Spillover effects in spending decisions: evidence from Italian municipalities

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Abstract

We investigate the fiscal interactions between Italian municipalities over the period 2001-2011, and we find a positive horizontal interdependence in spending decisions. Our results are robust to different specifications of the spatial neighbors and are confirmed by a natural experiment (earthquake in the Abruzzo region in 2009) that creates an exogenous variation in the neighbors' spending. Furthermore, there is no evidence of yardstick competition when we consider political effects, while we do find a negative relationship between spatial interaction and the size of the municipality. Thus, we conclude that spillover effects drive the strategic interactions in spending decisions.

Key words: Local public spending interactions, spillovers, yardstick competition, spatial econometrics, dynamic panel data, natural disaster, internal and external instruments.

JEL codes: C23, H72

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Introduction

Many studies in the last two decades aimed to assess the existence of spatial effects influencing local expenditure decisions. In particular, there is a line of work[i], both theoretical and empirical, that investigates whether governments make their spending decisions by taking into account the behavior of their neighbors. In such a framework, decisions on expenditures would depend not only on the traditional determinants of local spending, such as income, grants, socio-demographic and political characteristics of municipalities, but also on spending decisions of neighboring municipalities. Indeed, if municipalities choose their expenditures/taxes – which can affect the welfare of their neighbors – by maximizing their own welfare without taking into account their neighbors' welfare, they end up into inefficient levels of expenditure and/or taxes (Gordon, 1983).

The existence of strategic interactions between local governments is theoretically explained by several models, e.g. yardstick competition, tax and welfare competition, spillover effects, political trend and, more recently, knowledge diffusion and social learning. In the yardstick competition model, voters with no complete information on the cost of public goods and services compare expenditures and taxes in their jurisdiction to those of nearby jurisdictions (Salomon, 1987) and, hence, voters punish the incumbent politician if tax rates or spending decisions are not in line with those of their neighbors. Starting from the seminal work of Besley and Case (1995) – who show that neighbors' tax rates impact on the probability of re-election for the incumbent in the US states – a substantial body of literature has developed documenting and empirically testing yardstick competition (see, among others, Revelli, 2002a; Bordignon et al., 2003; Solé-Ollé, 2003; Allers and Elhrost, 2005; Padovano and Petrarca, 2014). The second source of spatial interdependence arises in tax competition models. Municipalities face mobile tax bases, which depend on both their own tax rate and their neighbors' tax rate giving rise to tax competition (Kanbur and Keen, 1993; Devereux et al., 2008; Rizzo, 2008). In the traditional "spillover" model, public expenditures of a municipality may have positive or negative effects beyond its own boundary, thus affecting the welfare of residents in neighboring municipalities. As a result, municipalities might decide the level of their own expenditure by strategically taking into account the expenditures of their neighbors (Case et al 1993; Revelli, 2002b; Revelli, 2003; Baicker, 2005; Solé-Ollé, 2003; Werck et al., 2008; Costa et al., 2015). Yet, strategic interactions among local governments can be also explained by political interactions[ii]. This idea is based on the assumption that the local incumbent politician, in order to take into account the common ideology, makes her decisions on taxes and expenditure by looking only to those neighbors belonging to the same political party (Geys and Vermier, 2008; Santolini, 2009). Empirical findings support this hypothesis. In particular, Foucalt et al. (2008), by using a panel dataset on French municipalities over the period 1983-2002, show that spending interactions exist between municipalities that have the same political affiliation. The same results are confirmed for Spanish municipalities by Delgado et al. (2014), while for the Italian case, political ideology is a relevant determinant of fiscal interaction only for right-wing and centrist parties (Santolini, 2008)[iii]. Finally, another source of fiscal interaction might be related to knowledge diffusion and social learning. This occurs when a local government mimics other local governments that result to be well informed on the setting of optimal tax rates and efficient levels of expenditure (Glick, 2014).

Most of the empirical literature estimates fiscal strategic interactions by considering the tax side of the local budget. Indeed, there are only few papers that focus explicitly on public expenditures (Case et al., 1993; Figlio et al., 1999; Baicker, 2005; Revelli 2002 and 2003, Foucalut et al., 2008 and Costa et al., 2015) and, among these, only two works deal with the Italian framework (Ermini and Santolini, 2011; Bartolini and Santolini, 2012). However, the latter are conducted on a sample of sub-national Italian jurisdictions (municipalities belonging to Marche region[iv]) and they focus only on current expenditure. Thus, to the best of our knowledge, no one has investigated strategic interactions in both current and capital expenditure decisions, by using a comprehensive dataset on Italian municipalities.

In this work, we aim to fill this gap by assessing the existence of spatial effects influencing the spending decisions of Italian municipalities and identifying the source of such interdependences. We use information on all Italian municipalities (except for those in autonomous regions) over the period 2001-2011. By employing the Arellano-Bond estimator, we estimate an empirical model where the public expenditure in a given municipality depends on the average of their own border municipalities' expenditures and on a set of control variables, including the lagged value of the expenditure. We find a positive horizontal interdependence in spending decisions among Italian municipalities. However, some political variables turn out to be important determinants of local expenditure. In fact, the election year positively affects both total and capital expenditure, implying the presence, among Italian municipalities, of a political budget cycle, i.e., strategic incentives to manipulate policy decisions close to the time of elections (Rogoff and Sibert, 1988; Rogoff, 1990). Moreover, the level of expenditure is higher among those municipalities where the mayor wins the election with a strong majority. Interestingly, we also find that the population size of the municipality negatively affects the impact of neighbors' expenditure on its own expenditure, such that, above a certain level of population, the positive horizontal interdependence in the municipal expenditure vanishes. This last finding, together with the not significant interactions with political variables (i.e., electoral and pre-electoral years, political power of the mayor and mayors that, by law, cannot be re-elected), let us argue that the strategic interaction is due to spillover effects and it is not driven by yardstick competition.

The main contribution of this paper derives from the properties of our dataset. Since it includes all Italian municipalities for the period 2001-2011, it allows testing the existence of local spending interactions by also controlling for the persistency in local expenditures. Such a feature has been exploited only by few papers, including Foucalut at al. (2008); Bartolini and Santolini (2012) and Costa et al. (2015)[v]. Moreover, our study is the first that investigates the source of interactions on capital expenditure for the Italian case. The local policy maker uses these investments as a way to attract economic activities, firms and households, and hence it is highly likely to observe strategic interactions between municipalities. If two municipalities are neighbors and one of them invests in roads, there is also an incentive for the other municipality to invest in roads, in this way the residents of both municipalities would have higher benefits from road usage.

Finally, we test the robustness of our results not only by using alternative weighting matrices - as it is common in the applied literature of spatial econometrics - but also by employing a natural experiment approach. In particular, we focus on the period 2009-2010, and we consider 49 municipalities of Abruzzo region that were hit in 2009 by a dreadful earthquake that caused economic losses of more than 14.7 billion euros. We build a dummy variable equals to one for municipalities hit by the earthquake, and then we convert it in a measure of the intensity of the earthquake by using the Mercalli-Carcani-Sieberge scale. For each municipality we identify the neighbors, and we use the corresponding value of the earthquake intensity to instrument the change in the average expenditure of neighboring municipalities from 2009 to 2010. The estimates of spatial interactions in municipal expenditure obtained in this experimental context confirm those obtained by relying on internal instruments (using the same sample of municipalities belonging to Abruzzo region), and so pointing to the existence of interactions in public expenditures among local governments.

The rest of the paper is organized as follows: the following section illustrates the institutional framework; the second section discusses the econometric strategy and the third section describes the data. The fourth section presents our main results, while robustness tests are shown in the fifth section. Then, in the sixth section, we investigate more in depth the source of spatial interaction, by testing yardstick competition and spillover hypotheses. Finally, the last section concludes.

Institutional framework: a brief analysis of Italian municipalities' spending

The Italian Constitution defines four administrative government layers: central government, regions, provinces and municipalities. While most regions and provinces are ruled by ordinary statutes, some of them – the autonomous regions and provinces – are ruled by special statutes[vi]. Furthermore, Italy counts 107 provinces, which have recently been reformed by the law 56/2014 that reduced their public competences and eliminated the possibility of direct elections of their own representatives. Finally, municipalities are the smallest level of jurisdiction and are around 8,000, the average size is around 6,400 inhabitants and most of them have less than 15,000 inhabitants (approximately 90%).

Municipalities in Italy are responsible for several public functions, such as social welfare services, territorial development, local transport, infant school education, sports and cultural facilities, local police services, water delivery, waste disposal as well as most infrastructural spending. According to our data, municipalities' total expenditure accounts, on average, for about 8.7% of all total public expenditures in Italy during the period 2001-2011.

Municipalities' current expenditure, on average, accounts for 71% of the municipalities' total expenditure, which corresponds to 63 billion euros per year during 2001-2011. Among current expenditure, approximately 75% is concentrated on four main functions: *Administration and Management*, *Roads & Transport Services*, *Planning and Environment* and *Social welfare*. The remaining 25% of the current expenditure is allocated to the *Municipal police*, *Education*, *Culture*, *Sport*, *and Tourism*. Finally, a very low amount of resources goes to three functions, *Economic development*, *In-house production services* and *Justice*, managed by many medium-sized and small municipalities networking with other municipalities.

Municipalities are also responsible for investments, which are on average 29% of the total expenditure in the period 2001-2011. However, it is worth noting that the share of these expenditures sharply decreased in the period 2006-2011, switching from 34% to 21% of total expenditures. At the same time, the share of current expenditure has increased. Looking at the specific functions, municipalities allocate resources for investments mainly to *Administration and Management* (16.7% of the capital expenditure) *Roads and Transport Services* (26%), *Planning and Environment* (27.5%) and *Education* (9%).

Empirical framework

Our econometric strategy is based on the estimation of a spatial autoregressive dynamic panel model (Anselin et al., 2008), which takes the following form:

$$G_{it} = \alpha + \beta G_{(it-1)} + \gamma WG_{-it} + \rho X_{it} + \mu_i + \tau_t + \varepsilon_{it}, \quad (1)$$

where G_{it} is the per capita expenditure of municipality *i* in year *t*, and $G_{(it-1)}$ is its one year lagged value. $WG_{-i,t} = \sum_{j \neq i} \omega_{ij} G_{jt}$ is the weighted per capita average expenditure of the neighboring municipalities *j* at time *t*; ω_{ij} are exogenously chosen weights that aggregate the per capita expenditure of neighboring municipalities into a single variable $WG_{-i,t}$. The ω_{ij} are normalized so that $\sum_{j \neq i} \omega_{ij} = 1$. X_{it} is a matrix of demographic, socio-economic and political characteristics of municipality *i* at time *t*, and it also includes per capita transfers (current, capital or total grants, according to the dependent variable adopted in the estimation) from upper tiers of governments ($transfers_{it}$). μ_i is an unobserved municipal specific effect, τ_t is a year specific intercept and ε_{it} is a mean zero, normally distributed random error.

In equation (1), the coefficient β measures the degree of inertia of the municipal expenditure, whereas the coefficient γ captures the horizontal interdependence in the municipal expenditure, which is the reaction of the expenditure of a given municipality to a one-euro increase in the average expenditure of its neighbors. Focusing on the fiscal interaction term, γ, there are three possible cases that are related to the degree of complementarity and substitutability in the provision of public goods and/or services:

i) $\gamma = 0$: no horizontal interdependence, namely municipalities do not imitate each other in setting local public spending.

ii) $\gamma < 0$: negative horizontal interdependence, that is a one-euro increase in the average expenditure of neighboring municipalities leads to a reduction in the municipal expenditure. This case holds when public goods/services provided by neighbors' municipalities are substitutes of the municipality's own goods/services. For example, two swimming pools, one located in each municipality, are likely to be substitutes and, hence, there is no incentive for a given municipality to increase its expenditure as a response to an increase in neighbors' expenditure.

iii) $\gamma > 0$: positive horizontal interdependence, that is a one-euro increase in the average expenditure of neighboring municipalities leads to an increase in the municipal expenditure. This case holds when public goods/services provided by neighbors' municipalities are complements of the municipality's own goods/services. For example, road services provided by the two municipalities are likely to be complements and, hence, there might be an incentive for a given municipality to increase its expenditure as a response to an increase in neighbors' expenditure.

Since equation (1) includes endogenous variables, the OLS estimation is inappropriate as it generates biased estimates. The average neighboring expenditure, WG_{-it}, is endogenous because expenditure interactions are symmetric and simultaneous: each municipalities' behavior affects that of its neighbors and it is affected by their behavior in the same way. The lagged dependent variable, $G_{(it-1)}$, which is an important determinant of the municipal expenditure (Veiga and Veiga, 2007; Larcinese et al., 2013), is correlated with the municipality fixed effects in the error term, leading to biased and inconsistent fixed effects estimations (Nickell, 1981). The variable $transfers_{it}$ is also endogenous, as simultaneously decided with municipalities' expenditures. Thus, we use the system GMM (SYS-GMM) dynamic panel estimator (Arellano and Bover,1995; Blundell and Bond, 1998). [vii]

Data

The data on Italian municipalities used in our work include a full range of information for the period 2001-2011 and are organized into two sections: 1) municipality financial data and 2) municipality demographic, socio-economic and electoral data, such as population size, age structure, average income of inhabitants, election years. We restrict our sample to municipalities located in ordinary statute regions. We exclude municipalities that have a specific status of metropolitan areas (law 56/2014)[viii], because they usually provide a wider range of services compared to other municipalities. Our final sample includes 5,564 municipalities[ix], observed from 2001 to 2011, which generates a balanced panel data set of 61,204 observations. It is worth noting that all financial variables are expressed in 2011 real per capita value. The description and the summary statistics of all the variables used in the analysis are reported in Appendix B in the supplemental data online.

Dependent variables and variables of interest.

We estimate equation (1) using three different dependent variables: per capita total expenditure (*total expenditure*), per capita current expenditure (*current expenditure*) and per capita capital expenditure (*capital expenditure*). We use these aggregate measures of expenditure and not those disaggregated by functions, because many municipalities (especially the small ones) have expenditure crossing more than one function, but often registered only in one function.

To isolate the independent impact of neighboring expenditures on the expenditure of a given municipality, we use the neighbors' expenditures variable (*neigh expenditure*). In order to obtain this variable we use a contiguity matrix, defining $\omega_{ij} = 1/m_i$ where m_i is the number of municipalities contiguous to *i* and $\omega_{ij} = 0$ if municipalities are not contiguous. Hence, for each municipality *i* in period *t*, the average value of its own neighbors' per capita expenditure is given by $WG_{-i,t} = \sum_{j \neq i} \omega_{ij} G_{jt}$.

Control variables

The municipality expenditure can be affected by other factors, accounting for demographic, socio-economic and electoral characteristics. In particular, we include a set of time-varying variables, which characterizes the municipality's demographic and economic situation. We include the municipal population (*population*$*10^{-4}$) and per capita area (*area*$*10^{3}$) - square kilometers divided by population – as these variables can capture the presence of scale economies and/or congestion effects. The proportion of citizens aged between 0 and 5 (*children*$*10^{3}$) and the proportion of citizens aged over 65 (*aged*$*10^{3}$) can control for some specific public needs (e.g., nursery school, nursing homes for the elderly) and hence may influence the composition of the public spending.

In terms of economic and financial controls, we include the per capita personal income tax base (*income*$*10^{-3}$), i.e., a proxy of per capita average income, and per capita transfers (current, capital or total grants) from upper tiers of governments (*transfers*), that vary according to the dependent variable adopted in the estimation. These variables should have a positive impact on expenditure.[x] On the one side, higher levels of local expenditure might be associated with high level of local economic development (proxied by the per-capita personal income tax base) and, on the other side, an increase in the municipal revenue (proxied by transfers) should lead to an increase in expenditure.

Furthermore, following the literature (Bordignon et al, 2003; Foucalut at al., 2008; Bartolini and Santolini, 2012) we use a set of political variables that may influence the local budget. In particular, we define a dummy variable (*election*), which, during the period 2001-2011, is equal to 1 for a given municipality in the year of election.[xi] The coefficient of this variable is expected to be positive as the incumbent might have an incentive to expand the expenditure during the election period in order to be re-elected. We then measure the political power of the mayor by using the percentage of votes that have been necessary to win an election (*vote-share*): the stronger the power of the local policy maker, the greater is her capacity to influence the budget. Since Italian law establishes a limit of no more than two consecutive terms in office for a mayor, we use a dummy variable (*term-limit*) which is equal to 1 for all the years a mayor is at her second term (and hence she cannot be re-elected) and it is equal to 0 when the mayor is at her first term: the impossibility of further re-election may significantly bias the budget-related decisions of a municipality.

Since 2001[xii], the Italian central government – in order to fulfill the obligations of the European Stability and Growth Pact – imposes to each municipality above 5,000 inhabitants the so-called Domestic Stability Pact. Depending on the year, it implies either a constrained municipal deficit or a threshold on the municipal expenditure. Hence, we include a dummy (*domestic stability pact*) equals to one if a municipality has to fulfill the Domestic Stability Pact (i.e., it has more than 5,000 inhabitants) and 0 otherwise: this variable should lead to lower level of expenditure.

As discussed in the previous section, the dynamic model we estimate includes the lagged endogenous dependent variable, $G_{(it-1)}$ and two further endogenous variables, namely the average neighboring expenditure, $\mathrm{WG}_{-\mathrm{it}}$, and per capita transfers (current, capital or total grants) from upper tiers of governments ($transfers_{it}$). Therefore, all these variables are instrumented by using their lags[xiii].

Results

We first estimate equation (1) by using the OLS estimator (Table 1, col. 1), then we replicate the previous estimation by applying the FE estimator (Table 1, col. 2) and, finally, we perform the SYS-GMM estimator (Table 1, col. 3).

The coefficient of the lagged dependent variable is found to be positive and always significant in all specifications, and thus suggesting a certain degree of inertia of public expenditure. In particular, the estimated coefficient of *expenditure(-1)* ranges between 0.25 and 0.50. These values are in line with the findings of Veiga and Veiga (2007) and Foucalut et al., (2008), although they are slightly lower with respect to those found by Bartolini and Santolini (2012) for the Italian region of Marche.

Turning to the results associated with the presence of spending interactions, we find that the coefficient of *neigh expenditure* is always positive and significant in all specifications. This suggests the existence of a positive horizontal interdependence in the expenditure of Italian municipalities. In particular, looking at coefficient of the SYS-GMM (Table 1, col. 3), we find that a one-euro increase in the average expenditure of the neighbors generates, *ceteris paribus*, an increase in the expenditure of municipality *i* of 0.16 euro. In practice, public goods/services provided by neighbors' municipalities are complements of the municipality's own goods/services provision.

In terms of the other control variables all the coefficients have the expected signs. Considering our preferred specification (SYS-GMM, col. 3), the coefficients of both *transfers* and $income*10^{-3}$ are positive (0.38 and 17.93, respectively) and signficant, implying that total expenditure is higher for increasing levels of income and grants. Municipalities' geographic and demographic characteristics have also an effect on total expenditure. The positive coefficient of $area*10^{-3}$ (4.31 and significant at 1%) suggests the presence of economies of scale, since the lower the municipal area per capita the higher the level of expenditure; while the postive coefficient found for $population*10^{-4}$ (11.58 and statistically significant at 1%) accounts for the presence of congestion effects. Moreovoer, the municipal spending decreases as the proportion of children increase, being the coeffcient of $children*10^{3}$ negative (-2.02) and significant.

All our specifications include political and institutional variables as well. Focusing on the SYS-GMM, the dummy variable *election* has a positive and significant coefficient (20.24), implying the presence of the political budget cycle, as the incumbent mayor has an incentive to expand the expenditure in order to be re-elected. In addition, a higher level of expenditure is associated with a high value of *vote-share*

(75.86), suggesting that mayors supported by a large counsensus have more power to influence the local budget.

Finally, the dummy variable *domestic stability pact* shows a negative and significant coefficient (-38.08), confirming recent findings (Grembi et al., 2016) on the effectiveness of the Domestic Stability Pact in constraining local expenditures.

Insert Table 1 here

In Table 2 we report the results of the estimations using as dependent variable the two components of total expenditures: current expenditure (col. 1, 2 and 3) and capital expenditure (col. 4, 5 and 6). We apply OLS, FE and SYS-GMM estimators. In the latter case, as before, we instrument our lagged dependent variable and the other endogenous variables (*neigh expenditure* and *transfers*) with their lags.

For current expenditure, looking at our preferred specification, SYS-GMM (Table 2, col. 3), we find a certain degree of persistency in the lagged expenditure, however the effect is weakly significant and smaller (0.11) if compared to the one estimated for total expenditure. The coefficient associated with current expenditure of neighboring muncipalities (*neigh expenditure*) is positive (0.65), statistically significant at 1% and larger than the one estimated for total expenditure. Such a positive effect suggests that the interaction in current spending decisions at local level is driven by public goods and/or services of complement type.

Moving to capital expenditure, the results – looking at SYS-GMM (Table 2, col. 6) - show that the estimated coefficient of the lagged dependent variable is positive (0.31) and statistically significant at 1%. It is also very similar to the one estimated for total expenditure (Table 1, col. 3), indicating that capital expenditure at municipal level in Italy is likely to change slowly over time. The coefficient of capital expenditure of neighboring municipalities (*neigh expenditure*) is positive (0.10), significant at 5%, and lower than the one estimated for total expenditure. The positive coefficient associated to the neighboring expenditure reveals that spatial interactions on capital expenditure at the local level are driven by those investments that are complements in usage.

Control variables are also very informative about the determinants of both current and capital municipal expenditure. In particular, the coefficient associated with *population*$*10^{-4}$ is positive and significant and thus confirming the presence of congestion effects; the coefficient of per-capita area (*area*$*10^{3}$) is positive and statistically significant, implying the presence of economies of scale, and the coefficient of *vote-share* is positive and significant as we found for the total expenditure. On the contrary, the variable *domestic stability pact*, which captures financial constraints imposed by the central government to municipalities, is negative and significant both for current and capital expenditure. Moreover, for the specific case of current expenditure, the coefficient of *aged*$*10^{3}$ turns out to be positive and significant, indicating that a higher share of elderly people is associated with high level of current expenditure. On the side of capital expenditure, instead, the coefficients of *transfers* (0.47), *income*$*10^{-3}$ (2.59) and *election* (-33.89) play an important role in explaining investment decisions at municipal level.

Thus far, our empirical evidence leads to three main findings that can be summarized as follows. Firstly, local expenditure of Italian municipalities turned out to be persistent - especially for the case of capital expenditure - and this result is in line with the evidence found for other countries, such as France (Foucault et al., 2008) and Portugal (Veiga and Veiga, 2007; Costa et al., 2015). Moreover, our results show the presence of a positive horizontal interdependence in spending decision among Italian municipalities, with the effect being more pronounced for current expenditure. A one-euro increase in the average current expenditure of the neighbors generates, *ceteris paribus,* an increase of 0.65 euro in the municipality's current expenditure; whereas, a one-euro increase in the average capital expenditures of the neighbors generates, *ceteris paribus*, an increase of 0.10 euro in municipality's capital expenditure. While the presence of horizontal interactions in current spending decisions is a well known result for

Italian municipalities (Ermini and Santolini, 2011; Bartolini and Santolini, 2012), the findings of a positive interaction in capital expenditure – and thus of a complementarity relationship in the provision of local public goods – represent a novel result for the Italian case. Finally, political variables are important factors of municipal expenditure. In particular, the power of the mayor, in terms of political consensus, leads to higher expenditure – both current and capital. Being in an electoral year positively impacts only on capital expenditure, as spending on infrastructures is usually seen as the most visible ones (Drazen and Eslava, 2010).

Insert Table 2 here

Robustness tests

In order to cofirm the results found in the previous section, we run two sets of robustness tests. Firstly, we replicate the analysis using alternative weighting matrices. Then, we exploit a natural experiment and we compare the results obtained using an internal instrument to the results obtained with an external instrument.

Different weighting matrices

As a initial set of robustness test, we re-estimate the previous models by using three different neighbor's weighted matrices. We, first, consider neighbors all municipalities distant up to 25 km from a given municipality and we weight the corresponding expenditure with the inverse of that distance; for distances above 25 km the weight is 0. Then, by using the same procedure, we classify as neighbors all municipalities whose distance from a given municipality is no more than 50 km and, finally, we use a broader definition of neighbors, namely we define neighbors all municiplaities whose distance is within 100 km.

We perform the estimations for the total expenditure and its two components (current expenditure and capital expenditure) using the three spatial matrices, separately. [xiv]

What the results simply suggest is that although the estimated coefficients are found to be larger as the distance increases[xv], they are not stastically different between each other, leading us to conclude that the fiscal interaction effect is not statistically sensitive to the definition of "neighborhood".

To better illustrate these findings we plot the coefficients of the variable *neigh expenditure* and its 10% confidence interval, for each weighting matrix adopted (25, 50 and 100 km neighborhood) and for each dependent variable (*total*, *current* and *capital expenditure*). For example, in the case of current expenditure, we find that the neigh expenditure coefficient (0.77, statistically significant at 1%) obtained by using the definition of 25 km neighborhood (Table C1, col. 2) is not statistically different from the coefficient of neigh expenditure (0.88, and statistically significant at 1%) obtained by using the definition of 50 km neighborhood (Table C1, col. 5). Indeed, looking at Figure 1, Panel B, their confidence intervals overlap, while, on the contrary, there is no overlapping with the coefficient of neigh expenditure obtained using the definition of 100 km neighborhood. The same picture emerges from both total expenditure (Figure 1, Panel A) and capital expenditure (Figure 1, Panel C).

Figure 1: Point estimates and 10% confidence interval of the variable *neigh expenditure* for different specification of the municipal distance

Insert Figure 1

An experimental setting

Recent studies (Gibbons and Overman, 2012; Lyytikäinen, 2012; Baskaran, 2014; Isen, 2014) have pointed out that, within the framework of spatial econometrics, the use of internal instruments does not offer a valid identification of causal effects, which, in turn, might lead to biased estimates. Consequently, they suggest following the quasi-experimental approach by exploiting exogenous variation in the neighbors dependent variable.

In our case, as a source of exogenous variation in the municipal spending, we consider the severe earthquake that occurred in Abruzzo region in the year 2009[xvi]. In particular, during the period April-October 2009, 49 municipalities (corresponding to approximately 15% of the total municipalities of Abruzzo region) were hit by the tremors that caused the collapse of houses, churches, schools, buildings and cracks of sidewalks and roads[xvii].

We restrict our analysis to the Abruzzo's municipalities observed between 2009 and 2010, and we test whether the change in the average expenditure of neighboring municipalities in the same period affects the change in the expenditure of a given municipality. We rewrite Eq. (1) in first differences, without considering the lagged value of the dependent variable:

$$\Delta G_i = \gamma \Delta \sum_{j \neq i} \omega_{ij} G_j + \Delta x_i \rho + \varepsilon_i, \qquad (2)$$

where ΔG_i is the change in per capita expenditure of a municipality i from 2009 to 2010, $\Delta \sum_{j \neq i} \omega_{ij} G_j$ is the change, in the same period, in the average per capita expenditure of neighbouring municipalities. ω_{ij} are exogenously chosen, row-standardized, weights that give the value 1 to municipalities that share a border and 0 otherwise. Δx_i is the change, from 2009 to 2010, of the explanatory variables described within the third section[xviii], and ε_i is the error term.

We deal with the endogeneity issues by employing and comparing two strategies. The first strategy consists in estimating Eq. (2) by instrumenting the endogenous variables using an internal instrument.

Therefore, the change in the average per capita expenditure of neighbors, $\Delta \sum_{j \neq i} \omega_{ij} G_j$, from 2009 to 2010, is instrumented by using its lags, i.e., the change in the average per capita expenditure of neighbors from 2008 to 2009. The second strategy relies on the exogenous variation in the neighbors' expenditure induced by the natural disaster, which provides an "external" instrument. In particular, we define a dummy variable (*Earthquake*) equal to one if a municipality was hit by the earthquake in 2009 and zero otherwise. We then build a new variable, *Earthquake intensity*, given by the product of *Earthquake* and the Mercalli-Carcani-Sieberge (MSC) scale registered in each municipality hit by the earthquake. Finally we use the variable *Earthquake intensity* to build the variable W*Earthquake intensity*, measuring the intensity of the earthquake in the neighboring municipalities. The latter variable is then used to instrument the change in the average expenditure of neighbors' municipalities.

In Table 3 we report the results for both the internal and the external instruments, for each type of expenditure. Focusing on the internal instrument, when we consider the total expenditure (col.1), the *neigh expenditure* coefficient is equal to 0.73, statistically significant at 10%. When we use the external instrument (col. 2) the estimated coefficient of neighboring muncipalities is positive and significant at 5%, but lower (0.28), suggesting that estimations carried out with the internal instrument might lead to upward biased estimates.[xix] For the case of current expenditure, we find that the results using internal instruments (Table 3, col. 3) are very similar to those obtained by employing external instruments (Table 3, col. 4). Finally, for capital expenditure, we find that the coefficients are not statistically significant using both the internal (Table 3, col. 5) and the external (Table 3, col. 6) instruments, although they have the same (positive) sign[xx].

Overall, our results reinforce the evidence of a positive horizontal interdependence in spending decision among Italian municipalities.

Insert Table 3 here

Testing for sources of spatial interdependence

The results discussed in the previous sections have assessed the presence of strategic interaction between spending decisions at the local level, however they have not revealed any source of such interdependence. Therefore, we now investigate whether the municipal interdependence is driven by yardstick competition and/or spillover effects.

Yardstick competition hypothesis

The hypothesis of yardstick competition assumes that voters do not have complete information on the type of policy maker, and they compare policies carried out in their municipality with those of nearby municipalities (Salmon, 1987). Then, starting from these insights, the empirical literature has linked fiscal interactions with the political process. In particular, fiscal interdependences might be effective in both electoral (Sollé-Ollé, 2003) and pre-electoral (Bartolini and Santolini, 2012) years, when politicians mimic the behavior of their neighbor's to capture voters' preferences and to win elections. This behavior is more pronounced when politicians are not lame duck, which implies that they are interested in obtaining voters' confidence (Case, 1993; Bordignon et al., 2003), and it might depend further on the power of the policy maker, in terms of electoral consensus (Bordignon et al., 2003; Allers and Elhrost, 2005).

In order to test the existence of yardstick competition we interact the neighboring expenditure variable with the political variables, and we estimate the following model:

$$G_{it} = \alpha + \beta G_{(it-1)} + \gamma W G_{-it} + \delta(political\_variables_{it} * W G_{-it}) + \rho X_{it} + \mu_i + \tau_t + \varepsilon_{it}. \qquad (3)$$

We separately estimate equation (3) by using SYS-GMM and allowing for four different specifications of political variables (i.e., electoral and pre-electoral years, political power of the mayor and mayors that, according to the Italian law, cannot be re-elected) and we test the robustness of our results by considering alternative weighting matrices based on geographical distance. We consider neighbors all municipalities distant up to *i)* 25 km and *ii)* 50 km, respectively.

In the first specification we use the election year dummy (*election*) as a political variable. A positive and significant coefficient of the interaction between spending decision and the electoral dummy would imply the presence of yardsdtick competition. However, the interaction term (*neigh expenditure*election*) is never statistically significant (Table 4) for any of our dependent variables and for any adopted weighting matrix (contiguity and geographical distance – 25 and 50 km).

This result together with those obtained using other political variable, as well as results carried out using our experimental framework[xxi], indicate that yardstick competition is not a source of spatial interaction, that is municipalities do not mimic each other to get votes and the spatial interdependence is not sensitive to the electoral cycle.

Insert Table 4 here

Spillover Hypothesis and the size of municipalities

The absence of yardstick competition reveals that the source of spatial interactions in spending decisions among Italian municipalities is likely due to spillover effects. Therefore, we perform an additional test to verify whether the municipality size influences the spatial interdependence. The hypothesis is based on the recent findings of Ferraresi et al. (2017), who show – both theoretically and empirically – that the size of a municipality affects spatial spillovers. The rationale is that a highly populated municipality hardly reacts to changes in expenditure by a neighboring municipality, because spillover effects on its residents are negligible.

In order to evaluate the size of the municipality, we estimate the following model that includes the interaction of the neighbor's expenditure with the variable $population_{it} * 10^{-4}$:

$$G_{it} = \alpha + \beta G_{(it-1)} + \gamma W G_{-it} + \lambda (W G_{-it} * population_{it} * 10^{-4}) + \rho X_{it} + \mu_i + \tau_t + \varepsilon_{it}. \quad (4)$$

The estimate of the spatial spillover is given by $\gamma + \lambda$*population*10^-4^, which depends on the size of the municipality. Equation (4) is estimated adopting a SYS-GMM estimator. We also test the robustness of our results by considering alternative weighting matrices based on geographical distance (25 and 50 km, respectively).

The results are reported in Table 5. Considering the total expenditure (col. 1), the estimated coefficient of the spatial spillover ($\gamma + \lambda$*population*), is positive and statistically significant for any level of population below 90,000 inhabitants. Turning to current expenditure, according to the estimated coefficients (Table 5, col. 2), it emerges that the spatial spillover is positive and significant only for municipalities with less than 50,000 inhabitants. As capital expenditure concerns (Table 5, col. 3), municipalities positively react to an increase in capital expenditure of neighboring communities as long as the level of population is lower than 85,000 inhabitants. All results do not change when relying on our experimental framework (see Tables D6 and D7 of Appendix D in the supplemental data online).

Our results suggest that the complementarity relationship in the provision of local public goods and services holds only for population levels below a given threshold. In fact, it is very likely that a highly populated municipality hardly reacts to changes in per capita expenditure of a small neighboring municipality. In terms of public goods spillovers, these changes have a negligible per capita impact on the residents of a large municipality.

Insert Table 5 here

Conclusion

In this paper we have explored the existence of spatial interactions in spending decisions among Italian municipalities. We have estimated a spatial autoregressive dynamic panel data model, using data on 5,564 Italian municipalities observed during the period 2001-2011 and exploiting their border contiguity. We have found a positive effect of neighbors' expenditure on the expenditure of a given municipality, for total, capital and current expenditure, suggesting the presence of a complementarity relationship in the provision of local public goods

Our results are robust to the use of different weighting matrices, and are confirmed by a quasi-experimental approach. Moreover, we did not find any evidence of yardstick competition, and we are confident that spillover effects drive the strategic interaction. This conclusion is further supported by the negative relationship between spatial interaction and municipality's size, especially for current expenditures. A highly populated municipality should hardly react to changes in per capita expenditure of a small municipality, because public goods spillovers are negligible to the residents of large municipalities.

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Table 1: Estimation results for total expenditure with OLS, FE and SYS-GMM estimator

Dependent variable	Total Expenditure		
Model	OLS	FE	SYS-GMM
	(1)	(2)	(3)
Expenditure (-1)	0.50***	0.25***	0.31***
	(0.03)	(0.03)	(0.06)
Neigh expenditure	0.08***	0.11***	0.16*
	(0.01)	(0.02)	(0.10)
Transfers	0.54***	0.60***	0.38***
	(0.03)	(0.04)	(0.10)
Population*10^{-4}	6.09***	-189.54***	11.58***
	(0.85)	(38.80)	(1.79)
Children*10^{3}	-1.41***	-1.07	-2.02***
	(0.41)	(0.77)	(0.52)
Aged*10^{3}	-0.31***	0.10	0.23
	(0.11)	(0.30)	(0.24)
Area*10^{3}	1.47***	8.64***	4.31***
	(0.31)	(3.28)	(0.95)
Income*10^{-3}	21.45***	33.30***	17.93***
	(1.29)	(8.23)	(3.86)
Domestic stability pact	-6.23	-73.39**	-38.08***
	(4.08)	(29.09)	(11.04)
Election	11.66**	22.13***	20.24***
	(4.85)	(3.92)	(4.87)
Term-limit	3.11	7.15*	3.03
	(3.99)	(4.14)	(3.96)
Vote-share	4.32	21.43	75.86***
	(15.82)	(20.73)	(28.11)
Constant	104.70***	17.20	181.99**
	(36.37)	(150.67)	(73.11)
Observations	55,640	55,640	55,640
R-squared	0.84	0.46	
Number of municipalities	5,564	5,564	5,564
ar1p			0.000

hansenp	0.497
ar2p	0.727
Number of instruments	29

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors, clustered at the municipal level, are shown in parentheses. In all regressions we control for time fixed effects, while, in col. (2) and (3) we also include municipal fixed effects. In col. (3) the variable *Expenditure (-1)* is instrumented applying difference GMM, by using lags 1, 2 and 3; the variable *neigh expenditure* is instrumented applying SYS-GMM, by using lags 3 and 4; the variable *transfers* (total transfers) is instrumented applying SYS-GMM by using lags 3 and 4. The validity of the instruments is checked by using the standard Hansen test and the C test (results are available upon request).

Table 2: Estimation results for current and capital expenditures with the SYS-GMM estimator

Dependent variable	Current Expenditure			Capital Expenditure		
Model	OLS	FE	SYS-GMM	OLS	FE	SYS-GMM
	(1)	(2)	(3)	(4)	(5)	(6)
Expenditure (-1)	0.92***	0.41***	0.11*	0.37***	0.24***	0.31***
	(0.01)	(0.02)	(0.06)	(0.03)	(0.03)	(0.05)
Neigh expenditure	0.06***	0.27***	0.65***	0.06***	0.10***	0.10**
	(0.01)	(0.03)	(0.18)	(0.01)	(0.02)	(0.04)
Transfers	0.10***	0.15***	-0.33	0.61***	0.60***	0.47***
	(0.02)	(0.04)	(0.22)	(0.04)	(0.04)	(0.09)
Population*10^{-4}	1.33***	-94.36***	22.70***	2.51***	14.79	2.27***
	(0.42)	(17.87)	(3.33)	(0.55)	(20.13)	(0.84)
Children*10^{3}	-0.28***	-0.42***	-1.31***	-0.55	-0.30	-0.68*
	(0.08)	(0.16)	(0.46)	(0.38)	(0.68)	(0.37)
Aged*10^{3}	-0.05*	-0.07	0.62**	-0.10	0.48*	0.07
	(0.03)	(0.08)	(0.29)	(0.10)	(0.28)	(0.09)
Area*10^{3}	0.26***	4.88***	2.49***	0.85***	2.97	2.09***
	(0.06)	(0.80)	(0.69)	(0.25)	(2.74)	(0.36)
Income*10^{-3}	2.48***	9.59***	-1.20	3.65***	18.34**	2.59***
	(0.60)	(1.69)	(5.46)	(0.56)	(7.67)	(0.74)
Domestic stability pact	-2.71*	-7.11**	-43.26***	-23.07***	-55.88*	-33.89***
	(1.54)	(3.55)	(15.38)	(3.20)	(29.50)	(4.68)
Election	-1.40	-0.46	-0.52	15.03***	21.27***	17.60***
	(1.36)	(1.16)	(1.90)	(4.22)	(3.69)	(4.07)
Term-limit	-0.22	0.57	-2.62	4.48	7.16*	3.40
	(1.09)	(1.09)	(2.60)	(3.46)	(3.92)	(3.23)
Vote-share	4.34	8.77*	56.46***	21.82	16.44	51.61***
	(3.87)	(4.88)	(19.54)	(13.95)	(20.07)	(18.02)
Constant	-11.48	65.80	120.06	86.98***	-199.46	94.16***

	(10.02)	(40.29)	(109.93)	(32.19)	(127.26)	(33.19)
Observations	55,640	55,640	55,640	55,640	55,640	55,640
R-squared	0.92	0.47		0.78	0.46	
Number of municipalities	5,564	5,564	5,564	5,564	5,564	5,564
ar1p			0.000			0.000
hansenp			0.259			0.795
ar2p			0.581			0.769
Number of instruments			28			28

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors, clustered at the municipal level, are shown in parentheses. In all regressions we control for time fixed effects, while, in col. (2), (3), (5) and (6) we also include municipal fixed effects. In col. (3) the variable *Expenditure (-1)* is instrumented applying difference GMM, by using lags 1, 2, 3 and 4; the variable *neigh expenditure* is instrumented applying SYS-GMM by using lags 7 and 8; the variable *transfers* (current transfers) is instrumented applying SYS-GMM by using lag 4. In col. (6) the variable *Expenditure (-1)* is instrumented applying difference GMM by using lags 1 and 2; the variable *neigh expenditure* is instrumented applying SYS-GMM by using lags 2 and 3; the variable *transfers* (capital transfers) is instrumented applying SYS-GMM by using lags 3 and 4. The validity of the instruments is checked by using the standard Hansen test and the C tests (results are available upon request).

Table 3 Second stage results for total, current and capital expenditure: internal vs external instrument.

Dependent variable	Total expenditure		Current expenditure		Capital expenditure	
Type of instrument	Internal	External	Internal	External	Internal	External
	(1)	(2)	(3)	(4)	(5)	(6)
Neigh expenditure ($\Delta_{2010-2009}$)	0.73*	0.28**	0.17**	0.21**	8.35	0.38
	(0.41)	(0.14)	(0.07)	(0.09)	(29.86)	(0.27)
Earthquake intensity	96.61**	148.22***	-7.89	-10.72	-250.05	78.05***
	(46.44)	(35.23)	(8.50)	(10.34)	(1,227.81)	(23.86)
Transfers ($\Delta_{2010-2009}$)	0.09	0.08	0.51***	0.52***	0.10	-0.11
	(0.09)	(0.09)	(0.13)	(0.14)	(0.98)	(0.07)
Population ($\Delta_{2010-2009}$)	-0.04	-0.05	-0.05	-0.05	0.29	0.04
	(0.05)	(0.05)	(0.04)	(0.04)	(0.95)	(0.03)
Children ($\Delta_{2010-2009}$)	8,853.37	-3,037.41	83.05	363.82	147,953.39	757.78
	(14,557.95)	(11,478.13)	(5,354.22)	(5,046.00)	(572,687.85)	(11,980.09)
Aged ($\Delta_{2010-2009}$)	174.75	-1,057.48	-3,181.75*	-3,176.26*	25,308.44	4,402.26
	(8,227.77)	(7,654.80)	(1,920.22)	(1,924.80)	(94,865.76)	(7,182.92)
Area ($\Delta_{2010-2009}$)	35,015.25	46,267.37*	1,756.31	1,157.68	-44,963.74	28,670.93*
	(26,418.25)	(26,090.25)	(12,214.03)	(12,327.24)	(274,468.50)	(14,831.34)
Income ($\Delta_{2010-2009}$)	-0.19	0.06	0.06	0.05	-1.57	0.04

	(0.29)	(0.19)	(0.06)	(0.06)	(6.28)	(0.16)
Domestic stability pact	98.11	28.77	16.83	19.90	566.07	8.37
	(72.52)	(52.54)	(21.67)	(20.96)	(2,158.98)	(39.91)
Election	197.04*	196.04*	-16.58	-16.82	332.82	257.49**
	(115.58)	(110.21)	(37.93)	(38.19)	(839.85)	(130.93)
Term-limit	73.10	59.23	46.72**	46.48**	361.97	50.51
	(79.26)	(75.98)	(18.30)	(18.45)	(1,176.92)	(72.66)
Vote-share	112.45	91.53	104.53	104.89	261.83	-38.70
	(240.63)	(266.08)	(111.19)	(109.61)	(1,515.01)	(222.39)
Constant	-212.33	-169.21	-78.47	-80.26	-437.54	-67.72
	(137.36)	(147.56)	(75.00)	(74.63)	(1,653.62)	(108.65)
Observations	195	195	195	195	195	195
R-squared	0.45	0.52	0.70	0.69	0.35	0.35
Kleibergen-Paap F	14.36	76.593	34.973	56.366	0.062	32.25

Notes: *** significant at 1%; ** significant at 5%; significant at 10%.Columns (1), (3) and (5) display the results by using internal instruments, namely the change in the average per capita expenditure of neighbors from 2008 to 2009. Columns (2), (4) and (6) show the second stage results of the previous regressions by using the neighbor's earthquake intensity variable as instruments for the change in the average expenditure of neighboring municipalities The spatial weight matrix (W) used is of the type: contiguity-based and it is row-standardize. Robust standard errors are shown in parentheses. The corresponding first stage results are reported in Table C2.

Table 4: Estimation results for yardstick competition model with the interaction between neigh expenditure and Election

Weighting matrix	$W^{contiguity}$			W^{25km}			W^{50km}		
Dependent variable	Total	Current	Capital	Total	Current	Capital	Total	Current	Capital
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure (-1)	0.33***	0.10*	0.31***	0.37***	0.09*	0.33***	0.38***	0.07	0.32***
	(0.05)	(0.06)	(0.05)	(0.06)	(0.05)	(0.06)	(0.06)	(0.05)	(0.06)
Neigh expenditure	0.12*	0.62***	0.11***	0.25*	0.71***	0.13*	0.23**	0.84***	0.15*
	(0.07)	(0.16)	(0.04)	(0.13)	(0.16)	(0.07)	(0.12)	(0.17)	(0.09)
Neigh expenditure * election	0.10	0.02	-0.03	-0.06	0.02	-0.00	0.08	0.02	0.06
	(0.06)	(0.02)	(0.04)	(0.04)	(0.02)	(0.05)	(0.05)	(0.03)	(0.07)
Transfers	0.33***	-0.27	0.46***	0.32***	-0.11	0.44***	0.19**	-0.04	0.46***
	(0.08)	(0.20)	(0.09)	(0.10)	(0.22)	(0.10)	(0.09)	(0.19)	(0.09)
Election	-100.58	-11.92	31.16*	90.00*	-11.93	19.37	-77.19	-13.07	-11.90
	(75.23)	(16.82)	(18.46)	(50.47)	(18.85)	(25.07)	(60.61)	(22.44)	(33.93)
Constant	236.41***	120.28	90.13***	28.62	50.46	78.28**	56.61	-61.95	-9.35
	(62.06)	(96.98)	(32.77)	(110.48)	(133.16)	(39.39)	(105.99)	(103.93)	(40.66)
Observations	55,640	55,640	55,640	55,640	55,640	55,640	55,640	55,640	55,640
Number of municipalities	5,564	5,564	5,564	5,564	5,564	5,564	5,564	5,564	5,564
ar1p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
hansenp	0.341	0.315	0.919	0.510	0.153	0.428	0.28	0.138	0.397
ar2p	0.777	0.646	0.757	0.841	0.694	0.803	0.689	0.537	0.806
Number of instruments	31	30	31	31	30	31	34	31	31

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1. Robust standard errors, clustered at the municipal level, are shown in parentheses. We control for time and municipal fixed effects, *population*$*10^{-4}$, *children*$*10^{3}$, *aged*$*10^{3}$, *area*$*10^{3}$, *income*$*10^{-3}$, *domestic stability pact*, *term-limit*, *vote-share*. The variables *Expenditure (-1), neigh expenditure,* the interaction *neigh expenditure * election* and *transfers* are always instrumented using SYS-GMM, excluding for *Expenditure (-1)* in regression (2), (5) and (8), which is instrumented by using difference GMM. Instruments: (1) lags 1 and 2 for the variable *Expenditure (-1)*, lags 3 and 4 for the variables *neigh expenditure*, *neigh expenditure*election* and *transfers* (total transfers); (2) lags 1, 2 and 3 for the variable *Expenditure (-1)*, lags 7 and 8 for the variable *neigh expenditure*, lags 5 and 6 for the variable *neigh expenditure*election*, and lag 4 for the variable *transfers* (current transfers); (3) lags 1 and 2 for the variable *Expenditure (-1)*, lags 2 and 3 for the variable *neigh expenditure*, lags 6 and 7 for the variable *neigh expenditure*election*, and lags 3 and 4 for the variable *transfers* (capital transfers); (4) lags 1 and 2 for the variable *Expenditure (-1)*, lags 4 and 5 for the variables *neigh expenditure*, *neigh expenditure*election* and *transfers* (total transfers); (5) lags 1, 2 and 3 for the variable *Expenditure (-1)*, lags 7 and 8 for the variable *neigh expenditure*, lags 5 and 6 for the variable *neigh expenditure*election*, and lag 4 for the variable *transfers* (current transfers); (6) lags 1 and 2 for the variable *Expenditure (-1)*, lags 2 and 3 for the variable *neigh expenditure*, lags 6 and 7 for the variable *neigh expenditure*election*, and lags 3 and 4 for the variable *transfers* (capital transfers); (7) lags 1 and 2 for the variable *Expenditure (-1)*, lags 5, 6 and 7 for the variables *neigh expenditure*, lags 6, 7 and 8 for the variables *neigh expenditure*election* and *transfers* (total transfers); (8) lags 1 and 3 for the variable *Expenditure (-1)*, lags 7 and 8 for the variable *neigh expenditure*, lags 5 and 6 for the variable *neigh expenditure*election*, and lags 4 and 5 for the variable *transfers* (current transfers); (9) lags 1 and 2 for the variable *Expenditure (-1)*, lags 2 and 3 for the variable *neigh expenditure*, lags 6 and 7 for the variable *neigh expenditure*election*, and lags 3 and 4 for the variable *transfers* (capital transfers). The validity of the instruments is checked by using the standard Hansen test and the C tests (results are available upon request).

Table 5: Estimation results of the spending interdependence and size of municipalities

Weighting matrix	$W^{contiguity}$			W^{25km}			W^{50km}		
Dependent variable	Total	Current	Capital	Total	Current	Capital	Total	Current	Capital
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expenditure (-1)	0.45***	0.08	0.43***	0.46***	0.06	0.43***	0.86***	0.12	0.40***
	(0.07)	(0.07)	(0.11)	(0.07)	(0.07)	(0.11)	(0.23)	(0.08)	(0.09)
Neigh expenditure	0.45***	0.66***	0.47***	0.53***	0.82***	0.54***	0.67**	0.77***	0.50***
	(0.14)	(0.07)	(0.14)	(0.15)	(0.07)	(0.16)	(0.29)	(0.14)	(0.15)
Neigh expenditure *(population*10^{-4})	-0.02	-0.06*	-0.02	-0.02	-0.08***	-0.03	-0.10	-0.09***	-0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)	(0.09)	(0.03)	(0.02)
Transfers	0.12	-0.17	0.10	0.06	0.10	0.11	-0.13	-0.27	0.20
	(0.09)	(0.22)	(0.17)	(0.08)	(0.18)	(0.17)	(0.24)	(0.20)	(0.16)
Population*10^{-4}	37.64	63.11***	8.95	34.11	75.52***	12.86	118.86	81.11***	3.76
	(24.02)	(20.51)	(9.40)	(23.92)	(14.66)	(10.37)	(102.05)	(21.00)	(7.58)
Constant	14.46	70.96	0.90	-152.88	-83.74	-126.92**	-485.19	-2.06	-154.43**
	(102.81)	(65.17)	(47.36)	(122.32)	(62.32)	(55.54)	(340.89)	(91.49)	(62.50)
Observations	55,640	55,640	55,640	55,640	55,640	55,640	55,640	55,640	55,640
Number of municipalities	5,564	5,564	5,564	5,564	5,564	5,564	5,564	5,564	5,564
ar1p	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
hansenp	0.214	0.525	0.479	0.637	0.138	0.375	0.865	0.166	0.316
ar2p	0.636	0.834	0.488	0.498	0.358	0.581	0.987	0.828	0.667
Number of instruments	31	31	32	31	31	31	28	30	33

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ Robust standard errors, clustered at the municipal level, are shown in parentheses. We control for time and municipal fixed effects, *children*10^3*, *aged*10^3*, *area*10^3*, *income*10^{-3}*, *domestic stability pact*, *election, term-limit* and *vote-share*. The variables *Expenditure (-1), neigh expenditure,* the interaction *neigh expenditure*population*10^{-4}* and *transfers* are always instrumented using SYS-GMM, excluding *Expenditure (-1)* in regression (2), (5) and (8), which is instrumented using difference GMM. Instruments: (1) lags 1 and 2 for the variable *Expenditure (-1)*, lags 5 and 6 for the variable *neigh expenditure*, and lags 6 and 7 for the variables *neigh expenditure*population*10^{-4}* and *transfers*; (2) lags 1, 2 and 3 for the variable *Expenditure (-1)*, lags 5 and 6 for the variables *neigh expenditure* and *neigh expenditure*population*10^{-4}*, lags 4 and 5 for the variable *transfers* (current transfers); (3) lags 1, 2, 3 and 4 order lags for the variable *Expenditure (-1)*, lag 5 for the variable *neigh expenditure*, and lags 6 and 7 for the variables *neigh expenditure*population*10^{-4}* and *transfers* (capital transfers); (4) lags 1 and 2 for the variable *Expenditure (-1)*, lags 5 and 6 for the variable *neigh expenditure*, and lags 6 and 7 for the variables *neigh expenditure*population*10^{-4}* and *transfers*; (5) lags 1, 2 and 3 for the variable *Expenditure (-1)*, lags 5 and 6 for the variables *neigh expenditure* and *neigh expenditure*population*10^{-4}*, lags 4 and 5 for the variable *transfers* (current transfers); (6) lags 1, 2, 3 and 4 order lags for the variable *Expenditure (-1)*, lag 5 for the variable *neigh expenditure*, lag 2 for the variable *neigh expenditure*population*10^{-4}* and lags 6 and 7 for the variable *transfers* (capital transfers); (7) lag 3 for the variables *Expenditure (-1)* and *neigh expenditure*, lag 2 for tne variable variables *neigh expenditure*population*10^{-4}* and lags 2 and 3 for the variable *transfers*; (8) lags 1 and 2 for the variable *Expenditure (-1)*, lags 8 and 9 for the variables *neigh expenditure* and *neigh expenditure*population*10^{-4}*, lags 4 and 5 for the variable *transfers* (current transfers); (9) lags 1, 2, 3, 4 and 5 order lags for the variable *Expenditure (-1)*, lags 5 and 6 for the variable *neigh expenditure*, lag 2 for the variable *neigh expenditure*population*10^{-4}* and lags 6 and 7 for the variable *transfers* (capital transfers). The validity of the instruments is checked by using the standard Hansen test and the C tests (results are available upon request).

[i] For a theoretical survey on horizontal strategic interactions see, for example, Wilson (1999), while for an empirical survey on fiscal strategic interactions see, among others, Brueckner (2003), Revelli (2005) and, more recently, Delgado et al. (2014).

[ii] The role of political ideology has been found to be an important driver also at the country level, as shown by Cassette and Exbrayat (2009), who conduct an analysis on 27 European countries over the period 1995-2007 finding that ideology on tax interactions holds only for contiguous countries.

[iii] The findings of Santolini (2008) are based on a cross-section of 246 municipalities belonging to the Marche region for the year 1994. In our case, since we focus on a panel data of all Italian municipalities over the period 2001-2011, testing for the presence of strategic interactions between municipalities having the same political affiliation turns out to be unfeasible. This because the large majority of votes at local level are casted in favour of "civic" list (liste civiche), for which it is not possible to associate any political colour. Indeed, as shown by Bracco et al. (2015), more than 65% of Italian municipalities cannot be classified as left, neither as right. Therefore, testing whether spatial interactions are driven by political ideology would imply to use a very small fraction of municipalities (large only) – not even contiguous to each other – , which in turns would lead to less efficient and accurate estimates.

[iv] Ermini and Santolini (2011) found a positive and significant spillover effect for current expenditure, while, Bartolini and Santolini (2012) found evidence of yardstick competition, when they control for both the domestic stability pact and pre-electoral years.

[v] It is worth noting that our dataset includes 61,204 observations, making it the largest sample ever examined in applied work on strategic interactions in spending decisions at the local level. In fact, among those papers analyzing the existence of interactions related to public expenditure, Foucalut at al., (2008) use a panel dataset of 90 French municipalities over the period 1983-2002, leading to 1,710 observations; Bartolini and Santolini (2011) rely on a panel dataset of 246 Italian municipalities of Marche region during the period 1994-2003, for a total of 2,460 observations and Costa et al., (2015) use a panel dataset of 278 Portuguese municipalities for the period 1986-2006, summing up to 5,560 observations.

[vi] In Italy there are five autonomous regions (Sicilia and Sardegna, which are insular territories, Valle d'Aosta, Trentino Alto Adige and Friuli Venezia Giulia, which are northern boundary territories) and two autonomous provinces (Trento and Bolzano).

[vii] The system GMM estimator is described in details in Appendix A in the supplemental data online.

[viii] Milano, Roma, Napoli, Torino, Bari, Firenze, Bologna, Genova, Venezia and Reggio Calabria.

[ix] We did not consider municipalities with missing values in the dependent variables defined in the third section.

[x] Transfers from upper level of government represent a significant part, appoximatley around 25%, of the Italian municipal financing system. There is a well-known literature on the effects of grants on public expenditure (for a recent survey see Inman, 2009) usually finding that grants can stimulate government expenditures more than monetary transfers to individuals of the same amount—the so-called flypaper effect.

[xi] Since Italian municipalities have staggered times of elections it is feasible to include, simultaneously, a dummy variable for municipal election and annual fixed effects. In this way we can distinguish the effect of being in an electoral year from other fluctuations due to changes in macroeconomic conditions.

[xii] See law 388/2000, article 53.

[xiii] Information about lags used for instrumenting all endogenous variables are provided for each estimated specification.

[xiv] Results of this analysis are reported and discussed more in depth in Appendix C in the supplemental data online.

[xv] Similar results are found by Costa et al. (2015), who justify the increase in the size of the estimated coefficient by saying that "when allowing for a broader definition of neighborhood, a higher effect of neighbors' expenditure is captured" (pag. 1451).

[xvi] Details on the earthquake can be found in Appendix C in the supplemental data online.

[xvii] In our dataset we have information on only 195 out of 305 municipalities belonging to Abruzzo region. However, within our sample, the share of municipalities hit by the tremors is 12% (22 municipalities on 195), a percentage that is very close to real percentage of municipalities affected by the earthquake on the total number of municipalities belonging to Abruzzo region (49 municipalities on 305).

[xviii] Note that for our political variables, namely *election*, *term-limit* and *vote-share* we use the 2010 value expressed in levels, instead of taking the first difference as these variables are related to the political cycle and therefore they do not show the classical panel dimension.

[xix] The first stage results are reported in Table C2 and indicate that both internal and external instruments have a positive and highly significant impact on the change of neighbors' expenditure, both for total (col. 1 and 2) and current expenditure (col. 3 and 4), thus indicating that they are good instruments. For the case of capital expenditure, instead, only the external instruments turns out to have a positive and highly significant impact (col. 6).

[xx] A possible explanation of this result might be related to the fact that many big infrastructures, such as schools and hospitals, were completely destroyed in Abruzzo municipalities because of the earthquake occurrence. Clearly, while damages in infrastructures of small entity can be recovered in short time, say within a year, the process of recovering spending for severe damages, as those occurred in Abruzzo, usually takes several years. In our exercise, we only consider one-year variation in capital expenditure, which practically corresponds to the first year this figure is included in the local budget. Therefore, it is possible that the municipal reaction to neighbors' capital spending takes place in the long run when most of the spending for the recovery occurs.

[xxi] These analyses are presented in greater detail in Appendix D in the supplemental data online. In particular, the results using the political variables term-limit, pre-electoral year and vote-share are shown in Tables D1, D2 and D3, respectively. As it regards results when relying on our experimental setting, see Tables D4 and D5.