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ABSTRACT: We setup a model in which the residents of two neighboring municipalities can use the services provided by public infrastructures located in both jurisdictions. If services are either complements or substitutes in use, the municipalities strategically interact when investing in infrastructures; moreover, when they differ in population size, the small municipality reacts more to the expenditure of its neighbor than the big one. The theoretical predictions are then tested by estimating the determinants of the stock of public infrastructures of the municipalities belonging to the Autonomous Province of Trento, in Italy.

JEL Codes: D72, H61, H77

Keywords: Local public goods spillovers, spatial interactions, size of local jurisdictions

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1 Introduction

Is the provision of public infrastructures by a local jurisdiction affected by that of its neighbors? And how is the effect (if any) related to the size of local jurisdictions in terms of population? A proper answer to these questions can give an important contribution to the discussion about the optimal boundaries of areas over which public infrastructures are provided. In fact, this is a hot topic in Europe, where some countries are rethinking the structure of their public sector (in terms of both the number and the types of government layers) by relying on two main theoretical arguments, namely the presence of scale economies and of positive spillovers in infrastructures provision, both pointing at inefficient levels of infrastructure provision by local jurisdictions that are too small in size.[1]

The theoretical literature on fiscal externalities recognizes that there are various ways in which decisions taken in one jurisdiction may spill-over into other jurisdictions.[2] Fiscal policies of regional governments can directly affect the welfare of residents in neighboring jurisdictions, as for expenditures on public goods and services (e.g., environmental policies) whose benefits transcend borders. Public policies in one region can also indirectly affect residents elsewhere through their impact on local governments' budgets, giving rise to the so-called fiscal externalities (e.g., tax policies that induce tax base mobility across jurisdictions). Case et al. (1993) is the first systematic empirical work addressing these issues; using data on expenditures of continental US States over the period 1970-1985, they find that state government's per capita expenditure is positively and significantly affected by that of its neighbors'. Other important studies are Murdoch et al. (1993) and Solé-Ollé (2006), showing that public expenditure spillovers are stronger at low levels of government's layers than at high levels.

There is also a growing literature on fiscal externalities specifically related to the provision of local infrastructures. Cremer et al. (1997) modelling the provision of local infrastructures in a federation in which two communities strategically interact by comparing the per capita cost of providing infrastructures with the transport cost that their own citizens must bear to go and enjoy the infrastructures provided by the neighboring community. For given production and transport costs, the decision to provide

[1]In the celebrated Decentralization Theorem by Oates (1972), the exploitation of scale economies and the internalization of spillovers account for the benefits of centralization, while uniform public goods provision in the presence of heterogenous preferences at the local level account for its costs.

[2]For a comprehensive analysis of the issue, see, e.g., Dahlby (1996).

infrastructures depends on the size of the community. Haughwout (2002) proposes a spatial equilibrium model by considering the role of infrastructures in determining the distribution of economic activity across regions. The empirical evidence suggests that central cities' land prices are positively related with public infrastructures provision; however, as the same author points out, the omission from the model of the costs and benefits of spillovers might be one of the main causes of the limited local infrastructure benefits found in the empirical analysis. Buettner et al. (2004), by using German data on public expenditure of Lander governments, find that the agglomeration level has no effect on the per capita expenditure on infrastructures; in particular, there is no cost disadvantage, both for highly urbanized and for sparsely populated regions. Also in this case, however, one might argue that the results are driven by the assumption of no spatial interaction between local infrastructures. In fact, if spatial autocorrelation turns out to be an important expenditure determinant, not accounting for it can yield biased and inconsistent estimates for many of the determinants of the expenditure equation (Case et al., 1993; Revelli, 2002).

In our work, to set the stage for the empirical analysis, we build up a simple theoretical model in which two neighboring local jurisdictions independently provide public infrastructures. If local infrastructures can be consumed by the citizens of both jurisdictions, the model shows that each local government increases (respectively, reduces) its expenditure on infrastructures in response to an increase in its neighbor's expenditure if local infrastructures are complements (respectively, substitutes) in use by citizens. Public infrastructures like roads, bridges, or dams, are examples of *complement infrastructures*, since they share the property that their benefits from use are higher if also the neighboring jurisdictions provide the same type of infrastructures on their territory. If two neighboring jurisdictions provide good roads, and if roads are not used only for local trips (i.e., confined within the boundaries of a given jurisdiction) but also for inter-jurisdictional trips, then the benefits from road usage are higher for the residents of both jurisdictions than in the case in which only one of them provides good roads. In this sense, local roads, like other types of infrastructures, can be complement in use. On the contrary, public facilities like theaters, libraries, or sport grounds, are examples of *substitute infrastructures*, since the citizens of a given jurisdiction can use either the facilities provided in their own jurisdiction or those provided in the neighboring jurisdictions, but never both at the same time.

The theoretical model also shows that, in per capita terms, the size of the reaction of expenditure on infrastructures to changes in the expenditure by the neighboring jurisdiction is decreasing, in absolute value, in the size of the local jurisdiction. That is, in per capita terms a highly populated jurisdiction hardly reacts to changes in infrastructures of a scarcely populated neighbor, since any given change in the per capita expenditure of a small jurisdiction has a negligible per capita impact, in terms of public goods spillovers, on the residents of a large jurisdiction.

In the empirical analysis, we use a dataset containing financial and socioeconomic variables for the 223 municipalities belonging to the Italian Autonomous Province of Trento. After constructing a measure of the stock of infrastructures provided by municipalities, we estimate their determinants by explicitly introducing a spatial lag-error component. We find robust evidence that some types of public infrastructures are of the complement type, since in small municipalities their level is positively affected by the level of infrastructures provided by the neighboring communities. However, and in accordance with our theoretical predictions, the spatial interaction tends to vanish for large municipalities.

The work is structured as follows. Section 2 presents the theoretical model. Section 3 describes the data, Section 4 outlines the estimation strategy and discusses the results. Section 5 concludes.

2 The theoretical model

Consider a regional economy composed of two municipalities, labelled $i = 1, 2$.[3] Let N_i be the population resident in jurisdiction i, and y_i its per-capita endowment of income, exogenously given. Income is used to consume private and local public goods, the latter financed with a local income tax. We assume that individuals cannot change their place of residence, although they can move to consume the public good provided in the neighboring municipality.

Consider, without loss of generality, community 1. The utility function of the rep-

[3] The fact of limiting the analysis to the case of only two jurisdictions obviously implies that each one of them is 'the neighbor' of the other one. We adopt such a simplified setup for analytical convenience. A richer, but also more complex, specification is that of the 'circular region', a formalization akin to that used in spatial models of product differentiation, in which the local jurisdictions are located along a circle, so that each one of them has two neighbors, one at its left and one at its right of the regional territory (see Solé-Ollé, 2006, for an application of such a type of framework).

resentative individual resident in municipality 1 is:

$$u_1(z_1, z_2) = \left(\alpha_1 - \frac{z_1}{2}\right) z_1 + \theta \left[\left(\alpha_1 - \frac{z_2}{2}\right) z_2 + \phi z_1 z_2\right] + \left(\beta_1 - \frac{x_1}{2}\right) x_1, \qquad (1)$$

where z_i denotes the effective service-level of public infrastructures provided by municipality i on its territory, and x_1 the consumption of private goods. The parameters $\alpha_i > 0$ and $\beta_i > 0$ are a measure of the intensity of preferences for the consumption of public and private goods, respectively.[4]

The utility function (1) also contains two parameters, $\theta \in [0, 1]$ and $\phi \in [-1, 1]$, which are key for the analysis, and that are assumed to be identical in the two jurisdictions. The parameter θ represents a classical positive spillover of local public goods provision; at one end, $\theta = 1$ implies full spillover; at the other end, $\theta = 0$ implies no spillovers.[5] A first interpretation is that a share θ of the residents in jurisdiction 1 fully enjoy the public infrastructures located in jurisdiction 2. A second interpretation is that all residents in jurisdiction 1 enjoy at a $\theta\%$ rate the public infrastructures located in jurisdiction 2.

The parameter ϕ measures instead the degree of complementarity (if positive) or substitutability (if negative) in the use of public infrastructures provided by the two jurisdictions.[6] For instance, road services provided by the two municipalities are complement in usage if drivers (e.g., commuters, or shoppers) must cross the border in a typical journey: in this case, it is $\theta > 0$, $\phi > 0$. Two swimming pools, one located in each municipality, are instead likely to be substitutes in usage: in this case, it is $\theta > 0$, $\phi < 0$. Finally, it is also possible that services provided are neither complements nor substitutes; in this case, it is $\theta > 0$, $\phi = 0$. For instance, a swimming pool in one

[4]Heterogeneity between jurisdictions in terms of the preference parameters α_i and β_i can be due to geographical factors, demographic factors (e.g., the share of elderly in total population), characteristics of the local economy, and so on.

[5]In line with the prevalent literature, we assume that the spillover is automatically determined by the provision of local infrastructures. It is possible to extend our framework to the more realistic case in which the effective level of enjoyment depends on usage levels, endogenously chosen by individuals of the two jurisdictions.

[6]Most models analyzing local public goods spillovers assume that the total amount of public goods enjoyed by the residents of any given jurisdiction is equal to a weighted sum of the 'home' and the 'neighbors' public goods supplies, which means that the public goods provided by different jurisdictions are perfect substitutes (in our model, this case is obtained by setting $\phi = -1$). The more general functional form of the utility function given in Eq. (1) is widely used in oligopolistic models with product differentiation (see, e.g., Singh and Vives, 1984).

jurisdiction, and a public library in the other one, are likely to be independent in usage by the residents of both jurisdictions.

In any given jurisdiction i, the per-capita effective service-level of public infrastructures depends on total expenditure, E_i, and on the total number of users, $\tilde{N}_i$, according to the function:[7]

$$z_i = \frac{E_i}{\tilde{N}_i^r}, \qquad i = 1, 2, \tag{2}$$

where $r \in [0, 1]$ and

$$\tilde{N}_1 = N_1 + \theta N_2, \qquad \tilde{N}_2 = N_2 + \theta N_1. \tag{3}$$

Consistently with the utility function defined in Eq. (1), Eq. (3) shows that public infrastructures provided in a given jurisdiction are fully enjoyed by all its residents and by a share θ of the residents in the neighboring jurisdiction or, alternatively, that they are fully enjoyed by all its residents while they are enjoyed at a reduced $\theta\%$ rate by all non-residents. In Eq. (2), the parameter r, which is identical for the two jurisdictions, captures the degree of congestion in the use of public infrastructures. At one end, $r = 0$ implies non rivalry in the use of public services; at the other end, $r = 1$ implies that public services are fully rival. Note that while the parameter r defines the degree of rivalness in consumption within the boundaries of the jurisdiction in which the public good is provided, the spillover parameter θ defines the degree of non-rivalness in spatial terms, so that $\theta = 0$ defines a purely local good whereas $\theta = 1$ defines a purely 'national' good.

Let t_i be the per capita local tax and g_i an unconditional grant, in per-capita terms, received by municipality i from an upper tier of government (e.g., the regional government). By substituting the local government budget constraint, $N_i(t_i + g_i) = E_i$, into the representative individual's budget constraint, $x_i = y_i - t_i$, we obtain the local economy resource constraint:

$$x_i = y_i + g_i - \frac{E_i}{N_i}. \tag{4}$$

2.1 Investment in public infrastructures

Local policy makers simultaneously and independently set their own expenditures on infrastructures with the aim of maximizing the welfare of the representative resident.

[7] Note that the specification given in Eq. (2), by which the stock variable z_1 is a function of the flow variable E_i, implicitly assumes full depretiation of the expenditure in infrastructures within the time period. That is, we consider a simple static model instead of a more complex dynamic framerwork.

Formally, and considering, without loss of generality, municipality 1, the policy maker chooses public expenditure E_1 to maximize Eq. (1), subject to Eqs. (2) and (4) for $i = 1$, taking as given the public expenditure E_2 of municipality 2.

The first order condition of the given problem is:

$$\frac{\partial u_1}{\partial E_1} = (\alpha_1 - z_1 + \theta\phi z_2)\frac{\partial z_1}{\partial E_1} + (\beta_1 - x_1)\frac{\partial x_1}{\partial E_1} = 0,$$

that can be written as:

$$\left(\alpha_1 - \frac{E_1}{\tilde{N}_1^r} + \theta\phi\frac{E_2}{\tilde{N}_2^r}\right)\frac{1}{\tilde{N}_1^r} - \left(\beta_1 - y_1 - g_1 + \frac{E_1}{N_1}\right)\frac{1}{N_1} = 0. \tag{5}$$

By solving Eq. (5) with respect to E_1, we obtain the best response (or reaction) function:

$$\tilde{E}_1(E_2, N_1, N_2) = \left(\frac{\alpha_1}{\tilde{N}_1^r} - \frac{\beta_1 - y_1 - g_1}{N_1} + \frac{\theta\phi}{\tilde{N}_1^r\tilde{N}_2^r}E_2\right) \Big/ \left(\frac{1}{N_1^2} + \frac{1}{\tilde{N}_1^{2r}}\right). \tag{6}$$

The second order sufficient condition for a maximum holds true, since:

$$\frac{\partial^2 u_1}{\partial E_1^2} = -\left(\frac{\partial z_1}{\partial E_1}\right)^2 - \left(\frac{\partial x_1}{\partial E_1}\right)^2 = -\left(\frac{1}{N_1^2} + \frac{1}{\tilde{N}_1^{2r}}\right) < 0.$$

A similar best response function, denoted by $\tilde{E}_2(E_1, N_2, N_1)$, can be obtained for municipality 2. By combining the two functions, one can solve for the Nash equilibrium in the public expenditure levels of the two municipalities.[8] We characterize the factors that determine the sign and the size of the slope of the reaction function (6). In fact, the latter represents the key interaction effect for the expenditure decisions of local governments that we try to assess in our empirical analysis.

2.2 The slope of the reaction function

By linearity of the best response function (6), it is immediate to obtain its slope as:

$$\frac{\partial \tilde{E}_1}{\partial E_2} = \frac{\theta\phi}{\tilde{N}_1^r\tilde{N}_2^r} \Big/ \left(\frac{1}{N_1^2} + \frac{1}{\tilde{N}_1^{2r}}\right). \tag{7}$$

Provided that the benefits of public infrastructures spill-over across jurisdictions (i.e., $\theta > 0$), Eq. (7) shows that the sign of the slope of the reaction function is

[8] If a stable Nash equilibrium exists, then it is unique, since the reactions functions are linear in the expenditure levels. On the normative side, it is possible to show that in general the expenditure decisions emerging in the Nash equilibrium are not efficient, since local policy makers do not internalize the positive spillovers of public expenditure accruing to the residents in the other municipality.

determined by the sign of the parameter ϕ, expressing complementarity (when positive) or substitutability (when negative) of public infrastructures services in the neighboring jurisdictions. The following proposition summarizes the result.

Proposition 1 *Assume that local infrastructures services spill-over across jurisdictions (i.e., $\theta > 0$). If the services provided by the two jurisdictions are complements in consumption by citizens (i.e., $\phi > 0$), then the best response function relating the optimal public expenditure levels of one jurisdiction to the public expenditure levels of the other jurisdiction is positively sloped. It is instead negatively sloped if the services provided by the two jurisdictions are substitutes in consumption (i.e., $\phi < 0$).*

Quite obviously, if public services provided by the two jurisdictions are neither complements nor substitutes in use (i.e., $\phi = 0$), then public expenditure in each jurisdiction is independent of that in the other jurisdiction, even in the presence of positive spillovers.

2.3 The role of population size

In this section we explore how the population size affects the terms of the strategic interaction between the two local governments. Let $e_i = E_i/N_i$ denote per capita public expenditure in jurisdiction i. Expressed in per capita terms, the slope of the best response function is equal to:

$$\frac{\partial \tilde{e}_1}{\partial e_2} = \left(\frac{N_2}{N_1}\right) \frac{\partial \tilde{E}_1}{\partial E_2}.$$

Using Eqs. (7) and (3), the latter expression can be written as:

$$\frac{\partial \tilde{e}_1}{\partial e_2} = \left[\left(\frac{N_2}{N_1}\right) \frac{\theta\phi}{(N_1+\theta N_2)^r (N_2+\theta N_1)^r}\right] \Big/ \left(\frac{1}{N_1^2} + \frac{1}{(N_1+\theta N_2)^{2r}}\right). \tag{8}$$

We are interested in examining how the size of the slope shown in Eq. (8) is affected by changes in N_1, for given N_2, by focusing on some specific, but relevant, cases. In particular, assuming maximal spillovers (i.e., $\theta = 1$), we consider in turn the two 'polar' cases of services that are fully non-rival (i.e., $r = 0$) and fully rival (i.e., $r = 1$) in consumption.

If $\theta = 1$ and $r = 0$, then Eq. (8) reduces to:

$$\left.\frac{\partial \tilde{e}_1}{\partial e_2}\right|_{\theta=1,r=0} = \frac{\phi N_2}{\frac{1}{N_1} + N_1}. \tag{9}$$

Eq. (9) shows that, for given ϕ and N_2, the slope of the best response function is, in absolute value, decreasing in $N_1 > 1$, since:

$$\left.\frac{\partial^2 \tilde{e}_1}{\partial e_2 \partial N_1}\right|_{\theta=1,r=0} = -\phi\gamma N_2, \quad \text{where } \gamma = \frac{N_1 - 1}{1 + N_1} > 0 \text{ for } N_1 > 1.$$

Substituting for $\theta = 1$ and $r = 1$ into Eq. (8), and then differentiating with respect to N_1, we get:

$$\left.\frac{\partial^2 \tilde{e}_1}{\partial e_2 \partial N_1}\right|_{\theta=1,r=1} = -\phi\eta N_2, \quad \text{where } \eta = \frac{N_1^2 + (N_1 + N_2)(N_1 - N_2)}{\left[N_1^2 + (N_1 + N_2)\right]^2} > 0 \text{ iff } N_1 > \frac{N_2}{\sqrt{2}}.$$

The latter expression shows that, for given ϕ and N_2, the slope of the best response function is, in absolute value, decreasing in N_1, provided that $N_1 > N_2/\sqrt{2}$, i.e., that jurisdiction 1 is not too small relative to the neighboring jurisdiction 2.

The results are summarized in the following proposition.

Proposition 2 *Assume maximal spillovers $\theta = 1$. If $r = 0$, that is if services of local infrastructures are non-rival in use, then the size of the slope of the best response function of jurisdiction i is, in absolute value, decreasing in its population N_i, for given population N_j of the neighboring jurisdiction j. If $r = 1$, that is if services are rival in use, then the size of the slope of the best response function of jurisdiction i is, in absolute value, decreasing in N_i, for given N_j, provided that $N_i > N_j/\sqrt{2}$.*

The intuition behind these results is simple. In per capita terms, a large jurisdiction has little incentives to react to changes in the infrastructures level by a small neighboring community, as any given change in the per capita expenditure of the latter brings about benefit spillovers to the residents in the large community that are, in per capita terms, very small.[9]

3 The empirical analysis

The model presented in the previous section is tested by using a dataset on the 223 municipalities belonging to the Italian Autonomous Province of Trento. Italy counts

[9] Although no analytical solutions are available for the general case in which $r \in (0, 1)$ and $\theta < 1$, by means of numerical simulations it is possible to show that the results of Proposition 2 are robust. In particular, for r sufficiently close to zero, the slope of the best response function is, in absolute value, decreasing in N_1, for given N_2. Instead, for r sufficiently close to 1, it is decreasing in N_1 provided that N_1 is above a given threshold $\bar{N}$, with $\bar{N} < N_2$. Details of the simulations are available from upon request.

four administrative government layers: the central authority and, at the local level, 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.[10] Autonomy means wider competencies on public functions than those attributed to Ordinary Regions and Provinces, as well as the right to cash almost all tax revenues that originate at the local level. In particular, the Province of Trento cashes 90% of all revenues from central taxes that originate on its territory, while the remaining 10% is withheld by the central government. Thanks to its autonomy, the Province of Trento is a very interesting experimental framework, as fiscal federal theory can be tested within a simple institutional setting in which there are only two government layers: the Province in the role of the central authority and the Municipalities in the role of local authorities, with the latter financing their expenditure functions with own revenues and transfers from the Province.

At the municipal level, own revenues include a property tax and a range of user-fees,[11] while provincial transfers are in part of the 'specific' type (i.e., targeted to specific expenditure functions) and in part of the 'general' type, with the latter allocated by means of formulas based on fiscal needs and fiscal capacities of the municipalities. On the expenditure side, budgetary data distinguish between 'recurrent' and 'capital' outlays. Our focus is on the latter type of expenditures, since they build up over time the stock of public infrastructures.

3.1 Data and variables

The main variable in the dataset is the yearly capital expenditure, in real terms,[12] for the 223 municipalities over the period 1990-2007, divided into 12 functions that reflect investments on different types of infrastructures. We also collected data on the capital transfers granted by the Province of Trento to its municipalities, since this source of

[10] Italy counts five Autonomous Regions (Sicily and Sardinia, which are insular territories, and Valle d'Aosta, Trentino Alto-Adige, and Friuli Venezia-Giulia, which are northern boundary territories) and two Autonomus Provinces (Trento and Bolzano, making up the Trentino Alto-Adige Region).

[11] For the period covered by our study, the main local tax at the municipal level is ICI (Imposta Comunale sugli Immobili), which is based on the cadastral value of real estates and on the market value of building lots. Minor taxes include a surcharge on the personal income tax and a surcharge on the tax on electricity consumption. User charges include waste collection and fees for public services such as public transport, nursery schools, and so on.

[12] We used the 2007 base year deflator for gross fixed capital formation computed by the "Autorità per l'Energia" (www.autorita.energia.it).

revenues is an important determinant of investment outlays.[13] The provincial capital transfers are in part of the specific type (i.e., earmarked to specific infrastructural projects in one of the 12 expenditure functions) and in part of the general type (usually formula-based, with reference to measures of fiscal needs and fiscal capacities).[14]

We build a measure of the municipal capital stock (i.e., the endowment of infrastructures) by applying the perpetual inventory method (see, e.g. Goldsmith, 1951; Meinen et al., 1998), according to which the capital stock at time t is assumed to be equal to the capital stock at time $t-1$, net of depreciation (if any), plus gross investment (capital expenditure) at time t. In our benchmark definition of the capital stock, we consider year 2001 as the initial capital stock, given that all the control variables are available from 2001 to 2007: the initial 2001 capital stock is computed by summing the yearly expenditure flows over the twelve-year period from 1990 to 2001. Assuming no depreciation, the 2002 capital stock is then obtained by adding to the 2001 stock the 2002 expenditure, and similarly for the following years from 2003 to 2007. Hence we end up with a seven-year series of municipal capital stock for the period 2001-2007. However, the capital stock does not show great variance between years, since infrastructural investments that typically take several years to be completed usually appear in the municipal budgets as uniform annual quota of expenditures. Furthermore, not all the controls (see below) are either available for each one of the years 2001-2007 or, when available, they do not show great variance between years. Therefore, in the empirical analysis of Section 4 we use a cross-sectional dataset instead of a panel, by using as dependent variable the average value of the capital stocks for the period 2001-2007.[15]

[13]There is also a well known literature on the effects of grants on public expenditure, usually finding that grants can stimulate government expenditures more than monetary transfers to individuals of the same amount (Gramlich, 1977). Hence, a quota of the federal money sticks to the public sector instead of being distributed to citizens (the so-called *flypaper effect*). Interestingly, Wyckoff (1991) finds that capital expenditures are particularly sensitive to grants.

[14]Data on general transfers cover the period 1991-2007 and acconut for about 60% of capital expenditures of all municipalities. Specific transfers cover only the period 2001-2007 since for the period 1991-2000 there was no distinction between the two categories of transfers in budgetary data. For the period 2001-2007, total transfers account for about 68% of capital expenditure, with specific transfers accounting for about 60% of the total.

[15]To compute the per capita value of the 2001-2007 stock, we divide it by the average population over the same period. To test the robustness of the results, we built several different measures of the capital stock, and found no significant changes (the details are available upon request). In particular, we computed the initial capital stock in year 1994 (obtaining a 14-year series) and in year 2006 (obtaining a 2-year series), assuming no depreciation. Then we also considered linear depreciation rates of 2%,

The per capita value of the average capital stocks for the period 2001-2007 is about 16,671 euros. Table 1 shows that almost 75% of the total stock is concentrated on three expenditure functions, namely *Administration & Management*, *Roads & Transport* and *Planning & Environment*. Moreover, these three functions are also those for which, in every year considered, all municipalities have a positive expenditure. For these reasons, our empirical analysis focuses on the determinants of four measures of infrastructural endowments: the total stock and the three above mentioned functions.

Table 1: Summary statistics on the infrastructural stocks

Expenditure Function	Per Capita Value (euro)	Percentage on the total	Number of zeros	% of observations with zero
	(1)	(2)	(3)	(4)
Administration & Management	3,625.57	21.75	0	0.00
Municipal police	7.39	0.04	210	94.17
Justice	236.09	1.42	25	11.21
Education	966.39	5.80	20	8.97
Culture	463.25	2.78	8	3.59
Sport	947.73	5.68	18	8.07
Tourism	226.63	1.36	85	38.12
Roads & Transport services	4,688.47	28.12	0	0.00
Planning & Environment	4,172.41	25.03	0	0.00
Social welfare	816.42	4.90	6	2.69
Economic development	468.83	2.81	63	28.25
In-house productive services	51.83	0.31	152	68.16
TOTAL	**16,671.01**	**100.00**		

Turning to the control variables, we build up a measure of the provincial capital grants (*grants*) using the same method outlined above for the capital stock. As for the other variables, the dataset includes demographic, territorial and socioeconomic data that can be relevant determinants of infrastructural stocks. The average altitude level, from 2001 Census, of the municipal territory (*altitude*) can account for the fact that providing public services in the mountains requires 'greater', hence more costly, infrastructures than in plains. The number of residents (*population*, the 2001-2007 average value) can capture the presence of scale economies in infrastructures provision. The

3%, 4% and 5%, which are in line with those used in similar studies estimating the stock of public infrastructures, such as those carried by the World Bank (Agénor et al., 2005; Arestoff and Hurlin, 2006) and the IMF (Kamps, 2006). For the Italian case, Marrocu and Paci (2008) use a 4% depreciation rate to build a measure of the capital stock series for the period 1996-2003 at the regional level.

shares (also in this case we refer to the 2001-2007 average value) of inhabitants older than 65 (*aged*) and of those aged 0-5 (*child*) can account for some specific infrastructural needs (e.g., infant schools, nursing homes for elderly). The per capita number of houses (*houses*), from 2001 Census, can capture the demand for public infrastructures from resident households, as well as those linked to tourism activities, since the variable includes also holiday properties. The per capita number of employees (from 2001 Census) in both the public and the private sector, (*total employees*), as well as the per capita number of firms (from 2001 Census) in the private sector (*local units*), can proxy the demand for public infrastructures from the productive sector. Finally, in order to capture a possible link between expenditure variation and population change we include the population growth rate (*growth*), defined as the percentange difference between the population average in 2001-2007 and that in 1991-1997.[16]

A peculiarity of the Province is the presence of 16 'communities', each one formed by several contiguous municipalities belonging to an homogenous geographic and economic area. By means of their community, the municipalities jointly provide some public services that benefit the whole area covered by the community, thus realizing some economies of scale and spillover internalization. Since the community of affiliation can bear some weight in the investment decisions of a municipality, we include as a control a dummy variable for each community (*communities dummy*).

In order to control for the outliers, we compute the interquartile range (IQR) for all the dependent variables, picking up those observations (outliers) passing over the left or right boundary and defining accordingly a dummy variable (*outliers dummy*).[17] Finally, we define a dummy variable (*metropolitan dummy*), equal to one for the two most populated cities in the Province, which are Trento (about 110,000 inhabitants) and Rovereto (about 35,000 inhabitants). These are by far the biggest cities, since the other 221 municipalities have an average population of about 1,600 inhabitants.

Summary statistics, data description and data sources of all the variables used in the analysis are reported in Appendix A, Tables A1 and A2, while Table A3 provides the list of municipalities outliers.

[16] The years 1991 and 2001 are the census years and 2007 is the last year of the dataset.

[17] We used the IQR stata command, which allows for the detection of both mild and severe ouliers.

4 Econometric specification

Estimation of the standard empirical model of public expenditure through a linear specification might not take into account expenditures and or economic shocks in neighboring municipalities which can be correlated with exogenous controls and so lead to biased and inconsistent estimates of the parameters (Case et al., 1993; Revelli, 2002). Therefore, before deciding upon the econometric strategy, we need to know whether the data present spatial dependence among municipalities.

To do so we first need to define spatial variables. We build a matrix of neighbors to each municipality based upon their geographical location, which can be expressed through a (223×223) matrix, such that the element corresponding to row a and column b is 1 if the spatial units a and b are geographically neighbors, and zero otherwise. We then make a row standardization such that the elements of each row sum to one; note also that, since all neighbors have the same weight, all elements of a row are identical. Hence, the product of the (223×223) matrix by the (223×1) vector of expenditure levels yields for each municipality a simple average of its neighboring municipalities expenditure.

We compute the traditional measure of spatial dependence that is the Moran's spatial statistics (Cliff and Ord, 1981; Anselin, 1988) for the per capita *Total Infrastructures* and for the three selected sub-functions, *Administration & Management*, *Roads & Transport* and *Planning & Environment*. As Table 2 shows, all our variables of interest exibit a spatial pattern of postive autocorrelation that is stronger for both expenditures in *Total Infrastructures* and *Roads and Transport*.

Table 2: Moran spatial statistic

	Total	Administration & Management	Roads & Transport	Planning & Environment
	(1)	(2)	(3)	(4)
Moran I statistic	0.14***	0.08**	0.18***	0.06*

Notes: The spatial matrix used to compute the Moran test is a binary, contiguity-based one, according to which two municipalities are neighbors if they share a border, and is row-standardized. *** significant at 1%; ** significant at 5%; *significant at 10%.

However, the result of the Moran test is unable to descriminate properly between spatial-lag and spatial-error dependence.[18] Hence, in order to obtain a more precise

[18] There are two primary types of spatial dependence. The *spatial error dependence* occurs when the error terms across different spatial units are correlated. In this case the OLS assumption of uncorrelated error terms is violated and hence the estimates are biased. Spatial error is due to omitted (spatially

indication of which is the most likely source of spatial dependence, we perform the two robust Lagrange multiplier (LM) tests proposed by Anselin et al. (1996),[19] which are based on the OLS residuals of a non-spatial regression model, using all the control variables described in Section 3.1. Table A4 shows that the robust LM tests indicate the presence of spatial lag dependence for *Total Infrastructures* (the robust LM test value is 3.53 and statistically significant at 10%) while for the *Roads & Transport* expenditure function the spatial pattern appears to be driven by both spatial lag and spatial error, even though the test statistic for the former (the robust LM test statistic is 9.50 and statistically significant at 1%) is larger than that for the latter (the robust LM test statistic is 6.05 and statistically significant at 5%). On the other hand, the robust LM test for the *Planning & Environment* expenditure function suggests the presence of spatial dependence in the error term (the test is equal to 5.44 and statistically signficant at 5%), while for *Administration & Management* the robust LM test does not indicate the presence of neither spatial lag nor spatial error dependence.

For each one of the four infrastructural measures, we now proceed to estimate the slope of the reaction function characterized in Proposition 1, and then test for the results in Proposition 2, by estimating whether the size of the slope of the reaction function depends on population size.

4.1 Strategic interaction evidence

Using the per-capita neighbors' average expenditure, we first estimate the OLS coefficients (Table 3, columns 1, 3, 5 and 7). Moreover, since the spatial tests shown above suggest the presence of different patterns of spatial dependence for the four infrastructural measures we focus on, we perform a three-step procedure developed by Kelejian and Prucha (1998) to estimate a spatial autoregressive model with autoregressive disturbance (Table 3, columns 2, 4, 6 and 8) taking into account both the source of spatial dependence (spatial-lag and spatial-error) by using as instruments the average of all

correlated) covariates that, if not attended, would bias the estimate. Spatial error models sort out of the problem by estimating the coefficient of the spatial error. The *spatial lag dependence* implies that the dependent variable y in jurisdiction i is affected by independent variables of jurisdiction i and j and hence the dependent variable of j also affects it, and vice-versa. The assumption of uncorrelated error terms and independent observations is violated and therefore the regression estimates are biased. The solution to this puzzle can be that of instrumenting the endogenous spatial lag (i.e., the dependent variable of j entering in the estimate of the dependent variable of i).

[19] Both LM-statistics are Chi-Square distibuted with one degree of freedom.

neighbor's exogenous variables and correcting for heteroskedasticity of unknown form (GS2SLS Robust; see Drukker et al., 2010, 2011, for details).

The estimated spatial lag coefficient, λ, for *Total Infrastructures* is 0.17 and 1% significant while the spatial error coefficient, ρ, is not significant (Table 3, col. 2). The positive coefficient suggests that municipalities tend to increase their own infrastructure spending as a response to the rising expenditure of their neighboring municipalities, thus confirming the hypothesis of horizontal expenditure spillovers with complementarity in use; that is, in terms of the model in Section 2, the estimated coefficient λ is consistent with the existence of positive spillovers ($\theta > 0$) and complementarity in use ($\phi > 0$), which implies best responde functions that are positively sloped. As for the specific expenditure functions, for *Road & Transport* we find a 1% signficant and positive coefficient of 0.25 for the spatial lag coefficient, λ, and a negative spatial error coefficient of 0.44 (5% singificant), indicating that both types of spatial dependence coexist in the model (Table 3, col. 6). For *Planning & Environment* the estimated spatial lag coefficient is not significant but in this case we find a negative and 5% significant spatial error coefficient of magnitude -0.47 (Table 3, col. 8). Finally, for the *Administration & Management* expenditure function we do not find any evidence of horizontal strategic interaction, since neither the spatial-lag nor the spatial-error coefficient are statistically different from zero (Table 3, col. 4). These results confirm those of the spatial auto-correlation tests illustrated in Tables 2 and A4. The reason is that the *Road & Transport* function contains investments on infrastructures that are complement in use, like roads and bridges, since the benefits from use of the infrastructure in one jurisdiction are higher if also the neighboring jurisdictions provide the same type of infrastructures on their territory. In the *Planning & Environment* function, where the expenditure is related to infrastructures like dams, the spatial link in expenditure does not hold. However, there is a spatial link in the residuals of the estimate, which can be explained by some missing spatial variable reflected by the significance in the spatial error coefficient. Finally, in the *Adminstration & Management* function, which contains expenditures for buildings and facilities necessary to provide purely local administrative services, we do not find any spatial link, since there are no spillovers in use ($\theta = 0$, in terms of the model in Section 2).

Table 3: Spatial model estimation results

	Total		Administration & Management		Roads & Transport		Planning & Environment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
λ	0.10*	0.17***	-0.17*	-0.03	0.14*	0.25***	-0.03	0.19
	(0.06)	(0.05)	(0.10)	(0.09)	(0.08)	(0.07)	(0.12)	(0.12)
ρ		-0.19		-0.17		-0.44**		-0.47**
		(0.16)		(0.15)		(0.17)		(0.19)
Grants	0.87***	0.85***	0.37**	0.37**	0.82***	0.79***	0.72***	0.74***
	(0.09)	(0.09)	(0.18)	(0.16)	(0.13)	(0.12)	(0.14)	(0.13)
Altitude	4.31***	3.83***	1.33	1.18	1.61**	1.44**	0.75	0.48
	(1.47)	(1.29)	(0.90)	(0.79)	(0.79)	(0.65)	(1.01)	(0.87)
Population	-0.07*	-0.07**	-0.06**	-0.06**	-0.03**	-0.04**	-0.03*	-0.03**
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.01)
Houses	2,509.36***	2,520.73***	446.31	391.00	633.78*	553.40*	1,290.00**	1,129.69***
	(883.25)	(812.42)	(527.35)	(491.88)	(380.58)	(334.17)	(501.19)	(416.22)
Aged	1,969.37	1,113.78	3,885.67	2,863.65	-1,603.27	-3,598.87	7,444.27	7,796.44
	(9,428.57)	(8,908.13)	(6,030.13)	(6,095.43)	(4,648.27)	(4,038.59)	(5,463.26)	(4,872.74)
Children	607.58	-3,717.58	-2,784.41	-5,084.36	-14,927.14	-16,478.47	11,248.30	5,203.81
	(30,717.96)	(28,556.94)	(18,234.70)	(17,034.96)	(20,203.51)	(18,083.26)	(16,124.65)	(14,392.43)
Population density	-0.83	-0.72	-0.46	-0.34	0.30	0.34	-0.31	-0.20
	(0.86)	(0.78)	(0.51)	(0.44)	(0.37)	(0.31)	(0.48)	(0.40)
Population growth	4,595.67	4,509.20	-2,203.88	-2,162.01	-1,762.93	-2,020.82	-416.09	-150.50
	(4,267.68)	(3,894.62)	(3,181.63)	(2,927.71)	(2,367.13)	(2,218.06)	(3,124.13)	(2,585.39)
Total employees	4,176.50	4,136.67	1,997.99	1,998.71	1,014.33	903.37	91.68	666.79
	(3,153.76)	(2,872.37)	(2,095.22)	(1,916.08)	(1,246.07)	(1,171.68)	(1,670.28)	(1,435.63)
Local unit	16,940.34	17,513.38	7,418.23	6,664.84	201.99	1,013.53	341.13	293.50
	(12,216.94)	(11,371.28)	(7,250.13)	(6,699.34)	(5,564.78)	(5,066.46)	(7,977.42)	(7,186.91)
Outliers dummy	10,167.77**	10,676.13***	8,286.30***	8,370.97***	7,490.02***	7,646.37***	8,541.15***	8,514.42***
	(4,115.77)	(3,944.14)	(1,171.37)	(1,141.15)	(1,011.15)	(906.81)	(1,671.18)	(1,443.07)
Metropolitan dummy	3,667.06	3,693.94	1,457.60	1,603.52	993.67	1,483.74	448.00	251.21
	(2,529.95)	(2,589.14)	(1,410.58)	(1,495.82)	(1,171.10)	(1,464.50)	(1,070.78)	(1,059.25)
Constant	-3,169.04	-3,278.43	-757.66	-598.66	1,138.46	1,408.10	-1,229.46	-1,821.05
	(2,911.58)	(2,688.47)	(1,975.98)	(1,909.38)	(1,689.41)	(1,466.95)	(1,711.60)	(1,469.92)
Communities dummy	YES	YES	YES	YES	YES	YES	YES	YES
Observations	223	223	223	223	223	223	223	223
R-squared	0.91		0.72		0.86		0.82	

Notes: Columns (1), (3) ,(5) and (7) display OLS robust estimator results by using, respectively, total per-capita expenditure, administration and management per-capita expenditure, road and traffic per-capita expenditure and planning and environment per-capita expenditure as dependent variables. Columns (2), (4) ,(6) and (8) show the spatial lag-error model estimation results by using GS2SLS (Generalized method of moment and instrumental variables) robust estimator correcting for heteroskedasticity issues of unknown form. The spatial weight matrix (W) used is of the type: contiguity-based and it is row-standardized. Robust standard errors are shown in parentheses. *** significant at 1%; ** significant at 5%; *significant at 10%.

4.2 The impact of the population size

In this section we extend our empirical analysis by interacting the average of neighbor's per capita expenditure with the population.[20] We first estimate a spatial model in which we account for the interaction term by OLS (Table 4, columns 1, 4, 7 and 10).[21] We then use the GS2SLS estimator (Table 4, columns 2, 5, 8 and 11) where we account only for the endogeneity issue of the spatial parameter, but we do not instrument its interaction with the population. In order to check whether the results obtained from GS2SLS regression are robust to possible endogenity bias due to the interaction term we also include, as additional instruments, the product of the neighbor's exogenous variables with population (columns 3, 6, 9 and 12, Table 4).

The spatial interaction parameter, λ, is significantly different from zero for *Total Infrastructures* in all three specifications: OLS (col. 1), GS2SLS (col. 2) where only neighbor's infrastructure are instrumented with all neighbors exogenous variables, and GS2SLS (col. 3) where neighbor's infrastructure are instrumented with all neighbors exogenous variables and the product of neighbors'infrastructure with population is instrumented with the product of neighbor's exogenous variables with population, confirming that municipalities' infrastructures are positively affected by those of the neighbors. Also for the *Roads & Transports* expenditure function λ remains significantly different from zero in all three specifications. We also find evidence of horizontal spending spillovers for *Planning & Environment*, since λ turns out to be significantly different from zero at 10% in the specification when we instrument only for neighbor's infrastructure (col. 11) and in the specification when both neighbor's infrastructure and the product of neighbors'infrastructure with population are instrumented (col. 12).

In columns 1, 2 and 3 of Table 4 we find evidence that the externality effect on *Total Infrastructures* is driven by population (in fact the intercation term *neighbors spending*population* is equal to -0.39, 5% significant in the specification in column 1; -0.45, 1% significant in the specification in column 2; -0.39, 5% significant in the specification in column 3), and then, inspecting more in detail we observe that this result is entirely due to the *Roads & Transport* expenditure function (columns

[20]To test the robustness of our results, we have also taken into account the relative size of a municipality with respct to its neighbors by interacting the average of neighbor's per capita expenditure with the ratio between population and the average of neighbor's population, finding no changes in the results. Results are available upon request.

[21]The results of the non-spatial regression model are reported in Table A5.

7, 8 and 9), for which the interaction term is negative (-1.17, 1% singificant in the specification in column 7; -1.23, 1% significant in the specification in column 8 and -1.00, 1% significant in the specification in column 9). For *Planning & Environment* the interaction term is negative but, however, is statistically not different from zero (col. 10, col. 11 and 12). Finally, for *Administration & Management* the spatial coefficients and the interaction turns out to be statistically not different from zero in all the specifications, apart in the OLS specification (col. 4) where the spatial parameter λ is negative (-0.20) and statistically different from zero at 10%.

As for the spatial error coefficient, ρ, it is not significantly different from zero for *Total Infrastructures* (in both specifications at column 2 and 3) while it is significant for both *Road & Transport* (-0.44, 1% significant in the specification in col. 8 and -0.46, 1% significant in the specification in col. 9) and *Planning & Environment* (-0.41, 5% significant in the specification in col. 11 and -0.45, 5% significant in the specification in col. 12).

Our results show that *Total Infrastructures* are positively determined by the neighbor's infrastructure and so, by using Proposition 1, we can say that infrastructures affecting the provision of neighbor's infrastructures are complements: this result is strongly determined by *Roads & Transport* infrastructures. Moreover, the population of the municipality plays an important role, for both *Total Infrastructures* and *Roads & Transport,* in determining the size of the slope of the reaction function (confirming the result in Proposition 2); in particular, as the population increases the slope of the reaction function decreases.

Table 4: Spatial model and interaction with population estimation results

	Total			Administration & Management			Roads & Transport			Planning & Environment		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
λ	0.14**	0.21***	0.21***	-0.21*	0.00	-0.08	0.25***	0.35***	0.34***	0.01	0.21*	0.23*
	(0.06)	(0.05)	(0.05)	(0.11)	(0.09)	(0.09)	(0.08)	(0.07)	(0.07)	(0.14)	(0.13)	(0.13)
ρ		-0.18	-0.19		-0.24	-0.18		-0.44***	-0.46***		-0.41**	-0.45**
		(0.16)	(0.17)		(0.15)	(0.14)		(0.16)	(0.17)		(0.18)	(0.19)
Neighbors spending * Population	-0.39**	-0.45***	-0.39**	0.25	0.19	0.27	-1.17***	-1.23***	-1.00***	-0.27	-0.21	-0.15
	(0.18)	(0.17)	(0.16)	(0.25)	(0.20)	(0.23)	(0.33)	(0.29)	(0.27)	(0.23)	(0.23)	(0.23)
Grants	0.86***	0.84***	0.84***	0.37**	0.37**	0.37**	0.78***	0.76***	0.76***	0.71***	0.73***	0.73***
	(0.09)	(0.09)	(0.08)	(0.18)	(0.16)	(0.16)	(0.13)	(0.12)	(0.12)	(0.15)	(0.13)	(0.13)
Altitude	4.65***	4.22***	4.10***	1.15	0.99	1.01	1.99**	1.79***	1.68***	0.65	0.37	0.34
	(1.42)	(1.25)	(1.25)	(0.91)	(0.80)	(0.79)	(0.77)	(0.64)	(0.63)	(1.01)	(0.87)	(0.87)
Population	0.48*	0.57**	0.47**	-0.18	-0.15	-0.18*	0.36***	0.37***	0.30***	0.05	0.03	0.01
	(0.26)	(0.24)	(0.23)	(0.12)	(0.09)	(0.11)	(0.11)	(0.10)	(0.09)	(0.07)	(0.06)	(0.07)
Houses	2,382.34***	2,369.45***	2,384.41***	484.14	389.59	441.10	512.95	428.70	453.67	1,281.75**	1,152.44***	1,142.47***
	(869.47)	(796.88)	(795.87)	(521.15)	(484.35)	(483.57)	(380.20)	(332.94)	(332.02)	(504.77)	(427.44)	(423.56)
Aged	1,906.98	1,288.11	1,195.29	4,063.03	2,407.21	3,055.88	-2,017.58	-3,781.36	-3,755.80	7,549.66	7,668.45	7,592.31
	(9,407.78)	(8,879.32)	(8,900.37)	(6,016.28)	(6,212.11)	(6,035.80)	(4,582.24)	(3,997.87)	(3,967.90)	(5,415.54)	(4,881.79)	(4,864.78)
Children	-1,315.34	-5,454.08	-5,799.35	-2,758.28	-6,246.95	-4,949.05	-18,838.30	-20,766.69	-20,361.58	11,001.59	5,930.14	5,517.65
	(30,629.61)	(28,469.76)	(28,452.73)	(18,311.44)	(16,960.47)	(17,131.07)	(19,908.48)	(17,752.45)	(17,807.80)	(16,199.31)	(14,502.75)	(14,432.38)
Population Density	-1.05	-0.96	-0.92	-0.44	-0.27	-0.32	0.10	0.17	0.20	-0.35	-0.23	-0.21
	(0.86)	(0.78)	(0.78)	(0.49)	(0.42)	(0.42)	(0.40)	(0.34)	(0.33)	(0.48)	(0.41)	(0.41)
Population growth	4,685.98	4,616.63	4,653.86	-2,210.55	-2,176.45	-2,174.15	-1,636.99	-1,770.11	-1,778.99	-445.50	-237.30	-209.57
	(4,269.57)	(3,895.49)	(3,886.30)	(3,191.27)	(2,900.26)	(2,915.19)	(2,325.04)	(2,181.09)	(2,179.00)	(3,119.88)	(2,631.02)	(2,603.18)
Total employees	3,869.87	3,879.20	3,899.29	2,174.53	2,082.59	2,161.76	1,012.47	1,043.16	1,022.35	115.09	580.74	621.57
	(3,137.68)	(2,837.23)	(2,838.74)	(2,163.75)	(1,921.45)	(1,963.50)	(1,234.55)	(1,166.29)	(1,164.82)	(1,669.06)	(1,461.46)	(1,453.64)
Local unit	19,179.96	19,763.99*	19,498.96*	7,042.96	6,155.76	6,377.81	1,315.12	1,603.29	1,532.70	615.30	368.31	272.37
	(12,207.45)	(11,319.90)	(11,310.91)	(7,296.97)	(6,677.07)	(6,717.98)	(5,582.83)	(5,093.50)	(5,057.19)	(7,992.98)	(7,221.57)	(7,198.25)
Outliers dummy	10,254.36**	10,755.43***	10,779.10***	8,291.36***	8,384.63***	8,374.56***	7,415.54***	7,492.34***	7,510.43***	8,533.51***	8,543.25***	8,553.18***
	(4,118.36)	(3,931.83)	(3,937.91)	(1,171.67)	(1,145.34)	(1,135.08)	(973.47)	(874.58)	(873.39)	(1,682.66)	(1,468.69)	(1,457.61)
Metropolitan dummy	91.18	-236.31	340.84	2,517.13	2,374.30	2,671.16	-1,630.26	-1,027.21	-517.47	-199.97	-176.38	-35.82
	(3,733.13)	(3,759.75)	(3,599.99)	(1,908.58)	(1,579.04)	(1,739.14)	(1,456.69)	(1,751.09)	(1,680.15)	(932.33)	(1,007.91)	(1,068.37)
Constant	-3,563.93	-3,706.10	-3,658.38	-476.14	-255.08	-296.57	1,167.71	1,517.63	1,508.55	-1,179.54	-1,696.90	-1,783.81
	(2,936.28)	(2,714.56)	(2,711.99)	(2,046.49)	(1,960.47)	(1,984.59)	(1,669.05)	(1,447.14)	(1,443.67)	(1,719.73)	(1,507.46)	(1,503.76)
Communities dummy	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	223	223	223	223	223	223	223	223	223	223	223	223
R-squared	0.91			0.73			0.87			0.82		

Notes: Columns (1), (4), (7) and (10) display OLS robust estimator results by using, respectively, total per-capita expenditure, administration and management per-capita expenditure, road and traffic per-capita expenditure and planning and environment per-capita expenditure as dependent variables. Columns (2), (5), (8) and (11) show the spatial lag-error model estimation results by using GS2SLS (Generalized method of moment and instrumental variables) robust estimator correcting for heteroskedasticity issues of unknown form. Columns (3), (6), (9) and (12) replicate the previous estimation by using the lag of the explanatory variables multiplied by the population as additional instruments. The spatial weight matrix (W) used is of the type: contiguity-based and it is row-standardized. Robust standard errors are shown in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

5 Conclusions

In this study we investigated the types of interactions that can emerge (if any) among municipalities in providing infrastructures. First, we setup a theoretical model in which two jurisdictions provide their own infrastructures, assuming that the inhabitants of both jurisdictions can use them. If local infrastructures are complements in use, there is a positive interaction when jurisdictions set their own expenditures; the interaction is instead negative if infrastructures are substitute in use by citizens. The model also predicts that an increase in population decreases the size of the reaction function slope. We then tested these results by using data on municipalities of the Italian Province of Trento, finding that total infrastructures of a jurisdiction are positively linked to neighbor's total infrastructures. This result holds also for some specific types of infrastructures, namely *Roads & Transport* and *Planning & Environment*, for which the municipalities show a complementarity relationship with their neighbors as it regards decisions on infrastructure provisions. Also the theoretical prediction about the impact of population on the stratetgic response has been confirmed for the same type of infrastructural measures, since the size of the slope of the reaction function decreases in magnitude as population increases.

References

Agénor, P.R., Nabli, M.K., Yousef T.M. (2005). Public Infrastructure and Private Investment in the Middle East and North Africa. *World Bank Policy Research Working Paper*, No.3661.

Anselin, L. (1988). *Spatial econometrics: Methods and models*. Boston: Kluwer Academic Publisher.

Anselin, L., Bera, K., Florax, R.J.G.M., and Yoon, M. (1996). Simple diagnostic tests for spatial dependence. *Regional Science and Urban Economics, 26*, 77–104.

Anselin, L., and Florax, R.J.G.M. (1995). Small sample properties of tests for spatial dependence in regression models: Some further results. In L. Anselin and R.J.G.M. Florax, *New directions in spatial econometrics* (pp. 21–74). Berlin-Heidelberg: Springer.

Arestoff, F., anf Hurlin, C. (2006), Estimates of Government Net Capital Stocks for 26 Developing Countries, 1970-2002. *World Bank Policy Research Working Paper*, No.3858.

Buettner, T., Schwager, R., and Stegarescu, D. (2004). Agglomeration, population size, and the cost of providing public services: An empirical analysis for German States. *Public Finance and Management, 4*, 496–520.

Case, A.C., and Rosen, H.S. (1993). Budget spillovers and fiscal policy interdependence: Evidence from the States. *Journal of Public Economics, 52*(3), 285–307.

Cliff, A., and Ord, J. (1981). *Spatial processes. Models and applications*. London: Pion.

Cremer, H., Marchand, M., and Pestieau, P. (1997). Investment in local public services: Nash equilibrium and social optimum. *Journal of Public Economics, 65*(1), 23–35.

Dahlby, B. (1996). Fiscal externalities and the design of intergovernmental grants. *International Tax and Public Finance, 3*(3), 397–412.

Drukker, D., Egger, P., and Prucha, I.R. (2010). On two-step estimation of a spatial autoregressive model with autoregressive disturbances and endogenous regressors. *Technical Report*, Department of Economics, University of Maryland.

Drukker, D., Prucha, I.R., and Raciborski, R. (2011). A command for estimating spatial-autoregressive models with spatial-autoregressive disturbances and additional endogenous variables. *Technical report, Stata*.

Goldsmith, R.W., (1951). A Perpetual Inventory of National Wealth, in *Studies in Income and Wealth*, M.R. Gainsburgh (eds), 14, 5-74. Princeton: Princeton Univeristy Press.

Gramlich, E.M. (1977). Intergovernmental grants: a review of the empirical literature. In W.E. Oates (Ed.), *The political economy of fiscal federalism*, Lexington, MA (pp. 219–239).

Haughwout, A.F. (2002). Public infrastructure investments, productivity and welfare in fixed geographic areas. *Journal of Public Economics, 83*(3), 405–428.

Kamps, C. (2006). New Estimates of Government Net Capital Stocks for 22 OECD Countries, 1960-2001. *IMF Staff Papers*, *53*(1), 120–150.

Kelejian, H., and Prucha, I.R. (1998). A generalized spatial two-stage least squares procedure for estimating a spatial autoregressive model with autoregressive disturbances. *The Journal of Real Estate Finance and Economics, 17*, 99–121.

Marrocu, E., and Paci, R. (2008). The effects of public capital on the productivity of the Italian regions. *Applied Economics, 42* (8), 989–1002.

Meinen, G., Verbiest, P., and deWolf, P. (1998). Perpetual inventory method: Service lives, discard patterns and depreciation methods. *Technical report, Statistics Netherlands*.

Murdoch, J., Rahmatian, M., and Thayer, M. (1993). A spatially autoregressive median voter model of recreation expenditures. *Public Finance Quarterly, 21*, 334–350.

Oates, W. E. (1972). *Fiscal federalism*. New York: Harcourt Brace Jovanovich.

OECD (1993). *Methods Used by OECD Countries to Measure Stocks of Fixed Capital, National Accounts: Sources and Methods*. No. 2, Paris.

Revelli, F. (2002). Testing the taxmimicking versus expenditure spill-over hypotheses using English data. *Applied Economics, 34*(14), 1723–1731.

Singh, N., and Vives, X. (1984) Price and quantity competition in a differentiated duopoly. *The RAND Journal of Economics, 15*(4), 546–554

Solé-Ollé, A. (2006). Expenditure spillovers and fiscal interactions: Empirical evidence from local governments in Spain. *Journal of Urban Economics, 59*(1), 32–53.

Wyckoff, P.G. (1991). The elusive flypaper effect. *Journal of Urban Economics, 30*, 310–328.

APPENDIX

Table A1: Data description and data sources

Variables	Description	Source
Total per capita expenditure	Per capita stock of expenditure on infrastructure over the period 1990-2007 expressed in 2007 base year values by using deflator for gross fixed capital formation.	Province of Trento (PAT)
Neighbouring total per capita expenditure	Neighbouring average value of Total per capita expenditure on Infrastructure.	Our computation on PAT data
Administration & Management per capita expenditure	Per capita stock on Administration and Management expenditure function over the period 1990-2007 expressed in 2007 base year values by using deflator for gross fixed capital formation.	PAT
Neighbouring Administration & Management per capita expenditure	Neighbouring average value of Road and Traffic per capita expenditure.	Our computation on PAT data
Roads & Transport per capita expenditure	Per capita stock on Road and Traffic expenditure function over the period 1990-2007 expressed in 2007 base year values by using deflator for gross fixed capital formation.	PAT
Neighbouring Roads & and Transport per capita expenditure	Neighbouring average value of Road and Traffic per capita expenditure.	Our computation on PAT data
Planning & Environment per capita expenditure	Per capita stock on Planning and Environment expenditure function over the period 1990-2007 expressed in 2007 base year values by using deflator for gross fixed capital formation.	PAT
Neighbouring Planning & Environment per capita expenditure	Neighbouring average value of Road and Traffic per capita expenditure.	Our computation on PAT data
Neighbors spending population*	Neighbouring total per capita expenditure and neighbouring per capita expenditure related to Administration and Management, Road and Traffic, Planning and Environment functions *population*10^{-3}	Our computation on PAT data
Grants	Stock of total per capita grants over the period 1990-2007 and stock of per capita grants related to Administration and Management, Road and Traffic, Planning and Environment functions.	Our computation on PAT data
Population	Average population over the period 2001-2007.	ISTAT
Children	Average population between 0-5 years old over the period 2001-2007 divided by population	ISTAT
Altitude	Height of municipality above the level of the sea	ISTAT
Aged	Average population over 65 years old over the period 2001-2007 divided by population.	ISTAT
Houses	Number of houses in 2001 divided by population.	ISTAT
Population Density	Population divided by area.	Our computation
Total Employees	Number of public and private employees in 2001 divided by population.	ISTAT
Local Unit	Number of local productive unit in 2001 divided by population.	ISTAT
Outliers Dummy	Outliers dummy=1 if the municipality is an outliers with respect to per capita expenditure. See Table A3.	Our computation
Metropolitan Dummy	Metropolitan dummy=1 if the municipality is either Trento or Rovereto.	Our computation
Population Growth	Average population over the period 2001-2007 divided by average population over the period 1991-1997 minus one.	Our computation

Table A2: Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max
Total per capita expenditure	223	16,671.01	9,987.06	4,377.21	77,057.88
Neighboring total per capita expenditure	223	15,920.16	5,047.97	6,487.54	28,237.72
Neighboring total per capita expenditure*population*10^{-3}	223	3,093.01	10,417.03	148.06	147,749.70
Administration & Management per capita expenditure	223	3,625.57	3,395.87	513.22	24,825.35
Neighboring Administration & Management per capita expenditure	223	3,521.14	1,783.10	1,032.28	9,032.59
Neighboring Administration & Management per capita expenditure*population*10^{-3}	223	734.35	3,201.84	15.11	46,962.10
Roads & Transport per capita expenditure	223	4,688.47	3,928.27	589.79	25,643.57
Neighboring Roads & Transport per capita expenditure	223	4,277.21	2,047.51	1,156.27	11,686.00
Neighboring Roads & Transport per capita expenditure*population*10^{-3}	223	781.91	2,466.72	39.05	34,585.22
Planning & Environment per capita expenditure	223	4,172.41	3,836.61	577.56	39,446.68
Neighboring Planning & Environment per capita expenditure	223	3,903.58	1,485.85	1,211.78	8,986.70
Neighboring Planning & Environment per capita expenditure*population*10^{-3}	223	739.80	2,159.21	29.84	28,659.04
Total per capita grants	223	10,072.23	7,925.70	2,352.13	70,388.19
Administration & Management per capita grants	223	1,729.18	1,238.74	23.93	10,450.14
Roads & Transport per capita grants	223	2,189.10	2,157.26	264.42	17,314.44
Planning & Environment per capita grants	223	2,229.67	2,582.99	90.81	31,624.64
Altitude	223	709.40	294.15	85.46	1,491.12
Population	223	2,224.06	7,865.26	108.29	109,334.90
Houses	223	0.77	0.41	0.36	3.18
Aged	223	0.19	0.03	0.12	0.32
Children	223	0.06	0.01	0.03	0.10
Population Density	223	105.27	264.90	3.72	3,699.05
Population Growth	223	0.07	0.07	-0.18	0.31
Total employees	223	0.26	0.16	0.06	0.98
Local Unit	223	0.08	0.04	0.03	0.37

Notes: The spatial matrix used to compute the neighboring variables is a binary contiguity-based one, according to which two municipalities are neighbors if they share a border, and is row-standardized

Table A3: Municipalities outliers

	Total		Administration & Management		Roads & Transport		Planning & Environment	
Q1	9507.48		1645.68		2255.12		2047.08	
Q3	20498.20		4212.22		5691.41		5134.31	
IQR	10990.72		2566.54		3436.28		3087.24	
Q1 –1.5*IQR e Q3 + 1.5*IQR	-6978.60	36984.28	-2204.13	8062.03	-2899.30	10845.83	-2583.78	9765.17
Number of mild outliers	9		10		6		3	
Q1 –3*IQR e Q3 + 3*IQR	-23464.68	53470.36	-6053.94	11911.84	-8053.73	16000.26	-7214.64	14396.03
Number of severe outliers	2		7		7		6	
Municipalities	ALBIANO	44965.76	ALBIANO	24825.35	AMBLAR	15036.89	CENTA SAN NICOLO'	15202.88
	BRESIMO	41930.06	BOCENAGO	11175.95	BRESIMO	19096.17	DAONE	11027.09
	BRIONE	37741.92	BRIONE	13511.83	CAGNO'	15326.98	LARDARO	18115.57
	CASTEL CONDINO	42865.77	CADERZONE	8814.79	CASTEL CONDINO	17584.93	LUSERNA	12485.57
	GARNIGA	43060.11	CASTEL CONDINO	9132.70	DARE'	10885.35	MASSIMENO	20114.78
	GRAUNO	40976.11	CASTELFONDO	9509.00	GRAUNO	24137.27	PALU' DEL FERSINA	18117.79
	MASSIMENO	44222.98	CINTE TESINO	12137.98	MASSIMENO	12692.81	SAGRON MIS	11081.02
	PALU' DEL FERSINA	66917.53	DON	14464.66	PALU' DEL FERSINA	25643.57	TERRES	16701.57
	PIEVE TESINO	39948.09	GARNIGA	20772.40	PRASO	11988.20	VIGNOLA FALESINA	39446.68
	SAGRON MIS	44057.73	GIUSTINO	8306.35	PREZZO	17483.32		
	VIGNOLA FALESINA	77057.88	GRUMES	11120.82	SAGRON MIS	22423.47		
			LONA-LASES	12860.40	STREMBO	12627.79		
			MASSIMENO	10839.78	VIGNOLA FALESINA	19491.20		
			PIEVE TESINO	22963.56				
			RONZONE	9163.028				
			TIARNO DI SOTTO	10135.25				
			VIGNOLA FALESINA	8643.582				

Table A4: Non spatial model – OLS regression

	Total	Administration & Management	Roads & Transport	Planning & Environment
	(1)	(2)	(3)	(4)
Grants	0.87***	0.38**	0.82***	0.72***
	(0.09)	(0.17)	(0.14)	(0.14)
Altitude	5.09***	1.17	2.09***	0.69
	(1.40)	(0.90)	(0.72)	(1.00)
Population	-0.07*	-0.06*	-0.03**	-0.03*
	(0.04)	(0.03)	(0.02)	(0.02)
Houses	2,620.32***	321.17	585.34	1,287.76**
	(910.86)	(535.36)	(379.05)	(500.74)
Aged	2,814.87	2,279.31	-2,118.45	7,334.39
	(9,310.60)	(6,303.39)	(4,681.13)	(5,380.26)
Children	8,782.41	-6,071.13	-8,850.30	10,936.83
	(30,648.31)	(18,043.98)	(20,418.58)	(16,040.36)
Population Density	-0.96	-0.30	0.33	-0.30
	(0.87)	(0.46)	(0.38)	(0.47)
Population growth	3,748.01	-2,319.11	-2,362.06	-411.85
	(4,317.05)	(3,293.26)	(2,347.50)	(3,111.54)
Total employees	4,471.62	1,862.30	1,032.61	103.64
	(3,204.03)	(2,092.94)	(1,218.65)	(1,670.92)
Local unit	16,134.72	6,497.92	-355.68	240.67
	(12,747.64)	(7,280.13)	(5,619.08)	(7,940.58)
Outliers dummy	9,698.34**	8,416.57***	7,551.73***	8,579.50***
	(4,124.96)	(1,247.66)	(1,049.15)	(1,661.39)
Metropolitan dummy	3,700.99	1,266.15	963.65	453.63
	(2,435.73)	(1,379.38)	(1,120.07)	(1,083.12)
Constant	-2,795.09	-479.78	1,198.57	-1,299.48
	(2,968.83)	(2,009.99)	(1,728.93)	(1,734.73)
Communities dummy	YES	YES	YES	YES
Observations	223	223	223	223
R-squared	0.91	0.72	0.86	0.82
Robust LM test for spatial error dependence	0.84	0.43	6.05**	5.44**
Robust LM test for spatial lag dependence	3.53*	0.60	9.50***	2.10

Notes: Robust standard errors are shown in parentheses. The spatial weights matrix used to compute the test is a binary, contiguity-based one, according to which two municipalities are neighbors if they share a common border and it is row-standardized. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table A5: Non spatial model and interaction with population – OLS regression

	Total	Administration & Management	Roads & Transport	Planning & Environment
	(1)	(2)	(3)	(4)
Neighbors spending * Population	-0.17	0.06	-0.48*	-0.26
	(0.15)	(0.20)	(0.27)	(0.17)
Grants	0.86***	0.38**	0.81***	0.71***
	(0.09)	(0.17)	(0.14)	(0.14)
Altitude	5.39***	1.12	2.40***	0.67
	(1.39)	(0.92)	(0.75)	(1.00)
Population	0.17	-0.09	0.13	0.04
	(0.22)	(0.09)	(0.09)	(0.05)
Houses	2,586.13***	324.51	520.00	1,282.95**
	(912.68)	(534.95)	(379.75)	(502.05)
Aged	2,950.51	2,244.79	-2,456.38	7,579.84
	(9,329.84)	(6,338.17)	(4,698.42)	(5,331.12)
Children	9,516.40	-6,226.33	-8,470.91	11,118.14
	(30,790.85)	(18,158.54)	(20,440.38)	(16,034.68)
Population Density	-1.08	-0.28	0.26	-0.35
	(0.89)	(0.46)	(0.40)	(0.48)
Population growth	3,624.18	-2,326.46	-2,505.92	-445.23
	(4,315.08)	(3,303.50)	(2,342.38)	(3,114.20)
Total employees	4,394.32	1,899.96	1,037.81	109.83
	(3,213.64)	(2,123.14)	(1,208.27)	(1,665.94)
Local unit	16,959.44	6,358.39	-81.32	632.79
	(12,973.07)	(7,326.33)	(5,673.08)	(7,972.03)
Outliers dummy	9,645.76**	8,424.25***	7,541.33***	8,521.32***
	(4,133.69)	(1,252.12)	(1,047.43)	(1,667.64)
Metropolitan dummy	2,142.87	1,522.80	-121.78	-165.00
	(3,052.42)	(1,590.26)	(1,264.99)	(916.63)
Constant	-2,895.81	-395.41	1,230.17	-1,159.33
	(2,996.47)	(2,053.22)	(1,737.68)	(1,753.69)
Communities dummy	YES	YES	YES	YES
Observations	223	223	223	223
R-squared	0.91	0.72	0.86	0.82

Notes: Robust standard errors are shown in parentheses. *** significant at 1%; ** significant at 5%; * significant at 10%.

2011

2011/1, Oppedisano, V; Turati, G.: "What are the causes of educational inequalities and of their evolution over time in Europe? Evidence from PISA"
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2012

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