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Fiscal Federalism

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ON THE DETERMINANTS OF LOCAL TAX RATES: NEW EVIDENCE FROM SPAIN*

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ABSTRACT: This paper studies the determinants of local tax rates. For the two main local taxes in Spain - the property tax and the motor vehicle tax - we test the existence of tax mimicking, yardstick competition and political trends in a sample of 2,713 municipalities. Using different spatial models, the results support the hypothesis of tax mimicking, with coefficients over 0.40. We also show the relevance of political variables such as the ideology of the incumbents and political fragmentation. The fact that incumbents with weaker political support display stronger mimicking behaviour is interpreted as evidence in favour of yardstick competition. Finally, we find incumbents mimic neighbouring municipalities ruled by the same political party, confirming the political trends hypothesis.

JEL Codes: C31, H71, H77

Keywords: Local taxation, tax mimicking, yardstick competition, political trends

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1. Introduction

The setting of local tax rates is the result of a wide set of economic and political factors, both internal and external to the municipality. Among the external factors are changes in state or federal grants (Lago-Peñas, 2008), regional or national economic shocks (Castells et al, 2004), and tax choices made by neighbouring jurisdictions.

This last factor is the main driving force of the recent literature on local tax setting. Empirical studies are usually based on spatial econometrics, where tax choices are represented as a function of choices made by other governments and a series of control variables.

Most of those studies confirm the existence of interactions between municipalities in terms of tax policy. Several explanations for tax mimicking have been provided, including tax competition based on mobility (Tiebout, 1956; for a review see Wilson, 1999), spillovers (Hanes, 2002; Revelli, 2002; Lundberg, 2006; and Solé-Ollé, 2006), and yardstick competition (Salmon, 1987; Besley and Case, 1995). Political yardstick competition is founded on the idea that voters are "rationally ignorant" and use information from other jurisdictions to judge the performance of their own incumbents. Fiscal choices made in nearby municipalities serve as benchmarks.

More recently, Santolini (2008, 2009) has introduced the idea of "social interactions" in order to explain mimicking. Politicians belonging to the same party interact with each other - socially rather than strategically - to draw inferences about party preferences. This mechanism is based on previous work which explains common behavior in terms of a propensity to behave in the same way as a reference group (Redoano, 2007). The main reference group for politicians is their own political party (Geys and Vermeir, 2008a, b) because it aims to provide a common ideological

framework and discourse for its members and impose these on them (Rodden and Wibbels, 2005).

This paper focuses on the strategic interactions in Spanish municipalities. Using a cross-section dataset for 2005 comprising 2,713 municipalities with populations of over 1,000, we test both yardstick competition and the existence of social interactions. We centre our attention on the two main local taxes in Spain - property tax and motor vehicle tax - which jointly represent 66% of local tax revenue.

Our research is of interest for three different reasons. First, Spain is an interesting case study as it is a highly decentralized country, with 17 regional governments and 8,112 municipalities managing 35.8% and 13.4% of total public expenditure respectively.[1] According to the *Regional Authority Index*[2] computed by Hooghe et al (2010), on the basis of data for 2005 Spain is placed sixth after Germany, Belgium, USA, Canada and Italy. Second, we test the existence of tax mimicking, yardstick competition and political trends and provide an extensive review of the literature on these topics. Third, from a methodological standpoint we estimate spatial lag, spatial Durbin and two-regime spatial lag models, with several definitions of the weight matrix. Furthermore, following the proposal by LeSage and Pace (2009), we compute the total, direct and indirect impacts of the explanatory variables.

The paper is organized as follows. Section 2 provides a review of the related literature. In Section 3, the model and the econometric issues of estimation are discussed. In Section 4 we present the data and the main results of the empirical analysis. Section 5 concludes and offers possible extensions of this work.

[1] Data for 2006 from the OECD biennial publication "Government at a Glance 2009." The central government spends 22.4% and the remaining 28.5% corresponds to Social Security expenditure. In terms of the percentage of expenditure corresponding to central government, Spain has the third lowest share of the OECD countries, behind Switzerland with 14.8% and Germany with 19.1%. The OECD average was 43.9%.

[2] Regional authority is measured across eight dimensions: institutional depth, policy scope, fiscal autonomy, representation, law making, executive control, fiscal control and constitutional reform.

2. Literature review

Previous work on yardstick competition in local taxes and related topics is reported in Table 1.[3] Since the seminal paper by Case (1993) for the United States, there has been an increasing interest in these topics, especially over the last five years. Bordignon et al (2004) showed that "yardstick competition theory is too weak to produce well-defined empirical predictions concerning the fiscal choices of neighbouring jurisdictions, and some of the possible theoretical solutions do not involve mimicking behaviour at all". However, based on different methodological approaches, most empirical papers support the existence of comparative performance evaluation. Only one of the revised papers, Edmark and Agren (2008), does not confirm this cause of strategic interactions, while Bordignon et al (2003) and Santolini (2008) found partial evidence of yardstick competition.

Studies on yardstick competition rely upon cross-section or panel data. Both kinds of datasets have advantages and drawbacks. Panel data allows controlling for unobserved fixed local specifications. On the other hand, the cross-section approach allows a large domain for the data and avoids the problems posed by structural changes in factors such as tax laws. Moreover, these studies are based on either a tax-reaction function or a vote-function framework. The former has been followed by Allers and Elhorst (2005), Dubois et al (2007), Edmark and Agren (2008), and Deskins and Hill (2010), while the vote function has been used by Solé-Ollé (2003), Vermeir and Heyndels (2006), Bosch and Solé-Ollé (2007) or Dubois and Paty (2010). There are different ways to test the yardstick competition hypothesis (Elhorst and Fréret, 2009): i)

[3] For surveys on strategic interactions, see Brueckner (2003), Allers and Elhorst (2005) and Delgado and Mayor (2010). See also the study on tax innovation carried out by Ashworth et al (2006) focusing on the establishment of new taxes. With data from 17 EU countries over the period 1970-1999, Redoano (2007) confirms the yardstick competition hypothesis for income tax.

two-equation spatial lag model; ii) spatial lag model with cross-products; and iii) two-regime spatial lag model. The first approach has been followed by Besley and Case (1995) and the second has been used by Case (1993), Schaltegger and Küttel (2002) and Solé-Ollé (2003), using an instrumental variables procedure. The third has been followed by Bordignon et al (2003) and Allers and Elhorst (2005), both using maximum likelihood estimators.

The papers devoted to date to the Spanish case are Solé-Ollé (2003) and Bosch and Solé-Ollé (2007) for yardstick competition and Delgado and Mayor (2010) for tax mimicking. Solé-Ollé (2003) analysed several local taxes for 105 municipalities of the province of Barcelona with panel data corresponding to 1992-1999. He found that tax rates were higher with wider electoral margins, with leftist incumbents, and in non-election years. Bosch and Solé-Ollé (2007) studied the effective rates of the local property tax in 2,799 municipalities with data for the period 1991-2003. They showed the existence of comparative voting behaviour, whereby higher taxes translate into a loss of votes. Both of these papers used a spatial lag model with cross-products and estimated vote functions. Finally, Delgado and Mayor (2010) studied tax mimicking in the main local taxes in a sample of municipalities located at the northern Spanish region of Asturias. They estimated both spatial lag and spatial error models for the tax reaction functions and their empirical evidence partially supports the existence of tax mimicking.

Table 1: Survey of literature on local yardstick competition and related topics (taxation)

Study	**Socio-economic and demographic variables**	**Political variables**	**Weight matrixes and Estimation procedure**	**Main results**
Case (1993) United States (States) Income tax Panel data, 1979-1988	Population Black, elderly, young population Per capita income Per capita grants Unemployment rate	Party	Contiguity matrix Tax reaction function Instrumental variables	Yes.
Besley and Case (1995) United States (States) Several taxes (sales, income and corporate) Panel data, 1960-1988	Young population (5-17) Elderly population (65+) Per capita income Unemployment rate Debt	Leader age	Contiguity matrix Vote and tax reaction functions Instrumental variables and maximum likelihood	Yes. Vote-seeking and tax-setting are tied together.
Schaltegger and Küttel (2002) Switzerland Revenue 26 cantons Panel data, 1980-1998	Population Ratio of urban population Per capita income	Ideology Coalition Fragmentation Autonomy	Contiguity matrix Other W: similar population, income Tax reaction function	Yes, but institutions of direct legislation and fiscal autonomy matter in the policy mimicking
Bordignon et al. (2003) Italy (Milan) 143 municipalities > 4,000 inhabitants Property tax Cross-section, 2000	Population Young population Elderly population Area Urbanization rate Unemployment rate Per capita income Per capita grants	Party Vote share Last election or re-election Election year	Contiguity matrix Tax reaction function Maximum likelihood	Yes, but partially Positive spatial autocorrelation in tax rates when mayors run for re-election. No interaction when mayors face a term limit or large majorities
Solé-Ollé (2003) Spain (Barcelona) 105 municipalities > 5,000 inhabitants Several taxes Panel data, 1992-1999	Population Per capita fiscal base Per capita income Per capita grants	Party Electoral margin (% from 50%) Ideology	W: distance (20 km) Other W: size (population), economic, political Vote function Instrumental variables	Yes. Tax rates are higher with bigger electoral margins, with leftist incumbents and in non-election years

Table 1: Survey of literature on yardstick competition and related topics (taxation) (cont.)

Study	Socio-economic and demographic variables	Political variables	Weight matrixes Estimation procedure	Main results
Allers and Elhorst (2005) Netherlands 496 municipalities Property tax Cross section, 2002	Population Low-income households rate Property value Per capita income Per capita grants	Party Majority	Contiguity matrix (also a matrix with large municipalities) Tax reaction function Maximum likelihood	Yes. Voters penalize incumbents for anticipated tax rate differentials, but not for unanticipated
Vermeir and Heyndels (2006) Belgium (Flanders) 308 municipalities Income and property tax Panel data, 1988-2000	Unemployment rate Per capita income Per capita expenditure (Tax rates)	Prior vote share Number of government parties	Contiguity matrix Vote function Instrumental variables	Yes. Incumbents are punished for higher rates, more intensely with lower rates in neighbouring jurisdictions
Bosch and Solé-Ollé (2007) Spain 2,799 municipalities >1,000 inhabitants Property tax Panel data, 1991-2003	Population Per capita unemployment	Party Coalition First or following	Based on pure proximity: 10, 20, 30 and 40 km thresholds. They applied 20 km threshold based on the fit results Vote function Instrumental variables	Yes. Evidence of "comparative voting behaviour" (a tax increase bigger than the others municipalities has an important vote loss)
Dubois et al (2007) France 93 departments Business tax Cross-section, 1999	Population Old people Area Urbanization rate Unemployment rate Per capita grants Per capita income	Electoral margin Political proximity Ideology	Contiguity matrix Tax reaction function Maximum likelihood	More evidence of partisan government than Leviathan government hypothesis

Table 1: Survey of literature on yardstick competition and related topics (taxation) (cont.)

Study	**Socio-economic and demographic variables**	**Political variables**	**Weight matrixes Estimation procedure**	**Main results**
Fiva and Rattso (2007) Norway 301 municipalities Property tax Cross section, 2001	Population Children (0-5) Young population (6-15) Elderly population (+67) Rural (share pop at rural areas) Income distribution Per capita income Per capita grants	Political fragmentation Party	Contiguity matrix Estimation: spatial model with discrete dependent variable; spatial latent variable approach (Bayesian)	Yes. Importance of political factors: more socialists in the council and more party fragmentation are associated with higher propensity to have property tax
Edmark and Agren (2008) Sweden 283 municipalities Income tax Panel data, 1993-2006	Population Young population (0-15) Elderly population (65+, 75+) Unemployment rate Per capita income Per capita grants	Party Majority Election year	Contiguity matrix Tax reaction function Instrumental variables	No. Similar interaction between weak and strong majority, and in election years
Santolini (2008) Italy (Marche region) 246 municipalities Property tax Cross section, 1994	Population Elderly population (65+) Area Coast situation Per capita income Per capita grants	Electoral distance (% vote until 100%) Coalition Majorities Election year	Contiguity matrix with same coalition/party Two spatial autocorrelation regimes and three spatial regimes to distinguish between election year and non election year Spatial lag model introducing a spillover variable	Yes, but partially: Yes, regarding right-wing coalitions No, between small and large majorities No, in election years Political trends
Dubois and Paty (2010) France 104 municipalities > 50,000 inhabitants Housing tax Panel data, 1989-2001	Tax rate	Vote share previous national election Vote share previous local election Prime Minister´s popularity Years as mayor Public positions in the past Re-election	W1: Geographical (belong to the same urban area, 1/dij) W2: Geographical and demographical (nearby cities where population is >50.000 inhab., 1/dij) Vote function Instrumental variable	Yes. The relevant neighbours are the economic ones –similar population- and not the geographical ones –belong to the same urban area-.

Table 1: Survey of literature on yardstick competition and related topics (taxation) (cont.)

Study	**Socio-economic and demographic variables**	**Political variables**	**Weight matrixes Estimation procedure**	**Main results**
Deskins and Hill (2010) United States States Personal income tax and sales tax Panel data, 1978-2006	Population density Median income College education Unemployment rate Age 25-44 population Age 45-64 population Elderly population (65+)	Party Election year	W1: Contiguity matrix W2: Contiguity and relative populations W3: Distances Tax reaction function	Temporal perspective: the responsiveness of one state of the tax policy of the neighbouring states may change over time

Source: own elaboration

3. The model and estimation procedure

To test the tax mimicking hypothesis the first step is to define the tax-setting function. This function is then estimated using both a spatial lag model and a spatial Durbin model.

The spatial lag model follows the expression:

$$T = \rho WT + \alpha P + \beta X + \varepsilon \quad (1)$$

where T is the tax vector, P is a vector of political variables, X is the vector of control variables that includes a set of socioeconomic factors, and W is the weight matrix.

In the tax competition literature, the dominant specification strategy is the so-called "specific-to-general" strategy, based on the result of the Lagrange Multiplier test and its robust version (Florax et al. 2003). However, a recent paper by Mur and Angulo (2009) shows that the "general-to-specific" strategy seems to be more robust to the existence of anomalies in the Data Generating Process. Hence, they proposed a more complex model as a starting point, such as the Spatial Durbin Model. From an economic point of view, Lesage and Pace (2009) and Elhorst (2010) draw on the contribution of Manski (1993), who pointed out that three different interaction effects may explain the spatial pattern of an economic phenomenon: an endogenous interaction effect, an exogenous interaction effect and a correlated effect. These authors assert that the best strategy to test for spatial interaction effects is to start with the most general model, e.g. the Manski model. In order to avoid parameter identification problems, Lesage and Pace (2009) propose the exclusion of the spatially autocorrelated error term and specify the Spatial Durbin Model.[4]

The spatial Durbin model extends equation (1) by including the exogenous interaction effect through the spatially lagged independent variables (*WX* and *WP)*:

[4] If the spatial dependence in the dependent variable or independent variable is ignored, the estimator of the coefficients is biased and inconsistent. On the other hand, the omission of the spatially autocorrelated error term only causes a loss of efficiency.

$$T = \rho WT + \alpha P + \beta X + \alpha' WP + \beta' WX + \varepsilon \qquad (2)$$

In order to test for yardstick competition, the third step is to define a spatial lag model with two regimes represented by a dummy variable (*D*). When the focus is on the majorities, *D* is coded 1 if the corresponding incumbent enjoys a strong majority, defined as a vote share of 50% or more,[5] and 0 otherwise. *B* is a diagonal matrix ($n \times n$) with diagonal elements equal to 1 when *D*=1 and (*I-B*) is its complementary matrix with diagonal elements equal to 1 when *D*=0. *BWT* is the average tax rate of the contiguous municipalities with strong majorities while *(I-B)WT* is the average tax rate of the contiguous municipalities without strong majorities.

$$T = \rho_{D=1} BWT + \rho'_{D=0}(I-B)WT + \mu_{D=1} + \mu'_{D=0} + \alpha P + \beta X + \varepsilon \qquad (3)$$

where the parameters $\rho_{D=1}$ and $\rho'_{D=0}$ measure the intensity of the tax interaction of municipalities belonging to the first and the second regimes respectively. If fiscal policy interaction is driven by yardstick competition, we expect the interaction coefficient $\rho_{D=1}$ to be significantly smaller than the interaction coefficient $\rho'_{D=0}$. Different political regimes may also set different taxes regardless of the explanatory variables and the tax mimicking behavior. Two different intercepts ($\mu_{D=1}$ and $\mu'_{D=0}$) are therefore included in the model to capture this. A similar approach is followed when we study the effect of ideology.

The matrix W is defined according to several alternative criteria. First, we consider the contiguity matrix as a benchmark. Second, we use the k-nearest neighbour approximation with k= 4, 5, and 6, presenting the results with the k=4 alternative. The results are similar but we choose this matrix to control for the number of neighbours and the estimation problem caused by a too dense spatial weight matrix. Third, we define a matrix based on distance, concretely a distance less than 20 km (as in Solé-Ollé, 2003).

[5] Percentages of 60% and 70% were also considered as thresholds.

Finally, the political trend hypothesis is defined by Santolini (2008) as follows: "the incumbent politician mimics the tax rates of neighbouring jurisdictions governed by politicians belonging to the same party". Hence, we estimate a spatial lag model considering the tax interactions between contiguous municipalities with incumbents controlled by the same political party. This is achieved by analysing the spatial parameter (ρ) using a *W* coded 1 when jurisdictions *i* and *j* are neighbours and are ruled by the same political party, and 0 otherwise.

There are four different methods for estimating models that include spatial interactions: maximum likelihood (ML), instrumental variables (IV), Generalized Method of Moments (GMM) and the Bayesian Markov Chain Monte Carlo[6] (MCMC). In the 1980s and 1990s one of the problems of this last method was its computational cost but nowadays this has been solved. IV and GMM methods are less computationally burdensome and they do not rely on the normality assumption. However, these methods do not guarantee that the spatial coefficient estimates belong to its parameter space. In this case, the models described above are estimated by means of maximum likelihood (ML).

Another issue is how the coefficients in a spatial regression model should be interpreted. In the spatial lag model, any change in the dependent variable for a single municipality may affect the dependent variable in all the other municipalities. A change in the value of a political or demographic variable associated with a municipality will affect the municipality's own tax rate (direct effect) and if a spatial interaction exists it will also affect the tax rate of all other jurisdictions (indirect effect). This distinction is introduced by Lesage and Pace (2009). Furthermore, these effects are different in each

[6] See Lesage and Pace (2009).

municipality so it is necessary to present an average value[7] as proposed Lesage and Pace (2009).

The direct impact shows the average response of the dependent variable to the independent variables, including feedback influences that arise from impacts passing through neighbours and back to the municipality itself.[8] The indirect impact tackles the effect that any change in a jurisdiction has on others and how changes in all municipalities affect a given jurisdiction.

4. Data and results

4.1 Data

Our empirical analysis is focused on the two main local taxes in Spain: the property tax and the motor vehicle tax. These account for 50% and 16% of local tax revenue respectively. With regard to the local property tax, we adopt two different indexes. The first is the nominal tax rate, which is freely chosen by municipalities within an interval defined in national laws. However, liabilities depend not only on tax rates but also on the value of real estate assigned by the Spanish cadastral office (the tax base). Insofar as periodical reassessments are made every ten years or more and at different dates in each municipality, real estate values tend to be significantly higher in those municipalities with the most recent reassessments. Hence, as a second index we use the amount per receipt as a proxy of the effective tax rate. Regarding the motor

[7] The direct effect is measured by the average of the diagonal elements of the matrix $(I-\rho W)^{-1}$ times the coefficient $(\beta \ or \ \alpha)$ of the corresponding variable and the indirect effect is measured by the average of either the row sums or the column sums of the non-diagonal elements of the matrix $(I-\rho W)^{-1}$ times the coefficient $(\beta \ or \ \alpha)$ of the corresponding variable.

[8] The main diagonal of higher-order spatial weight matrixes is non-zero, which allows us to collect these feedback effects.

vehicle tax, municipalities can increase the quotas established by the central government with a coefficient ranging from 1 to 2. We use this coefficient as the local tax choice.

As explanatory variables, we consider the following:

a) structural and socio-demographic features:

- population (in thousands)
- area (km^2)
- percentage of population under 15 years
- percentage of population over 65 years
- unemployment rate

b) fiscal indicators:

- per capita grants received

c) political factors:

- ideology. Two dummies are defined to capture ideological differences of incumbents. The first is coded 1 in the case of leftist governments and 0 otherwise, while the second is coded 1 for rightist governments and 0 otherwise.
- electoral distance. In order to proxy political support enjoyed by incumbents and confidence in re-election, this variable is defined following Santolini (2008) as the difference between 100 and the share of the vote of the mayor's political party.
- political fragmentation. This is measured by the Herfindahl index, in line with Fiva and Rattso (2007). It is computed as the sum of the squares of the shares of each party's councillors. Hence the index is 1 if one party has all the councillors.

All estimates use cross-section data from year 2005, a non-electoral year. Local elections in Spain are celebrated each four years in May (2003, 2007). The electoral data corresponds to the municipal elections celebrated in 2003. Data for all the control variables are available for 2005. Only Spanish municipalities over 1,000 inhabitants are included, so the sample contains 2,713 local governments.

Table 2 reports some descriptive statistics. Regarding the political variables, 54% of local jurisdictions are ruled out by left-wing political parties and about 39.5% by rightist governments. The remaining municipalities are governed by centrist political parties or ideologically undefined local political parties. The average electoral distance is 46.25% and the mean political fragmentation is 0.44, with a range between 0.16 and 1[9].

Table 2: Descriptive statistics

Variable	Mean	S. D.	Minimum	Maximum
Dependent variable				
Property tax – nominal rate	0.6241	0.1635	0.3000	1.1600
Property tax – per receipt amount	141.22	92.74	12.75	1040.25
Motor vehicle tax rate	1.3020	0.2609	1.00	2.00
Explanatory variables				
Population (thousands)	12.998	77.23	1.002	3155.359
Area	102.59	139.53	0.36	1752.61
Share of population under 15 years	13.60	3.60	2.66	27.78
Share of population over 65 years	20.37	7.59	3.03	49.36
Unemployment rate	6.76	3.18	0.09	22.99
Per capita grants received	399.40	303.70	100.58	5244.70
Leftist incumbent	0.5396	-	0.00	1.00
Rightist incumbent	0.3951	-	0.00	1.00
Electoral distance	46.25	13.66	0.00	94.12
Political fragmentation	0.4439	0.1104	0.1557	1.00

Sources: Spanish Ministry of Economics and Public Finance, Spanish Home Office, Spanish Ministry of Public Administrations, Spanish Statistics Institute (INE). N= 2,713.

[9] A value of 1, corresponding to cases where there is only one party in the council, occurs for only 10 municipalities.

As a first test of the spatial pattern of the data, Moran statistics on dependent variables are reported in Table 3. The results corroborate the existence of positive spatial autocorrelation, which justifies our empirical approach. Spatial patterns seem to be similar when neighbours are defined by k-nearest neighbours and distance (20 km), but the contiguity-based results indicate lower spatial autocorrelation, and no autocorrelation in the per receipt amount in the property tax.

Table 3: Moran statistics on tax choices

	Property tax - Nominal rates	Property tax - Per receipt amount	Motor vehicle tax
a) Contiguity			
Moran	0.1286***	-0.0037	0.1783***
(z)	(4.35)	(-0.08)	(6.02)
b) k=4-n-n			
Moran	0.4600***	0.1266***	0.4813***
(z)	(28.13)	(7.81)	(29.42)
c) 20 km			
Moran	0.4364***	0.1470***	0.4714***
(z)	(41.13)	(13.90)	(44.43)

*** Significant at 1%

4.2 Results for the tax mimicking hypothesis

The main results in relation to the tax mimicking hypothesis are reported in Tables 4 to 6. For the sake of brevity, we only show results with k-nearest neighbours with k=4.

For the nominal tax rate of property tax (Table 4), the spatial coefficient is significant (0.48) and political variables matter. Leftist incumbents tend to choose higher rates. On the other hand, electoral distance and political fragmentation are not significant. The remaining variables do not appear to have a systematic effect on the tax rate, except for area and the share of elderly population. For the per receipt amount (Table 5), the spatial parameter is also significant but lower, at around 0.10. In this case, population, area and share of elderly population are significant. Regarding the political

variables, the dummies for both leftist and rightist incumbents are not significant but electoral distance and political fragmentation play an important role.

In the case of the motor vehicle tax (Table 6), mimicking behaviour is confirmed and found to be strong, with a parameter ρ=0.43. Now, all of the control variables are significant except the proxy for young people and rightist governments. Again, leftist governments tend to set higher taxes. Electoral distance and political fragmentation, on the other hand, are negatively related to tax rates.

In summary, the results show a positive and significant coefficient on the parameter ρ for both the property tax and the motor vehicle tax. Having confirmed tax mimicking, the following sub-sections explore the potential relevance of both yardstick competition and the political trends hypothesis, according to which there is a link between spatial interactions and some attributes of the political process.

With regard to the so-called "flypaper effect", the coefficients on per capita grants are negative and significant except for the nominal rates of property tax. Therefore, our estimates provide evidence in favour of the median voter model and reject the flypaper effect[10].

Once the coefficients are estimated, the impacts can be calculated based on the proposal of LeSage and Pace (2009) to decompose the total impact into direct and indirect impacts. As stated above, the first one reflects the impact of a one-unit change in the covariate on the dependent variable corresponding to the spatial unit (municipality) of interest. The second shows the impact of a one-unit change in the covariate on the dependent variable of first-order neighbours of the spatial unit of interest. Detailed results are reported in Tables 7 to 9.

[10] See Boarnet and Glazer (2002) for an application to the US or Dahlberg et al (2008) for Sweden.

If these models are estimated by OLS, the indirect impact of a change in one of the explanatory variables is set to zero. In the spatial lag model for the property tax rate, the indirect effect represents approximately a quarter of the direct effect for area, population over 65, leftist incumbent and political fragmentation. The magnitude of these effects increases when the spatial Durbin model is estimated and its interpretation is more difficult when the sign of the estimated coefficient of a variable is different from the sign of the coefficient of its spatial lag. In this model, for example, the indirect effect of the political fragmentation variable is 3.76 times the direct effect.

It is not surprising that the indirect impacts in the spatial lag model of the per receipt amount are lower than the nominal tax rate. In this case, if one of the explanatory variables increases, the increase in the neighbouring jurisdictions is approximately 10% of the increase in the jurisdiction itself.

Finally, the indirect effects in the spatial lag model for the motor vehicle tax are highly significant and represent approximately 15% of the direct impacts. Again, the interpretation of the Durbin model is more complex. On one hand, if the unemployment rate in a municipality increases, the motor vehicle tax increases (direct effect) but this tax is going to decrease in neighbouring municipalities. The average total effect of the unemployment rate is negative. On the other hand, the impacts of political fragmentation, for example, have the same sign and the indirect effect is 2.25 times greater than the direct effect.

Table 4: Results for property tax – nominal tax rate

	Spatial Lag	Spatial Durbin
ρ	0.21835***	0.47663***
	(284.77)	(640.72)
Population	0.000039	0.000042
	(1.03)	(1.21)
Area	0.000044**	0.000070***
	(2.05)	(3.44)
Share of population under 15 years	0.000404	0.001657
	(0.25)	(1.00)
Share of population over 65 years	-0.00254***	-0.001367
	(-3.25)	(-1.64)
Unemployment rate	-0.00318***	0.000724
	(-3.44)	(0.61)
Per capita grants received	0.000004	-0.000001
	(0.45)	(-0.09)
Leftist incumbent	0.026003**	0.023367**
	(2.17)	(2.16)
Rightist incumbent	0.013072	0.008663
	(1.06)	(0.78)
Electoral distance	0.000255	0.000070
	(0.57)	(0.17)
Political fragmentation	-0.11138**	-0.071973
	(-1.99)	(-1.41)
Lag Population		-0.000166**
		(-2.28)
Lag Area		-0.000077**
		(-2.37)
Lag Share of population under 15 years		-0.003179
		(-1.63)
Lag Share of population over 65 years		-0.001806*
		(-1.78)
Lag Unemployment rate		-0.002133
		(-1.47)
Lag Per capita grants received		0.000001
		(0.02)
Lag Leftist incumbent		-0.006425
		(-0.36)
Lag Rightist incumbent		-0.017623
		(-0.97)
Lag Electoral distance		-0.001351***
		(-2.96)
Lag Political fragmentation		-0.23672***
		(-3.96)
Log likelihood	1312.31	1517.60

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

Table 5: Results for property tax – per receipt amount

	Spatial Lag	Spatial Durbin
ρ	0.10171***	0.09422***
	(25.82)	(16.78)
Population	0.10888***	0.095423***
	(4.91)	(4.26)
Area	0.023037*	0.039710***
	(1.83)	(3.02)
Share of population under 15 years	-0.02819	1.4536
	(-0.03)	(1.36)
Share of population over 65 years	-2.7493***	-2.0109***
	(-5.98)	(-3.73)
Unemployment rate	-1.2246**	-1.2509
	(-2.26)	(-1.63)
Per capita grants received	-0.01291**	-0.0150***
	(-2.29)	(-1.79)
Leftist incumbent	4.04640	6.0180
	(0.58)	(0.86)
Rightist incumbent	4.1736	5.1532
	(0.58)	(0.72)
Electoral distance	-0.69565***	-0.66491**
	(-2.64)	(-2.53)
Political fragmentation	-151.01***	-140.59***
	(-4.60)	(-4.27)
Lag Population		0.24342***
		(5.12)
Lag Area		-0.08315***
		(-3.96)
Lag Share of population under 15 years		-1.2089
		(-0.96)
Lag Share of population above 65 years		-0.04023
		(-0.06)
Lag Unemployment rate		0.79528
		(0.84)
Lag Per capita grants received		-0.00333
		(-0.34)
Lag Leftist incumbent		2.8453
		(0.25)
Lag Rightist incumbent		0.67400
		(0.06)
Lag Electoral distance		0.32844
		(1.12)
Lag Political fragmentation		-1.8410
		(-0.05)
Log likelihood	-15963.10	-15941.62

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

Table 6: Results for motor vehicle tax

	Spatial Lag	Spatial Durbin
ρ	0.14036***	0.43023***
	(185.29)	(519.69)
Population	0.000391***	0.000301***
	(6.98)	(5.94)
Area	0.000148***	0.000217***
	(4.67)	(7.25)
Share of population under 15 years	0.000277	-0.000194
	(0.12)	(-0.08)
Share of population over 65 years	-0.008873***	-0.005826***
	(-7.63)	(-4.73)
Unemployment rate	-0.007825***	0.004785***
	(-5.71)	(2.74)
Per capita grants received	-0.000062***	-0.000062***
	(-4.34)	(-4.83)
Leftist incumbent	0.060429***	0.060068***
	(3.40)	(3.77)
Rightist incumbent	0.018425	0.026232
	(1.01)	(1.60)
Electoral distance	-0.001657**	-0.001170*
	(-2.49)	(-1.95)
Political fragmentation	-0.48798***	-0.33815***
	(-5.87)	(-4.50)
Lag Population		0.000066
		(0.61)
Lag Area		-0.000189***
		(-3.96)
Lag Share of population under 15 years		0.001551
		(0.53)
Lag Share of population over 65 years		0.000058
		(0.04)
Lag Unemployment rate		-0.012208***
		(-5.71)
Lag Per capita grants received		-0.000005
		(-0.25)
Lag Leftist incumbent		-0.035930
		(-1.36)
Lag Rightist incumbent		-0.007062***
		(-2.63)
Lag Electoral distance		-0.003828***
		(-5.63)
Lag Political fragmentation		-0.48088***
		(-5.44)
Log likelihood	257.80	491.03

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

Table 7: Impacts for property tax – nominal tax rate

	Spatial Lag			Spatial Durbin		
	Direct	Indirect	Total	Direct	Indirect	Total
Population	0.000040	0.000010	0.000050	0.000014	-0.00025	-0.00024
	(1.01)	(1.01)	(1.01)	(0.33)	(-2.02)**	(-1.64)
Area	0.000045	0.000012	0.000056	0.000061	-0.00007	-0.00001
	(2.08)**	(2.05)**	(2.08)**	(2.85)***	(-1.39)	(-0.22)
Share of population under 15 years	0.000410	0.000106	0.000516	0.001201	-0.00411	-0.00291
	(0.26)	(0.26)	(0.25)	(0.77)	(-1.33)	(-0.76)
Share of population over 65 years	-0.00258	-0.00067	-0.00324	-0.00184	-0.00423	-0.00606
	(-3.23)***	(-3.21)***	(-3.24)***	(-2.19**)	(-2.63)***	()
Unemployment rate	-0.00323	-0.00084	-0.00407	0.000382	-0.00308	-0.00269
	(-3.34)***	(-3.23)	(-3.34)***	(0.35)	(-1.58)	(-1.33)
Per capita grants received	0.000004	0.000001	0.000005	-0.000001	-0.000001	-0.000002
	(0.43)	(0.43)	(0.42)	(-0.92)	(-0.04)	(-0.06)
Leftist incumbent	0.026417	0.006851	0.033267	0.024267	0.008106	0.032373
	(2.23)**	(2.20)**	(2.23)**	(2.02)**	(0.26)	(0.83)
Rightist incumbent	0.013280	0.003444	0.016724	0.006087	-0.023207	-0.017121
	(1.06)	(1.05)	(1.06)	(0.52)	(-0.67)	(-0.39)
Electoral distance	0.000259	0.000067	0.000327	-0.000183	-0.002267	-0.002450
	(0.59)	(0.59)	(0.58)	(-0.41)	(-2.62)***	(-2.11)**
Political fragmentation	-0.11315	-0.02934	-0.14249	-0.123716	-0.466099	-0.589815
	(-2.00)**	(-1.98)**	(-2.00)**	(-2.21)**	(-4.20)***	(-4.03)***

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

Table 8: Impacts for property tax – per receipt amount

	Spatial Lag			Spatial Durbin		
	Direct	Indirect	Total	Direct	Indirect	Total
Population	0.109239	0.011969	0.121209	0.102981	0.271111	0.374093
	(4.99)***	(3.41)***	(4.99)***	(4.62)***	(5.40)***	(6.83)***
Area	0.023113	0.002533	0.025645	0.037332	-0.08529	-0.04796
	(1.81)*	(1.65)*	(1.81)*	(2.79)***	(-3.88)***	(-2.02)**
Share of population under 15 years	-0.02828	-0.00310	-0.03138	1.421532	-1.15130	0.270236
	(-0.03)	(-0.02)	(-0.02)	(1.36)	(-0.85)	(0.21)
Share of population over 65 years	-2.75837	-0.30225	-3.06062	-2.01781	-0.24671	-2.26452
	(-5.95)***	(-3.92)***	(-6.03)***	(-3.73)***	(-0.33)	(-3.08)***
Unemployment rate	-1.22868	-0.13463	-1.36331	-1.23066	0.727598	-0.50306
	(-2.22)**	(-1.97)**	(-2.22)**	(-1.64)	(0.79)	(-0.66)
Per capita grants received	-0.01295	-0.00142	-0.01437	-0.01028	-0.00460	-0.01488
	(-2.32)**	(-2.07)**	(-2.32)**	(-1.82)*	(-0.45)	(-1.24)
Leftist incumbent	4.059285	0.444796	4.504081	6.120164	3.665071	9.785235
	(0.54)	(0.53)	(0.54)	(0.88)	(0.32)	(0.69)
Rightist incumbent	4.187352	0.458829	4.646181	5.187941	1.245403	6.433344
	(0.52)	(0.52)	(0.52)	(0.74)	(0.14)	(0.47)
Electoral distance	-0.69795	-0.07648	-0.77442	-0.65696	0.285482	-0.37147
	(-2.64)***	(-2.25)**	(-2.63)***	(-2.50)**	(0.87)	(-0.91)
Political fragmentation	-151.505	-16.6011	-168.1063	-141.042	-16.2043	-157.247
	(-4.62)***	(-3.19)***	(-4.59)***	(-4.30)***	(-0.42)	(-2.95)***

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

Table 9: Impacts for motor vehicle tax

	Spatial Lag			Spatial Durbin		
	Direct	Indirect	Total	Direct	Indirect	Total
Population	0.000393	0.000061	0.000455	0.000334	0.000311	0.000645
	(6.88)***	(6.50)***	(6.95)***	(6.09)***	(1.79)*	(3.18)***
Area	0.000149	0.000023	0.000173	0.000201	-0.00015	0.00005
	(4.94)***	(4.56)***	(4.93)***	(6.46)***	(-2.01)**	(0.58)
Share of population under 15 years	0.000279	0.000043	0.000322	0.000048	0.002334	0.002382
	(0.07)	(0.05)	(0.07)	(0.06)	(0.54)	(0.49)
Share of population over 65 years	-0.00893	-0.00139	-0.01032	-0.00623	-0.00389	-0.01012
	(-7.55)***	(-6.42)***	(-7.52)***	(-4.94)***	(-1.80)*	(-3.86)***
Unemployment rate	-0.00787	-0.00123	-0.00910	0.003111	-0.01614	-0.01303
	(-5.47)***	(-4.63)***	(-5.39)***	(1.87)*	(-5.77)***	(-4.56)***
Per capita grants received	-0.00006	-0.00001	-0.00007	-0.00007	-0.00005	-0.00012
	(-4.74)***	(-4.62)***	(-4.77)***	(-4.84)***	(-1.48)	(-2.78)***
Leftist incumbent	0.060813	0.009483	0.070296	0.058404	-0.01604	0.042363
	(3.05)***	(2.99)***	(3.05)***	(3.39)***	(-0.36)	(0.82)
Rightist incumbent	0.018542	0.002891	0.021434	0.016445	-0.09434	-0.07790
	(0.87)	(0.87)	(0.87)	(0.92)	(-2.17)**	(-1.45)
Electoral distance	-0.00167	-0.00026	-0.00193	-0.00188	-0.00689	-0.00877
	(-2.58)***	(-2.51)**	(-2.57)***	(-2.87)***	(-5.60)***	(-5.31)***
Political fragmentation	-0.49108	-0.07658	-0.56766	-0.44148	-0.99602	-1.43749
	(-6.17)***	(-5.62)***	(-6.16)***	(-5.41)***	(-6.42)***	(-7.05)***

***, ** and *, significant at 1%, 5% and 10% respectively. K=4-nearest neighbours

4.3 Evidence on yardstick competition

In order to explain tax interactions between municipalities, yardstick competition is the mechanism most often invoked. In short, voters judge their incumbents by comparing their fiscal policies with those implemented in neighbouring municipalities. The yardstick competition mechanism predicts that governments supported by a large majority mimic neighbouring tax rates to a lesser extent than governments in precarious majority or minority. The strategy followed in our paper relies on the use of the two-regime spatial lag model to test for the existence of significant differences in the spatial interaction parameters under both regimes. To do so, we define a new variable, *Majority*, which is coded 1 if the mayor's political party share is above 50% (strong majority) and 0 otherwise (weak majority).[11] This latter category includes minority cabinets and coalition cabinets. Another dimension of the hypothesis, namely the impact of the ideology, is also tested with a two-regime spatial lag model.

As reported in Table 10, the differences between the estimations which control for majorities are significant, supporting the yardstick competition hypothesis. The gap between the spatial parameters is especially large in the case of the property tax when per receipt amount is considered.

Leftist incumbents, in line with the results in the previous subsection, tend to choose higher tax rates. However, the interactions of the leftist incumbents are more intense for the motor vehicle tax and for the nominal rates of property tax, with the differences being significant.[12] On the contrary, rightist incumbents interact to a lesser extent, with significant differences in the two taxes just mentioned.

[11] Given the rules governing the local electoral system in Spain, 50% of the votes may correspond to 60% or more of councilors. Hence, results do not hold if other vote percentages (60% and 70%) are used.
[12] This is in contrast to Solé-Ollé (2003) for Catalonian municipalities, where the interaction of the left-wing political parties was less intense.

Table 10: Yardstick competition hypothesis

	Property tax - Nominal rates	Property tax - Per receipt amount	Motor vehicle tax
ρ_{total} overall sample	0.21835***	0.10171***	0.14036***
ρ_{weak} weak majority	0.258435 (11.39)***	0.243375 (6.53)***	0.181017 (10.51)***
ρ_{strong} strong majority	0.196064 (12.06)***	0.019252 (0.74)	0.116274 (9.18)***
difference (t-value)	0.062371 (2.20)**	0.224123 (4.67)***	0.064743 (3.05)***
ρ_{left} left-wing party	0.240644 (12.41)***	0.096064 (3.23)***	0.169247 (11.12)***
$\rho_{no\text{-}left}$ non-left party	0.197393 (10.93)***	0.108124 (3.49)***	0.114270 (8.30)***
difference (t-value)	0.043251 (1.61)**	-0.012060 (0.27)	0.054977 (2.70)***
ρ_{right} right-wing party	0.184760*** (9.54)	0.098389*** (2.90)	0.102130*** (6.94)
$\rho_{no\text{-}right}$ non-right party	0.246634*** (13.66)	0.103909*** (3.76)	0.173469*** (12.21)
difference (t-value)	-0.061874** (2.31)	-0.005520 (0.12)	-0.071339*** (3.52)

***, ** and *, significant at 1%, 5% and 10% respectively. k=4-nearest neighbours. Spatial lag model

4.4 The political trends hypothesis

As stated above, to test this hypothesis we follow the proposal of Santolini (2008). The estimated spatial parameter reflects to what extent a 1% increase in a neighbouring jurisdiction's tax rate ruled by the same party increases the municipality's own rate. Table 11 reports the estimations for the case of leftist and rightist incumbents.

We observe a significant, although rather limited, fiscal interaction in both leftist and rightist incumbents. The several estimates of ρ indicate that tax interaction between neighbouring left-wing governments is stronger for the motor vehicle tax (ρ=0.062), but

we observe the opposite result for the nominal rates of the property tax in the case of rightist incumbents (ρ=0.089). When the focus is on the per receipt amount of the property tax the interactions according to ideology are similar, with ρ=0.04 in each case. Our results are in contrast to those of Santolini (2008) who found only partial evidence of political trends for Italian municipalities, the mechanism being significant for only right-wing (ρ=0.61) and Christian Democrat (ρ=0.037) parties.

Table 11: Political trends hypothesis (ρ)

	Property tax - Nominal rates	Property tax - Per receipt amount	Motor vehicle tax
Left-wing	0.0659***	0.0389***	0.0620***
	(62.59)	(48.03)	(60.47)
Right-wing	0.0890***	0.0399***	0.0259***
	(42.12)	(34.66)	(27.77)

*** Significant at 1%. k=4-nearest neighbours

5. Concluding remarks

We have studied the determinants of local tax rates using cross-section data for 2,713 Spanish municipalities with over 1,000 inhabitants. Our analysis was developed in three steps. First, the existence of tax mimicking behaviours through spatial lag and spatial Durbin models was tested. The results confirm that municipalities mimic the neighbouring tax rates, yielding a parameter over 0.4 in the case of the nominal property tax rate and the motor vehicle tax. Several socioeconomic variables such as population, area and the share of elderly population were statistically significant. The results for the effect of grants tend to support the median voter theorem instead of the flypaper effect hypothesis. Regarding the political variables, leftist incumbents choose higher tax rates, while electoral distance and political fragmentation are negatively related with rates. Direct and indirect effects of the explanatory variables on tax rates are also estimated.

Second, two-regime spatial lag models were implemented in order to test the yardstick competition hypothesis. Our results support this hypothesis and show that mimicking behaviour is weaker when incumbents enjoy the support of a stronger majority (50% or over). With regard to ideology, we observe that the tax interaction is more intense for leftist governments.

Finally, we have explored the political trends hypothesis. A spatial lag model was estimated where neighbourhood was qualified by political party affinity between incumbents. The estimated spatial parameters confirm this hypothesis for the cases of both leftist and rightist incumbents.

This paper can be extended in several directions. In particular, we aim to explore alternative and innovative definitions of the *W* matrix, such as the municipal quality of life, and to introduce the urban or rural nature of the jurisdictions into estimates.

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