Tax mimicking among local governments: some evidence from Spanish municipalities

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Abstract

The purpose of this paper is to study the strategic interactions in the Spanish local tax system with spatial econometrics procedures. We analyse the property tax, the motor vehicle tax and the building activities tax, that represent jointly the 80 per cent of the tax revenue at the local level of government in Spain. We consider three weight specifications to define competitors: contiguity, distance and the proposal of Fingleton. After carrying out a spatial exploratory analysis, the results of the estimation of spatial lag and spatial error models confirm the horizontal externalities or positive spatial-autocorrelation in the property tax and the building activities tax, with an order of magnitude between 0.3 and 0.5, but not in the motor vehicle tax. This tax mimicking is in line with the results achieved in the empirical literature on local tax competition.

Keywords: tax mimicking, spatial econometrics, local governments

JEL Codes: H71, H73

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1. Introduction

The study of the local tax competition is the objective of a broad empirical literature in the last years. The strategic interactions or externalities can be horizontal or vertical. Horizontal externality refers to when the fiscal choice made by a local government affects the fiscal decision of the neighbouring jurisdictions. And vertical externality arises from the interaction between several levels of government: municipal and regional or state, regional or state and national or federal. This means that the fiscal choice of a local government depends on the choice of the state or regional government level.

We analyze the horizontal externalities in the setting of the local tax system. Tax mimicking can be tested if we find significant correlation between the tax rates of a municipality and those current in the nearest jurisdictions. In advance, the explanations for the interaction could be based on mobility –the Tiebout (1956) model or tax competition-, the political yardstick competition -where voters use information from other jurisdictions to judge the performance of their own incumbents- or the expenditure spillovers –derived from the existence of correlation in expenditure levels across jurisdictions-. Note that the mobility and the yardstick competition allow the taxpayers to escape tax increases, in the first case by migration and in the second case by voting to change the politicians. If the differences on the tax rates are not too large to promote migration movements, and the spillover effects are some limited too, the yardstick competition could be the most plausible cause of the tax mimicking, as it is showed in some papers quoted below.

A selection of the previous papers on this topic is briefly reviewed in Table 1. First, several works have concluded evidence of such horizontal interactions at a local level, mainly for the income tax and property tax. But the estimation of the tax mimicking effect is different by taxes and countries (from 0.05 to 0.745). Besides, other papers studied the horizontal and vertical interactions jointly. The vertical interactions are confirmed in approximately the half of the studies. A growing literature is devoted to test the yardstick competition as the possible origin of the tax mimicking since the initial work of Besley and Case (1995). Among the studies revised, only Edmark and Agren (2008) rejected this hypothesis, in this case for the income tax in Sweden[1].

In this paper, we test the hypothesis of strategic interactions in the tax reaction functions from a sample of Spanish municipalities located in the northern region of Asturias. The proximity between the 78 local governments means that can be a good test for the strategic decisions. And we do not study vertical externalities because local taxes are not shared with other higher levels of government in Spain.

[1] Bordignon et al. (2004) provide a good overview of yardstick competition. Additionally, Hill (2008) studied the effects of agglomeration in the determination of tax rates by the jurisdictions. From data for county governments in Tennessee for sales tax and property tax, he found that counties with more establishments were able to maintain higher tax rates.

We estimate two models of spatial interaction: spatial lag model and spatial error model. The existence of a spatial process induces the failure of the ordinary least squares method. The multidirectionality of the spatial dependence causes changes into the properties of the least square estimators. If a spatial lag model is considered, the OLS estimator is biased and inconsistent irrespective of the properties of the error term, whereas the OLS estimator in a spatial error model has the same properties as a time series model: unbiased but inefficient. Anselin (1988) asserted that the maximum likelihood method is the best option to estimate spatial process. However, there are other econometric approaches to solve the problems described above, mainly the instrumental variables method (IV) as it is briefly discussed in the next section.

In this article the main local taxes in Spain are analysed: property tax, motor vehicle tax and tax on building activities. In 2004, these taxes represented the 14.93%, 4.77% and 4.64% of total revenue for the Spanish municipalities. With regard to the tax revenue, these shares were 49.25%, 15.72% and 15.30% respectively. Local business tax is not studied for several reasons. First and main, the 2002 reform of the local public finance system in Spain practically abolished the tax: only 10 per cent of previous taxpayers continued after the reform, concretely the corporations with net revenue above one million euros. In that year, this tax represented only the 3.07% of total revenue for the local level. Second, there is a broad national normative and municipalities only can alter one tax rate, the so-called coefficient of situation. It depends on the category of the street –the local level can establish between two and nine street categories- with a minimum rate not below 0.4 and a maximum not above 3.8.

In the local property tax, the municipality can establish the tax rate within an interval, between 0.4% and 1.1%[2], over the property value. However, this nominal rate must be complemented with the year of reassessment of that value, a fact that remarkably increases notably the liability. There exists a mechanism to avoid it, which is a reduction of the tax base to adequate to the new values in a ten-year period, and the option of decreasing the nominal rates. For this reason, we also compute an effective tax rate that combines both variables. As the nominal rate is more visible for the citizens and the politicians, we take both rates for the study.

In the motor vehicle tax, the municipality applies a coefficient between 1 and 2 over the amounts approved by the central government. As these rates can differ among vehicle types, we choose the average rate over the automobiles. For these, five categories are distinguished and reference liabilities are from 12.62 to 112 euros, so after the application of the local coefficient, the maximum taxes vary from 12.62 to 224 euros.

Finally, the local authority establishes a rate from 0 to 4 per cent in the tax on building activities, and this tax is not compulsory at the local level of government. Nevertheless, as the resource needs

[2] Indeed, the municipality has some increases if it is a capital or has urban public transport.

grow with the demanding of the citizens, an increasing number of local governments have introduced this tax. In 2004, in the sample of 78 municipalities, only 10 had not adopted the tax, whereas 9 had established the top rate of 4 per cent.

With regard to the scanty literature on this topic for Spain, in Solé-Ollé (2003), from a sample of municipalities in the province of Barcelona and by using instrumental variables approach, the estimations of the interaction effects were 0.39 -property tax- and 0.33 –motor vehicle tax-, he found no significant effect for the business tax and did not study the building activities tax. Bosch and Solé-Ollé (2007) study the yardstick competition from a sample of Spanish municipalities, and only in the local property tax, again by using an instrumental variables approach.

The remainder of the paper is organized as follows. Section 2 describes the empirical strategy. Section 3 contains the data, the spatial exploratory analysis and the results from the estimations of the tax reaction functions by spatial econometrics models. Finally, Section 4 concludes.

Table 1. Summary of the literature on local tax competition

Study	Country / taxes	Results
A) Tax mimicking: horizontal interactions		
Ladd (1992)	United States / Property tax, sales tax	Yes property, 0.5-0.8. No sales
Heyndels and Vuchelen (1998)	Belgium / Income tax and property tax	Yes, between 0.5 and 0.7
Brett and Pinkse (2000)	Canada (Brittish Columbia) / Business property tax	Yes, but with different results
Brueckner and Saavedra (2001)	United States (Boston) / Property tax	Yes, but with different results
Buettner (2001)	Germany / Business tax	Yes, but only 0.05
Solé-Ollé (2003)	Spain (Barcelona) / Several taxes	Yes property tax (0.389), vehicle tax (0.333). No business tax
Allers and Elhorst (2005)	Netherlands / Property tax	Yes, 0.35
Kangasharju et al. (2006)	Finland / Income tax	Yes, 0.303
Edmark and Agren (2008)	Sweden / Income tax	Yes, 0.745
B) Tax mimicking: horizontal & vertical interactions		
Feld and Kirchgässner (2001)	Switzerland / Income tax	Yes, horizontal and vertical
Hayashi and Boadway (2001)	Canada / Business tax	Yes, horizontal and vertical
Revelli (2001)	United Kingdom / Property tax	Yes horizontal, no vertical
Cavlovic and Jackson (2003)	Canada / Income tax and business tax	Yes in income tax No in business tax
Brulhart and Jametti (2006)	Switzerland / Tax index	Yes, horizontal and vertical
Leprince et al. (2007)	France / Business tax	Yes horizontal, no vertical
C) Yardstick competition		
Besley and Case (1995)	United States (States) / Several taxes	Yes. Vote-seeking and tax-setting are tied together.
Bordignon et al. (2003)	Italy / Property tax	Yes. 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) Several taxes	Yes. Tax rates are higher with bigger electoral margins, with left-wing governments and in non-election years
Allers and Elhorst (2005)	Netherlands / Property tax	Yes. Voters penalize incumbents for anticipated tax rate differentials, but not for unanticipated.
Vermeir and Heyndels (2006)	Belgium (Flanders) / Income tax and property tax	Yes. Incumbents are punished for higher rates, more intensely with lower rates in neighbouring jurisdictions
Bosch and Solé-Ollé (2007)	Spain / Property tax	Yes. Evidence of “comparative voting behaviour” (a tax increase bigger than the others municipalities has an important vote loss)
Edmark and Agren (2008)	Sweden / Income tax	No. Similar interaction between weak and strong majority, and in election years

2. Empirical strategy

First, we estimate the tax reaction function by OLS as benchmark or initial approach, and then the two main spatial models. As stated above, OLS estimations are not valid under the presence of spatial autocorrelation, so an exploratory spatial analysis is carried out to study both global and local autocorrelation patterns.

In spatial econometrics, there are two basic specifications in order to summarize the spatial autocorrelation: the spatial lag model and the spatial error model.

The spatial lag model[3] is based on the inclusion into the model of the spatially lagged dependent variable. The tax setting equation for each tax, in the spatial lag model specification, is as follows:

$$T = \rho WT + \alpha X + \varepsilon \qquad (1)$$

where T is the tax rates matrix, X is the matrix of explanatory variables, W is the weight matrix, ρ the spatial coefficient and ε the disturbance vector, with i.i.d. error terms (zero mean and constant variance). The presence on the right-hand side of the equation of the spatial lag term produces a non zero correlation with the error term. Each value of spatially lagged variable is not only correlated with the error term associated with this location, but with all of them.

There are two interpretations of the spatial autoregressive coefficient. In the first case, this parameter measures the spatial spillover when the actors under consideration match the spatial unit of observation and the spillover is the result of a theoretical model. The second interpretation is related to the spatial autocorrelation due to a mismatch between the economic phenomenon and the spatial area in which is allocated. In the tax setting analysis the suitable interpretation is the first option, as it is showed in Case et al. (1993).

The spatial error model consists on the specification of a spatial process for the disturbance term. The immediate consequence of this is the existence of nonspherical error covariance matrix. The most common approach is the inclusion of a spatial autoregressive process:

$$T = \alpha X + \delta,\ \delta = \lambda W\delta + \varepsilon \qquad (2)$$

where λ is the spatial autoregressive coefficient for the error lag. This type of model is adequate to include the spatial autocorrelation due to measurement errors or to variables that are not crucial in the model (nuisance dependence)[4].

In the tax competition framework, the spatial error model is consistent with a situation where determinants of the tax rate omitted from the model are spatially autocorrelated and with a situation where unobserved shocks follow a spatial pattern (Allers and Elhorst, 2005). And the spatial lag model is theoretically consistent with the situation where the tax rates interact with the tax rates in

[3] Anselin (1988) named this model as mixed regressive, spatial autoregressive model.

[4] There are other specifications for the spatial error process; see Cliff and Ord (1981) and Kelejian and Robinson (1993).

nearby jurisdictions (Brueckner, 2003). Nevertheless, a priori, none of these models is best to model the tax reaction function and empirical results will be determinant to select the most appropriate one[5]. In spatial econometrics literature the most common specification strategy is of type “specific to general” or bottom-up. In this paper we considered the specification search strategy based on robust test to local misspecification (Anselin et al., 1996) unfolded by Florax et al. (2003). In the first place, the LM test is applied in order to detect the existence of spatial dependence due to an omitted spatial lag or due to a spatial autoregressive error process. If both tests are significant, the model is selected according to the results of the robust LM test. If there is local misspecification, robust LM test has more power in pointing out the correct alternative test and, as a consequence, can be applied to choice the model specification.

With regard to W matrix, different criteria are applied to design the spatial weights and nowadays there is not a unique criterion or consensus about the system to obtain them. As Anselin (2002) stated, “the specification of the weight matrix is a matter of some arbitrariness and it is often cited as a major weakness of the lattice approach”. Recently, Fernández-Vázquez et al. (2009) analyzed the different ways to build a spatial weight matrix with two main options: in the first one, the spatial weight matrix is considered a theoretical conceptualization of the structure of spatial dependence (binary, distance matrix). These matrixes are not strictly related to the real data. In the second case, the spatial weight matrix is based on some “empirical” evidence about the variables.

We consider different options with the aim to analyze the sensibility of the results. In first place, we apply the binary matrix based on a contiguity criterion among the municipalities (W1), so $w_{ij} = 1$ if jurisdictions i and j share a border and 0 otherwise. Other frequent option consists of the distance based matrix (W2) where $w_{ij} = d^{-2}_{ij}$, being d_{ij} the distance between two jurisdictions i and j. This matrix summarizes the idea that the spatial dependence is reduced with the increase of distance among municipalities. These matrices could be considered as exogenous because they are obtained by means of criteria non related to the dependent variable.

There are other ways to define spatial weight matrix based on data related with the problem. These weights could be considered as a pseudo endogenous matrix. In this paper, we built as a third option (W3) the Fingleton (2001) matrix where $w_{ij} = Y^2_j / d^2_{ij}$, where Y_j is the per capita disposable income of territory j.

The weight matrix is usually standardized such that the elements of a row sum to one. This standardization makes easier the interpretation of the spatial lag variable as an average of neighbouring values. Furthermore, it allows the comparison among the spatial parameters associated to different models.

[5] See Revelli (2005) for a discussion on the empirical specification of strategic interaction models at local level.

The first contribution related to the maximum likelihood estimation (ML) of the spatial lag and error model was published by Ord (1975). After estimating the models without spatial interaction by OLS, the spatial lag model is estimated by a two-stage procedure and the spatial error model by an iterative two-stage procedure (Anselin, 1988).

In the spatial lag model, the inclusion of the spatially lagged dependent variable is considered as a form of endogeneity. The common estimation method applied when a problem of endogeneity appears is the instrumental variable estimation (Anselin, 1988). The key aspect consists of the selection of the proper instrumental variables[6]. Furthermore, the method is quite poor with small samples as in this paper. One advantage of this method consists of its operational simplicity since it is implemented in most of the commercial econometric software and probably this is the reason for its widespread application. More recently, Das et al. (2003) demonstrated that the IV estimators are less accurate than the ML.

The X matrix, following certain agreement in the literature on local tax interaction from the tax competition theory, is formed by the following variables[7]:

- structural characteristics: population and area;
- socio-demographic characteristics: percentage of population under 15 years, percentage of population over 65 years and rate of unemployment;
- fiscal magnitudes: per capita disposable income and per capita grants received[8].

With regard to the signs expected in the estimations, for the structural characteristics, a negative sign in the population can be interpreted as the existence of increasing returns in the public goods provision, while a positive sign in the area reflects that this provision is costlier in a bigger area. The three considered socio-demographic characteristics are expected to be positive correlated with the tax rates: young and elderly people need more resources than the rest of the population, and a bigger rate of unemployment also carries more public resources. Finally, it is expected that the per capita disposable income has a positive sign if public goods are normal, while the sign of the grants is of special interest in the study of the so-called flypaper effect or “money stick where they hit”. Theoretically, the standard median voter model predicts that block grants from higher levels of government crowd out local spending and some of the grants are distributed as lower taxes in accordance with the income elasticities of that voter. But in the empirical studies crowding-in or flypaper effect is frequently achieved, so the lump-sum grants have a positive and large effect (bigger than an income increase) on the local spending and no effect or positive on the local taxes;

[6] Kelejian and Robinson (1993) demonstrated that the instruments WX, WX^2, etc. in a spatial lag model allow to obtain a consistent estimation of the coefficient.

[7] It would be interesting to include the income inequality at the municipality, but data are not available.

[8] Grants represented the 35.13% of the total revenue for the Spanish municipalities in 2004. Theoretically, stronger revenue equalization system will imply less incentive to tax competition. As in other decentralized countries, there is vertical fiscal imbalance consequently with the greater decentralization of expenditures than taxes.

see the reviews by Hines and Thaler (1995) and Bailey and Connolly (1998). Recently Dahlberg et al. (2008) found evidence of crowding-in for Sweden. Although we are interested in the tax mimicking and we do not study the local spending, if the coefficient of the per capita grants received is positive we find some partial evidence of the flypaper effect or crowding-in, with the limitations of this approach.

3. Data, exploratory spatial analysis and empirical results

Table 2 contains the summary statistics of the variables, referenced to year 2004. One key characteristic in the study of the local public sector is the population. The 78 municipalities analysed range from 278 to 270,880 inhabitants with the following distribution: 16 below 1,000 citizens, 32 between 1,000 and 5,000, 23 between 5,000 and 20,000, 4 between 20,000 and 50,000 and finally 3 above 50,000 inhabitants, so the 70 per cent of the municipalities are between 1,000 and 20,000.

The property tax rates are the nominal rate and the effective rate as the relation between the tax liability and the tax base. In the motor vehicle tax, the rate is the average coefficient, between 1 and 2, over the liabilities of reference to the automobile. And in the building activities tax, we analyse the tax rate, between 0 and 4. Figure 1 shows the kernel density estimates for the tax rates. The explanatory variables are the population (thousands), the area, the percentage of young people as below 15 years, the percentage of elderly people as above 65 years, the unemployment rate, the per capita disposable income (thousand of euros) and the per capita grants received (thousand of euros) calculated from the public budgets.

Table 2. Descriptive statistics

Variable	Mean	Stand dev.	Minimum	Maximum
Property tax – nominal rate (%)	0.65	0.19	0.40	1.10
Property tax – effective rate (%)	0.55	0.17	0.28	1.04
Motor vehicle tax rate (coefficient)	1.24	0.18	1.00	1.70
Building activities tax rate (%)	2.43	1.12	0.00	4.00
Population (thousands)	13.79	39.17	0.21	270.88
Area (km^2)	135.94	130.83	5.29	823.57
% young population	8.45	2.04	3.87	14.36
% elderly population	28.70	6.31	16.77	42.72
Unemployment rate	11.83	4.64	4.67	31.55
Per capita disposable income (thousand)	12.20	0.94	9.90	14.01
Per capita grants (thousand)	0.51	0.44	0.15	2.57

Source: Ministry of Economics and Finance of Spain (tax rates and grants), National Statistics Institute of Spain – INE (population and area), SADEI (unemployment rate and per capita disposable income).

Before estimating the equations, it is useful to carry out an exploratory spatial data analysis. Moran statistics on tax rates are reported in Table 3. The spatial dependence is positive and significant in the four cases if the binary matrix based on contiguity criteria is used to calculate the Moran (*I*) global test by means of this expression:

$$I = \frac{n}{S_0} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} z_i z_j}{\sum_{i=1}^{n} z_i^2}; \; i \neq j \tag{3}$$

where $z_i = t_i - \bar{t}$, $S_0 = \sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}$.

So the relatively high (low) tax rate municipalities tend to be located nearby other high (low) tax rate territories more often than would be expected due to random chance.

Table 3. Moran statistics on tax rates (contiguity matrix)

	Property tax - Nominal rates	Property tax - Effective rates	Motor vehicle tax	Building activities tax
Moran	0.0835*	0.2724***	0.2017***	0.3340***
(p-value)	(0.096)	(0.001)	(0.004)	(0.001)

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Anselin (1995) asserted that the assumption of stationary or structural stability over space may be unrealistic and the strategy applied in the exploratory analysis usually forget this idea and only use global statistics to obtain statistic evidence of the existence of spatial dependence. The LISA (Local Indicators of Spatial Association) statistics allow identifying local spatial clusters and the existence of spatial outliers[9]. This is the expression of the local Moran statistic (I_i):

$$I_i = z_i \sum_{j=1}^{J_i} w_{ij} z_j \tag{4}$$

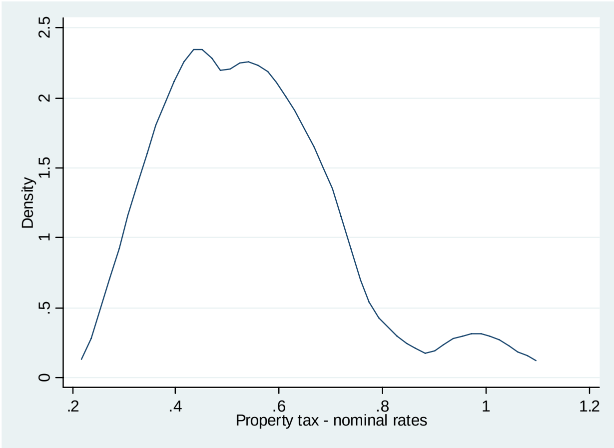
where J_i are the neighbouring municipalities of the jurisdiction *i*. This statistic shows a positive value when there is a spatial clustering of high values or a spatial clustering of low values. On the contrary, if LISA shows a negative value in a specific municipality, this is considered as a spatial outlier which can be high-low or low-high.

[9] Getis and Ord (1992) proposed also two statistics to study the existence of a local spatial autocorrelation pattern.

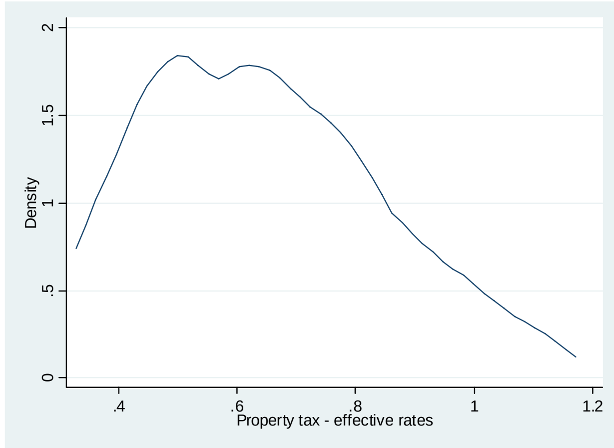
We include in Figure 2 the spatial clustering maps related to the four cases analyzed in the paper. There is spatial clustering of low values in the municipalities in the West of Asturias for the four tax rates analyzed. Moreover, it is possible to identify clearly a spatial cluster of high values in the north-east of Asturias when the motor vehicle and building activities tax rates are considered.

Figure 1. Kernel density estimates of tax rates

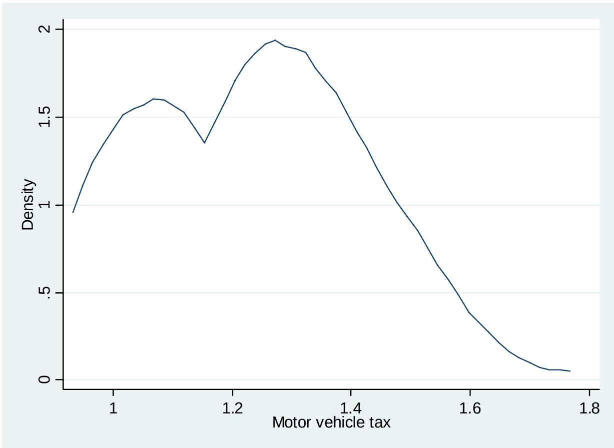
1(a). Property tax rates – nominal



1(a). Property tax rates – effective



1(c). Motor vehicle tax rates



1(d). Building activities tax rates

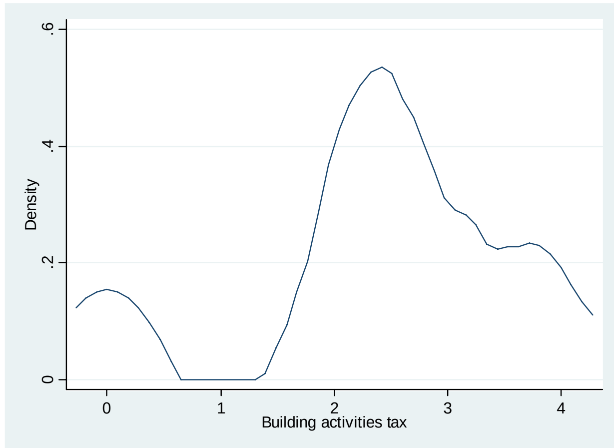
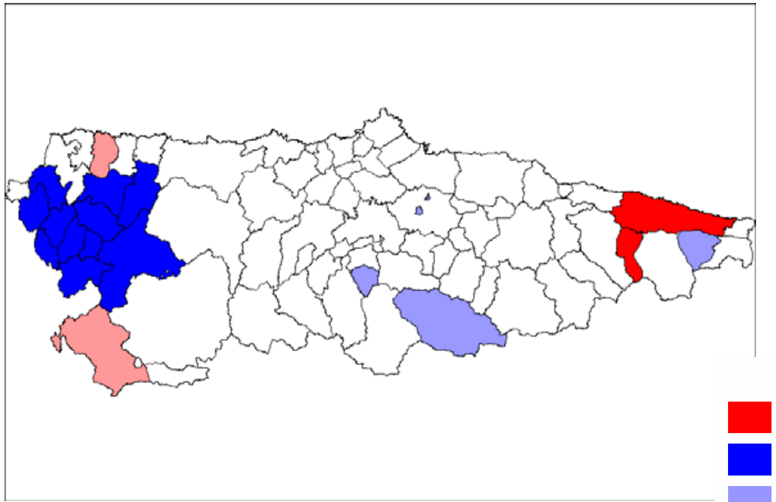
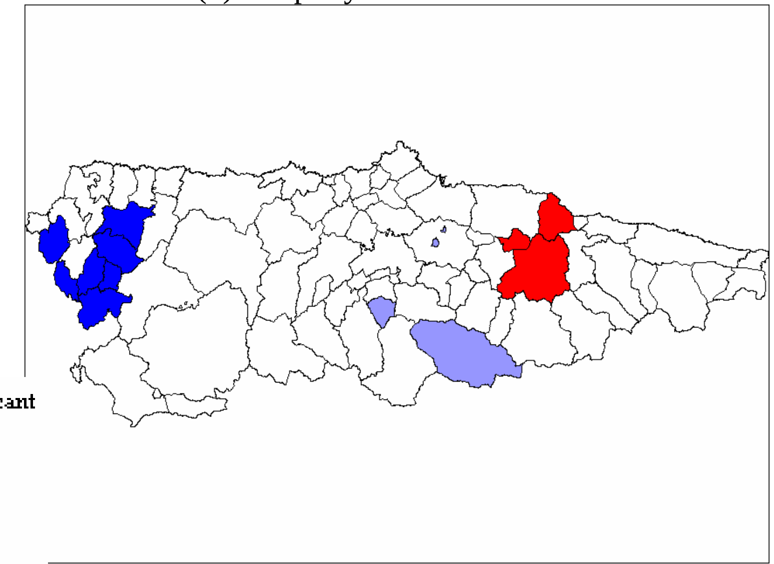


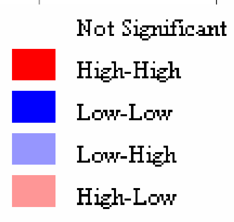
Figure 2. Spatial cluster for tax rates

2(a). Property tax rates – nominal

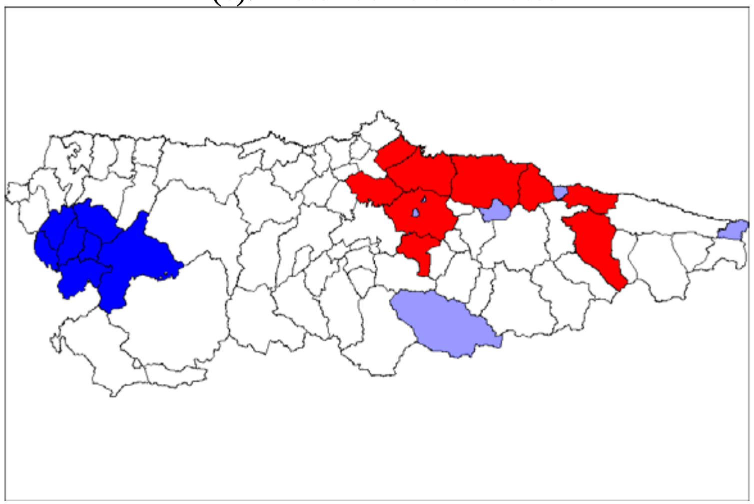


2(b). Property tax rates - effective

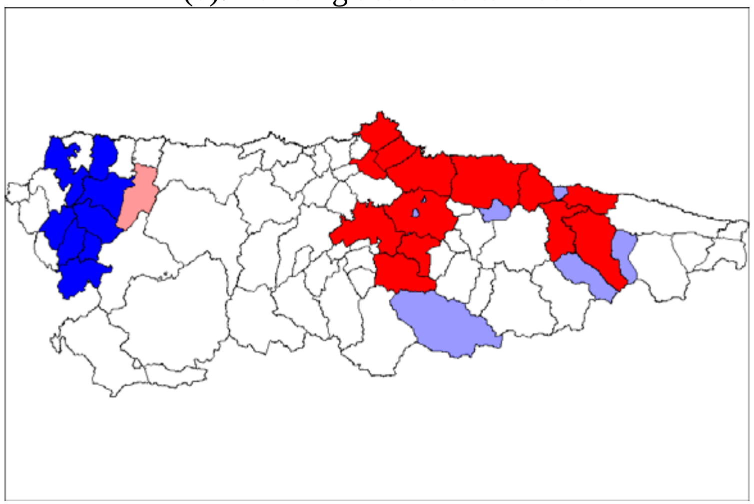




2(c). Motor vehicle tax rates



2(d). Building activities tax rates



The estimations of the tax reaction functions are reported in Tables 5 to 8, with the results of the specifications test in Table 4. We realized the Moran test on the OLS residuals of each variable and analyzed the sensitivity of the results to the different specifications of the spatial weight matrix. With the aim to select the most adequate model between lag and error model, we followed the strategy selection unfolded by Florax et al. (2003) as stated above.

The results of the Moran test are significant in order to reject the null hypothesis of no spatial autocorrelation on the OLS residual in the model of property tax with effective rates and building activities tax rates. In the first case, the results of LM and LM robust tests show the spatial lag model as the most adequate option when the contiguity matrix and distance matrix are considered, whereas the spatial error model is the best option with the Fingleton matrix. In the second case, the spatial lag model is the best specification. However, spatial and error model are estimated in order to confirm this choice.

When the analysis is focused on the OLS residuals of the model for property tax with nominal rates as dependent variable, the specification tests are not significant so we do not reject the null hypothesis with the exception of the Fingleton matrix. Similar results are obtained in the model of motor vehicle tax rates with the exception of Moran test with the contiguity matrix and Moran and LM lag with the Fingleton matrix.

The sensibility of the specification tests due to different specifications of the spatial weight matrix is low. For each model, the specification tests reach the same results with different spatial weight.

Our main objective in the estimations is the spatial coefficient as it quantifies the strategic interaction, but the signs of other variables, specially population, income and grants, are also of interest.

The results for the property tax using nominal rates are summarized in Table 5. The dummy variable is 1 if the municipality has revised the building values and 0 otherwise. The strategic interaction is positive but not significant. Among the control variables, the coefficient of the area is significant and positive, as it is expected and detailed previously. There is no significant effect of the grants on tax rates, although the estimated coefficient is negative and hence supports the flypaper effect, and the dummy variable is clearly significant and negative, as was discussed above.

When the effective rates are analysed (Table 6), there is evidence of tax mimicking. The spatial parameter is positive and significant, being 0.337 in the spatial lag model with the binary matrix, that is, a one higher tax rate in neighbouring municipalities causes a 0.337 higher tax rate in the jurisdiction, *ceteris paribus*. The spatial coefficient is bigger (0.557) with the distance matrix. In the analysis of the signs of the variables, again the per capita grants received are not significant with a small negative coefficient, in line with the flypaper effect hypothesis and contrary with the median voter model predictions. Now, the dummy variable is not significant as we expected because the effective rates include the effect of the new values. This opposite result when nominal and effective rates are studied can be somewhat contradictory in light of the more visibility of the nominal tax rates that are published in laws and official statistics.

In the motor vehicle tax, the interaction is positive but generally not significant, with one exception, the spatial error with the Fingleton matrix, as is reported in Table 7. With regard to the estimated coefficients of the explanatory variables, it is significant and with the expected sign for the population, positive reflecting decreasing returns, the area, positive, and the per capita income, positive too. The per capita grants received, also significant, present sign negative, so there is not evidence of the flypaper effect on the tax side here.

Finally, in the building activities tax (Table 8), we find evidence of tax mimicking with a spatial parameter of 0.325 with the binary matrix, and about 0.5 with the other weight specifications. In this case, again the per capita grants received are frequently significant with negative estimations, and hence with a negative effect of the grants on the local tax rates.

To sum up, these results about the spatial interaction are in line with those achieved by other studies where the parameter was in the 0.2-0.6 interval, as pointed out Allers and Elhorst (2005) in a review of the existing literature. More specifically, we achieve similar results than to Solé-Ollé (2003) for a Spanish sample of municipalities in the province of Barcelona in the property tax with effective rates (0.39), but not in the motor vehicle tax as he found tax mimicking (0.33). With regard to the effects of the grants on the local tax rates, we have found little evidence of the flypaper effect or crowding-in, our results are in agreement with the theoretical predictions from the standard median voter model or crowding-out.

Table 4. Specification tests

3(a). Property tax - nominal rates

	BINARY	FINGLETON	DISTANCE
Moran errors	1.241	2.124 **	1.901*
	(0.214)	(0.034)	(0.057)
LM-Lag	0.424	0.129	1.761
	(0.514)	(0.718)	(0.184)
LM-Error	0.453	1.350	1.309
	(0.501)	(0.245)	(0.253)
Robust LM-Lag	0.001	6.571**	0.577
	(0.971)	(0.010)	(0.447)
Robust LM-Error	0.031	7.791***	0.125
	(0.861)	(0.005)	(0.724)

3(b). Property tax – effective rates

	BINARY	FINGLETON	DISTANCE
Moran errors	3.273***	3.272***	3.735***
	(0.001)	(0.001)	(0.000)
LM-Lag	8.143***	2.326	11.567***
	(0.004)	(0.127)	(0.000)
LM-Error	6.564**	3.892**	7.843***
	(0.010)	(0.048)	(0.005)
Robust LM-Lag	1.985	5.852**	6.054**
	(0.158)	(0.015)	(0.013)
Robust LM-Error	0.406	7.412***	2.330
	(0.524)	(0.006)	(0.127)

3(c). Motor vehicle tax rates

	BINARY	FINGLETON	DISTANCE
Moran errors	1.866*	2.638 ***	1.516
	(0.062)	(0.008)	(0.129)
LM-Lag	0.659	3.621*	0.749
	(0.416)	(0.057)	(0.387)
LM-Error	1.661	2.320	00.710
	(0.197)	(0.127)	(0.399)
Robust LM-Lag	0.251	1.305	0.080
	(0.616)	(0.253)	(0.774)
Robust LM-Error	1.251	0.004	0.041
	(0.263)	(0.952)	(0.839)

3(d). Building activities tax rates

	BINARY	FINGLETON	DISTANCE
Moran errors	3.774 ***	5.077 ***	4.626 ***
	(0.000)	(0.00)	(0.000)
LM-Lag	10.923 ***	19.544***	14.931***
	(0.000)	(0.000)	(0.000)
LM-Error	9.412***	10.522**	13.414***
	(0.002)	(0.001)	(0.000)
Robust LM-Lag	1.549	10.762***	1.719
	(0.213)	(0.001)	(0.189)
Robust LM-Error	0.037	1.739	0.203
	(0.846)	(0.187)	(0.652)

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level. p-value between parenthesis

Table 5. Estimation results: local property tax models - nominal rates

		BINARY		FINGLETON		DISTANCE	
	OLS	Spatial lag	Spatial error	Spatial lag	Spatial error	Spatial lag	Spatial error
Constant	0.6573	0.6396	0.7123	0.6099	0.7244	0.5457	0.7058
	(1.20)	(1.24)	(1.37)	(1.15)	(1.41)	(1.07)	(1.34)
Population – total	-0.0002	-0.0002	-0.0003	-0.0002	-0.0005	-0.0002	-0.003
	(-0.48)	(-0.51)	(-0.54)	(-0.51)	(-1.10)	(-0.48)	(-0.59)
Area	0.0003**	0.0003**	0.0003**	0.0003**	0.0003**	0.0003**	0.0003**
	(2.11)	(2.20)	(2.34)	(2.26)	(2.55)	(2.29)	(2.48)
Population - % young	-0.0179	-0.0176	-0.0172	-0.0176	-0.0150	-0.0176	-0.150
	(-1.09)	(-1.15)	(-1.11)	(-1.14)	(-0.99)	(-1.16)	(-0.96)
Population - % old	-0.0018	-0.0020	-0.0022	-0.0018	-0.0020	-0.0020	-0.0018
	(-0.27)	(-0.34)	(-0.37)	(-0.29)	(-0.33)	(-0.34)	(-0.30)
Unemployment rate	0.0026	0.0023	0.0019	0.0025	0.0016	0.0021	0.0017
	(0.62)	(0.58)	(0.47)	(0.62)	(0.39)	(0.54)	(0.42)
Per capita income	0.1304	0.0107	0.0094	0.0129	0.0060	0.0096	0.0071
	(0.45)	(0.40)	(0.34)	(0.47)	(0.22)	(0.36)	(0.24)
Per capita grants	-0.0614	-0.0598	-0.0559	-0.0605	-0.0514	-0.0578	-0.0504
	(-1.26)	(-1.31)	(-1.22)	(-1.31)	(-1.15)	(-1.28)	(-1.10)
Dummy	-0.1387***	-0.1361***	0.1384***	-0.1375***	-0.1362***	-0.1301***	-0.134***
	(-3.03)	(-3.16)	(-3.19)	(-3.20)	(-3.23)	(-3.05)	(-3.04)
R square	0.334	0.222	0.230	0.216	0.249	0.227	0.248
Spatial ρ		0.0960		0.0900		0.2934	
		(0.62)		(0.42)		(1.46)	
Spatial λ			0.1200		0.2740*		0.3300
			(0.77)		(1.79)		(1.62)
Log likelihood	39.09	66.33	66.38	66.20	66.89	66.98	66.95

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 6. Estimation results: local property tax models - effective rates

		BINARY		FINGLETON		DISTANCE	
	OLS	Spatial lag	Spatial error	Spatial lag	Spatial error	Spatial lag	Spatial error
Constant	0.5701	0.6255	0.9342	0.4047	0.7429	0.4589	0.8594
	(0.88)	(1.08)	(1.52)	(0.66)	(1.24)	(0.81)	(1.40)
Population – total	-0.0005	-0.0006	-0.0006	-0.0005	-0.0010**	-0.0005	-0.0006
	(-0.86)	(-1.05)	(-1.20)	(-0.95)	(-2.09)	(-0.97)	(-1.17)
Area	0.0003	0.0003*	0.0003**	0.0003*	0.0003**	0.0003*	0.0003**
	(-1.54)	(1.81)	(2.07)	(1.75)	(2.21)	(1.90)	(2.14)
Population - % young	-0.0314	-0.0334*	-0.0351**	-0.0311*	-0.0270	-0.0293*	-0.0310*
	(-1.62)	(-1.93)	(-1.97)	(-1.74)	(-1.55)	(-1.73)	(-1.73)
Population - % old	-0.0033	-0.0057	-0.0067	-0.0033	-0.0040	-0.0046	-0.0051
	(-0.42)	(-0.83)	(-0.97)	(-0.46)	(-0.58)	(-0.68)	(-0.75)
Unemployment rate	0.0072	0.0051	0.0046	0.0059	0.0043	0.0046	0.0037
	(1.42)	(1.13)	(0.97)	(1.26)	(0.94)	(1.05)	(0.80)
Per capita income	0.0345	0.0196	0.0151	0.0337	0.0184	0.0166	0.0152
	(1.01)	(0.63)	(0.44)	(1.06)	(0.56)	(0.55)	(0.43)
Per capita grants	-0.0567	-0.0536	-0.0461	-0.0530	-0.0404	-0.0468	-0.0394
	(-0.98)	(-1.04)	(-0.88)	(-0.99)	(-0.78)	(-0.93)	(-0.76)
Dummy	-0.0883	-0.0682	-0.0637	-0.0801	-0.0812*	-0.0652	-0.0508
	(-1.63)	(-1.41)	(-1.28)	(-1.60)	(-1.68)	(-1.38)	(-1.00)
R square	0.168	0.170	0.256	0.148	0.246	0.203	0.286
Spatial ρ		0.3370**		0.2960		0.5570***	
		(2.47)		(1.55)		(3.52)	
Spatial λ			0.3610**		0.4590***		0.5970***
			(2.70)		(3.69)		(3.95)
Log likelihood	25.68	55.87	55.71	53.71	54.94	57.20	56.76

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 7. Estimation results: motor vehicle tax rates models

		BINARY		FINGLETON		DISTANCE	
	OLS	Spatial lag	Spatial error	Spatial lag	Spatial error	Spatial lag	Spatial error
Constant	0.8444*	0.7520	0.7235	0.6272	0.8344*	0.6658	0.7279
	(1.71)	(1.59)	(1.50)	(1.33)	(1.78)	(1.37)	(1.50)
Population – total	0.0008*	0.0008*	0.0007*	0.0009**	0.0006	0.0008*	0.0007*
	(1.73)	(1.83)	(1.73)	(1.99)	(1.61)	(1.82)	(1.72)
Area	0.0003**	0.0003***	0.0004***	0.0003***	0.0004***	0.0003***	0.0004***
	(2.54)	(2.85)	(3.16)	(2.90)	(3.01)	(2.85)	(2.83)
Population - % young	-0.0094	-0.0094	-0.0108	-0.0086	-0.0119	-0.0084	-0.0100
	(-0.62)	(-0.66)	(-0.75)	(-0.61)	(-0.85)	(-0.55)	(-0.69)
Population - % old	-0.0059	-0.0061	-0.0062	-0.0071	-0.0067	-0.0059	-0.0057
	(-1.03)	(-1.13)	(-1.15)	(-1.33)	(-1.24)	(-1.08)	(-1.03)
Unemployment rate	-0.0001	-0.0003	-0.0009	-0.0006	-0.0011	-0.0003	-0.0007
	(-0.04)	(-0.07)	(-0.23)	(-0.16)	(-0.30)	(-0.09)	(-0.19)
Per capita income	0.0519*	0.0481*	0.0621**	0.0407	0.0568**	0.0466*	0.0461**
	(1.94)	(1.81)	(2.33)	(1.52)	(2.20)	(1.73)	(2.27)
Per capita grants	-0.0881*	-0.0778*	-0.0655	-0.0738*	-0.0841**	-0.0776*	-0.0742*
	(-1.97)	(-1.83)	(-1.55)	(-1.76)	(-2.04)	(-1.82)	(-1.74)
R square	0.419	0.413	0.440	0.425	0.446	0.419	0.432
Spatial ρ		0.1090		0.2690		0.1850	
		(0.80)		(1.61)		(0.96)	
Spatial λ			0.2340		0.3149**		0.2810
			(1.60)		(2.14)		(1.33)
Log likelihood	44.73	72.07	72.68	73.19	72.86	72.16	72.27

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Table 8. Estimation results: building activities tax rates models

		BINARY		FINGLETON		DISTANCE	
	OLS	Spatial lag	Spatial error	Spatial lag	Spatial error	Spatial lag	Spatial error
Constant	-0.0710	0.6780	0.9392	1.0113	1.4261	0.5586	1.2063
	(-0.02)	(0.22)	(0.29)	(0.34)	(0.46)	(0.18)	(0.37)
Population – total	0.0040	0.0036	0.0028	0.0043	0.0014	0.0036	0.0029
	(1.24)	(1.24)	(1.02)	(1.56)	(0.58)	(1.28)	(1.08)
Area	0.0012	0.0014*	0.0015*	0.0015*	0.0016**	0.0014*	0.0014*
	(1.32)	(1.81)	(1.69)	(1.92)	(1.98)	(1.82)	(1.68)
Population - % young	-0.0819	-0.0716	-0.0790	-0.0511	-0.0610	-0.0570	-0.0764
	(-0.78)	(-0.77)	(-0.82)	(-0.57)	(-0.67)	(-0.62)	(-0.79)
Population - % old	-0.0262	-0.0353	-0.0418	-0.0417	-0.0402	-0.0329	-0.0410
	(0.65)	(-1.00)	(-1.16)	(-1.22)	(-1.15)	(-0.94)	(-1.15)
Unemployment rate	0.0084	0.0062	0.0061	-0.0013	-0.0050	-0.0005	-0.0043
	(0.31)	(0.26)	(0.24)	(-0.05)	(-0.21)	(-0.02)	(-0.17)
Per capita income	0.3231*	0.2021	0.2684	0.1148	0.2114	0.1728	0.2583
	(1.75)	(1.18)	(1.46)	(0.70)	(1.21)	(1.02)	(1.37)
Per capita grants	-0.6013*	-0.4670*	-0.4862*	-0.3733	-0.4328	-0.4462	-0.4834*
	(-1.94)	(-1.68)	(-1.72)	(-1.40)	(-1.62)	(-1.62)	(-1.73)
R square	0.291	0.300	0.372	0.336	0.403	0.317	0.403
Spatial ρ		0.3250**		0.5030***		0.4880***	
		(2.51)		(3.55)		(3.01)	
Spatial λ			0.3509***		0.5300***		0.5749***
			(2.60)		(4.77)		(3.68)
Log likelihood	-106.20	-75.36	-75.76	-73.30	-74.71	-74.40	-74.17

Note: *** significant at 1% level; ** significant at 5% level; * significant at 10% level

4. Concluding remarks

The election of the local tax rates is complex and depends on several factors. Theoretically, these variables include structural characteristics –population and area-, socio demographic characteristics –young population, elderly population and rate of unemployment- and fiscal magnitudes –per capita disposable income and per capita grants received. However, the decisions made by neighbouring municipalities can also be determinant and hence we must estimate the tax reaction functions by introducing the average of the tax rates of neighbouring jurisdictions with spatial econometrics procedures.

From a sample of Spanish municipalities, particularly the 78 jurisdictions of the region of Asturias, we have studied the horizontal externalities in the three main local taxes in Spain: property tax –both nominal and effective tax rates are analysed, motor vehicle tax and building activities tax, which represent about 80.3% of the local tax revenue jointly. We estimate both spatial lag model and spatial error model, with three specifications of the spatial weight matrix: binary, distance and the proposal of Fingleton.

The results show evidence of tax mimicking in the property tax when we study the effective rates with a spatial parameter of 0.337, but not in the nominal rates with a spatial parameter positive but not significant, in spite of the visibility of the later to take public decisions. The building activities tax also shows strategic interaction with a spatial parameter of 0.325 with the binary matrix, and near 0.5 with the other weight matrixes. However, we do not find tax mimicking in the motor vehicle tax, with a spatial parameter positive but not significant. The results are congruent with the empirical literature of tax mimicking; as Allers and Elhorst (2005) pointed out, the parameters are in general in the interval between 0.2 and 0.6.

Additionally, the study of the flypaper effect based on the sign of the coefficient of the grants received reveals little evidence of such effect –null or positive- of the grants on the local tax rates; our results are more in line with the theoretical predictions from the median voter model than with the empirical literature on the “money stick where they hit” hypothesis (for a review see Hines and Thaler, 1995).

Further research includes the search of explanations for that tax mimicking, with the yardstick competition as the most tested cause in the literature of strategic interactions among local jurisdictions. A complementary study will be the analysis of the local public expenditure interactions.

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