XXXIII CONFERENZA ITALIANA DI SCIENZE REGIONALI

Measuring spatial effects in presence of institutional constraints: the case of Italian Local Health Authority expenditure

Vincenzo ATELLA [*], Federico BELOTTI [†], Domenico DEPALO [‡], Andrea PIANO MORTARI [§¶]

Abstract

Over the last decades spatial econometrics models have represented a common tool for measuring spillover effects across different local entities (counties, provinces or regions). In this work we show that when these entities share common borders but obey to different institutional settings, ignoring this feature may induce misleading conclusions. Indeed, under these circumstances, and if institutions play do a role, we expect to find spatial effects mainly "within" entities belonging to the same institutional setting, while the "between" effect across different institutional settings should be attenuated or totally absent, even if the entities share a common border. In this case, relying only on geographical proximity will then produce estimates that are a composition of two distinct effects. To avoid these problems, we derive a simple model that allows to implement a methodology based on the partition of the standard contiguity matrix into *within* and *between* contiguity matrices that allow to separately estimate these spatial correlation coefficients and to easily test for the existence of institutional constraints. In our empirical analysis we apply this methodology to Italian Local Health Authority expenditures, using spatial panel techniques. Results show a strong and significant spatial coefficient only for the *within* effect, thus confirming the existence of institutional constraints.

JEL classification: H72, H51, C31
Keywords: spatial, health, expenditures, institutional setting

[*]University of Rome Tor Vergata and CHP-PCOR Stanford University
[†]University of Rome Tor Vergata
[‡]Bank of Italy
[§]University of Rome Tor Vergata
[¶]Corresponding author: Andrea Piano Mortari, Faculty of Economics, University of Rome Tor Vergata, via Columbia 2, 00133 Rome, Italy. E-mail: piano.mortari@economia.uniroma2.it, phone: +39 06 7259 5627

1 Introduction

It is widely recognized that geographical proximity plays an important role in local jurisdiction behavior through spillover (or spatial) effects. Often, these effects represent an important piece of information to explain the cross-sectional variation of specific indicators like, for example, economic growth, unemployment, crime rates, per-capita health care spending and the like. There exists a large body of literature recognizing the importance of such effects, all sharing a common methodological approach based on the idea that spillovers can be captured by specifying a predefined spatial weight matrix (usually defined on a geographical base), which incorporates the topology of the system and traces the spatial linkages among the reference units.[1]

However, an open issue in the literature is that a standard spatial matrix, based only on geographical characteristics, may not be enough to correctly identify spillover effects in presence of institutional constraints, i.e. when the unit of analysis (local unit) is clustered within a larger administrative area, characterized by specific institutional settings. In this cases, higher spillover effects should be found for local units "within" each administrative area, while lower or absent effects are expected for those units sharing a common border but not the same institutional framework.

Only recently the literature has started to explicitly tackle this issue (Parent and LeSage (2008), Arbia et al. (2009)), suggesting to use a non-conventional spatial weight matrix which incorporates a multidimensional concept of distance. However, this solution depends heavily on the availability of external sources of data (not always strictly exogenous). Our aim with this paper is to provide a flexible and general solution to this problem by proposing a methodology that exploits the institutional setting heterogeneity among units to split the standard contiguity matrix in two matrices: the "within" effect, among local units sharing borders and institutional setting, and the "between" effect among units that share only borders. In this way we allow for different spillover effects.

Moreover, we cast this idea into a theoretical framework within which health expen-

[1]Baicker (2005), Bénabou (1996), Costa-Font and Pons-Novell (2007), Glaeser et al. (1996), Moscone and Knapp (2005), Moscone et al. (2007), Revelli (2005, 2001), Topa (2001) are among the most relevant empirical contributions in this sector.

ditures of local units are set as the result of an expenditure mimicking behavior and from which we derive testable implications about the presence of institutional constraints. To perform this test we estimate a spatial panel Durbin model with time and individual fixed effects using both "within" and "between" matrices. Our empirical analysis focuses on the determinants of public health care expenditure in Italy from 2001 to 2005 at Local Health Authority (LHA) level, a level of expenditure aggregation never explored before.

We chose health care expenditure as it represents one of the most important and dynamic share of the public expenditure in Italy and, by far, the largest share of the regional budgets (about 70% for regions with *ordinary* autonomy and about 40% for regions with *special* autonomy).

The paper is organized as follows. Section 2 briefly describes the institutional setting. Section 3 discusses the regional and sub-regional health expenditure in Italy and presents some stylized facts. Section 4 sketches the theoretical framework. Section 5 introduces the empirical strategy, provides the algebraic derivation of the "within" and "between" matrices and discuss the economic interpretation of the coefficients involved in our empirical model. Section 6 presents the data and some descriptive statistics. Section 7 discusses our findings showing the importance of the institutional setting in explaining spatial correlation across LHAs. Finally, Section 8 offers some concluding remarks.

2 The institutional setting of the Italian National Health System (NHS)

The Italian NHS, established in 1978, provides universal coverage free of charge at the point of service, or with some (relatively) light form of co-payment. The system is based on the universalism principle and is funded from general taxation, while patients are free to choose where to be cured from a list of public and private accredited providers.[2] From an organizational perspective, the system is structured into three levels: national, regional and local. The national level is responsible for designing the national health plans with

[2]A recent and detailed description of the Italian NHS is available in Lo Scalzo et al. (2009).

the aim of ensuring general health objectives and interventions. Regional levels have then the responsibility of achieving the objectives posed by the national health plan through the regional health departments, which in turn are responsible for ensuring the delivery of a benefit package (the so called "Essential levels of medical care") through LHAs and a network of public and private accredited hospitals. LHAs are run by managers who are responsible to plan health care activities and to organize local supply according to population needs. Moreover, they are responsible for guaranteeing quality, appropriateness and efficiency of the services provided. They are also obliged to guarantee equal access, efficacy of preventive, curative and rehabilitation interventions and efficiency in the distribution of services. Finally, they are responsible for the financial balance between the funds provided by regions and the expenditures on health care services at local level. As we will see later, this last aspect is extremely important in our context as it represents a key feature of our theoretical model, where managers have a certain degree of discretionality to determine how much they want to spend relatively to other neighboring colleagues, but are bounded in this action by the institutional setting.

Since its inception in 1978, the system has undergone several reforms aimed at improving the management and containing costs. A key feature of this reform process has been the movement toward a more decentralized system, away from the original 1978 idea of an integrated and centralized system that left very few administrative responsibilities to the regional and local levels. This reform process has transformed the Italian NHS from a monolithic system to a very heterogeneous network of 21 regional health systems, highly autonomous and with full responsibility of all activities. Regions have used their autonomy to introduce different organizational models of health care, ranging from systems with minimal regulation and a complete purchaser-provider separation (e.g. Lombardia) to those where regional health services continued to be highly regulated and directly managed by the regional government (e.g. Emilia Romagna, Toscana) (Giardina et al. (2009)). More recently, the high level of heterogeneity existing in the system has also been recognized as an important impairing aspect of the original idea of providing an equal level of care to all Italian citizens. The negative effects of such heterogeneity on citizens belonging to different regions can be easily seen when confronting different co-payment schemes or different regulations for the adoption of new (and expensive) innovative drugs or devices. Moreover, differences are found also when confronting different financial and non-financial incentive schemes for health care providers.

In conclusion, the emerging picture shows that Italian regions enjoy substantial autonomy within a common legal framework. This peculiar institutional setting becomes relevant in shaping the distribution of health care services provided by each single LHA within and across Italian regions, by heterogeneously affecting the quality of care provided and, inevitably, the way in which the per capita expenditure can differ within and between regions.

3 The regional and sub-regional health expenditure in Italy: Some stylized facts.

The Italian total health expenditure has always been in line with the EU average, although substantially below that of peer high income countries. Today, the total health expenditure is around 9% of GDP. About 7% of it is publicly financed and this share has been growing over time from a low 5% during the '90s, although until 1999 the funding remained below 1992 levels at constant prices. According to France et al. (2005) during those years there has been a constant practice from the central government to first under-finance the NHS and then to periodically transfer additional funds to cover regional deficits. Overall, it has been estimated that these *ex-post* transfers are equivalent to an average shortfall in financing close to 5%.

Concerning the period of our interest (2001-2005), the regional allocation of these funds was based on a capitation formula. The rules used by the central government have often changed over the past two decades, mainly because the inspiring principles behind the allocation methods have never been clearly stated. Since 1997 the fund allocation has been based on a weighted capitation formula that was supposed to take into account the health needs of the local populations, using as proxies their mortality rates and then their age distributions. In general, under both criteria, older regions got higher funding. Clearly, as long as the distribution of health needs across regions is not uniform and as long as the capitation criteria correctly allocate funds, observing significant regional differences in per capita health expenditure should not be considered as a problem.[3]

At regional level, health care expenditure in Italy has been analyzed by several authors (Bordignon and Turati (2009), Francese and Romanelli (2011) Levaggi and Zanola (2003), Lo Scalzo et al. (2009), Giardina et al. (2009)) and in different time periods. The main conclusions reached by all these studies are the following: *i)* the per capita public health expenditure shows a non-negligible variation across regions and over time, *ii)* deep cross-regional inequalities in health care expenditure and in the supply and utilization of health care services persist even after adjusting for health needs and *iii)* such differences are the result of different territorial distribution in socioeconomic factors, supply of health care services, regional specific organizational and managerial structures and inefficiencies.

However, as regions are free to choose how to allocate resources within different programs (in accordance with regional planning targets) and across LHAs (may be using the same capitation formula used to transfer funds from the central to the regional level), it should be possible to see further significant within regional differences in per capita expenditures. To our knowledge, this level of analysis has been neglected in this strand of the empirical literature, although we believe it is important to understand to what extent within regional differentials are different from between regional differentials.

Based on data obtained from the Italian LHA Economic Accounts, in Table 1 we report, for each single region and for the country as a whole, the sex and age standardized average LHA public per capita health expenditure with its standard deviation.[4] What we can see is that "within" region variation is lower than "between" region variation, with

[3]It is worth mentioning that, due to the standard practice of central government of under-financing the health expenditure, many regions have generated deficits that, given the absence of credible penalties, have been higher in regions with lousy health expenditure governances. As a consequence, and as also noted by France et al. (2005), the bailout plans implemented to avoid the potential default of high deficit regions modified quite significantly the distribution of funds initially set by the allocation formula, mainly because the amount of supplementary funding received was calculated as a proportion of the absolute value of its deficit.

[4]Per capita health expenditure has been standardized by age and sex to take into account differences in the distribution of health care needs. In other words, we are interested in exploring patterns of within and between source of variability that do not depend on the distribution of health care needs.

Table 1: Age and sex adjusted LHA expenditures by region (2001-2005)

Region	Mean	Sd/Mean	N. of LHA
Piedmont	1.37	0.12	19
Aosta Valley	1.68	0	1
Lombardia	1.42	0.09	15
AP Bolzano	1.99	0.08	4
AP Trento	1.66	0	1
Veneto	1.43	0.09	21
Friuli-Venezia Giulia	1.44	0.05	6
Liguria	1.39	0.08	5
Emilia-Romagna	1.47	0.08	11
Tuscany	1.37	0.08	12
Umbria	1.37	0.06	4
Marche	1.36	0.09	13
Lazio	1.38	0.21	8
Abruzzo	1.44	0.07	6
Molise	1.54	0.09	4
Campania	1.42	0.28	13
Apulia	1.37	0.07	12
Basilicata	1.49	0.07	5
Calabria	1.32	0.14	11
Sicily	1.38	0.09	9
Sardinia	1.36	0.18	8
Italy	1.42	0.14	188

Source: Our calculation on Italian LHA Economic Accounts.
Mean values are in thousands of Euro per year

only 3 regions out of 21 with a "within" coefficient of variation higher that the "between" coefficient. It is worth noting that these regions (Lazio, Campania and Sardegna) are those that in 2006 accrued to more than 70% of the total debt of the Italian NHS.

These results seem to confirm that different institutional settings play a key role on per capita health expenditure across the Italian regions, with each single region operating as an independent health system, while within each region LHAs are more aligned in terms of expenditure once we control for health needs. This situation should then warn about the adoption of an econometric strategy that allows to adequately explore the presence of spatial correlation in a context where the unit of analysis (LHA) is at a level lower than the one imposed by the institutional setting (region).

4 A political economy model of health expenditures

In this section we present a theoretical model of yardstick competition based on the original contribution by Sollé Ollé (2003), adapted to the Italian institutional setting. The model consists of two agents: a local official and a representative voter. Local officials (i.e., LHA managers) are appointed by regional politicians, take the tax rate as given, and have some discretionary power over health expenditures. In fact, they can set the expenditure at a level that could ensures re-election of their political party (and implicitly of themselves), to keep extracting rents from their office. Voters don't know the optimal level of health expenditure because they are unaware of the optimal costs of health goods and services, but they can compare the outcome in their jurisdiction to that of the neighborhood. In this way they can evaluate the appropriateness of the expenditure and use this information when deciding whether or not to re-elect the incumbent government. As a consequence, incumbents are compelled to take into account the voter comparative behavior and keep expenditures and taxes in line with those in the neighborhood. Within this framework we derive an agency model of tax-expenditure setting decisions, whose outcome arises from the interaction between a principal (the representative voter) and an agent (the local official). However, and differently from the original Solé Ollé contribution, in our model we concentrate only on the expenditure side and consider the fundamental role played by institutional constraints in shaping voters' behavior. The theoretical prediction stemming from this new framework is that, assuming the rationality of the voters, only the expenditures within jurisdictions sharing similar institutional settings (i.e., LHAs within the same region) are relevant for voting behavior. Finally, we obtain testable predictions, namely that expenditures are *spatially* linked only among jurisdictions sharing both institutional setting and borders.

4.1 The voter [5]

The representative voter utility is defined as

$$\xi = \zeta(y_i - t_i) + \mu(e_i), \tag{1}$$

where ζ is a function of net income $(y_i - t_i)$, and $\mu(e_i)$ is the utility associated with the provision of public services, $\xi' = \partial\zeta/\partial(y_i - t_i) > 0, \mu' = \partial\mu/\partial e_i > 0$ and $\zeta'' = \partial\zeta'/\partial(y_i - t_i) < 0, \mu'' = \partial\mu'/\partial e_i < 0)$.

As voter's *desired* levels of taxation and public services (denoted by apices r) could be different from *actual* levels of taxation and public services (denoted by apices o), this causes an utility loss depending on the difference between desired and actual levels, i.e. $\upsilon^i = \zeta'(t_i^r)(t_i^o - t_i^r) + \mu'(e_i^r)(e_i^o - e_i^r)$. However, due to asymmetric informations, the voter does not know the appropriate level of expenditure as opposed to private perks of the LHA manager. Nevertheless, in a decentralized system (s)he could fill the information gap by observing the level (s)he would get living in jurisdiction j, i.e. $\xi^j = \zeta(y_j - t_j) + \mu(e_j)$, and the associated utility loss $\upsilon^j = \zeta'(t_i^r)(t_j^0 - t_i^r) + \mu'(e_i^r)(e_i^r - e_j^0)$. For this reason the voter can evaluate the relative utility loss (s)he would suffer from living in jurisdiction i rather than living in jurisdiction j, i.e.

$$\pi^i = \upsilon^i - \upsilon^j = \zeta'(t_i^r)(t_i^o - t_j^o) + \mu'(e_i^r)(e_i^o - e_j^o). \tag{2}$$

At this stage, differently from Sollé Ollé (2003), we simplify the analysis by concentrat-

[5] As our model strictly follows Sollé Ollé (2003), in what follow we avoid presenting all details. The interested reader may refer to that work for more details.

ing on the expenditure setting decision rather than on taxes. In our specific context we can easily justify this choice based on the following reasons: *i)* the Italian NHS is mainly financed through general taxation, with tax rates imposed by the central government. *ii)* The share of health care expenditure financed through taxes levied at regional level is only marginal;[6] Therefore, we drop the term $\upsilon'(t_i^r)(t_i^o - t_j^o)$ from equation (2).

Finally, from equation (2) it follows that the voter will re-elect the incumbent if the relative performance is greater than a threshold (e.g. $\pi^i > \epsilon_i$). As common in this literature, we assume that the parameter ϵ_i has a distribution function $F(\epsilon_i)$, with probability density $f_i = f_i(\epsilon)$. It then follows that the probability of re-election is given by $F(\pi^i) = F(\mu'(e_i^o - e_j^o))$, increasing (decreasing) when expenditure in jurisdiction i increases (decreases) with respect to jurisdiction j.

4.2 The local official

Local official utility when in office is given by

$$V^i \equiv \sigma^i + \phi^i(s_i) \tag{3}$$

where σ^i is the benefit accruing from wage and/or reputation, $\phi^i(s_i)$ the benefit from privately using public resources, with $\phi' = \partial\phi/\partial s > 0$ and $\phi'' = \partial\phi'/\partial s < 0$. The utility function is subject to the following budget constraint:

$$s_i + e_i = t_i + g_i.$$

where total expenditure, the sum of the provision of public goods (e_i) and perks (s_i), must be equal to total revenue from taxes (t_i) and grants (g_i). Therefore, the manager maximization problem is an inter-temporal problem that can be represented by the following objective function

[6]VAT accounts for 47% of total finance, income taxes accounts for slightly less than 40%, while the remaining part is provided by *ad hoc* transfer from Central Government and by regional budget own resources. During the period under analysis regional tax on personal income represents no more than 1% of total financing resources.

$$V_t^i = \max\{\sigma^i + \phi^i(s_i) + \beta^i(F_i E(V_{t+1}^i) + (1 - F_i)E(V_{t+1}^{n,i}))\} \tag{4}$$

where β is the discount factor, $E(\cdot)$ is the expectation operator, V_{t+1}^i is the utility achieved if re-elected and $V_{t+1}^{n,i}$ the utility if defeated. In equation (4) it must be emphasized the crucial role of F_i, which is the link between voters and manager and, most important, is our source of spatial interactions.

4.3 Choice of expenditures and institutional constraints

Taking the expenditure in the jurisdiction j as given, the maximization of equation (4) gives:

$$\Gamma = \phi_i' - f_i(\mu' + \mu''(e_j - e_i))\beta E(\Delta V_{t+1}^i) = 0 \tag{5}$$

where $\Delta V_{t+1}^i = V_{t+1}^i - V_{t+1}^{n,i}$. Equation 5 clearly shows that managers set the optimal levels of expenditure to equalize the marginal benefit of private interest (ϕ_i') with the political cost of non-reelection, which in turn depends on loss of votes from low expenditures, the discount factor and the utility difference between being in office or not (ΔV_{t+1}^i).

Solving equation 5 for e_i produces an expenditure setting equation whose comparative statics is reported below:

$$e_i = (\underset{?}{e_j}, \underset{-}{g_i}, \underset{+}{t_i}, \underset{-}{f_i}, \underset{-}{\sigma_i}, \underset{+}{\phi_i}, \underset{-}{\beta E(\Delta V_{t+1}^i)}). \tag{6}$$

Equation 6 provides the theoretical underpinning for an analysis of spatial spillovers at LHA level where only the geographical distribution of the units is taken into account, given that expenditure in jurisdiction i depends on the expenditures in the neighboring jurisdiction j, although the sign remains uncertain *ex-ante*.

However, it must be noted that in presence of institutional constraints the identification of *neighbor* jurisdictions could be misleading. In fact, we can have nearby units (i.e., LHAs) that are inside or outside the borders of a higher level jurisdiction (regions), sharing or not the same institutional setting. As already discussed in previous sections, when choosing the politician (and by consequence the LHA manager) in jurisdiction i, a rational voter should take into account the institutional framework. The principal should recognize that expenditures in jurisdiction j, if located outside the region, may be different because they may be associated with different policy goals.

Therefore, we reconsider our definition of expenditure and define

$$e_i^o = \alpha e_{i,B}^o + (1-\alpha) e_{i,W}^o \tag{7}$$

where $\alpha \in [0,1]$ represents a set of weights, B identifies jurisdiction outside the common institutional setting (region) and W jurisdictions within the same institutional setting. Clearly, the higher the institutional constraints, the closer to 0 will be the set of weights α adopted by a rational voter with complete information, thus leaving the possibility to observe only within region spatial spillovers. Under this new theoretical setting equation 8 can be written as:

$$e_i = (\underbrace{e_{j,B}, e_{j,W}}_{?}, \underset{-}{g_i}, \underset{+}{t_i}, \underset{-}{f_i}, \underset{-}{\sigma_i}, \underset{+}{\phi_i}, \beta E(\underset{-}{\Delta V_{t+1}^i})). \tag{8}$$

Thus the signs of $e_{j,B}$ and $e_{j,W}$ will be the object of our empirical analysis, from which we can infer about the validity of the model adopted.

5 The empirical strategy

Since the seminal paper by Cliff and Ord (1968), several models have been proposed to address the issue of spatial correlation in the data, namely the interaction between observable and/or unobservable components over the space and across different jurisdictions. A general specification, which can be extended to spatial models, is proposed by Manski (1993), where the outcome (say expenditures for concreteness) of unit i for a given time

t $(t = 1, ..., T)$ can be modeled as:

$$y_{it} = \alpha + \rho \sum_{j=1}^{N} w_{ij} y_{jt} + x_{it}\beta + \sum_{j=1}^{N} w_{ij} x_{jt}\theta + \mu_i + \gamma_t + \nu_{it} \quad (9)$$

$$\nu_{it} = \lambda \sum_{j=1}^{N} m_{ij} \nu_{it} + \epsilon_{it} \qquad i = 1, ..., N \quad (10)$$

where w_{ij} and m_{ij} are the (i, j)th elements of W and M, two spatial weight matrices describing the spatial arrangement of the units of interest, y_{it} is the dependent variable, x_{it} a $(1 \times K)$ row vector of covariates, $\Psi = (\beta, \rho, \lambda, \theta)$ the vector of unknown parameters, ϵ_{it} is the $IID \sim (0, \sigma^2)$ error term, μ_i and γ_t the individual and time fixed effect respectively. As standard in this literature, in the rest of the paper we will further assume that W and M are two known matrices, whose diagonal elements are equal to zero and off-diagonal elements are $w_{ij} \in \{0, 1\}$ and $m_{ij} \in \{0, 1\}$.

Following Manski (1993), in our specific context the propensity of LHAs belonging to a specific neighbor group to behave similarly can be explained by three different effects: the endogenous effect, the exogenous (or contextual) effect and the correlated effect. The endogenous effect arises if, all else equal, LHA behavior tends to vary with the average behavior of the LHAs in the same neighbor (ρ in (9)); the exogenous effect emerges if the LHA behavior is determined by exogenous variables such as the socio-economic composition of the reference group (θ in (9)). Finally, the correlated effects occurs if LHAs in the same group tend to behave similarly because they have similar unobserved factors (λ in (10)) (classical examples are orography, socio-cultural attitudes or even the fact that some services may be shared by multiple jurisdictions, for example hospitals).

As pointed out by Manski (1993), model (9)-(10) is not identified unless at least one of the three interaction effects is excluded. Depending on which interaction term we drop, we can obtain different types of models: a Spatial Durbin Model (SDM) (setting $\lambda = 0$ in Eq. 9), a Spatial Durbin Error (SDE) model (setting $\rho = 0$ in Eq. 9) or a Kelejian and Prucha (1998) model (KPM) (setting $\theta = 0$ in Eq. 9)

The choice of the specific restriction/model is usually determined by the research question. For example, the choice of the SDM with respect to the SDE relies on the interest we have in the spatial spillover effect (ρ). Furthermore, as pointed out by Elhorst (2010a), the SDM has also the advantage with respect to the KPM of not constraining the direct and indirect effects and, by allowing for spatially lagged values of the exogenous regressors, to control for spatial spillovers which may otherwise be absorbed by the error component.

The best option in our case is then to exclude the spatially autocorrelated error term (ν_{it}) in equation (9). This leads to obtain the following SDM with spatial and time fixed effects:

$$y_{it} = \alpha + \rho \sum_{j=1}^{N} w_{ij} y_{jt} + x_{it}\beta + \sum_{j=1}^{N} w_{ij} x_{jt}\theta + \mu_i + \gamma_t + \epsilon_{it} \tag{11}$$

Another advantage of the SDM follows from the possibility to nest two of the most popular spatial models. Indeed, setting $\theta = 0$ in Eq. 11 we obtain the Spatial Auto Regressive (SAR) model, while if $\theta = -\rho\beta$ we have the Spatial Error (SE) model. Therefore, the SDM produces unbiased estimates even if the true data-generation process is the SAR or the SEM.[7] Further, even if the true data generating process is SEM, then the SDM produces consistent standard errors for the coefficients (Elhorst, 2010a). Finally, the inclusion of the spatially lagged regressors could serve, as pointed out by LeSage and Pace (2009), as a control for omitted variables, if they are first order spatially correlated with the included regressors.

Regarding the estimation procedure, the main issue is if the spatial component should be included in the conditional mean function or in the error term. In the former case the simultaneity of the outcome across units makes the standard OLS or ML inconsistent, in the latter, while the point estimates are consistent, they cannot be used for statistical inference since the covariance matrix is not diagonal. Several approaches have been suggested to overcome the problem: when the spatial component is in the conditional mean one should use a GMM-IV (Kelejian and Prucha (1998) , Baltagi and Moscone (2009), Lee (2003)) or a Full Information ML (Anselin (1988), LeSage (1999), Elhorst (2003, 2010b), when it is in the error term a GLS (Kelejian and Prucha (1999)) or a ML.

[7]This feature holds true also for the KPM.

From an econometric point view a better understanding of the spillover effect could be obtained, exploiting the longitudinal dimension of the data. In fact, in this case, we are able to correctly identify the relevant spillover effects, disentangling its long run (stable) component from the one directly under control of the LHA manager during it mandate. As shown by Elhorst (2003, 2010a), the likelihood function in a panel data environment is the same as in the cross sectional case. The difference between the two approaches remains in the complication that follows from the data transformation needed to exploit the longitudinal dimension of the data. Elhorst (2003, 2010b) suggests a classical demeaning approach, where

$$y_{it} = y^*_{it} - \overline{y_{it}}$$

and where $\overline{y_{it}} = T^{-1}\sum_{t=1}^{T} y_{it}$. However, as recently shown by Lee and Yu (2010), this transformation may lead to disturbances that are linearly dependent over time. Hence they suggest a transformations that avoids this inconvenience, using a matrix $[F_{T,T-1}, \frac{1}{\sqrt{T}} l_T]$, with $F_{T,T-1}$ a $[T \times T-1]$ matrix of the eigenvectors corresponding to the eigenvalues different from zero and l_T a vector of ones.

In the light of the model presented in section 4 and recognizing that part of the income, expenditures and public goods provision are non-discretionary and thus are relatively constant over time, the voter enlarges the set of available information by looking at their varying part when (s)he judges the local officials.[8]

To formalize the distinction, in case of expenditures, we can write $e^* = \overline{e} + e$, where e^* is the observed level, $\overline{e}$ is the long run expenditures and e is the varying part, and similarly is for the other variables.

Exploiting the panel dimensionality it is likely to produce a smaller spatial correlation than when we neglect the distinction (i.e., we focus on e^*), because the methodology would purge all the time invariant characteristics, out of the control of local officials.

[8]with abuse of terminology, we may refer to the constant fraction as "habit formation", which is out of control of agents. Habit formation can be the result of municipalities clustered in some areas having the same needs or sharing similar preferences.

5.1 Modeling the institutional settings

In order to interpret the results we need to correctly define group membership, since in a context where institutional settings are important the definition of a group is not always clearcut. In the Italian's LHAs case there are two relevant group definitions. The first one is represented by all those LHAs sharing common borders (i.e. contiguous LHAs) independently from the institutional setting. This definition is coherent with a classical spatial analysis, where geography is the only driver of the interactions between the units. The second possibility is to take into account only the institutional framework, defining as contiguous all those LHAs sharing common institutional settings (i.e. LHAs within a region), independently from their geographical position. According to our model specification in section 4 the two definitions should coexist. The model suggests that the LHA behavior in a specific region could be more affected by the behavior of the contiguous LHAs *belonging to the same region* rather than LHAs in other neighborhood regions, even if the the latter share a common border.

To our knowledge, the existence of "other than geographical" determinants and their role in modifying spatial spillovers has already been recognized in the literature on spatial effects. For example by Arbia et al. (2009) and Parent and LeSage (2008) have proposed a methodology that could partially solve this problem using non-conventional spatial weight matrices which incorporate a multidimensional concept of distance. The selection of the best weight matrix specification is obtained according to an information criterion. Based on this methodological framework, Arbia et al. (2009) find that holding the geographical distance fixed, the regions which share a similar institutional framework tend to converge more rapidly to each other. This implies that institutions play an important role with respect to geographical factors, obtaining further support that confirms the "primacy of institutions over geography" (Rodrik et al. (2004)). Similarly, Parent and LeSage (2008) uses a weight matrix that is adjusted for the possibility that firm patents are obtained in the same sector of activity. However, these approaches presents practical implementation problems related to the availability of relevant variables to appropriately re-weight the distance matrix and to some degree of subjectivity in the selection of the variables used as weights.

What we propose is instead a methodology that is independent from the availability of additional variables and guarantees the exogeneity in the choice of the weights. The basic idea behind our approach is the following. Within a regional setting the spatial interaction estimated using the pure geographical approach would produce biased estimates since the coefficient would be the "composition" of the spatial interaction between the LHAs that share the same borders *and* are in the same region (call it "within" for short) and those that share the same borders *but* are in different regions (call it "between" for short). If in alternative one uses sequentially the within (between) matrix and then the between (within) matrix, it is impossible to reach conclusive results on the joint contribution of the two effects.

To solve this problem, we start with a classical contiguity matrix, where each element of the $\mathbf{W}$ matrix is equal to 1 if i and j share a common border. In order to disentangle the true spatial spillovers from those induced by the institutional setting, we partition the contiguity matrix in the following way. We define the matrix $\mathbf{W_w}$ whose elements are equal to 1 if i and j share a common border *and* belong to the same region, and the $\mathbf{W_b}$ matrix whose elements are equal to 1 if i and j share a common border but belong to the different regions. It then follows that $\mathbf{W} = \mathbf{W_w} + \mathbf{W_b}$ by construction.

With this new weighting matrix setting the standard spatial models can be rewritten accordingly. Table 2 presents a comparison of the possible model specifications using either a single spatial matrix or the new approach with "within" and "between" matrices.

Finally, it should be noticed that in principle there exist infinitely many possible spatial matrices, each capturing a different kind of spatial interaction. Among the many possible matrices, a meaningful choice is the one that considers a first order contiguity matrix because we focus on neighbors within the same regions, hence there would be very few second nearest neighbors within the same region. Finally, the distinction of LHA within the same regions from those between different regions prevents us from using a distance based matrix or focussing on other weighting variables (e.g. population, income, etc).

By adopting the matrix partition approach described above, Equation 11 can be rewrit-

Table 2: Summary of the possible model specifications based on matrix partition

Model	Matrix partition NO	Matrix partition YES
SAR	$y = \rho W_a y + x\beta + u$	$y = \rho_w W_w y + \rho_b W_b y + x\beta + u$
SEM	$y = x\beta + u$ $u = \lambda W_a u + \epsilon$	$y = x\beta + u$ $u = \lambda_w W_w u + \lambda_b W_b u + x\beta + \epsilon$
SDM	$y = \rho W_a y + x\beta + \theta W_a x + \epsilon$	$y = \rho_w W_w y + \rho_b W_b y +$ $+ x\beta + \theta_w W_w x + \theta_b W_b x + \epsilon$
SDM Restrictions that give		
SAR	$\theta = 0$	$\theta_w = \theta_b = 0$
SEM	$\theta = -\beta\rho \neq 0$	$\theta_w = -\beta\rho_w \neq 0; \theta_b = -\beta\rho_b \neq 0$
Durbin	$\theta \neq -\beta\rho \neq 0$	$\theta_w \neq -\beta\rho_w \neq 0; \theta_b \neq -\beta\rho_b \neq 0$

ten in the following way:

$$y_{it} = \alpha + \rho_w \sum_{j=1}^{N} w_{ij} y_{jt} + \rho_b \sum_{j=1}^{N} w_{ij} y_{jt} + x_{it}\beta + \sum_{j=1}^{N} w_{ij} x_{jt}\theta_w + \sum_{j=1}^{N} w_{ij} x_{jt}\theta_b + \mu_i + \gamma_t + \epsilon_{it} \quad (12)$$

where the w_{ij} come from a row-standardized version of the spatial matrices.[9]

5.2 The economic interpretation of a SDM

A final point to clarify is the economic interpretation of a SDM. To better understand this point is useful to remember that the SDM encompasses both the SAR and the SE models.

A SAR model could be seen as a model in which only endogenous effects are present and where health expenditures are determined *simultaneously* in all jurisdictions and the spatial correlation is independent of the levels of the Xs, i.e. health expenditures are high if neighbours' health expenditures are high (under the assumption that $\rho > 0$), irrespective of the reason why the latter are high. Situations like this may occur when LHAs managers engage in "copy-cat" behavior, where managers across geographic space mimic each other's expenditure choices. Similarly, this model is consistent with a situation

[9] Row-standardization in required to ensure the existence of the $(I - \rho_w W_w)^{-1}$ and $(I - \rho_b W_b)^{-1}$ matrices when $|\rho_b| < 1$ and $|\rho_w| < 1$ as in Anselin (2003). Furthermore, One may expect that $\rho \mathbf{W} y = \rho_w \mathbf{W_w} y + \rho_b \mathbf{W_b} y$. While this is true for SAR models with non standardized matrices, it does not necessarily hold for a SDM with row standardized spatial matrices. The reason lies both in the standardization procedure and in the effects of the spatially lagged regressors on y

where individuals have incomplete information that they try to fill by looking at what happens in nearby LHAs, hence inducing a yardstick competition in the LHA management (see for example Case and Hines (1993), or Sollé Ollé (2003)).

In the SE model only correlated effects are present as the spatial autocorrelation is confined to the error term. This may reflect the case that some relevant variables correlated over space are not included in the model specification because they are not observable by the researcher. This case is consistent with a situation where voters have a reasonable knowledge of the determinants of health expenditures in their own jurisdictions, hence the competition across different jurisdictions comes only through the unobservable part (Bordignon and Cerniglia (2003). Another possible justification is that two near jurisdictions belong to different, independent, entities: while they look one to each other, the spatial interaction between them can be only on unobservable factors.

Another advantage of the SDM is that it allows to properly estimate the direct, indirect and total effects of a change in the explanatory variables on the dependent one. In the SDM setting the per capita health expenditures depends also on the spatially lagged values of the regressors, hence expenditures in LHA i are a function of i's specific controls and of both expenditures and independent variables in LHA j, if the latter shares a border with the former. This means that, if a particular explanatory variable in unit i changes, it will produce an effect not only on the dependent variable in that unit but also on the dependent variables in other units, through a feedback effect (e.g. the change of the regressor k in unit j directly affects y_j which then influences y_i). We call the former the direct effect and the latter the indirect effect as in , while the total effect is simply a composition of the two.[10]

6 The data

We study the per capita health expenditure, net of migration across regions, of Local Health Agencies (LHA) in Italy for the years 2001-2005, as function of demand and

[10]For a formal derivation of the effects the reader can refer to LeSage and Pace (2009) together with Elhorst (2010a)

supply variables. Controls for demand are age shares, the share of men, immigrants and female graduates over total population, the average per-capita income and the prevalence of cardiovascular and respiratory diseases as well as the prevalence of cancer. On the supply side we include in the regression the number of health employees distinguishing between doctors, nurses and administrative personnel, the number of beds per 1,000 inhabitants, the number of public hospitals trusts. All variables are in logs. Data on health expenditures come from the LHAs balance sheets and include all the costs sustained by the LHA. The average income at LHA level as been constructed starting from the data of the italian municipalities provided by the Italian Department of Finance. Prevalence of diseases have been acquired from the Health Search - SiSSI database of the Italian General Practitioners. The informations for the supply side controls have been obtained from the Italian Ministry of Health while gender and age controls come from the Italian Statistical Agency.

Table 3: Summary stats

Variable	**Mean**	**(Std. Dev.)**	**Min.**	**Max.**
LHA expenditures p.c.	1407.17	(249.288)	449.808	2938.729
Share aged 0-15	0.149	(0.024)	0.1	0.235
Share aged 16-40	0.341	(0.024)	0.27	0.414
Share aged 41-50	0.14	(0.007)	0.121	0.159
Share aged 51-65	0.183	(0.016)	0.139	0.221
Share aged 66-85	0.168	(0.028)	0.08	0.249
Share aged over 85	0.019	(0.006)	0.005	0.04
Males share	0.487	(0.006)	0.466	0.505
Immigration rate	0.032	(0.021)	0.002	0.124
Income p.c.	9488.133	(2767.768)	4276.795	19020.002
Female graduate share	0.398	(0.031)	0.337	0.478
Public hospital trust	0.597	(1.169)	0	10
Hospital beds (1000 inhab)	4.456	(1.508)	0.159	8.787
Clercks employed p.c.	0.002	(0.001)	0.001	0.005
Nurse employed p.c.	0.008	(0.002)	0.001	0.015
Doctors employed p.c.	0.003	(0.001)	0.001	0.007
Cardiovascular prevalence	0.179	(0.074)	0.021	0.333
Tumor prevalence	0.064	(0.034)	0.007	0.162
Respiratory prevalence	0.043	(0.027)	0.005	0.188

6.1 The Spatial Matrices

The spatial matrices used in this study have been constructed *ad hoc* using Quantum GIS v.1.6.0 starting from the shape files at municipalities level and reconstructing the borders of the LHAs.[11,12] For two municipalities (Rome and Turin) some LHAs are smaller than the municipality. In this cases we have generated a "rappresentative" LHA and aggregated the expenditures and the controls at that level.

7 Results

In this section we present our empirical analysis based on various matrix definitions and different model specifications, devoting more attention to discuss the results on the spatial interaction parameters.

Our analysis starts from testing for the presence of spatial spillovers by means of the Moran's I test. The results, presented in Table 5, confirm the presence of spatial autocorrelation in the residuals, although from this result we cannot infer about the best spatial matrix to use. The values of the Moran's I obtained using $\mathbf{W}$ or $\mathbf{W_w}$ are very similar, while the test seems to suggest that using $\mathbf{W_b}$ leads to a lower level of spatial autocorrelation. The second step is then to decide about the appropriate spatial matrix and the appropriate model specifications. As the latter will be informative for the former, we do not distinguish between the two issues. As clearly shown in table 4, the SDM is the more appropriate model since, independently from the matrix form specification, we reject all the hypothesis that could lead to SAR or SE models.

In terms of regressors, our best specification includes controls for age, sex, immigration rate, the number of clerks, doctors, nurses, public hospital trusts, hospital beds and the level of per capita income, as well as spatial and time-period fixed effects. All variables are expressed in logs. We have also used a second specification in which we add the prevalence of cardiovascular and respiratory diseases and cancer

[11]Available at: http://www.qgis.org/
[12]Available at: http://www.istat.it/it/strumenti/cartografia

Table 4: Wald Test for model selection

	Test
Specification 1	
$H_0 : \theta_a = 0$	2.3***
$H_0 :\theta_a = \rho_a\beta$	6.2***
$H_0 : \theta_w = 0$	1.7*
$H_0 :\theta_w = \rho_w\beta$	16.0***
$H_0 : \theta_b = 0$	3.6***
$H_0 : \theta_b = \rho_b\beta$	2.3***
$H_0 : (\theta_w, \theta_b) = 0$	2.5***
$H_0 : (\theta_w = \rho_w\beta, \theta_b = \rho_b\beta)$	15.8***
Specification 2	
$H_0 : \theta_a = 0$	2.3***
$H_0 :\theta_a = \rho_a\beta$	6.8***
$H_0 : \theta_w = 0$	1.8**
$H_0 :\theta_w = \rho_w\beta$	16.2***
$H_0 : \theta_b = 0$	4.1***
$H_0 : \theta_b = \rho_b\beta$	2.7***
$H_0 : (\theta_w, \theta_b) = 0$	2.5***
$H_0 : (\theta_w = \rho_w\beta, \theta_b = \rho_b\beta)$	15.6***

Note: The hypotheses with $\theta = 0$ are a test for the SAR specification.The hypotheses with $\theta = \rho\beta$ are a test for the SEM specification.

7.1 The spatial effect

In the light of the model presented in section 4, we expect a rational voter, who takes into account the institutional setting when choosing his strategy, to be influenced only by “within” neighbors, which implies that α should be close to zero. As clearly shown in Table 5 our empirical results supports this prediction: by estimating the model with both the “within” and the “between” matrices we see that ρ_w is positive and statistically significant, while ρ_b is not statistically significant and, indeed, very close to zero. The value of ρ_w =0.16 is slightly lower than the interaction effects indicated by Besley and Case (1995) (0.17) and by Sollé Ollé (2003) (0.18), two studies that control for both spatial and time-period fixed effects, but in a tax-setting context.

Indeed, given the Italian institutional setting one might wonder whether a single matrix of “within regions” entries is the most appropriate. We strongly argue against this conjecture for three equally important reasons: *i)* as pointed out before, we test the unconstrained model (with the "within" and the "between" components) and the constrained model (containing only the "within", or the "between", or the "all" components) using a LR test, but reject the null hypothesis that the latter is nested in the former (Table 5); *ii)*using a single matrix is equivalent to run a conditional test, whereas what we propose here is a joint test: while the latter is informative and conclusive, the former is certainly indicative but not conclusive; *iii)* the use of a specification with the two matrices informs us that, even if its spatial coefficient is not significant, the inclusion of the "between" matrix is important since some of the interaction between the $\mathbf{W_b}$ matrix and the regressors are statically significant. We interpret this result as an indication that spatial spillovers are not totally absent between different regions, and most probably they are related to other unobservable factors.

Table 5: SDM estimates by type of spatial matrix.

	SDM W_{all}	SDM W_w	SDM W_b	SDM W_w W_b
	β	β	β	β
Share aged 0-15	0.303	0.537	0.967***	0.598
Share aged 41-50	-0.719*	-0.111	0.687***	-0.155
Share aged 51-65	0.097	0.106	0.956***	0.160
Share aged 66-85	0.205	0.987***	1.291***	1.048***
Share aged over 85	-0.155	-0.175	-0.103	-0.127
Males share	-7.010***	-4.423**	-4.448**	-3.934*
Immigration rate	-0.100**	-0.083**	0.021	-0.094**
Clercks employed p.c.	0.028	0.034	0.030	0.033
Nurse employed p.c.	0.073*	0.039	0.041	0.040
Doctors employed p.c.	0.036	0.073*	0.071*	0.073*
Public hospital trust	0.008***	0.008***	0.008***	0.008***
Hospital beds (1000 inhab)	-0.009	-0.011	-0.028**	-0.014
Income p.c.	0.383**	0.294*	0.378***	0.399**
Spatial				
ρ_a	0.291***	0.293***	-0.023	
ρ_w				0.161***
ρ_b				-0.006
Wx_a	Yes	No	No	No
Wx_w	No	Yes	No	Yes
Wx_b	No	No	Yes	Yes
Likelihood	947.99	949.15	938.32	968.32
Obs	752	752	752	752
LR test (against SDM W_w W_b)	40.66***	38.34***	59.99***	
Moran's I	12.460***	12.295***	1.593***	

*** is 1% confidence level (CL), ** is 5% CL, * is 10% CL

Table 5 investigates more carefully this issue by presenting parameters estimates obtained using different spatial matrices. Focusing on the spatial coefficient we see that the spillover effect obtained using the $\mathbf{W_a}$ or the $\mathbf{W_w}$ matrix alone are very similar in magnitude and both positive and significant, while the estimate of ρ_b with $\mathbf{W_b}$ alone is very close to zero and not statistically significant. The last column of table 5 clarifies the full picture: ρ_w is positive and statistically significant, but lower than the spatial effect estimated with the classical contiguity matrix (ρ_a). Furthermore, the between component is not statistically significant. Hence, these results how that, by not properly taking into account the relationship between LHAs and regions may lead to an upward bias, concluding that spatial spillover are higher than in reality. These results are in line with other studies that analyzed health expenditures in a spatial setting but without controlling for the institutional framework. For example Costa-Font and Pons-Novell (2007) studied the Spanish case with a spatial error model, and found a spillover effect of 0.291, similar, in magnitude, to our ρ_a. Also Barreira (2011), using IV techniques, found even stronger spillover effects (0.43) in the Portuguese context, while Moscone and Knapp (2005) found a lower value (0.12) in they analysis of UK's mental health expenditures.[13]

7.2 Direct, Indirect and Total Effects

In a spatial setting, the effect of an explanatory variable change in a particular unit affects not only that unit but also its neighbors. Hence, the coefficient β is just a component of the total effect, which includes also the coefficients of the spatially lagged regressor and the spatial spillover coefficients. It should be noted that for each regressor we have a $N \times N$ matrix of coefficients, indicating how a change in that regressor influences all the units in the sample. This implies that if K is the number of controls in the model we have $(K \cdot N \times N)$ matrices of indirect effects and K vectors of $N \times 1$ direct effects.[14] The latter are the diagonal elements of the $N \times N$ matrix of total effects and indicate how the dependent variable changes in unit i given the changes in the k^{th} regressor in unit i.

[13]This result may be driven by the fact that the authors analyze a very specific component of health expenditures

[14]The effects can be summarized using the procedure illustrated in Elhorst (2010a)

Indirect effects are, instead, the off diagonal elements of the matrix of total effects and indicate how a change in the explanatory variable in unit i affects the dependent variable in unit j trough a feedback process that could, in principle, pass the effect to all the other units in the sample. As shown in Table 6 the results obtained computing these effects are very different from the simple β coefficients in Table 5 . Furthermore, it should be noted that the direct and indirect effect may go in opposite directions, thus looking only at one of them may not be enough and that, given the longitudinal nature of this study, that the effects we present should be interpreted as "short-run" effects given that we control for time and spatial fixed effects.

The coefficients of the total effects for the share of young and elderly people have the expected signs, positive, and are strongly significant. With respect to the share of people aged between 16 and 40, the omitted reference group, an increase in the share of people aged less than 15 or more than 85 increases the expenditures of LHAs. It is worth noting that the coefficient β for the share of young people in the population is not significant. Also the number of doctors employed per capita has a positive, but smaller, impact on expenditures. We found a negative and significant coefficient for the number of hospital beds for 1000 inhabitants. While we expected a positive sign, more beds should be associated with more inpatient expenditures, we note that this is only a proxy for the supply of hospitalization services: having more beds does not lead to have more patients. The coefficient for the per capita income is positive and significant as expected. Given that income is expressed in logs, we can also infer that public health expenditure is not a luxury good, since the elasticity is lower than 1, and this result is not surprising since the Italian NHS offers health care coverage, regardless of individual income. This result is in line with the findings by Costa-Font and Pons-Novell (2007).

Looking at the βs, gender seems to be a very important control but, once we compute its total effect, the latter turns out to be non significant. The need to properly take into account that contiguous units influence each other also has an effect on the magnitude of the coefficients. For doctors and income, both with positive and significant βs, the total effect is still positive and significant but higher than the βs.

Since these effects are different for each unit and for each covariate in the model, we chose to represent the direct effects and the average total effect using a map so as to visualize the impact on the Italian LHA's. For example in Figure 1 we report the direct, indirect an total effects for the share of people aged from 66 to 85. From its upper left panel we see that the total effect ranges from a minimum of 1.3 to a maximum of 2.4, indicating that, behind the average total effect reported, in Table 6 there is a large heterogeneity across LHAs, with those located in the the regions with the younger population, for example Sicily, Campania or Calabria, exhibiting the lowest total effects. Furthermore, in the lower panel of Figure 1 we report a plot of the indirect effects matrix. On the vertical and horizontal axes we have the 188 LHAs of our sample and from the plot we can see how the spillover effect decays as we move from one neighbor to the next.

8 Conclusions

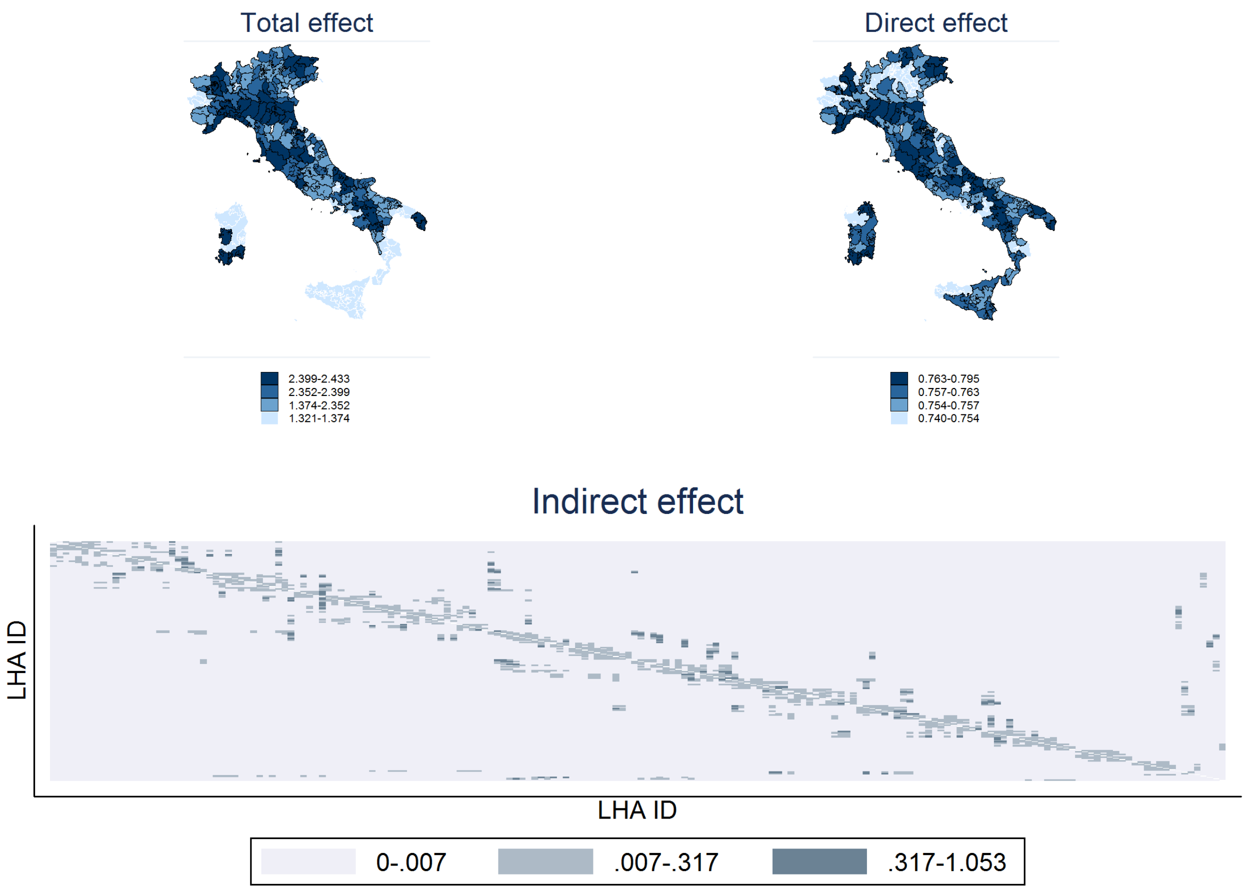
By splitting the matrix in the "within" and "between" regions components, we obtain different matrices that could mimic spatial interactions taking into account the institutional framework. From our viewpoint, this is an important refinement of the result with respect to the existing literature, because when we properly consider the institutional constraints, the spatial interaction may be very than one would conclude without such distinction: this is not a simple robustness check but the difference between a correct as opposed to an incorrect approach.

Table 6: Direct, Indirect and Total effects by type of spatial matrix

	SDM W_{all}			SDM W_w			SDM W_b			SDM W_w W_b		
	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects	Direct effects	Indirect effects	Total effects
Share aged 0-15	0.356	0.858	1.214**	0.605	0.865	1.470***	0.968***	-0.360	0.608*	0.656*	0.534	1.190**
Share aged 41-50	-0.605	1.862***	1.256***	-0.033	1.116**	1.083***	0.679***	0.153	0.832***	-0.103	1.117**	1.014**
Share aged 51-65	0.115	0.318	0.433	0.178	1.015	1.193*	0.955***	-0.832**	0.123	0.251	0.683	0.935
Share aged 66-85	0.257	0.899*	1.156***	0.995***	0.064	1.059***	1.285***	0.678**	1.964***	1.045***	0.797	1.841***
Share aged over 85	-0.144	0.145	0.002	-0.168	-0.091	-0.259	-0.109	0.347***	0.238	-0.127	0.308	0.181
Males share	-7.318***	-4.683	-12.001**	-5.054**	-7.964**	-13.017***	-4.452**	3.533*	-0.919	-4.237**	0.647	-3.590
Immigration rate	-0.095**	0.154**	0.059	-0.071*	0.142***	0.071	0.021	-0.015	0.006	-0.087**	0.115**	0.028
Clercks employed p.c.	0.025	-0.036	-0.010	0.029	-0.060	-0.031	0.030	0.022	0.053	0.029	-0.056	-0.027
Nurse employed p.c.	0.069	-0.074	-0.005	0.040	0.001	0.041	0.042	-0.074	-0.032	0.041	-0.066	-0.025
Doctors employed p.c.	0.045	0.171	0.217*	0.075*	0.015	0.090	0.071*	0.209***	0.280***	0.074*	0.221**	0.295***
Public hospital trust	0.008***	0.000	0.008	0.008***	0.001	0.009*	0.008***	0.001	0.009**	0.008***	-0.001	0.007
Hospital beds (1000 inhab)	-0.011	-0.037	-0.048	-0.012	-0.003	-0.014	-0.028**	-0.046**	-0.073***	-0.016	-0.065**	-0.081**
Income p.c.	0.386**	-0.089	0.297*	0.301*	-0.061	0.239	0.375***	0.088	0.463***	0.398**	0.059	0.457***

*** is 1% confidence level (CL), ** is 5% CL, * is 10% CL

Figure 1: Share aged 66-85. Effects partition



References

Anselin, L. (1988). *Spatial econometrics: methods and models.* London: Kluwer.

Anselin, L. (2003). Spatial externalities, spatial multipliers and spatial econometrics. *International Regional Science Review 26*(131-165), 153–166.

Arbia, G., M. Battisti, and G. Di Vaio (2009). Institutions and geography: Empirical test of spatial growth models for european regions. *Economic Modelling, 27*(1), 12–21.

Baicker, K. (2005). The spillover effects of state spending. *Journal of Public Economics 89*, 29–544.

Baltagi, B. H. and F. Moscone (2009). Health care expenditure and income in the oecd reconsidered: Evidence from panel data. (09/5).

Barreira, A. (2011). Spatial strategic interaction on public expenditures of the northern portuguese local governments. *CIEO - Spatial and Organizational Dynamics Discussion Papers* (2011-2).

Bénabou, R. (1996). Equity and efficiency in human capital investment: The local connection. *Review of Economic Studies 63*, 237–264.

Besley, T. and A. C. Case (1995). Incumbent behavior: Vote-seeking, tax-setting, and yardstick competition. *American Economic Review 85*(1), 25–45.

Bordignon, M. and F. Cerniglia (2003). In search of yardstick competition: a spatial analysis of Italian municipality property tax setting. *Journal of Urban Economics 54*(2), 199–217.

Bordignon, M. and G. Turati (2009). Bailing out expectations and public health expenditure. *Journal of Health Economics 28*, 305–321.

Case, A. and J. Hines (1993). Budget spillovers and fiscal policy interdependence:: Evidence from the states. *Journal of public economics 52*(3), 285–307.

Cliff, A. and J. Ord (1968). *The Problem of Spatial Autocorrelation.* University of Bristol; Joint discussion paper; Department of Economics. University.

Costa-Font, J. and J. Pons-Novell (2007). Public health expenditure and spatial interactions in a decentralized national health system. *Health Economics 16*(3), 291–306.

Elhorst, J. P. (2003). Specification and Estimation of Spatial Panel Data Models. *International Regional Science Review 26*(3), 244–268.

Elhorst, J. P. (2010a). Applied spatial econometrics: raising the bar. *Spatial Economic Analysis 5*(1), 9–28.

Elhorst, J. P. (2010b, jun). Panel Spatial Model Review. pp. 1–30.

France, G., F. Taroni, and A. Donatini (2005). The italian healthcare system. *Health Economics 14*(S1), 187–202.

Francese, M. and M. Romanelli (2011). Healthcare in italy: expenditure determinants and regional differentials. *Temi di Discussione Banca d'Italia* (828).

Giardina, E., M. Cavalieri, C. Guccio, and I. Mazza (2009). Federalism, party competition and budget outcome: Empirical findings on regional health expenditure in italy. *MPRA Paper*.

Glaeser, E., B. Sacerdote, and J. Scheinkman (1996). Crime and social interactions. *Quarterly Journal of Economics 111*, 507–548.

Kelejian, H. H. and I. R. Prucha (1998). A generalized spatial two stage least squares procedure for estimating a spatial autoregressive model with autoregressive disturbances. *Journal of Real Estate Finance and Economics 17*(1), 99–121.

Kelejian, H. H. and I. R. Prucha (1999). A generalized moments estimator for the autoregressive parameter in a spatial model. *International Economic Review 40*(2), 509–533.

Lee, L. F. (2003). Best Spatial TwoStage Least Squares Estimators for a Spatial Autoregressive Model with Autoregressive Disturbances. *Econometric Reviews 22*(4), 307–335.

Lee, L. F. and J. Yu (2010). Estimation of spatial autoregressive panel data models with fixed effects. *Journal of Econometrics 154*(2), 165–185.

LeSage, J. P. (1999). *Spatial and spatiotemporal econometrics.* JAI Press.

LeSage, J. P. and R. K. Pace (2009). *Introduction to Spatial Econometrics.* Taylor & Francis.

Levaggi, R. and R. Zanola (2003). Flypaper effect and sluggishness: evidence from regional health expenditure in ital. *Int Tax Public Finance 10*(5), 535–547.

Lo Scalzo, A., A. Donatini, L. Orzella, A. Cicchetti, S. Profili, and A. Maresso (2009). Italy: Health system review. *Health Systems in Transition 11*(6), 1–216.

Manski, C. (1993). Identification of Endogenous Social Effects: The Reflection Problem. *Review of Economic Studies 60*(3), 531–542.

Moscone, F. and M. Knapp (2005). Exploring the spatial pattern of mental health expenditure. *Journal of mental health policy and economics 8*, 205–217.

Moscone, F., E. Tosetti, and M. Knapp (2007). Sur model with spatial effects: an application to mental health expenditure. *Health Economics 16*(12), 1403–1408.

Parent, O. and J. P. LeSage (2008). Using the variance structure of the conditional autoregressive spatial specification to model knowledge spillovers. *Journal of Applied Econometrics 23*(2), 235–256.

Revelli, F. (2001). Spatial patterns in local taxation: tax mimicking or error mimicking? *Applied Economics 33*(9), 1101–1107.

Revelli, F. (2005). On spatial public finance empirics. *International Tax and Public Finance 12*(4), 475–492.

Rodrik, D., A. Subramanian, and F. Trebbi (2004). Institutions rule: The primacy of institutions over geography and integration in economic development. *Journal of Economic Growth 9*, 131–165.

Sollé Ollé, A. (2003). Electoral accountability and tax mimicking: the effects of electoral margins, coalition government, and ideology. *European Journal of Political Economy 19*(4), 685–713.

Topa, G. (2001). Social interactions, local spillovers and unemployment. *Review of Economic Studies 68*, 261–295.