimate equation (6) for Total, Capital, Current, and Investment Expenditures, using W^T as the weight matrix. In Section 5.2, we test for alternative weighting matrices, estimating equation (6) for Total expenditures. Finally, under Section 5.3, we extend our empirical analysis to investment components. Throughout the

[13] Odivelas, Trofa and Vizela.

analysis we implement a similar GMM-Sys strategy, which facilitates the comparison of results obtained for different dependent variables and weighting matrices.

5.1. Total, Capital, Current, and Investment Expenditures

Table 2 presents estimation results for total, capital, current and investment real *per capita* expenditures. For total expenditures, we estimate equation (6) by Ordinary Least Squares (OLS), Fixed Effects (FE) and System Generalized Method of Moments (GMM-Sys) in columns (1) to (6). For the remaining dependent variables, we only estimate the model by GMM-Sys. In all specifications we estimate equation (6) with and without neighbouring expenditures. The spatial dependence variable was computed using the matrix W^T, which considers all Portuguese municipalities as neighbours, with weights in inverse proportion to the distances between them. For the GMM-Sys we use the two-step estimation with the finite-sample correction for standard errors suggested by Windmeijer (2005). For all specifications we include time specific dummies. The reported statistics are robust to heteroskedasticity and serial correlation in the errors. Since we suspect the errors are non-spherical, we report the Hansen consistent test instead of the Sargan statistic.

For the GMM regressions discussed below, we instrument, for the differenced equations, first-differences of the dependent variable using its levels lagged at least two periods, and its lagged first-differences as instruments for the level equations. Grants, taxes and neighbouring municipalities expenditures are assumed to be endogenous, and are instrumented similarly to lagged own expenditures. The argument is that transfers from the central government and taxes collected by municipalities can be, to some extent, influenced by local governments. Finally, the demographic variables, as well as the time dummies, are assumed as exogenous. We based this belief on the fact that municipalities have little or no control over demographic variables (such as population density and the percentage of people under 15 and over 65). Furthermore, any shocks that may affect the entire country, which are controlled for by time dummies, are also exogenous to individual municipalities.

Our first result (OLS, columns (1) and (2), Table 2) indicates that total expenditures show some degree of persistence. Focusing on our key explanatory variable, neighbouring total expenditures, we conclude that there are positive spillover effects across municipalities. When accounting for unobserved municipality specific effects, in columns (3) and (4), we corroborate the results obtained by OLS. Although OLS and FE produce biased estimates, due to the presence of the lagged dependent variable on the right hand-side of equation (6), they provide a useful benchmark on what we should expect from the consistent GMM estimates.

The serial correlation pattern in the first-differenced residuals in models (5) and (6), by showing a significant AR2 (and insignificant AR3), indicates that we need to instrument the equations in first-differences with three lags of the dependent variable, and first-differences lagged two periods for the equations in levels. Additionally, we restrict the instruments for first-differences equations to five lags. In order to limit the number of instruments, we have not applied each moment condition underlying the system-GMM procedure to each time period and lag available. Instead, we apply a single moment condition for each period and regressor.[14] This restriction was not applied in the definition of the instruments of neighbouring total expenditures, column (6), which justifies the significant increase in instruments from column (5) to column (6).

By estimating our model using the GMM system procedure we confirm that total expenditures exhibit some persistence, revealed through an estimated coefficient of 0.43 for lag total expenditures, which is statistically significant at the 1% level – column (6). This might result from the fact that municipalities' spending decisions are highly dependent on their resources and on their population needs, which are also persistent over time. The

[14] The model has been estimated with Stata's command XTABOND2, and the option 'collapse' has been used to define the instruments for G_{it-1}, *Grant and Taxes*.

exclusion of neighbouring total expenditures, column (5), does not significantly alter the level of persistency in the series.

Focusing on column (6), we conclude that the elasticity of own expenditures with respect to neighbouring total expenditures is significant and about 0.38: a one percent increase in neighbours' expenditures is associated with an increase in own expenditures of about 0.38%, confirming the existence of complementarity or mimicking effects. This result clearly indicates that total expenditures spill over municipalities; *i.e.*, own expenditures vary positively with neighbours' decisions regarding this variable. There is strong evidence in favour of expenditure interactions among Portuguese municipalities – the variable WG_{jt} is statistically significant and positively signed.

Both grants and taxes are statistically significant and have the expected signs, with a larger coefficient for the former, derived from the fact that transfers from the central government are municipalities' main source of revenue. The density of the population and, particularly, the share of dependent population, exert a positive and statistically significant effect on total expenditures. This result confirms our prior that the elderly and the youth demand for specific services that local governments try to satisfy, namely kindergartens, elementary education, sport infrastructures, and day care for the eldest.

The tests for serial correlation in the error term reveal, as expected, negative serial correlation in first-differences, which disappears for third and higher orders. This result follows from the formulation of equation (6), and constitutes a first validation of the instruments used. The Hansen test's statistic is 111.0, has 96 degrees of freedom, and an associated *p-value* of 0.14. This result validates the instrument set used in the estimation of column (6). A similar conclusion is valid for the estimates presented in column (5).

[Table 2 about here]

Moving to capital expenditures, Table 2, columns (7) and (8), the estimated coefficient for the lagged dependent variable is slightly smaller than the one estimated for total expenditures. Previous results extend to capital expenditures; *i.e.*, capital expenditures are positively determined by grants and taxes. The information conveyed by the serial correlation tests, AR(1) to AR(3), together with the Hansen test, validate de instruments used in our regressions. For both estimations, columns (7) and (8), the p-value of the Hansen test is bounded between 0.15 and 0.23, and the serial correlation in first-differenced residuals disappears after two lags. The estimated coefficient associated with capital expenditures of neighbouring municipalities is statistically significant at the 5% level, large and positively signed. At the same time, the grants' elasticity has increased considerably: a 10% increase in grants induces almost a 4% increase in capital expenditures. One possible explanation of why the spatial interaction coefficient is only statistically significant at the 5% level for capital expenditures is that there might be opposite effects on the various components of these expenditures that balance each other out. Investment expenditures represent the bulk of Capital expenditures (around 80%), and, therefore, we test for this hypothesis in subsequent regressions (columns 11 and 12).

Moving to current expenditures, columns (9) and (10), reveals a different pattern in terms of residual serial correlation. As we can see in the AR tests, residual's serial correlation only disappears after 3 lags. This implies that in the instrument set we use current expenditures lagged three to five periods for first-differences equations, and first-differences of current expenditures lagged two periods for equations in levels. The remaining variables are instrumented as discussed above. Focusing our attention on column (10), the model with neighbouring current expenditures, we now observe that there are spillovers of this item across municipalities: a 10% increase in neighbours' expenditures brings about a 3.1% increase in own current expenditures. Persistence is now much higher, when compared to the previous expenditure variables. This is consistent with the economic theory, since local governments may not be able to make sudden changes in their fiscal choices, either because they have too high adjustment costs or because they are blocked by law, namely regarding the wage policy and firing decisions.[15] This is particularly true for current expenditures, which are usually set in advance for several years and are not easily changeable. Furthermore, grants, taxes and the demographic variables, although correctly

[15] Expenditures with employees represent around 50% of current expenditures.

signed, seem to have a smaller impact when compared to the previous two items. Overall, estimations under columns (9) and (10) are validated by the serial correlation and Hansen tests.[16]

Finally, investment expenditures reveal significant and large overall investment spillovers from neighbouring expenditures with an elasticity of 0.92. There is also evidence that investment decisions depend on resources available. As before, the instrument set is validated. Given the relevance of this sort of expenditures we will discuss the spillovers for different investment components in Section 5.3.

5.2. Alternative weighting matrices

In order to test the robustness of the results regarding the use of the weighting matrix, we will now implement our analysis using three alternative weighting matrices described in section 4.1: binary/contiguity (W^0), 50 kms (W^{50}), and 100 kms (W^{100}). The results are shown in Table 3. Columns (1) to (3) present distance decay results considering the contiguity matrix, while columns (4) and (5) consider 50km and 100km, respectively, as the maximum distance after which weights are set to zero. The binary/contiguity matrix (W^0) assigns the value 1 to municipalities that share a border, and 0 otherwise. Throughout this section we only consider total expenditures as our dependent variable.

[Table 3 about here]

Not accounting for specific effects, Table 3, column (1), the elasticity of own expenditures to neighbouring total expenditures is quite small (0.04). However, this result is biased, as we ignore both the fixed unobserved effects and the lagged dependent variable. The inclusion of municipalities' fixed effects (column 2) increases the degree to which local governments react to their neighbours expenditure decisions. In order to render our results more comparable to those presented in the previous section, we implement the system

[16] As with Total Expenditures, we do not restrict the number of instruments when defining the set of instruments for neighboring Current Expenditures, column (10), which explains the high number of instruments used in this regression.

GMM estimation[17] (column 3) and the results clearly indicate the presence of neighbouring spillover effects. Analysing the results shown in columns (4) and (5), both estimated by GMM-Sys, not only do we reinforce the conclusion that there are spillovers of total expenditures between neighbours, but also that their size is determined by the weighting matrix we use. It is clear from our results that, when allowing for a broader definition of neighbourhood, we capture a higher effect of neighbours' expenditures. Under the definition of 100 km neighbourhood, we estimate an elasticity of 0.51 (Table 3, column 5), while considering 50km neighbourhood (Table 3, column 5), we estimate such elasticity to be of about 0.32. This is understandable, given that the latter definition of neighbourhood is more restrictive. The remaining results are similar for all regressions.

This set of results corroborates and strengthens the discussion and the options made in Section 5.1. As such, we conclude that there is strategic interaction regarding Portuguese municipalities' total expenditure levels.

5.3. Components of Investment Expenditures

There is no reason to assume that patterns of expenditure interdependence are the same for all categories of investment. It is possible that some types of spending exert complementarity and others substitutability, cancelling each other out and reducing the aggregate effect. An analysis of aggregate spending levels might bias downward the effects of spillovers on spending. To investigate this possibility, the model defined in equation (6), and discussed in Section 5.1, is now implemented for the sub-components of investment expenditures.

Until 2001, investment expenditures had seven main categories: (1) *Acquisition of Land*, (2) *Housing*, (3) *Transportation Material*, (4) *Machinery and Equipment*; (5) *Miscellaneous Constructions*; (6) *Other Buildings*, and (7) *Other Investments*. *Miscellaneous*

[17] Hansen tests indicate that, for our data, the system-GMM is preferable to the GMM that only includes the first-differenced equations.

Constructions and *Other Buildings* were de-composed in, respectively, six and three subcomponents. When analysing the data set we realized that some of these items have a significant number of zeros and missing values, which led us to exclude some of them from the analysis.[18] Table 4 shows the results for 11 of the 16 components and subcomponents of investment expenditures. In this table, we only report the estimated coefficient for WG_{it} and its standard error. Additionally, for the GMM type regressions we report the statistic for the Hansen test, and its degrees of freedom.[19] We report estimation results obtained when using the matrix W^T, that is, the matrix that considers all municipalities as neighbours. The instrument set associated within each GMM regression is similar to the one discussed in Section 5.1 for investment expenditures. In order to keep the regressions as comparable as possible, we use the same structure to define the instruments, particularly in what concerns exogeneity/endogeneity, and the lags used for the instruments are the minimum required to validate the estimates. For each investment component we report the OLS, FE, and GMM-Sys estimates.

When using the GMM procedure there is evidence of positive spillovers across the border for *Transportation material*, *Machinery and equipment*, *Overpasses, streets and complementary works*, *Rural Roads*, and *Other miscellaneous constructions*. As before, the instrument set is validated, both by the serial correlation tests, and by the overidentification tests. When considering OLS and FE results, expenditure decisions on sewage also seem to depend on neighbours' decisions. The significant coefficient for the spatial interaction variable associated with *Rural roads* may be due to coordination among neighbouring municipalities, since the road network is common to several jurisdictions. Regarding other items the positive strategic interaction is likely to be due to mimicking of nearby municipalities, since some expenditures may be used to attract households and firms.

[18] *Acquisition of land*, *Housing*, *Infrastructures on solid waste treatment*, *Social equipment*, *and Other investments* were excluded because they all have an average of more than 50 missing values or zeros per year.
[19] Results for the entire regressions are available from the authors upon request.

6. Conclusion

The paper aims at testing if there are significant interactions in Portuguese municipalities' expenditure levels by estimating a dynamic panel data model, based on jurisdictional reaction functions. Strategic interaction is said to exist when a given municipality is more affected by the actions of nearby ones than of those which are more distant. This may be due to benefit spillovers that arise when neighbouring jurisdictions' spending decisions have an impact on each other, because each jurisdiction derives utility, not only from its own expenditures, but also from those of its neighbours.

The analysis was performed for all 278 Portuguese mainland municipalities from 1986 to 2006. Given the persistence of the expenditure series, estimations were performed by GMM using alternative ways to measure neighbourhood. Results allow us to conclude that local governments do not make their spending decisions in isolation; they are significantly influenced by the actions of neighbouring municipalities. For total expenditures, there is evidence that a 10% increase in nearby municipalities' expenditures increases expenditures in a given municipality by 3.8%, on average. For current and, especially for capital expenditures, the effect is also visible at the aggregate level. Results also support the existence of strong benefit spillovers for investment expenditures, and for the sub-components *Transportation Material*, *Machinery and Equipment*; and expenditures on constructions that require coordination among neighbouring municipalities.

In future research, we intend to test for alternative weighting matrices, using demographic and political data. It would be interesting to test for yardstick competition and if, besides geographical proximity, political party similarity also plays a role in Portuguese mayors' fiscal decisions.

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Table 1 – Descriptive Statistics

	No Obs.	Mean	Stand. Dev.	Min	Max
Total Expenditures	5791	540.28	317.40	72.05	2315.13
Current Expenditures	5791	277.76	170.40	41.45	1471.92
Capital Expenditures	5791	262.50	179.20	13.48	1620.73
Investment Expenditures	5791	213.71	156.37	10.08	1359.76
Acquisition of land Expenditures	3460	7.57	12.62	0.0007	233.23
Housing Expenditures	3009	15.67	31.29	0.0002	394.90
Transportation material Expenditures	3998	6.41	7.78	0.008	88.99
Machinery and equipment Expenditures	4359	11.86	11.48	0.009	146.35
Miscellaneous constructions Expenditures	4398	127.85	113.04	0.07	1810.72
Overpasses, streets and complementary works Expenditures	4230	31.11	38.01	0.0004	479.11
Sewage Expenditures	3761	16.50	23.98	0.002	393.37
Water treatment and distribution Expenditures	3726	19.63	29.42	0.001	570.88
Rural roads Expenditures	3783	43.88	57.64	0.003	772.90
Infrastructures and solid waste treatment Expenditures	1074	5.09	23.44	0.0001	561.10
Other Miscellaneous Constructions Expenditures	4061	25.70	44.23	0.003	705.72
Other buildings Expenditures	4393	34.02	38.61	0.02	531.77
Sports, recreational and schooling facilities Expenditures	3951	14.55	24.64	0.001	361.29
Social equipment Expenditures	1597	6.27	13.28	0.0003	237.66
Other Expenditures in Other Buildings	4319	18.94	28.06	0.001	349.35
Other investments Expenditures	2063	6.60	13.33	0.0003	191.87
Total Grants	5791	363.15	282.35	37.10	3079.16
Capital Grants	5790	194.64	175.41	5.89	2791.43
Current Grants	5791	168.54	124.34	27.53	979.14
Taxes	5791	41.10	76.43	0.06	1912.83
Population (number of inhabitants)	5799	34827	57972	1767	727500
Population Density (inhabitants per km)	5799	2.91	8.68	0.06	86.76
Share of Dependent Population (%)	5799	35.88	4.14	17.10	58.19

Sources: INE, DGAL, SI (several years)
Notes: Monetary values are expressed in real and *per capita* terms. The sample period goes from 1986 to 2006, except for investment expenditures subcomponents, for which the period has been restricted to 2001.

Table 2 – Estimation Results for Total, Capital, Current and Investment Expenditures

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
D. Variable	TotExp	TotExp	TotExp	TotExp	TotExp	TotExp	CapExp	CapExp	CurExp	CurExp	InvExp	InvExp
Model	OLS0	OLS	FE	FE	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
G_{it-1}	0.57***	0.56***	0.30***	0.29***	0.54***	0.43***	0.29***	0.30***	0.87***	0.73***	0.44***	0.44***
	(0.03)	(0.03)	(0.0164)	(0.02)	(0.09)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)	(0.04)	(0.04)
WG_{jt}		0.15***		0.37***		0.38***		0.92**		0.31***		0.92**
		(0.06)		(0.09)		(0.11)		(0.36)		(0.09)		(0.42)
Grant	0.33***	0.32***	0.41***	0.40***	0.18***	0.27***	0.46***	0.38***	0.09***	0.13***	0.50***	0.39***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.06)	(0.04)	(0.12)	(0.11)	(0.02)	(0.02)	(0.12)	(0.12)
Taxes	0.08***	0.07***	0.07***	0.06***	0.17***	0.10***	0.24***	0.18***	0.02	0.04***	0.37***	0.27***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)	(0.07)	(0.05)	(0.02)	(0.01)	(0.08)	(0.05)
Depend	-0.001	-0.002*	0.002	0.003*	0.02***	0.01***	0.02	0.01	0.0004	0.002	0.02	0.01
	(0.001)	(0.001)	(0.002)	(0.002)	(0.006)	(0.003)	(0.01)	(0.01)	(0.003)	(0.002)	(0.01)	(0.009)
Denspop	0.003***	0.003**	-0.002	-0.002	-0.0005	0.003*	0.0001	0.002	0.001*	0.002**	-0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.0008)	(0.001)	(0.003)	(0.002)
Observations	5,508	5,508	5,508	5,508	5,508	5,508	5,507	5,507	5,508	5,508	5,507	5,507
R-squared	0.94	0.94	0.90	0.90								
Municipalities			278	278	278	278	278	278	278	278	278	278
AR1					-6.81	-9.47	-12.65	-12.72	-7.81	-7.58	-12.02	-11.81
p-value					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR2					1.97	2.02	1.03	0.50	2.90	2.82	-0.20	-0.49
p-value					0.05	0.04	0.30	0.62	0.004	0.005	0.84	0.62
AR3					-1.84	-1.42	-1.09	-0.91	-0.46	-0.49	0.14	0.23
p-value					0.07	0.16	0.28	0.36	0.64	0.62	0.89	0.82
Hansen					7.45	111.0	12.04	10.61	12.01	152.4	25.00	26.27
p-value					0.49	0.14	0.15	0.23	0.06	0.07	0.13	0.20
DF					8	96	8	8	6	128	18	21

Sources: INE, DGAL, SI (several years).

Notes: Robust standard errors in parenthesis. Significance level for which the null hypothesis is rejected: ***1%, **5% and *10%. GMM stands for GMM system estimation; two-step estimation results are presented. AR(1), AR(2) and AR(3) refer to first, second and third order autocorrelation tests. DF stands for degrees of freedom. In each model the dependent variable corresponds to D.Variable.

Table 3 – Estimation Results for different weighting matrices

	(1)	(2)	(3)	(4)	(5)
Weighting Matrix		Binary: W^0		W^{50}	W^{100}
Model	OLS	FE	GMM-Sys	GMM-Sys	GMM-Sys
G_{it-1}	0.56***	0.29***	0.51***	0.48***	0.47***
	(0.03)	(0.02)	(0.09)	(0.08)	(0.07)
WG_{jt}	0.04**	0.07***	0.18**	0.32***	0.51***
	(0.02)	(0.02)	(0.07)	(0.11)	(0.17)
Grant	0.32***	0.41***	0.16**	0.14**	0.14**
	(0.02)	(0.02)	(0.06)	(0.07)	(0.06)
Taxes	0.08***	0.06***	0.15***	0.14***	0.11**
	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)
Depend	-0.002	0.002	0.02***	0.017***	0.01*
	(0.001)	(0.002)	(0.006)	(0.006)	(0.007)
denspop	0.003**	-0.002	0.0002	0.0007	0.002
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Observations	5,508	5,508	5508	5508	5508
R^2	0.94	0.90			
Municipalities		278	278	278	278
AR(1)			-6.96	-7.24	-7.42
p-value			0.00	0.00	0.00
AR(2)			1.70	1.62	1.60
p-value			0.09	0.11	0.11
Hansen test			6.84	6.77	6.02
p-value			0.55	0.56	0.65
DF			8	8	8

Sources: INE, DGAL, SI (several years)

Notes: Robust standard errors in parenthesis. Significance level for which the null hypothesis is rejected: ***1%, **5% and *10%. GMM-Sys estimations present two-step results. AR(1) and AR(2) refer to first and second order autocorrelation tests. DF stands for degrees of freedom. In each model the dependent variable is Total Expenditures.

Table 4 – Estimation Results for Some Investment Components

D. Variable	OLS	FE	GMM-Sys Coeff.	GMM-Sys Htest
1. Acquisition of land	n.a	n.a.	n.a	n.a
2. Housing	n.a	n.a.	n.a	n.a
3. Transportation material	0.71	0.23	0.69	68.13*
	(0.11)***	(0.20)	(0.35)**	[54]
4. Machinery and equipment	0.72	-0.12	0.74	90.34*
	(0.09)***	(0.20)	(0.17)***	[71]
5. Miscellaneous constructions	0.10	0.24	0.28	29.83*
	(0.09)	(0.13)*	(0.67)	[21]
5.1. Overpasses, streets and complementary	0.46	0.32	0.81	56.83
works	(0.15)***	(0.20)	(0.49)*	[55]
5.2. Sewage	0.43	0.45	0.22	75.16
	(0.12)***	(0.24)*	(0.36)	[61]
5.3. Water treatment and distribution	0.19	0.21	0.25	11.60
	(0.13)	(0.20)	(0.37)	[12]
5.4. Rural roads	0.71	0.48	0.69	77.69
	(0.16)***	(0.25)*	(0.34)**	[63]
5.5. Infrastructures on solid waste treatment	n.a	n.a.	n.a	n.a
5.6. Other Miscellaneous Constructions	0.05	-0.30	0.57	17.98
	(0.14)	(0.19)	(0.28)**	[12]
6. Other buildings	-0.19	-0.001	0.66	14.52
	(0.14)	(0.18)	(0.64)	[12]
6.1. Sports, recreational and schooling	-0.15	0.03	0.05	17.13
facilities	(0.17)	(0.19)	(0.39)	[12]
6.2. Social equipment	n.a	n.a.	n.a	n.a
6.3. Other Expenditures in Other Buildings	-0.24	-0.44	-0.56	25.28
	(0.15)	(0.19)**	(0.78)	[20]
7. Other investments	n.a	n.a.	n.a	n.a

Sources: INE, DGAL, SI (several years)

Notes.: Robust standard errors in parenthesis. Hansen test's (H-test) degrees of freedom in brackets. Significance level for which the null hypothesis is rejected: ***1%, **5% and *10%. GMM-Sys estimations present two-step results. In each model the dependent variable corresponds to D. Variable. The reported coefficient and standard error is for the neighbouring variable.

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