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The influence of population size on the relevance of demand or supply models for local public goods: Evidence from France*

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Abstract. The relevance of models explaining local public expenditure behaviour may depend upon the size of the population of municipalities. To refine this intuition, the paper puts two alternative specifications in competition, one from the demand side and the other from the supply side. The data set includes 14,900 French municipalities for 1998. The econometric methodology uses a data-sorting method developed to test whether the responsiveness of local governments to voters is stable across small-size and large-size municipalities. It appears that the median-voter model is rejected for the 1,579 municipalities with more than 5,000 inhabitants, for which a supply-driven model fits better.

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1 Introduction

The study of local democracy and of the corresponding provision of public goods has its roots in the spatial voting models of Hotelling (1929). In a context of direct democracy, the demand side reflected by the decisive voter's most preferred level of public good is prevalent. However, institutions matter and local elected officials as well as bureaucrats are not merely cogs on the wheel. They can pursue their own objective, more or less independently from that of the voters: supply no longer strictly reflects demand. This simple but consequential fact has triggered a vast public choice literature, not only in national frameworks, but also at the regional or local levels.

If we focus here on decentralized levels of governments, determinants of public expenditure mainly fit into two broad categories of models, depending on the nature of the decision process (the agenda setting) for the provision of local public goods. On one hand, the agenda setting process can be assumed to be mostly competitive and its results are as close as possible to local

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individual preferences. The latter are usually expressed through the median voter model (Holcombe 1989; Turnbull and Mitias 1999; Turnbull and Geon 2006). In that first case, the demand side is predominant. On the other hand, the agenda setting process may not be perfectly competitive, in which case the supply side does not strictly reflect local preferences. The causes for this departure may lie in bureaucratic behaviour (Wyckoff 1990), ineffective tax structure (Dye and Mac Guire 1997), interest groups (Ahmed and Greene 2000), agenda control (Feld and Matsusaka 2003), or the degree of home rule (Turnbull and Geon 2006).

The first category of models is thus driven by the demand for local public services. Conversely, the second explanation rejects the assumption according to which spending levels are a function of the characteristics (income and tax price) of the median voter. The corresponding models are hence mainly driven by supply. The debate in the literature remains quite open as to the respective virtues of the two categories of models. It nevertheless seems to forget, to our knowledge, an important dimension of the problem, namely the influence of the size of the population on the explanatory power of the competing models. Intuitively, one may hypothesize that the higher the level of government, the less relevant is the median voter model. What is original in our approach is that it tests whether a similar thing happens *within a given level of the government structure*. The rationale behind this hypothesis can be traced back to Tullock (1969) for whom federalism (or more generally multi-level government) cannot separate the problem of efficient government from the question of the size of its constituencies.

The relative relevance of demand or supply driven explanations of public expenditures *across* levels of government is of course particularly important. For instance, Turnbull and Mitias (1999) show that the median voter model applies to the lowest tier of a federal structure, but not to the higher levels of government. The question addressed here is different. Considering a given level of jurisdiction (here local governments), we ask whether the size of the population of a community inside this level of government influences the responsiveness of local governments to the preferences of the electorate. It thus may not be relevant to utilize only one model of explanation for a whole set of jurisdictions, even if they are at the same level. It may indeed be possible that the behaviour of large size communities be best explained by supply driven models while for communities of smaller size, the median voter model would perform better.

This paper intends to test whether the power of the median voter model against a competing model changes with the size of the population within a given level of government. Estimations use data for French municipalities and allow for an unknown breakpoint. The empirical strategy combines the J test proposed by Davidson and MacKinnon (1981) with a test for sample splitting with threshold effect suggested by Hansen (2000). Our findings corroborate the intuition presented above. For small municipalities (with populations under 5,000) the demand side model holds while the supply driven model prevails above this threshold. Responsiveness to local preferences decreases as population increases and as local elected officials thereby get more degrees of discretion.

The paper is organized as follows. Section 2 describes alternative political processes of public good provision, namely the median voter model and a supply driven model. Section 3 presents the econometric methodology. Empirical results are given in section 4, followed by concluding comments and discussion in section 5.

2 Alternative models of public good provision

Following Holcombe (1989), we take the median voter hypothesis as the benchmark for explaining the spending behaviour of a given level of government. This hypothesis states that government behaves ‘as if’ it were maximizing the median voter’s utility. Demand side factors emanating from the local electorate are predominant (subsection 2.1). In counterpoint, elected representatives may depart from a strict commitment to the choice of the median voter. In this case, the supply side prevails. Self interested local officials and bureaucrats are more likely to determine the outcome of local public expenditures (subsection 2.2). Those two alternative models can finally be expressed by their econometric specifications (subsection 2.3).

2.1 The demand side and the median voter's choice

The analytical framework is the following. Local jurisdictions are indexed $i = 1, \dots, I$. Indexes i can be omitted for the moment. Individual consumption of the numéraire is x. Jurisdictions provide a local public good q (not necessarily pure). The utility function of the median voter is then $u_m(x_m,q)$. His or her individual income is y_m and the tax base is b_m. For a tax rate τ, the median voter's individual budget constraint can be written $x_m + \tau b_m = y_m$. Local public expenditures are denoted E while the total tax base is B. Total grants received from other levels of government amount to G. It follows that the budget constraint of the jurisdiction is $E = \tau B + G$. Finally, for a population N in the community, the congestion function is $f(N)$ such that $q = f(N)E$.

We introduce the following per capita variables $e = E/N$, $b = B/N$, $g = G/N$. The program of the median voter combines the previous three constraints:

$$\max_{x_m, q} \quad u_m(x_m, q) \quad \textit{subject to} \quad x_m + \frac{q}{Nf(N)} \frac{b_m}{b} = y_m + g\frac{b_m}{b} \tag{1}$$

Solving this program gives the tax price of the median voter:

$$p_m \overset{def}{=} \frac{\partial u_m / \partial q}{\partial u_m / \partial x_m} = \frac{1}{Nf(N)} \frac{b_m}{b} \tag{2}$$

Furthermore, we distinguish the marginal spending effects of the median voter's income and of his or her share of grants (Turnbull 1998). This is in a way a first departure from the pure median voter model since it conveys the likelihood of fiscal illusion, but the specification remains demand-driven. Under the assumption of log-linearity, the corresponding median voter demand function takes on the following form:

$$q = c_1 p_m{}^{\varepsilon} y_m{}^{\beta_1} \left(g\frac{b_m}{b} \right)^{\beta_2} \tag{3}$$

with c_1 a constant. Coefficients ε, β_1 and β_2 respectively represent tax price elasticity, income elasticity and grant elasticity. Replacing tax price p_m by its value from (2) gives:

$$q = c_1 \left(\frac{1}{Nf(N)} \frac{b_m}{b} \right)^{\varepsilon} y_m{}^{\beta_1} \left(g\frac{b_m}{b} \right)^{\beta_2}$$

Variable q is not observable, but using $q = f(N)E = Nf(N)e$, one obtains:

$$e = c_1 \, [Nf(N)]^{-(1+\varepsilon)} \left(\frac{b_m}{b} \right)^{\varepsilon+\beta_2} y_m{}^{\beta_1} g^{\beta_2} \tag{4}$$

This equation depicts the possible influence respectively of the congestion process, the median voter's tax share, income and grants per head, on per capita local public expenditures.

2.2 The supply side and the representatives' choice

The competing model rests on the supply side of local public expenditures. The 'self-interested' elected politician may depart from the median voter's preferences for many reasons. Bureaucracy, political agenda control, voter information, fiscal and institutional complexity may account for a drastic divergence from the demand for public spending. Consequently, the representative would not have to take into account the characteristics of the median voter: income and tax price of this voter do not appear in the spending equation of the supply side model. The tax share is rather $1/b$ since the representative does not consider the distribution of individual tax bases but only their average level.

The elected politician p is assumed to maximize a popularity function $u_p(q,\tau)$ with $\partial u_p/\partial q > 0$ and $\partial u_p/\partial \tau < 0$. Since it does not take into account the median voter's budget constraint, the program is:

$$\max_{q,\tau} \quad u_p(q,\tau) \quad \textit{subject to} \quad \frac{q}{Nf(N)} = \tau b + g \tag{5}$$

The representative's tax price is thus:

$$p_p \overset{def}{=} \frac{\partial u_p / \partial q}{-\partial u_p / \partial \tau} = \frac{1}{Nf(N)}\frac{1}{b} \tag{6}$$

Assuming again log-linearity, the supply-side expenditure function is:

$$z = c_2 p_p^{\varepsilon} g^{\beta_2} \tag{7}$$

Using (6) and $q = Nf(N)e$, one obtains:

$$e = c_2\,[Nf(N)]^{-(1+\varepsilon)}\left(\frac{1}{b}\right)^{\varepsilon} g^{\beta_2} \tag{8}$$

Equations (4) and (8) provide the theoretical rationale for the econometric specifications of the two competing models of local public good provision. Similarities concern the congestion process, and the influence of grants. Differences come from the absence in the supply model of the income of the median voter as well as of his or her tax base.

2.3 Econometric specifications

We reintroduce indexes $I = 1, \ldots, I$ for each of the local jurisdictions. Congestion is approximated using the classical Borcherding-Deacon function $f(N_i) = N_i^{\eta}$ with $\eta < 0$. Alternative functions can be found in Buchanan (1965) with $f(N_i) = N_i^{\eta_1}\exp(\eta_2 N)$ or in Edwards (1990) with $f(N_1) = \exp(\eta_3 N + \eta_4 N^2 + \eta_5 N^3)$. Guengant et al. (2002) show that the Borcherding-Deacon specification is the one which performs best when the aim is to describe the congestion of local public goods. Moreover, in order to capture the unequal distribution of land across the municipalities, we add the municipal area A_i as an explanatory variable.[1] Finally, dummies for chief towns (the DUMCT variable equals 1 for chief towns and 0 for other cities) have also been

[1] Including density instead of land area could also make sense. However, as density is just the ratio of population to land area and as variables are taken in Logs, both specifications should lead to the same results in our models.

included in order to take into account the fact that public expenditures are higher in those cities because of the presence of regional/provincial/etc. government offices.

Once these effects are introduced into the theoretical expenditure Equations (4) and (8), the regression equations are derived as follows:

Median voter model

$$\begin{aligned} Ln(e_i) = a_0 + a_1 Ln(y_{im}) + a_2 Ln(b_{im}/b_i) + a_3 Ln(g_i) + a_4 Ln(N_i) + \\ a_5 Ln(A_i) + a_6 DUMCT_i + u_i \end{aligned} \tag{9}$$

Competing supply model

$$Ln(e_i) = \alpha_0 + \alpha_1 Ln(1/b_i) + \alpha_2 Ln(g_i) + \alpha_3 Ln(N_i) + \alpha_4 Ln(A_i) + \alpha_5 DUMCT_i + v_i \tag{10}$$

From which population size would the demand model give way to the supply model? To answer this question, we suggest conducting the following testing strategy.

3 Testing strategy

We combine the J test procedure (Davidson and MacKinnon 1981) with a test for parameter instability and threshold effect suggested by Hansen (2000). The median voter and supply models are considered as rival models where the median voter is the null model and the supply model is the alternative. The J test statistic is the ordinary t statistic for $\gamma = 0$ in the following regression:

$$\begin{aligned} Ln(e_i) = a_0 + a_1 Ln(y_{im}) + a_2 Ln(b_{im}/b_i) + a_3 Ln(g_i) + a_4 Ln(N_i) + \\ a_5 Ln(A_i) + a_6 DUMCT_i + \gamma Ln(\hat{e}_i^S) + u_i \end{aligned} \tag{11}$$

where $Ln(\hat{e}_i^S)$ is the vector of fitted values from the OLS estimation of the supply model (*H1* model). Asymptotically, J is distributed as standard normal and Davidson and MacKinnon (1981) show that as $I \to \infty$, if *H1* is true, the probability that $\hat{\gamma}$ significantly differs from zero approaches 1. The sample is split into two groups (or 'regimes'), with one group generated by the *H0* model while the other group is generated by *H1* with an unknown breakpoint. To sum up, we have:

H0: The demand side model continuously holds over the sample.
H1: Under an unknown threshold θ, the demand model holds ($N_i \le \theta$) while beyond this breakpoint the supply model prevails ($N_i > \theta$):

$$\begin{cases} H0: \quad Ln(e_i) = a_0 + a_1 Ln(y_{im}) + a_2 Ln(b_{im}/b_i) + a_3 Ln(g_i) + & i = 1, \ldots, I \\ \qquad a_4 Ln(N_i) + a_5 Ln(A_i) + a_6 DUMCT_i + u_i & \\ \text{and} & \\ H1: \begin{cases} Ln(e_i) = a_0 + a_1 Ln(y_{im}) + a_2 Ln(b_{im}/b_i) + a_3 Ln(g_i) + & N_i \le \theta \\ \qquad a_4 Ln(N_i) + a_5 Ln(A_i) + a_6 DUMCT_i + u_i & \\ Ln(e_i) = \alpha_0 + \alpha_1 Ln(1/b_i) + \alpha_2 Ln(g_i) + \alpha_3 Ln(N_i) + & N_i > \theta \\ \qquad \alpha_4 Ln(A_i) + \alpha_5 DUMCT_i + v_i & \end{cases} \end{cases}$$

The unknown parameter θ is estimated from the data.

Building on the threshold estimation technique suggested by Hansen (2000), we define the indicator function $\psi_i(\theta) = \begin{cases} 0 & \text{for } N_i < \theta \\ 1 & \text{for } N_i > \theta \end{cases}$. The estimated model we use to test for *H0* against *H1* is:

$$\begin{aligned} Ln(e_i) = a_0 + a_1 Ln(y_{im}) + a_2 Ln(b_{im}/b_i) + a_3 Ln(g_i) + a_4 Ln(N_i) + \\ a_5 Ln(A_i) + a_6 DUMCT_i + \gamma\, \psi_i(\theta)\, Ln(\hat{e}_i^S) + u_i \end{aligned} \tag{12}$$

The last step consists in defining $S_1(\theta)$ as the residual sum of squares with the threshold level of the N_i variable fixed at θ. The least squares estimators of θ are given by $\hat{\theta} = \arg\min_{\theta} S_1(\theta)$. It is important to determine whether the threshold effect is statistically significant. In Equation (12), testing for no threshold effect amounts to testing the null hypothesis *H0*: $\gamma = 0$. Hansen (1996) suggests a bootstrap method to simulate the asymptotic distribution of the following likelihood ratio test of *H0*: $LR_0 = \left(S_0 - S_1\left(\hat{\theta}\right)\right) / \hat{\sigma}^2$, where S_0 and $S_1\left(\hat{\theta}\right)$ are the residual sum of squares under *H0*: $\gamma = 0$ and *H1*: $\gamma \neq 0$, respectively; and $\hat{\sigma}^2$ is the residual variance under *H1*. Moreover, Hansen shows that the best way to form a confidence region for $\hat{\theta}$ is to compute the 'no-rejection region' using the likelihood ratio statistic for tests on θ. We now apply this testing strategy to our data set.

4 Empirical results

We begin with a short description of the French local public sector. There are three levels of decentralized government in France. The regions are the upper tier of government and the most recently established one, with 22 regions created in 1986. The intermediate tier is formed by *départements* (numbering 100) while the municipalities or *communes* form the lower tier. There are 36,565 *communes*, providing an impressive specificity of the French local public sector. Average *commune* population is 1,600 compared to an average of 5,200 across the rest of Europe. French *communes* represent nearly half the total number of incorporated local jurisdictions in Europe! Because of alleged difficulties arising from this large number of lower jurisdictions, a move to encourage co-operation between them has been implemented by the French central government since 1992.

There exists a clear distribution of responsibilities between the three tiers of local governments. Regions are mainly responsible for economic development and high school buildings and facilities; *départements* deal with public assistance and buildings and facilities of the *collèges* (middle schools); while municipalities are in charge of public services related to local needs: assistance to individuals, communal roads, municipal police, environment and waste management, water treatment, etc.

In 2004, French GDP amounted to €1,700 billion. Total public expenditure and local public expenditure respectively represented 54% and 10.7% of GDP. Our econometric analysis concerns the municipal level, which accounts for around 60% of local public expenditure. Current expenditures represent from two-thirds to three-quarters of it. Around 50% of municipal public revenue comes from taxation and 30% from central government grants. The remaining 20% is composed of user fees and borrowing. There are four main local taxes in France: *Taxe d'habitation*, an occupancy tax; *Taxe professionelle*, a local business tax; and *Taxes foncières sur les propriétés bâties* and *non-bâties*, developed and undeveloped property taxes, respectively. The rental value of housing is the tax base of the occupancy tax and property taxes while the business tax is mainly based on the capital of firms. Local governments are quite unconstrained in setting tax rates, with only a few limiting rules. In the econometric analysis, the total tax base per inhabitant of the municipality (b) is computed as the sum of the four local tax bases divided by the municipal population, while the tax base of the decisive voter (b_m) is measured by the sum of the occupancy tax base and the property tax bases divided by the population. Variations in the ratio (b_m/b) come mainly from differences in firm location across municipalities. A low ratio indicates that firms bear a high proportion of local taxes which decreases the decisive voter's tax share.

There are three kinds of grants from the central government. *Dotation globale de fonctionnement* (DGF) is lump-sum and partly computed such that it reduces fiscal inequalities among local jurisdictions. It represents more than 20% of total local revenues for communes. *Dotation générale de décentralisation* (DGD) is designed to compensate the transfer of responsibilities to the sub-national governments due to the ongoing devolution process. The DGD and the DGF are adjusted annually and are not earmarked transfers. The *Dotation d'équipement* is designed to help municipalities to finance capital purchases. In our econometric analysis, our variable for per capita grants from the central government, (s), is measured as the sum of these three grants divided by the population.

The data set includes the 14,900 French municipalities with local population greater than 500 inhabitants for 1998. The framework is that of representative democracy. The Appendix gives definitions for all the variables used in the econometric analysis and provides summary statistics. Since the size of the sample is large, the search for the least-square estimators is limited to the grid {0.40%, 0.60%, 0.80% . . . , 99.60%} which contains 500 quantiles of approximately 30 municipalities of increasing population size.

We first verify that there is indeed evidence of a threshold by employing the Lagrange multiplier (LM) test for a threshold (Hansen 1996). Since the threshold is not identified under the null hypothesis of no threshold, the p-values are computed by a bootstrap procedure.

Using 1,000 bootstrap replications, the p-values for the threshold model using local population is highly significant at 0.001, which indicates that there may indeed be a sample split based on local population.

Figure 1 displays a graph of the normalized likelihood ratio sequence $LR_0(\theta)$ statistic as a function of the local population. The least square estimate of θ is the value that minimizes this graph, which occurs at $\hat{\theta} = 448$. This corresponds to a local population of 5033 inhabitants and the percentage of municipalities in the 'small population category' is close to 89.4% of the sample. The asymptotic 95% critical value (7.35) is shown by the horizontal dotted line. Where it crosses $LR_0(\theta)$ it displays the confidence set [442, 450] or equivalently [4540, 5181] when expressed in terms of local population. Figure 1 also indicates that there may be a second dip in the likelihood ratio around [100, 150]. According to the procedure suggested by Bai (1997), we set the threshold at $\hat{\theta} = 448$ and split the sample in two groups based on population. We then search for other thresholds on each sub-sample. None of the bootstrap test statistics were significant and therefore no further splitting was possible with the chosen threshold variable.

In order to evaluate the sensitivity of this result to grid dimension, the search for the least-square estimators of the population threshold is also performed with a grid containing 1,000 quantiles. As in the case of a 500 quantiles-grid, the value corresponds to a local population of 5,033, so that this threshold population level may be assumed to be independent of the initial grid dimension.

Table 1 presents estimates for the threshold regression and for each regime. All coefficients are statistically significant at the 5% level in the threshold model. Recall that the existence of a threshold cannot be inferred simply from the significance level of the coefficient of the term $\psi(N_i > 5033)\,Ln(\hat{e}_i^{\,S})$ since the distribution of the t-statistic for this variable is highly nonstandard under the null hypothesis of no threshold effect. However, the distribution of the

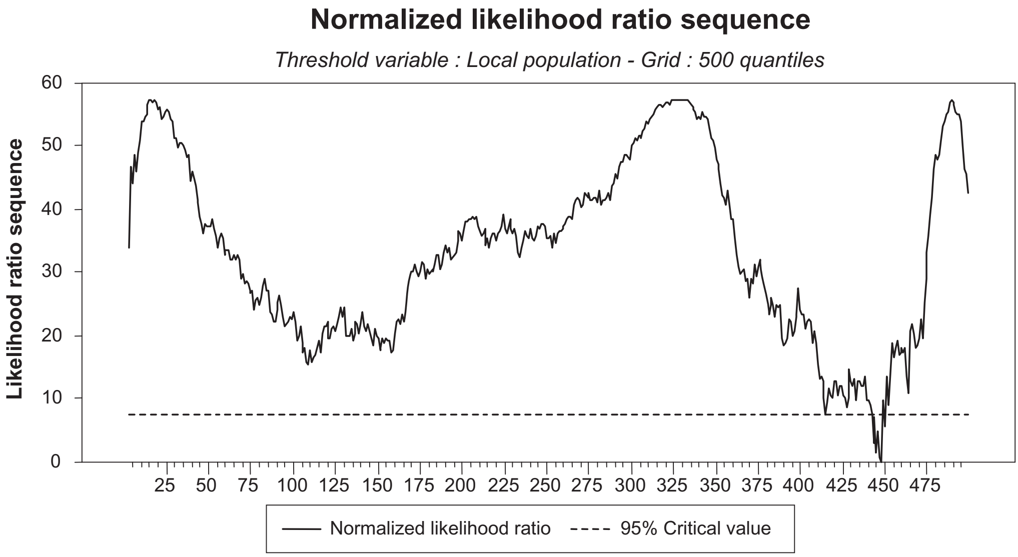

Fig. 1. Determination of the threshold

Table 1. Regression estimates

Independent variables	Threshold regression	Regime 1 $N_i \leq 5{,}033$	Regime 2 $N_i > 5{,}033$
Constant	4.234* (0.097)	4.164* (0.107)	3.379* (0.103)
$Ln(y_i)$	–0.021* (0.009)	–0.018 (0.010)	
$Ln(b_{im}/b_i)$	–0.172* (0.007)	–0.170* (0.007)	
$Ln(1/b_i)$			–0.203* (0.015)
$Ln(g_i)$	0.438* (0.007)	0.435* (0.007)	0.402* (0.013)
$Ln(N_i)$	0.080* (0.003)	0.080* (0.003)	0.065* (0.005)
$Ln(A_i)$	0.053* (0.003)	0.062* (0.003)	0.019* (0.004)
DUMCT	0.178* (0.006)	0.186* (0.011)	0.185* (0.010)
$\psi(N_i > 5{,}033)Ln(e_i^S)$	0.008* (0.001)		
R^2	0.725	0.669	0.755
SEE	0.201	0.205	0.149
Obs.	14,900	13,321	1,579

Notes: Standard errors are given in parentheses. * indicates significance at 5% level.

t-values of all explanatory variables keeps its usual distribution under the alternative hypothesis of a threshold effect.

Taken as a whole, the results seem to indicate that the median voter model is supported by French data for municipalities with population smaller than 5,033 inhabitants. On the other hand, the supply driven model seems to be superior for municipalities with population above this level. The testing procedure seems to support the view that those two models have to be considered as complementary explanations of the level of public good provision in French municipalities.

In order to better evaluate the relative fit of the median voter and supply driven models, we compute residual sum of squares obtained when estimating alternatively the median voter model over the whole sample, the supply driven model over the whole sample, and the combined model. The latter comprehends the median voter model for municipalities with less than 5,033 inhabitants and the supply driven model for those above 5,033 inhabitants. Empirical results are 900.83 for the median voter model, 1,530.49 for the supply driven model and 821.35 for the combined model. The lower value obtained with this last model clearly adds support to the view that both demand and supply models have to be considered as successive explanations of public expenditure behaviour in French municipalities, according to the population size criterion.

The third and fourth columns of Table 1 present coefficient estimates in each regime. Except for the income elasticity estimated with the median voter model, all the coefficients are significant at the usual 5% confidence level. However, as the income variable may be endogenous, the Hausman test is performed to test for endogeneity/exogenity of the income variable. The associated p-value is close to 0.139 so that the null of exogeneity is not rejected by the data at the usual 5% confidence level.[2] Elasticities calculated from price coefficient and grants coefficient estimates behave in the usual way in both regimes. They are negative and significant, respectively $\varepsilon = (\hat{a}_2 - \hat{a}_3) = -0.170 - 0.435 = -0.605$ for Regime 1 (median voter model) and $\varepsilon = \hat{\alpha}_1 = -0.203$ for Regime 2 (supply model). The lower value of the price elasticity in the supply model may be due to the less 'responsive' tax share it takes into account. Moreover, these values are similar to those obtained in other studies, for example McGreer and McMillan (1993) for Canada or Feld (1999) for Switzerland. The income coefficient takes an unusual negative sign in Regime 1 but the estimated coefficient is close to zero and only marginally significant at the 5% level. Testing for a zero income coefficient in this model leads to a p-value of 6.02% so that there is some evidence in favour of zero income elasticity, which is consistent with previous work (Gramlich and Rubinfeld 1982). Grants always have a significant impact on per capita local public expenditures and they appear with the expected positive sign. Finally, population and surface area are also significant.

5 Conclusion and discussion

The intuition according to which median voter based spending models perform less adequately for higher levels of government is usually confirmed by empirical tests (Turnbull and Mitias 1999). To our knowledge, no attempts have been previously made to test the responsiveness of such models inside a given fiscal tier. Our estimations have focused on the lower level of government in France, namely the municipalities or *communes*. Since they present a high degree of variety in population, one may expect that spending decisions need not follow the same model throughout the whole range of local communities. We have thus allowed for an unknown breakpoint and have found that the median voter model is relevant for populations of approximately less than 5,000 inhabitants. Above this threshold, determinants of public good provision no longer significantly build on the characteristics of the median voter (income and tax price). At this stage, we can provide exploratory explanations for what appears to be a significant chasm in public spending behaviour. They can roughly be classified into supply side and demand side explanations.

With respect to the supply side, Turnbull and Mitias (1999) offer two possible hints (but which they do not corroborate in their empirical study). First, they account for the increased complexity of the budgetary structure as population grows. In the French case, larger budgets certainly increase fiscal illusion and possibly generate a sense of remoteness of decisions that

[2] The statistic for the Hausman test is $(\beta^{IV} - \beta^{OLS})' [V(\beta^{IV}) - V(\beta^{OLS})]^{-1} (\beta^{IV} - \beta^{OLS})$ where $(\beta^{IV} - \beta^{OLS})$ is the difference between the instrumental variable (IV) and ordinary least squares (OLS) estimates of the model coefficients, and $[V(\beta^{IV}) - V(\beta^{OLS})]$ is the difference between the covariance matrixes of the IV and OLS estimates. The instrumental variables used in the IV estimates include altitude and the distance to the nearest tourist city.

provides a form of independence for the representative. This independence can be unintended (a kind of isolation effect) or strategic (as in Denzau and Mackay 1983). Second, Turnbull and Mitias (1999) mention urbanization effects: As population grows, the range of services for a given function is provided by an increasing number of overlapping jurisdictions (this is the case for instance with the provision of security or infrastructures). In the case of France, the *communes* basically have the same assignment of prerogatives whatever the size of their population. This is a constitutional statement and changes in prerogatives are legislative decisions that are to uniformly apply to every local community. To use the framework of Turnbull and Geon (2006), French *communes* follow Dillon's rule (local governments do not have a power unless central government uniformly grants them the corresponding authority) rather than Home rule (whereby local governments have a wide degree of self-government).

It nevertheless remains that politicians take their decisions in quite different surroundings whether they are elected in small or large communities. In particular, the direct principal agent relationship between citizens and the elected representatives simultaneously comprehends both the expression stage and the implementation stage of citizens' preferences. As population grows, it is likely that the proportion of professional managers increases. An intermediate principal agent relationship appears which creates two agency levels. The first one (with citizens as principals and representatives as agents) conveys the expression stage of preferences. Expressive voting is then the main rationale for electoral participation (Aldrich 1997). The second agency level (with representatives as principals and professionals as agents) deals with the implementation stage. It is possible that this extension of agency relations would lead to the prevalence of supply side explanations. At least, our empirical analysis cannot reject them.

Furthermore, it is possible that the level of intrinsic motivation of local public officials decreases with the size of the town. Intrinsic motivation relates to the individual's desire to perform his or her task for its own sake, independently from possible rewards and punishments. Public officials would then act in the public interest and consequently closely follow citizens' preferences. However, the implementation stage of the electorate's preferences rests on an agency relation and as such it mostly builds on extrinsic motivation (Bénabou and Tirole 2003). Agents respond to contingent rewards and incentives are mostly material payoffs. This monitoring system has hidden costs (Frey 1997). Bicchieri et al. (2005) show that intrusive monitoring through bureaucratic oversight can generate an atmosphere of low trust, which will result in a decline in intrinsic motivation. Bigger cities have larger bureaucracies that may require tighter agency monitoring. Local officials are thus likely to act in a more self-interested manner when they are employed in larger towns. Their actions may diverge away from the electorate's preferences.

To those supply side explanations can be added demand side factors. Borck (2002) documents how political participation decreases with population size. Since participation is not evenly spread throughout the population, this will possibly shift power from the theoretically decisive median voter. This gives more degrees of freedom for the elected politician to follow his or her own agenda and less interest in taking the median characteristics into account. Another decisive factor of participation in public affairs is the level of information of voters (Mudambi et al. 1996). In smaller towns, information circulates more easily and the involvement of citizens through associations and elections makes it so that the median voter model has a good explanatory power. As the size of municipalities augments, there is more room for redistributive politics and rent seeking by interest groups, all the more so that the cost of such activities can be dispersed among a greater number of taxpayers (Coates et al. 2007 provide evidence of it at the national level). Furthermore, as the impact of individual participation gets smaller, rational ignorance spreads among voters. This line of reasoning fits Olson's theory of groups (Olson 1965, 1982), according to which, there is an inverse relation between group size and individual information levels. Increases in group size decrease the incentive for each individual to be active in becoming informed. Self interested local officials and bureaucrats thus have greater opportunities to diverge away from local preferences.

Taken together, supply side and demand side explanations suggest that the determinants of public spending behaviour do change with increases in population. This may happen both across levels of government and within a given fiscal tier as this paper has demonstrated in the case of French municipalities.

6 Appendix

6.1 Description of the variables

Variable	Content
e_i	Per capita expenditures on local public services (wages of local civil servants, provisions for depreciation, consumption of other inputs). This variable takes account of both strictly municipal costs and contributions to co-operation structures (mainly inter-communal).
y_{im}	Income of the median voter (since the median income is not available, it is replaced by the average one)
b_{im}	Tax base of the median voter which is measured by the sum of the property taxes and occupancy tax bases divided by the municipal population.
b_i	Total tax base per inhabitant (property taxes, local business tax, occupancy tax).
g_i	Grants received by the municipality (which is the sum of the three main central grants to the communes) per inhabitant.
N_i	Municipal population.
A_i	Surface of municipalities.
$DUMCT_i$	Dummies for chief towns (equals 1 for chief towns and 0 for other cities).

6.2 Summary statistics

Variables	Mean	Standard deviation
e_i €	514.09	359.15
y_{im} €	4,545.32	1,245.46
b_{im}/b_i	34.90%	11.74%
$1b_i$	0.08%	0.03%
g_i €	119.49	110.70
N_i	3,364.28	13,214.02
A_i sqkm	1,971.49	1,893.53

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