The range of local public services and population size: Is there a "zoo effect" in French jurisdictions?

Quentin Frère [*]
Hakim Hammadou [**]
Sonia Paty [***]

1 Introduction

Since the seminal work of Borcherding and Deacon (1972) and Bergstrom and Goodman (1973), the estimation of demand functions for publicly provided goods has received much attention in the literature. Based on the median voter model, the papers by Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) suggest that local and state governments provide goods with roughly the same degree of rivalry in consumption as private goods (Reiter and Weichenrieder, 1997). Their analysis assumes that collectively provided goods may be measured using physical units.

However, Oates (1988) emphasizes a drawback to this approach based on the observation that larger cities provide a broader range of services than smaller ones. Basically, the intuition comes from the existence of important indivisibilities for many public goods, such as zoos: "the first 'unit' of output for such goods requiring a substantial expenditure, it is not desirable to provide the good until population reaches a critical size, for which the sum of the marginal rates of substitution equals (or exceeds) the cost of the first unit" (Oates, 1988, p. 88). [1] This is the so called "zoo effect". Thus, an increase in the population generates an increase in local public expenditures both because the degree of rivalry of local public goods is high and because the range of local public goods is broader.

* INRA-CESAER Dijon
** EQUIPPE, Universités de Lille
*** CREM, CNRS et Université de Caen and EQUIPPE, Universités de Lille
Corresponding author, sonia.paty@univ-lille1

1 Central Place Theory, originally proposed by Christaller (1933), is based on a similar idea. As a settlement increases in size, the range and number of its functions will increase. The number of high-order services will also increase.

The zoo effect has strong implications for the design of econometric models. Ignoring it, Borcherding and Deacon (1972) and Bergstrom and Goodman (1973) would erroneously attribute the positive relationship between the level of local public expenditure and the size of jurisdictions exclusively to crowding. Consequently, estimates of congestion may be upwardly biased: the "zoo effect".

However, there is very little empirical evidence of this effect. The pioneering work on this phenomenon was done by Schmandt and Stephens (1960), prior to its formalization by Oates (1988). Using a data set of 19 Milwaukee county municipalities, Schmandt and Stephens (1960) built a service index based on a sharp partition of municipal services into 550 subfunctions [2]. They approximated the range of municipal public services with the number of activities performed by each municipality. As a result, they observed that the bigger the locality, the more diversified the supply of municipal services. To our knowledge, there is no other measure specific to the zoo effect in the literature.

In this paper, we try to test the existence and assess the magnitude of this bias using a dataset of 2,533 local French groups of municipalities (communities). For many years and especially since 1999, the French government has encouraged the creation of voluntary groups of municipalities to solve the problem of "municipal fragmentation" in France. [3] These communities group together several municipalities to enable collective financing and management of some local public services. We focus on the range of local public services provided by the French communities. Local public services typical of these jurisdictions are based on and benefit from substantial economies of scale, allow to internalize spillover effects in production, and reduce coordination difficulties by enabling a higher decision level than the municipality.

Our estimation results provide evidence of a zoo effect in French local jurisdictions. In other words, we find that larger communities provide a broader range of services than smaller ones. Therefore, inter-municipal cooperation seems to provide a way to increase the range of local public services through the supply of new indivisible public goods. We also find that the extent of the zoo effect varies along the urban-rural gradient. It is less intense in rural than in urban communities, suggesting that urban areas enable more substantial economies of scale.

---

2 E.g., "police protection is broken down into 65 categories including foot and motorcycle patrol, criminal investigation, youth aid bureau, ambulance and pulmotor service, school crossing guards, radio communication, radar speed units, and manual traffic control" (Schmandt and Stephens, 1960, pp.370-371).

3 In 2010 there are 36,500 French municipalities, i.e. nearly half the total European municipalities (EU15). Thus, 87% of French municipalities had less than 2,000 inhabitants, accounting for 25% of the metropolitan French population (DGCL - DESL, 2010).

Our contribution extends the existing literature in two ways. First, we study the impact of population size on the range of the local public services provided in the French case for the first time, and contribute to work on the empirical significance of the zoo effect. Second, the issues raised by the zoo effect contribute to the debate on the optimal organization of the public sector. In terms of policy, centralization *vs.* decentralization means the tradeoff between greater economies of scale (i.e. less expensive public services) *vs.* a better match between local public services supplied and spatially heterogeneous citizens' preferences (Tiebout, 1956). The empirical implication of the zoo effect is that there are strong incentives to share the costs of some services among a larger population, that is, to enable bigger local jurisdictions. Finally, in terms of public policy, our results confirm the relevance of government incentives to develop cooperation among local municipalities in more densely populated areas.

The paper is organized as follows. Section 2 discusses the theoretical foundations of the zoo effect. The French institutional context is presented in Section 3 and Section 4 presents the methodology and econometric model. Section 5 provides the results of our estimations.

2 The range of local public services and population size

To describe the zoo effect, we use the general and very simple framework developed by Oates (1988). Let us assume that E, the level of expenditure in one jurisdiction on a range of services is a continuous function of L, the level of individual services, and R, the range of services provided, that is:

$$E=f(L,R) \tag{1}$$

We assume also that both L and R are increasing functions of population size, N:

$$L=g(N) \text{ with } g'(N)>0 \text{ and } R=h(N) \text{ with } h'(N)>0 \tag{2}$$

More specifically, L is defined in the literature as $L = TL/N^{\gamma}$, where TL is the total level of services provided by the jurisdiction with a population N, and γ is the crowding parameter (or the "capturability parameter") such as $[\gamma=\varepsilon_{POP}/1+\varepsilon_{PRICE}]$ where ε_{POP} is the population elasticity of spending, and ε_{PRICE} is the price elasticity of demand.

The total derivative can be written:

$$\frac{dE}{dN} = \frac{\partial E}{\partial L}\frac{dL}{dN} + \frac{\partial E}{\partial R}\frac{dR}{dN} > 0 \tag{3}$$

where both terms on the right-hand side of (3) are positive.

The population elasticity of expenditures for the level of local services becomes:

$$\varepsilon_{POP} = \frac{\partial E}{\partial L}\frac{dL}{dN} = \frac{dE}{dN} - \frac{\partial E}{\partial R}\frac{dR}{dN} = \hat{\varepsilon}_{POP} - \frac{\partial E}{\partial R}\frac{dR}{dN} \quad (4)$$

with $\frac{\partial E}{\partial R}\frac{dR}{dN}$ the zoo effect component and ε_{POP} the real population elasticity in comparison with $\hat{\varepsilon}_{POP}$, estimates of the population elasticity provided by Borcherding and Deacon (1972), and Bergstrom and Goodman (1973). This explains why ignoring the zoo effect leads to upwardly biased estimates of the population elasticity for the congestion parameter.

Our aim is to establish the empirical significance of the zoo effect by testing for its presence and estimating its magnitude. We then focus on estimation of the relationship between the range of public goods and the jurisdiction size, that is $R=h(N)$.

3 The French institutional context

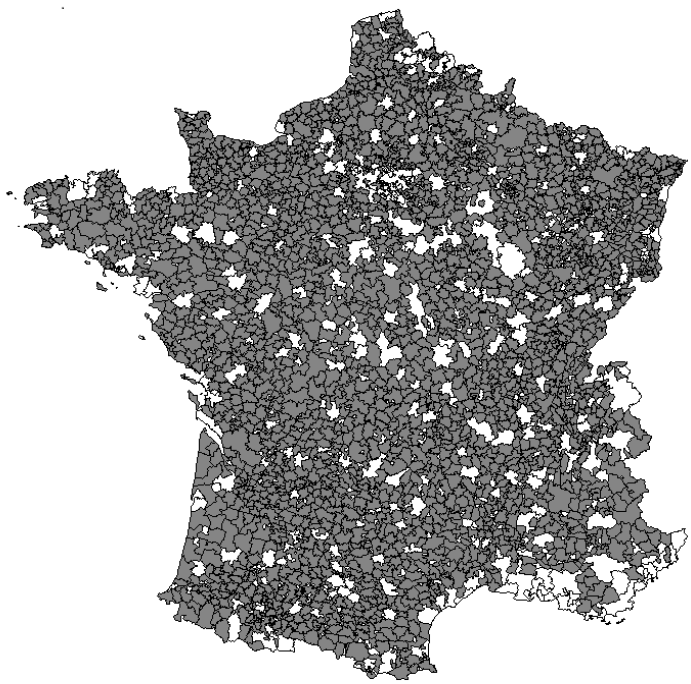
Since the beginning of the 1990s, several laws have been published relating to local cooperation in France. [4] Based on the volunteer principle, neighboring municipalities that want to collectively finance and manage some public services can create, or join, a group of municipalities; let us call it a community. This supra-municipal structure co-exists with the municipal structure and must meet both "exclusivity" and "specialty" principles: the competences assigned to a community do not apply to any other local government unit and delimit the boundaries of their decisional power. Since 1999, this form of local cooperation has been widely promoted by the government, using financial incentives, as a solution to the problem of "municipal fragmentation". Communities, it is hoped, will enable substantial economies of scale that reduce public expenditures and limit fiscal and spending inequalities between member municipalities. This dual objective is targeted by transferring tax and spending abilities from municipalities to communities.

In 2010, 95% of French municipalities belonged to a community. The average community involves 13.2 municipalities. Communities (displayed in Map 1) almost cover the whole metropolitan France (excluding Corsica).

There are three jurisdictional forms for French communities, based on demographic criteria: the *communauté urbaine* (CU), with a minimum of 500,000 inhabitants, the *communauté d'agglomération* (CA), 50,000 inhabitants

4 There are three main laws on the development of communities in France: the law of 6th February 1992 lays the basis for inter-municipal cooperation and was reinforced and simplified by the law of 12th July 1999, and the law of 13th August 2004 which rationalized the inter-municipal map.

Map 1. *Distribution of inter-municipal jurisdictions*



Data source: DGCL (2008) [5]

with a member municipality bigger than 15,000 inhabitants, and the *communauté de communes* (CC) that does not require any demographic criteria. These demographic criteria generate a rural-urban gradient, CUs and CAs being almost exclusively present in the urban space, while communities in rural areas are CCs (see Table 1).

Table 1. *Distribution of the various types of communities on the rural-urban gradient*

	Communauté urbaines	**Communauté d'agglomération**	**Communauté de communes**	**Total**
	(CU)	(CA)	(CC)	
Urban	14	163	1051	1228
Rural	0	2	1317	1319
Total	14	165	2368	2547

Data source: INSEE-INRA (1999) [6], DGCL (2008)

5 DGCL: Direction Générale des Collectivités Locales.

6 INSEE: Institut National de la Statistique et des Etudes Economiques, INRA: Institut Nationale de la Recherche Agronomique.

In practice, municipalities "democratically" decide which services will be delegated to the community among a total of 84, broken down in 14 categories (see Table A in the appendix). More precisely, every service considered – at the qualified majority [7]– as being of "community interest" will be financed and managed collectively by the community. These decisions are made at the time that the community is formed, but changes are possible at any time, on the initiative of the municipal or community councils. The community is managed by a board of delegates elected by member municipalities from their local councilors, at the absolute majority. [8] Therefore, unlike municipalities, "départements" or regions, communities operate under indirect democracy and therefore, remain a decision making level and not a proper administrative level.

The jurisdictional status also involves some compulsory responsibilities. For instance, a CC must take responsibility for at least one service in the category of "spatial planning", and one in the area of "economic development and planning". Similarly, CAs are required to take on one responsibility in each of four specific categories, and CUs are required to take responsibility for six. [9] As a result, the most frequent services supplied by communities are economic planning and development, and garbage collection and treatment (see Table 2). Note that this in line with government aims related to coordination between local policies and economies of scale, which are particularly important in network services.

However, legal commitments are not a bias in our study. Inter-jurisdictional status (CA, CC, CU) may have an impact on the choices made by communities in relation to categories of competences, but more marginally on the number of services they supply. In our sample, only three communities have opted to manage only the minimum number of public services required by law. Moreover, the mean number of services supplied by communities is much higher, with a small standard deviation across communities. The average number of services for the whole sample is 17.5 with a standard deviation of 6.3.

---

[7] Consensus is based on agreement among; (i) the biggest member municipality *and* (ii) two-thirds of the MCs (municipal councils of member municipalities) which represent more than 50% of the community population *or* (ii) 50% of the MCs which represent more than two-thirds of the community population. .

[8] On condition that each municipality must have at least 1 seat, and in order that no single municipality can hold more than the half of the inter-municipal council's seats, the number of seats held will be proportional to the municipal population, or the same for each municipality, or the result of a bargaining process among the municipalities.

[9] In addition to "space planning" and "economic development and planning", a CA must manage at least one service pertaining to "accommodation and housing conditions" and "urban policy"; a CU is required also take responsibility for a service relating to the "environment and living environment" category and one from a list of collective interest services.

4 The econometric model

Here we test the existence and assess the magnitude of the zoo effect among French communities. The basic idea is to estimate the impact of population size (N) on the range of public services (R) provided by communities. At the same time, we assume that the range of local public services depends on some exogenous socio-economic characteristics (X) of the community i.

Our estimation equation becomes:

$$R=h(N, X) \tag{5}$$

More precisely, R is the number of services provided by the community. This database is provided by the DGCL and quarterly updated. For each community, it lists all member municipalities and, based on a national nomenclature, all the services provided, using 14 categories broken down in 84 services (see Table A in the appendix). Data sources for the variables are presented in Table B in the appendix.

N is the total population of the community. For a community grouping n municipalities j with a population Pop_j, N is defined as follows:

$$N = \sum_{j=1}^{n} Pop_j \tag{6}$$

Graph 1 represents the number of services supplied by communities in relation to population size (both in log). We observe first that it would seem to corroborate a positive and linear relationship between the two variables.

Graph 1. *Range of local public services and population size*

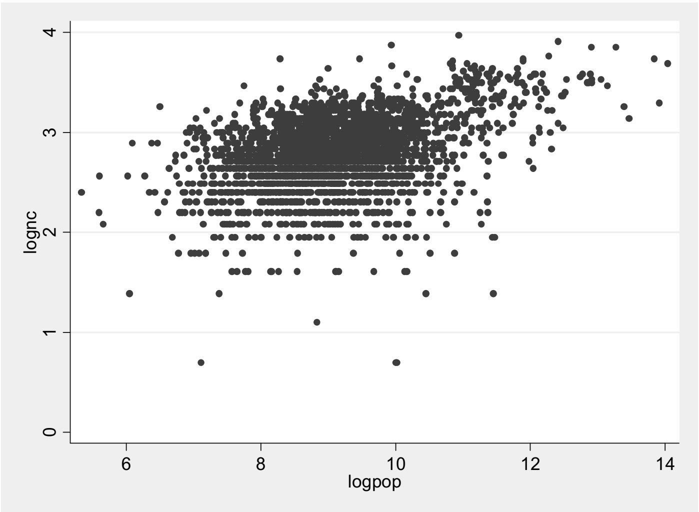


Table 2. *Most frequent services by communities by jurisdictional form and space in the rural-urban gradient*[10]

		The five most frequent services supplied by French communities				
		1st	**2nd**	**3rd**	**4th**	**5th**
By jurisdictional form	COMMUNAUTE URBAINE	Water treatment, piping and supply *(100%)*	Garbage collection *(100%)*	Organization of urban public transport *(100%)*	Road building, planning and maintenance *(100%)*	Local program for living environment *(100%)*
	COMMUNAUTE D'AGGLOMERATION	Economic planning *(99.4%)*	Local program for living environment *(98.2%)*	Organization of urban public transport *(97.0%)*	Economic development *(95.8%)*	ZAC *(93.3%)*
	COMMUNAUTE DE COMMUNES	Economic planning *(89.2%)*	Garbage collection *(85.7%)*	Economic development *(84.9%)*	Garbage treatment *(82.8%)*	Tourism *(80.9%)*
By space on the rural-urban gradient	URBAN	Economic planning *(90.7%)*	Garbage collection *(85.7%)*	Economic development *(84.7%)*	Garbage treatment *(84.4%)*	SCoT (78.0%)
	RURAL	Economic planning *(88.8%)*	Economic development *(86.4%)*	Garbage collection *(85.8%)*	Tourism *(85.6%)*	Garbage treatment *(82.0%)*
	TOTAL	Economic planning *(89.8%)*	Garbage collection *(85.8%)*	Economic development *(85.6%)*	Garbage treatment *(83.2%)*	Tourism *(80.2%)*

10 SCoT and ZAC are town planning documents and responsibilities in the category "spatial planning". Percentages in parentheses denote the fraction of communities in the group considered, that take responsibility for a specific service.

X includes the following variables:

– A Herfindahl index (H) that takes account of the composition of the community in terms of population, that is, using the same notation as in equation 6:

$$H = \sum_{j=1}^{n} [Pop_j / N]^2 \tag{7}$$

The Herfindahl index (H) ranges from 1/n to 1. A high value of this index implies that the municipality includes a small number of heavily populated municipalities, while a low value correspond to a large number of small municipalities. The expected sign for the associated coefficient is uncertain for the following reasons. On the one hand, the number of services provided by the community depends in part on the choice of the municipalities involved to keep a public service at the municipal level, or transfer it to the community level. In other words, they will decide between giving up political power over a particular service (and risking weakening the links with their electorate), and attempting to reap the advantages of economies of scale and increase the coordination with neighboring municipal policies. In essence, the smaller the municipality, the smaller is the range of public services provided and the more responsibilities it will transfer to the community (Leprince and Guengant, 2002). On the other hand, we can assume that if there are few big municipalities (i.e. high H), they can more easily coordinate to transfer expensive services to the community.

– An urban dummy (DU) to take account of the spatial specificities of communities distinguishing between urban and rural communities. This dummy takes the value 1 for communities located in urban areas and 0 otherwise, and provides a check on whether the relationship between the supply of public services and population size differs along the rural-urban gradient. We also interact the dummy DU with population size. More specifically, as spillovers are commonly assumed to be more important for urban areas, we can expect the zoo effect to be more intense in these areas than in rural areas. Indeed, since communities allow spillovers to be internalized, urban municipalities will tend to transfer more competences to the inter-municipal level than their rural neighbors, *ceteris paribus*. Also, since member municipalities' populations become smaller as they become more rural, citizens will have more control over government's actions, and a demand model would provide a better fit than a supply one (Josselin *et al.*, 2009). Consequently, in order to preserve a strong link with citizens' preferences, rural municipalities will tend to retain decisional power for local public services and the zoo effect will be less intense.

– *Surf* is the total surface area of the community. This variable is supposed to take account of some network effects. More specifically, since we are following a *ceteris paribus* reasoning and we are controlling for the total population of the community with N, *Surf* actually measures the impact of population density on the number of services supplied by the community. Therefore, in communities with relatively low population density (i.e. for a given population level, the surface area is relatively large), the gains from economies of scale will be so small that municipalities will be more likely to retain decision-making powers and transfer few services to the community. This seems to apply to particular services, such as "road maintenance" and "water treatment and distribution", and we would expect it to be characteristic of rural communities. [11] Consequently, surface area will have a negative impact on the number of public services provided by the community, especially in rural areas more exposed to network effects.

– U is the unemployment rate in the community calculated as a weighted average of municipal unemployment rates, where the weights are municipality populations. The expected impact of this variable on the number of competences is uncertain. On the one hand, if the existence of the community is seen as a solution to imbalances in the local labor market, we should observe a positive impact. On the other hand, municipalities with relatively high unemployment may prefer to retain decision making power in this sensitive area in order to maintain a close relationship with the voters.
– G is a Gini coefficient that measures inequalities within the community. Based on municipal unemployment rates, this indicator of heterogeneity tends towards 0 when total equality is reached, and towards 1 for maximum inequality. We assume that high heterogeneity within the community provides an incentive to retain some public services (such as social services) at municipality level. Then we can expect a negative sign for this indicator of inequality.
– $Pop15$ and $Pop60$ respectively denote, for each community, the percentage of population aged under 15 and over 60 years. These variables are computed as a weighted average of municipal figures, where the weights are the municipalities' populations. The expected signs are uncertain. We can assume that if the shares of young and old people in the community are relatively high, then municipalities will tend to transfer more competences related to these populations (or corresponding to their demand for local public services particularly high) in order to decrease production costs based on economies of scale, or to improve the quality of the public services. However, municipalities also may wish to keep these competences for electoral reasons.

[11] Alternatively, we could imagine that communities with relatively high population densities (i.e. for a given population level, the surface area is relatively small), there would be some congestion effects that would diminish the net gains released by economies of scale. Also, in that case, municipalities will be less keen, *ceteris paribus*, to transfer these competences. Here, we would expect this phenomenon to be characteristic of urban communities. Yet, none of the responsibilities that community can take on appears particularly sensitive to congestion effects.

Additionally, it would be interesting to study the impact of community political characteristics –such as political color or fragmentation– on the range of local public services provided by the community. However, this information is not available at this level of government. [12]

All variables are log-transformed. Summary statistics are presented in Table C in the appendix. Therefore, we analyze the determinants of the range of local public services provided in French communities, by specifying the model:

$$\ln(R_i) = \beta_0 + \beta_1 \ln(N_i) + \beta_2 DU_i \ln(N_i) + \beta_3 \ln(Surf_i) + \beta_4 \ln(U_i) \quad (8)$$

$$+ \beta_5 \ln(Pop15_i) + \beta_6 \ln(Pop60_i) + \beta_7 \ln(H_i) + \beta_8 \ln(G_i) + \beta_9 DU_i + \varepsilon_i$$

Finally, spatial externalities are accounted for explicitly in our model. Local officials communicate with each other and since communities in closer proximity will be able to communicate more easily, we should observe spatial dependence in the range of local public services provided by communities.

Econometrically, we test for the existence of spatial auto-correlation and use the appropriate specification and estimation procedure based on spatial econometrics developed by, among others, Anselin (1988). We know from the literature on spatial econometrics that equation (8) cannot be estimated consistently using standard ordinary least squares (OLS), if there is spatial dependence. Maximum-Likelihood (ML) or instrumental variables (IV) estimation techniques are needed. The equation for this spatial autoregressive (SAR) model can be written as:

$$\ln(R_i) = \beta_0 + \rho \mathrm{W} \ln(R_{-i}) + \beta_1 \ln(N_i) + \beta_2 DU_i \ln(N_i) + \beta_3 \ln(Surf_i) + \beta_4 \ln(U_i) \quad (9)$$

$$+ \beta_5 \ln(Pop15_i) + \beta_6 \ln(Pop60_i) + \beta_7 \ln(H_i) + \beta_8 \ln(G_i) + \beta_9 DU_i + \varepsilon_i$$

where W is the weighted matrix based on Euclidean distance decay such as $W_{ij} = 1/d_{ij}$ and d_{ij} is the distance between the centers of each community.

Second, the error term in equation (8) can exhibit spatial dependence, i.e. it can be correlated across communities. When there is spatial error dependence, the error vector ε follows the relationship:

$$\varepsilon = \lambda W\varepsilon + \nu \quad (10)$$

[12] More precisely, we know the political color of town councils only for municipalities with more than 3,500 inhabitants. Even if we restrict our data sample to communities where every member municipality respects this criterion, we do not know the exact distribution of seats among municipalities on the inter-municipal council. This, we cannot take account of the political fragmentation, or even the political color, of the communities in our study.

where W is the same weight matrix as in equation (9) and ν is a well-behaved error vector. Spatial error dependence is likely to arise either when ε includes omitted variables that are also spatially dependent (such as the politics of the community) or when there are unobservable common shocks affecting neighboring jurisdictions (such as shocks related to the costs of providing local public goods) (Revelli, 2005).

Case *et al.* (1993) point out that if this spatial error dependence is ignored ($\lambda=0$), estimation of (9) might provide false evidence of strategic interaction. There are several approaches to deal with this problem (see Brueckner and Saavedra, 2000). One is to estimate equation (9) taking account of the error structure given by equation (10), as in Case *et al.* (1993). However, since Anselin (1988) claims that reliable estimation of the two separate parameters might be difficult, we use a different method which separately tests the hypotheses ($\lambda=0$) and ($\rho=0$) using the robust Lagrange multiplier tests developed by Anselin *et al.* (1996).

5 Estimation results

Our estimation strategy is as follows. First, we estimate the model in equation (8) using OLS. The results of this estimation are shown in Table 3, columns 1 and 2. We then run appropriate spatial tests based on the Lagrange multiplier (see Table D in the appendix). The SARMA test allows us to test the general hypothesis of the presence of spatial autocorrelation in our model. [13] By comparing the significance levels of LM_{LAG}, LM_{ERR} and their robust versions RLM_{LAG} and RLM_{ERR}, we can conclude that there is spatial error dependence. [14] We then use a non-linear optimization routine –the ML approach– in order to get unbiased and consistent estimators of the parameters in equations (8) and (10). The estimation results using ML are shown in Table 3. Recall that a significant coefficient of lambda (in equation 10) may be caused either by the existence of omitted variables, which themselves are spatially dependent, or by unobservable common shocks on neighboring communities.

First, let us consider the main issue, which is the relationship between the range of local public services and population size. We find the parameter associated with $\ln(N)$ to be highly significant, with a positive coefficient (Table 4, columns 1 to 4). We can conclude then that the range of public services provided by the community is an increasing function of its population size. Therefore, by gathering the citizens of various neighboring municipalities, communities can promote the range of local public services by supplying new indivisible public goods.

---

[13] Following a chi-square law, the null hypothesis is that there is no spatial autocorrelation.

[14] Following Anselin et al. (1996), if LM_{ERR} is more significant than LM_{LAG} and RLM_{ERR} but not RLM_{LAG} is significant, we are in presence of spatial *error* dependency.

Table 3. *Estimation results*

Estimation technique	OLS (1)	OLS (2)	ML (3)	ML (4)
Intercept	1,6360***	2,0298***	1,5808***	1,9477***
	(<,0001)	(<,0001)	(<,0001)	(<,0001)
Population	0,1429***	0,1038***	0,1422***	0,1056***
	(<,0001)	(<,0001)	(<,0001)	(<,0001)
Population*Du	-	0,0599***	-	0,0556***
	-	(<,0001)	-	(<,0001)
Population -15	0,0425	0,0848	0,0079	0,0469
	(0,492)	(0,1097)	(0,8782)	(0,3721)
Population +60	0,0701*	0,0869**	0,0592	0,0745**
	(0,0598)	(0,0199)	(0,1080)	(0,0436)
Herfindhal index	-0,0054	-0,0068	-0,0004	-0,0008
	(0,6733)	(0,5921)	(0,9746)	(0,9505)
Unemployment	-0,0031	-0,0066	0,0023	-0,0007
	(0,8598)	(0,7049)	(0,8943)	(0,9684)
Surface area	0,0061	0,0094	0,0088	0,0121
	(0,5746)	(0,3858)	(0,4534)	(0,2991)
Gini index	0,0247*	0,0235	0,0309*	0,0301*
	(0,0981)	(0,1144)	(0,0523)	(0,0585)
Urban Dummy	-0,0018	-0,5421***	-0,0068	-0,5083***
	(0,9120)	(<,0001)	(0,6686)	(<,0001)
Lambda			0,7139	0,7118
			(<,0001)	(<,0001)
R^2	0,166	0,1715		
Log likelihood			-837,8551	-830,3576

*p-value in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. All variables except the dummy, are in log.*

Result 1: There is a "zoo effect" in the French communities. In other words, the variety of services provided in larger communities exceeds those in smaller communities.

In order to check if the zoo effect is higher in urban areas, we interact the urban dummy with population size (see Table 3, columns 2 and 4). As expected, we find that the zoo effect is more intense in urban areas than in suburban and rural areas. There may be more substantial scale economies in urban than in rural areas. Moreover, this trend may be exacerbated by the fact that rural communities usually gather small municipalities that prefer municipal management in order to be more in line with the preferences of their citizens (Josselin *et al.*, 2009).

Result 2: The intensity of the "zoo effect" depends on the urban-rural gradient. It is less intense in rural than in urban areas.

This result could have major implications for public policy. Financial incentives for cooperation among municipalities should be fostered in urban areas.

In the specification with interaction terms (results shown in column 4), the impact of urban areas on the range of local public services provided must be interpreted by computing the sum of the intercept and the urban dummy (see Brambor *et al.*, 2005). In this case, the effect of urban areas is significantly positive (1.447), suggesting that the range of local public services is significantly higher in urban than in rural areas.

Let us turn now to the estimation results for the remaining exogenous variables. None of the control variables is significant with the exception of the proportion of older people which has the expected positive sign (see columns 2 and 4 in Table 3). This result reveals that community socio-economic characteristics are not very relevant to the number of services provided. This can be explained by the absence of a direct voting process, or the fact that the degree of integration at the inter-municipal level in the supply of local public services may be more sensitive to local parameters –such as local public decision-makers' preferences for the community– than the socio-economic characteristics of the jurisdiction. This last point is in line with the presence of spatial error dependence in our model (see Table D in the appendix).

6 Conclusion

Since many public goods are indivisible, the range of public goods should increase with jurisdictions' size, which is in line with the zoo effect defined by Oates (1988). Using a dataset of French communities, i.e. local governments that gather several neighboring municipalities in order to manage collectively some local goods, this paper aims at establishing the empirical evidence for this phenomenon. Mobilizing spatial econometrics, the estimation results favor the idea proposed by Oates (1988) that the range of services provided by larger communities is more diversified than those offered by smaller ones. As a consequence of the zoo effect, establishment of a community could be considered as a good way to increase the variety of local public services supplied. Indeed, since by nature communities are bigger than their member municipalities, they are able to provide additional services that the latter would be unable to provide on their own. At the same time, we highlight that the intensity of the zoo effect depends on the urban-rural gradient: it is less intense in rural areas than in urban communities, suggesting that more substantial economies of scale may exist in urban areas or/and are more beneficial due to the internalization of spillovers. In terms of public policy, our results confirm the relevance of government incentives to develop cooperation among local municipalities in more densely populated areas.

As prospects, future research should estimate the degree of congestion in local public goods taking account of the zoo effect. Another extension would be to analyze the zoo effect for different classes of local public goods using discrete choice models.

References

Anselin, L. (1988), "A test for spatial autocorrelation in seemingly unrelated regressions", Economics Letters, Vol.28, No.4, pp.335-341.

Anselin, L., Bera, A.K., Florax, R. and Yoon, M.J. (1996), "Simple diagnostic tests for spatial dependence", Regional Science and Urban Economics, Vol.26, No.1, pp.77-104.

Bergstrom, T.C. and Goodman, R.P. (1973), "Private demands for public goods", The American Economic Review, Vol.63, No.3, pp.280-296.

Borcherding, T.E. and Deacon, R.T. (1972), "The demand for the services of non-federal governments", The American Economic Review, Vol.62, No.5, pp. 891-901.

Brambor, T, Clark, W.R. and M. Golder (2005), "Understanding interaction models: Improving empirical analyses", Political Analysis, Vol. 14, pp.63-82.

Breunig, R. and Rocaboy, Y. (2008), "Per-capita public expenditures and population size: A non-parametric analysis using French data", Public Choice, Vol.136, No.3, pp.429-455.

Brueckner, J.K. and Saavedra, L.A. (2000), "Do local governments engage in strategic property-tax competition?", Econometric Society World Congress 2000 Contributed Papers, No.0357.

Case, A.C., Rosen, H.S. and Hines, J.Jr.. (1993), "Budget spillovers and fiscal policy interdependence: Evidence from the states", Journal of Public Economics, Vol.52, No.3, pp.285-307.

Christaller, W. (1933), Central Places in Southern Germany, in C.W. Baskin (trans.) Die Zentralen Orte in Süddeutschland, Englewood Cliffs, NJ: Prentice Hall.

Josselin, J.M., Rocaboy, Y. and Tavéra, C. (2009), "The influence of population size on the relevance of demand or supply models for local public goods: Evidence from France", Papers in Regional Science, Vol.88, No.3, pp.563-574.

Leprince, M. and Guengant, A. (2002), "Interactions fiscales verticales et réaction des communes à la coopération intercommunale", Revue Economique, Vol.53, No.3, pp.525-535.

Oates, W.E. (1988), "On the measurement of congestion in the provision of local public goods", Journal of Urban Economics, Vol.24, No.1, pp.85-94.

Reiter, M. and Weichenrieder, A. (1997), "Are public goods public? A critical survey of the Demand estimates for local public services", FinanzArchiv, Vol.54, pp.374-408.

Revelli, F. (2005), "On spatial public finance empirics", International Tax and Public Finance, Vol.12, N°4, pp.475-492.

Schmandt, H.J. and Stephens, G.R. (1960), "Measuring municipal output", National Tax Journal, Vol.13, No.4, pp.369-375.

Appendix

Table A. *List of the 14 categories of competences that an community can exert*

Name of the competence category	Max. number of competences that can be exerted by an community
Energy production and supply	6
Environment and living environment	8
Funeral services	3
Sanitation and social	4
Urban policy	4
Local plans of action of crime prevention	2
Economic development and planning	3
Social and cultural development and planning	8
Space planning	14
Road network	3
Tourist development	2
Accommodation and housing conditions	11
Infrastructures	6
Other	10
TOTAL	**84**

Table B. *Data description*[15]

Symbol	Description	Data source (*year*)
R	The number of competences exerted by the community	DGCL (*2008*)
N	Total population of the community	INSEE (*2006*)
H	Herfindahl index focused on the repartition of the community's population among its member municipalities	INSEE (*2006*)
DU	Dummy that takes the value 1 for communities located in urban areas, and 0 otherwise	INSEE-INRA (*1999*)
Surf	Total surface area of the community	INSEE (*2006*)
U	Unemployment rate of the community	INSEE (*2006*)
G	Gini index focused on inequalities between member municipalities regarding unemployment	INSEE (*2006*)
Pop15	Percentage of community's population under 15 years old	INSEE (*2006*)
Pop60	Percentage of community's population over 60 years old	INSEE (*2006*)

Table C. *Summary statistics*

Variable	Mean	Std. Dev.	Min	Max
R	2.7978	.3740	.6931	3.9702
N	9.1267	1.103241	5.332719	14.0411
N*Du	4.6270	4.856279	0	14.0411
pop15	-1.7526	.2041	-3.6375	-1.0818
pop60	-1.4025	.3095	-3.1380	-.4936
U	-2.3613	.4191	-4.6442	-1.0986
Area	9.6540	.6982	5.7930	12.7709
H	-1.6327	.5723	-4.0629	.8599
G	-1.7582	.4871	-6.1261	-.4840
DU	.4833	.4998	0	1

All variables are in log except the dummy.

15 Because of difficulties related to data availability, our database contains files from various years. However, the relatively gradual evolution of the data on municipalities' spatial position on the rural-urban gradient, and data on the competences exerted by communities because of important administrative waiting periods, makes this bias acceptable.

Table D. *Lagrange Multiplier tests*

	SARMA	**LM err**	**LM lag**	**RLM err**	**RLM lag**
(1)	224.1044	212.4778	165.3192	58.7853	0.1939
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.6597)
(2)	213.6013	208.59	168.8851	44.7162	1.1235
	(<.0001)	(<.0001)	(<.0001)	(<.0001)	(0.2892)

p-value in parentheses. Results on line 1 (resp. 2) corresponds to estimation in column 1 (resp. 2) in Table 3.