Tax Interactions among Belgian Municipalities: Does Language Matter?

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Abstract

This paper tests the existence of strategic interactions among municipalities using a panel of Belgian local tax rates from 1985 to 2004. A special emphasis is put on the role of the language spoken in the various municipalities. Our results first confirm previous findings for Belgium suggesting that municipalities interact with each other over the two main local tax rates, the local surcharge on the (labour) income tax rate and the local surcharge on the property tax. Using tools of spatial econometrics and an original methodology for specifying weights matrices, we find out that municipalities are sensitive to tax rates set by their close neighbours only. We also reject the hypothesis that the language does not matter: in the within model and for the local income tax rate, the intensity of interactions is shown to be lower between municipalities speaking different languages than between municipalities speaking the same language. That observation is particularly relevant for today Belgium and might be viewed as a contribution to the ongoing debate on the regionalisation or partial decentralization of some taxes.

JEL Code: H24, H31, H71.

Keywords: tax interactions, panel data, spatial econometrics, local tax rates, tax competition, yardstick competition.

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1. Introduction

During the last two decades, a large theoretical literature on tax competition has developed following the seminal papers of Zodrow and Mieszkowski (1986), Wilson (1986), Wildasin (1988) – see Wilson (1999) for a survey. The basic argument is that jurisdictions interact with their neighbours to attract a mobile activity or a mobile tax base. There is an alternative theoretical explanation for local authorities being affected by their competitors when they set their tax rates. It is based on the idea that citizens evaluate the performance of their incumbent leaders by comparing their public decisions with those set by the nearby local authorities. This theoretical literature on "yardstick competition" has been developed a.o. by Salmon (1987) and Besley and Case (1995).

Although theoretical literature on strategic interactions is quite voluminous, empirical studies are quite recent. Most papers concentrate on tax interactions among local jurisdictions within a country or among states within a federal country – see Brueckner, (2003) for a survey. These models are usually implemented empirically by means of estimation of a fiscal reaction function, where the optimal tax rate in a jurisdiction depends on the tax rates in nearby jurisdictions (Revelli, 2005). Most papers including those of Ladd (1992), Case (1993), Brett and Pinske (2000), Buettner (2001), Heyndels and Vuchelen (1998), Brueckner (1996), Brueckner and Saavedra (2001), Richard, Tulkens and Verdonck (2002), Feld and Reulier (2005), Feld, Josselin and Rocaboy (2003), Bordignon, Cerniglia and Revelli (2003), Solé-Ollé (2003), Leprince, Madiès et Paty (2007), Charlot et Paty (2007) find empirical evidence of positive interactions among sub-national governments using various data sets. Our paper is mainly in line with this strand of literature by using a panel of Belgian local tax rates data from 1985 to 2004.

Our contribution is twofold. First, we find that Belgian municipalities interact with each other on the two main local tax rates, the local surcharge on the income tax and the local surcharge on the property tax. That first result is consistent with the results obtained by previous studies, especially Heyndels and Vuchelen (1998), which proposes a cross section analysis, and Richard, Tulkens and Verdonck (2002), which, on the same period, uses a dynamic model where the slope of the reaction function is not directly estimated. Using tools of spatial econometrics and an original methodology for specifying weights matrices, we find out that municipalities are sensitive to tax rates set by their close neighbours only.

Second, we explore the effects of the proximity in terms of language on the empirical evidence of tax interdependence. Then, we reject the hypothesis that the language does not matter for interactions among nearby jurisdictions. Especially, for the local income tax rate, in the within model, the intensity of interactions is shown to be lower between municipalities speaking different languages than between municipalities speaking the same language – the three languages spoken in Belgium are Dutch, French and German. That observation is particularly relevant for today Belgium and might be viewed as a contribution to the ongoing debate on the regionalisation of some taxes.

That reflects the observation that residents' location choice is influenced by the language spoken in the municipality. A Belgian citizen usually prefers living in a municipality where the residents speak his own language, in order to avoid costs induced by the unavailability of schools, sport and cultural facilities in his own language, or by the need to translate official document received in another language. A policy-maker who fears the mobility of its tax base (the residents) will thus pay more attention to the fiscal choices of the nearby municipalities that share the same language. Moreover, an incumbent who does not fear the residents' mobility but wants to be re-elected is likely to take as a yardstick the fiscal choices of the nearby municipalities that share the same language because the access to information on fiscal conditions is supposed to be easier between such municipalities – e.g. Belgian newspapers, as to national news, are rather focused on their own language community.

Notice that the fact that the difference in terms of interaction occurs for the local income tax, which is levied on a residence principle, rather than for the tax on immovable property, levied on a source base, is *per se* an interesting result: as we will repeat in the conclusion, that results supports the view that providing the regions with more fiscal autonomy is less likely to generate externalities if that autonomy focuses on a tax levied according to the residence principle and related to the personal taxpayer location decision than on a tax levied according to the source principle and related to the location decision of taxpayer's wealth.

The paper is organized as follows. The next section presents the empirical design. The results are shown in section 3 and the last section concludes.

2. Empirical Design

In this section we provide some useful information as to Belgium before discussing the specification of our model and presenting the data set that we use.

2.1. Belgium, municipalities and local taxation

Belgium is a multilevel government country[2], a federation consisting of three regions and three communities. Regions – Flanders, Wallonia and Brussels – are basically in charge of matters related to the territory, like economic development, employment policy, infrastructure and the supervision of municipalities. Communities – the Dutch, French and German-speaking communities – are responsible for issues related to persons, like education and health. Each region and each community has its own government and parliament though Flanders and the Dutch-speaking communities have been merged. Since March 2008, the Walloon Region and the French-speaking Community have the same Minister-President. According to the Belgian Constitution, the residual power belongs to the regions and communities. Even if they are not competent for territorial matters, the authority of communities corresponds to a territory, that of the Dutch-speaking to Flanders and Brussels, and that of the French-speaking one to Wallonia and Brussels as well; the authority of the small German-speaking community is on a series of municipalities attributed to Belgium after the first world war and located in Wallonia.

In today Belgium, the corporate income tax and the value added tax are only federal; the personal income tax is mainly federal, but regions are permitted to add positive or negative

[2] For details, see e.g. Gérard (2002).

surcharges, and municipalities as well – see below; the immovable property tax goes to the regions which decide of its rate but municipalities add surcharges. Regions are mainly financed by transfers from the federal government and by regional taxes as well, while communities are essentially financed by transfers.

Belgium also consists of ten provinces and 589 municipalities. In the sequel of the paper we focus on municipalities. Their major expenditure categories include culture and education, police, welfare and transport infrastructure and general administration. They levy numerous local taxes and receive the revenue of the surcharges mentioned above so that taxation accounts for more than 40 per cent of local revenues. The remaining comes from transfers from the regional authorities. However, two taxes, the local income tax and the local property tax, are their major sources of revenue, accounting for 80 per cent of municipal tax revenues; the former accounting for more than the latter in a ration between 1.7 to 1 and 1.2 to 1 depending on the region. Both local taxes are surcharges freely determined by municipalities:

- the local income tax is a surcharge on the federal income tax paid by individuals, the rate of the surcharge is between 0 and 10 per cent; in practice this is a tax on labour income (savings income is taxed separately),
- the local property tax is a surcharge on the regional property tax; its base, also defined at federal level, is an imputed income on immovable property; that tax is paid by all the taxpayers – individuals, companies, charities… – on the basis of the location of the property.

Notice that the regional property tax amounts to 1.25 per cent in Brussels and the Walloon Region, and to 2.5 per cent in the Flemish Region, of the imputed income on immovable property; the local surcharge varies between 293.75 and 5,750 per cent of the regional tax. It is important to say that the location of the property determines the place where the tax is to be paid; as an illustration, an individual resident of municipality A which owns a real property in municipality B will pay the local income tax on his labour income in municipality A but the local property tax in municipality B. This explains why, on the sea side, two municipal councils elected by resident taxpayers have decided for a zero local income tax rate, charging the burden of local tax revenue on the property tax paid by non-resident owners, or users, of the houses and flats.

Each municipality has thus a council elected every six years by residents who vote on lists of candidates presented either by political parties – those also active at regional and federal level – or by local groups, e.g. "list of the mayor", usually affiliated with one or some of the parties; each list has municipal counsellors in proportion to the number of votes obtained. Then a majority contract is passed within the municipal council; on that base the mayor is designated by the Region and his deputies, in charge of specific fields like finance, education, culture… are elected by the council. The mayor and his deputies form the municipal college, the executive of the municipality.

Finally, the main factors of mobility within Belgium are the location of the workplace, though many Belgian residents commute a lot for reaching their workplace, and the price and size of grounds and houses; as explained above, the residents' localisation choice is also influenced by the language spoken in the municipality.

2.2. Empirical specification

2.2.1. The econometric model

Our aim is to test the existence of strategic interactions among municipalities and to find the effect of linguistic proximity on this interdependence. Both theoretical models of tax and yardstick competition have the same empirical predictions that jurisdiction *i* fiscal decisions in year *t*, $\tau_{i,t}$, depend on *i* 's own neighbours' corresponding fiscal decisions, $\tau_{j,t}$, and on *i* 's own socio-demographic characteristics $X_{i,t}$. Using a linear formulation, we obtain the following model

$$\tau_t = \alpha + W(\rho)\tau_t + X_t\beta + \eta + \varepsilon_t \quad (1)$$

where, $\tau_t = (\tau_{1,t},\ldots,\tau_{N,t})'$ is the vector of fiscal decisions by all the jurisdictions at date t, X_t is the matrix of the socio-demographic characteristics and $W(\rho)$ is a matrix of spatial weights. This matrix depends on ρ, which is a vector of parameters measuring the intensity of interaction. Moreover, $W(0) = 0$ (The specification of $W(\rho)$ will be examined later on, section 2.2.2). The vector $\eta_t = (\eta_1,\ldots,\eta_N)'$ is a vector of fixed municipal effects, taking into account the impact of the unknown time-invariant factors influencing the tax rates.

Stacking over periods $t = 1,\ldots,T$, and using Kroneker products, Equation (1) may also be written as

$$\tau = \alpha + \left[I_T \otimes W\left(\rho\right) \right] \tau + X\beta + \left[e_T \otimes I_N \right] \eta + \varepsilon \tag{2}$$

where I_T (resp. I_N) is the identity matrix at order T (resp. N) and e_T is a column $(N,1)$ vector with all its elements equal to 1. It is a spatial panel data model with a spatially lagged dependent variable[3]. There are three possibilities for estimating this type of model. The first one is to consider that the elements of the vector of municipal effects, η, are fixed coefficients to be estimated jointly with β and the vector of spatial autoregression coefficients, ρ. On theoretical grounds, this strategy may be accepted. Municipalities are fixed entities so that a larger sample is a sample with the same municipalities but additional periods; therefore, the set of coefficients to be estimated does not vary with the sample size, ensuring consistency. However, estimating the whole set of coefficients of this fixed effects model implies estimating 600 coefficients and may raise computational problems.

Alternatives strategies are to estimate a transformed model, using either the *between* municipalities or the *within* municipalities transformation. These transformations come from the following decomposition of every variable *y*

$$y_{it} = \overline{y}_i + \left(y_{it} - \overline{y}_i \right) \tag{3}$$

[3] This type of model is not very well documented in the spatial econometrics literature; see, however, Elhorst, 2003 and Anselin, Jayet and Le Gallo, 2007.

where, for every municipality *i*, $\bar{y}_i = T^{-1}\sum y_{i,t}$ is the mean over all periods and $(y_{it} - \bar{y}_i)$ is the deviation to the municipal mean at period *t*. Let us note that the (*N*,1) column vector of municipal means, $\bar{y} = (\bar{y}_1,\dots,\bar{y}_N)$, may be written in matrix form as

$$\bar{y} = T^{-1}\left(e_T^{'} \otimes I_N\right) y \tag{4}$$

Then the matrix form of the previous decomposition is

$$y = T^{-1}\left(e_T \otimes I_N\right)\bar{y} + \left[y - T^{-1}\left(e_T \otimes I_N\right)\bar{y}\right] = T^{-1}\left(e_T e_T^{'} \otimes I_N\right)y + \left[\left(I_T - T^{-1}e_T e_T^{'}\right)\otimes I_N\right]y \tag{5}$$

The *between* municipalities transformation uses the first term of this decomposition, the municipal mean. For every municipality, the whole time series of the dependent and the explanatory variables are replaced by their mean over the whole period: starting from model (2), and pre-multiplying all the terms by the matrix $T^{-1}\left(e_T^{'} \otimes I_N\right)$, one gets

$$\bar{\tau} = \alpha + W(\rho)\bar{\tau} + \bar{X}\beta + \eta + \bar{\varepsilon} \tag{6}$$

where $\bar{\tau} = T^{-1}\left(e_T^{'} \otimes I_N\right)\tau$ is the vector of municipal mean tax rates, $\bar{X} = T^{-1}\left(e_T^{'} \otimes I_N\right)X$ is the vector of municipal means of the explanatory variables, and $\bar{\varepsilon} = T^{-1}\left(e_T^{'} \otimes I_N\right)\varepsilon$ is the vector of municipal mean residuals. The standard assumption that the municipal effects, are i.i.d. with variance σ_η^2 ($V\eta = \sigma_\eta^2 I_N$) and are not correlated with the random terms, $\varepsilon_{i,t}$, also deemed to be i.i.d. with variance σ_ε^2 ($V\varepsilon = \sigma_\varepsilon^2 I_{NT}$), implies that the random part of the between municipalities model is also i.i.d with variance $\sigma^2 = \sigma_\eta^2 + T^{-1}\sigma_\varepsilon^2 : V(\eta + \bar{\varepsilon}) = \sigma^2 I_N$.

Alternatively, we can assume that the vector η is spatially autoregressive

$$\eta = W(\lambda)\eta + \zeta \Leftrightarrow \eta = \left(I_N - W(\lambda)\right)^{-1}\zeta \tag{7}$$

where ζ is a vector of i.i.d. random terms ($V\eta = \sigma_{\zeta}^{2} I_N$), so that

$$V\left(\eta + \bar{\varepsilon}\right) = \sigma_{\zeta}^{2}\left(I_N - W\left(\lambda\right)\right)^{-1}\left(I_N - W'\left(\lambda\right)\right)^{-1} + \sigma_{\varepsilon}^{2} T^{-1} I_N \quad (8)$$

In both cases, the between municipalities model can be estimated using standard maximum likelihood methods.

The *between* model focuses on mean differences across municipalities; it neglects time evolutions for each municipality. Conversely, with the within transformation, the mean differences across municipalities disappear and the analysis focuses on time evolutions.

The standard *within* municipalities transformation uses the second term of the decomposition, the deviation from the mean: starting from model (1'), and pre-multiplying all the terms by the matrix $\left[\left(I_T - T^{-1} e_T e_T^{'}\right) \otimes I_N\right]$, one gets:

$$\Delta\tau = \left[I_T \otimes W\left(\rho\right)\right] \Delta\tau + \Delta X\beta + \Delta\varepsilon \quad (9)$$

where $\Delta\tau = \left[\left(I_T - T^{-1} e_T e_T^{'}\right) \otimes I_N\right]\tau$ is the vector of deviations of tax rates to their municipal mean, $\Delta X = \left[\left(I_T - T^{-1} e_T e_T^{'}\right) \otimes I_N\right] X$ is the matrix of deviations of the explanatory variables to their municipal mean, $\Delta\varepsilon = \left[\left(I_T - T^{-1} e_T e_T^{'}\right) \otimes I_N\right]\varepsilon$ is the vector of deviations of residuals to their municipal mean.

The technical advantage of the within municipalities transformation is that the vector of municipal effects, η, disappears. It is well known that, when there is no spatial lag (the vector ρ being zero, so that $W(\rho) = 0$), this model can be efficiently estimated using ordinary least squares. However, as noted by Anselin, Jayet and Le Gallo (2007), as soon as there is a spatially lagged endogenous variable, the standard within model can no longer be estimated by maximum likelihood. The reason is very simple: the residual terms are linked to each other by the equalities $\sum\left(\varepsilon_{i,t} - \bar{\varepsilon}_i\right) = 0$ for all *i*, and then the variance-covariance matrix, $V\left(\Delta\varepsilon\right) = \sigma_{\varepsilon}^{2}\left[\left(I_T - T^{-1} e_T e_T^{'}\right) \otimes I_N\right]$ is not full rank.

We overcome this problem using a variant of the within municipalities transformation where, instead of using deviations from the mean, we use deviations from a reference year; observations for that year are then deleted from the sample. For example, if the reference year is year 1, this variant of the within municipalities transformation is

$$D\tau = \left[I_T \otimes W(\rho) \right] D\tau + DX\beta + D\varepsilon \qquad (10)$$

where *D* is the matrix

$$D = \left[-e_{N-1} \quad I_{N-1} \right] = \begin{bmatrix} -1 & 1 & 0 & \dots & \dots & 0 \\ \vdots & 0 & \ddots & \ddots & & \vdots \\ -1 & \vdots & \ddots & 1 & \ddots & \vdots \\ \vdots & \vdots & & \ddots & \ddots & 0 \\ -1 & 0 & \dots & \dots & 0 & 1 \end{bmatrix} \qquad (11)$$

In equation (10), the variance-covariance matrix is full rank and the model can be estimated by maximum likelihood. Moreover, we are able to prove that[4]

- The ML estimators of the vectors ρ and β do not depend upon the reference year.
- If the vector ρ equals zero, the ML (and GLS) estimator of β is the standard OLS estimate of (6).

2.2.2. Specifying the weights matrix

The weights matrix, $W(\rho)$, is the matrix with current element $w_{i,j}(\rho)$. The line *i* of *W* is the set of weights used for calculating the spatial lag of municipality *i*. Usually, the weights matrix is assumed to be linear, $W(\rho) = \rho W^1$, where W^1 is row normalised, each row summing to unity, and the vector ρ reduces to a scalar. Standard choices for W^1 are row normalised contiguity matrices (only the *k* nearest neighbours have a positive weight), or weights inversely proportional to distance or to the square of the distance. The fact that the weights matrix is arbitrarily chosen is unsatisfactory, as different matrices may lead to

[4] Proofs are available on request from the authors

different results. Therefore, some authors test several matrices, in order to assess the robustness of the conclusions. But, in most cases, only one matrix is used.

In this paper, we propose a more general formulation, the weights matrix $W(\rho)$ being a linear combination of partial weights:

$$W(\rho) = \rho_1 W^1 + \cdots + \rho_K W^K \tag{12}$$

where the vector of coefficients is $\rho = (\rho_1, \ldots, \rho_K)$ and each matrix $W^1, \ldots W^K$ corresponds to a specific type of interaction between municipalities. This formulation reduces to the standard one when $k = 1$.

This specification of the weights matrix has been used twice. In a first stage, we used it to test the maximum distance separating two interacting municipalities. More precisely, for every municipality i, we sort all the other municipalities by increasing distance. Then, we build pseudo-contiguity matrices $C^1, \ldots, C^9$, such that $c_{i,j}^k = 1$ if, after sorting by increasing distance to municipality i, municipality j has a rank between a minimum n_-^k and a maximum n_+^k, with

Rank	1	2	3	4	5	6	7	8	9
n_-^k	1	11	25	45	73	113	169	249	361
n_+^k	10	24	44	72	112	168	248	360	520

Therefore, $c_{i,j}^1 = 1$ if municipality j is among the ten municipalities closest to i; $c_{i,j}^2 = 1$ if municipality j is not among the ten municipalities closest to i but is among the 24 closest ones; and so on.

The choice of these thresholds implies that the number of nonzero elements of C^k is roughly proportional to the square root of k, so that the distances covered by each matrix are roughly similar. Then, for every k, W^k is obtained after a row normalisation of C^k.

2.2.3. Does language matter?

In a second stage, we use a similar methodology for testing whether language matters for interactions between municipalities. More precisely, among the 589 Belgian municipalities, 335 are Flemish-speaking, 235 are French-speaking, and 19 – those of the Brussels region – are bi-lingual. We test the hypothesis that the intensity of interactions is lower between two municipalities speaking different languages than between two municipalities speaking the same language.

For testing that hypothesis, for every *k*, we write W^k as the sum of 5 sub-matrices

$$W^k = W^{k,FF} + W^{k,WW} + W^{k,BB} + W^{k,FW} + W^{k,FB} \tag{13}$$

where

- $w_{i,j}^{k,FF} = w_{i,j}^{k}$ when both municipalities *i* and *j* are Flemish, zero otherwise,
- $w_{i,j}^{k,WW} = w_{i,j}^{k}$ when both municipalities *i* and *j* are Walloon, zero otherwise,
- $w_{i,j}^{k,BB} = w_{i,j}^{k}$ when both *i* and *j* are in the Brussels region, zero otherwise,
- $w_{i,j}^{k,FW} = w_{i,j}^{k}$ when *i* is Flemish (resp. Walloon) and *j* is Walloon (resp. Flemish), zero otherwise,
- $w_{i,j}^{k,FB} = w_{i,j}^{k}$ when *i* is Flemish (resp. in the Brussels region) and *j* is in the Brussels (resp. Flemish), zero otherwise,

To sum up, $W^{k,FF}$, $W^{k,WW}$ and $W^{k,BB}$, correspond to interactions within the same region, respectively Flanders, Wallonia and Brussels; while $W^{k,FW}$ and $W^{k,BW}$ correspond to interactions between Flanders and the other two regions, Wallonia and Brussels respectively[5].

[5] Note that we do not include interactions between the Brussels and Walloon municipalities since Brussels is completely surrounded by Flemish municipalities.

Therefore, the full weights matrix takes the following form

$$W(\rho) = \sum_k \left(\rho_{k,FF} W^{k,FF} + \rho_{k,WW} W^{k,WW} + \rho_{k,BB} W^{k,BB} + \rho_{k,FW} W^{k,FW} + \rho_{k,FB} W^{k,FB} \right) \qquad (14)$$

2.3. Data set

We estimate equations (1), (2) and (6), using annual data for the 589 Belgian municipalities over the period 1985-2004. These data have been collected by Richard, Tulkens and Verdonck (2002) and by Van Parys and Verbecke (2006). The main data sources are the National Institute of Statistics, the Department of Economics and the Department of Geography of the Université Catholique de Louvain, in Louvain-la-Neuve. Table 2 reports the summary statistics.

As noted above, local tax policies also reflect the impact of differences in economic and demographic factors grouped in the vector *X* in equation (1). Following the empirical literature, we include a set of socio-demographic variables, such as the unemployment rate, the population density and per capita income. These three variables may be interpreted as expenditure needs variables. We thus expect a positive sign for the respective corresponding parameters. We also include three electoral dummies to check the existence of an electoral cycle, i.e. lower tax rates the years around the election year and higher tax rates in the middle of the legislative period, which last for six years – elections occurred in the last quarter of 1988, 1994 and 2000 respectively. Finally we include a trend variable.

Table 1 displays standard summary statistics for the two explained variables and the three main explanatory variables. Table 2 provides a decomposition of the variance of these variables using the two dimensions introduced above, *within* and *between* municipalities. For the local income tax, the local property tax, and the unemployment rate, differences across municipalities are the main source of variability; differences across time also exist, but they are a minor source of variability.

Table 1 - Summary statistics

Variable	Mean	Standard dev.	Min	Max
Local income tax	6.84	1.07	0	10
Local property tax	2633.51	689,67	293.75	5750
Population density	6.71	17.42	0.19	201.96
Per capita income	350.45	101.92	147	704.86
Unemployment rate	3.60	1.85	0	21.51

Note: Number of observations: 11780 (T=20, N=589)

Table 2 - Variance disaggregation

Variable	Total	Within	Between	variance within in % of variance
Local income tax	0.0451	0.011	0.0342	24.3
Local property tax	0.0859	0.0264	0.0595	30.7
Population density	1.37	0.002	1.37	0.1
Income per capita	0.084	0.065	0.019	77.4
Unemployment rate	0.274	0.065	0.208	23.9

3. Results

Both the *within* and the *between* transformed models have been estimated using the weights matrices presented in section 2.2. Estimations have been carried out using maximum likelihood. Due to the complexity of the structure of the weights matrix, we systematically tested for the inclusion of coefficients, using a top down approach: interaction effects between municipalities were not included when, after a Wald test, the hypothesis of a zero coefficient has been accepted.

For both the *within* and the *between* model, we started with a general specification where spatially autoregressive effects are included for both the endogenous variable and the error term.

We estimated that model in two stages. In the first stage, using equation (9), we took into account distances between municipalities without any distinction between regions; the results are summarized in Table 3. In the second stage, we used the results of the first stage as well as equation (14) to investigate the differences across regions; results are reported in

Table 4. Finally, we examined the impact of control variables, like population density, unemployment rate and per capita income, as well as the direction of the trend – see Table 5 in the main text and Table 6 in Appendix.

3.1. Without interregional differences

Those results have several interesting implications. Prior to their examination, remember that, though the *within* model copes with year to year evolution for each municipality, the *between* model focuses on differences from the mean, across municipalities and over the whole twenty year period.

First of all, there is a striking difference between the estimation results of the *within* model and the *between* model.

The *within* model confirms the existence of strategic interactions across municipalities, the coefficients of the autoregressive terms for the endogenous variable being highly significant. The *between* model suggests the opposite conclusion: no autoregressive term for the endogenous variable has a significant effect so that there is no interaction across municipalities.

The second implication is that, for the *within* model, interactions are limited to municipalities which are close to each other.

Given that the matrices W^1 to W^4 correspond to the 72 closest neighbours at most and that there are 589 municipalities in Belgium, each Belgian municipality interacts with around its ten per cent closest neighbours.

The absence of interactions between municipalities in the *between* model implies that the mean tax level of a municipality is not influenced by the mean tax level of its neighbours. However, the fact that there are significantly positive interactions in the *within* model implies that municipalities react to tax changes decided by their neighbours: if next door municipality *j* decreases its tax rate, municipality *i* also decreases its own rate.

Table 3 - Autoregressive effects and proximity

Interaction matrix			W^1	W^2	W^3	W^4
Within model	Local Income Tax (LIT)	Endogenous variable	0.359**	0.090**	0.062*	0.087*
		Error Term				
	Local Property Tax (LPT)	Endogenous variable	0.142*	0.283**	0.118**	
		Error Term	0.185**			
Between model	Local Income Tax (LIT)	Endogenous variable				
		Error Term	0.300**			
	Local Property Tax (LPT)	Endogenous variable				
		Error Term	0.361**	0.408**		

Notes: Coefficients not significantly different from zero at the 5% level have been omitted.
*: 10% significant, **: 5% significant, ***: 1% significant.

3.2. The role of interregional differences, or languages matter

In the second stage, we use the results of the first stage as well as equation (14) to investigate the differences across regions. More precisely, for every matrix W^k with a significant effect in the previous subsection, we tested and, when relevant, estimated the decomposition given by equation (14). Since there are no interaction between municipalities in the *between* model, there is no need to analyse how these interactions vary across regions, so that the analysis is carried out for the *within* model only and the results are displayed in Table 4. There was no regional decomposition of W^3 for the local property tax and of W^4 for the local income tax, as statistical tests accepted the null hypothesis of no differences between regions.

Our main result shows that there are significant differences between the three regions. For the local income tax, the interaction of a municipality with its closest neighbours is much higher in Brussels and Wallonia than in Flanders. The elasticity of the local income tax rate to the average rate over its closest neighbours amounts to 0.5 in Brussels and Wallonia, while it is only 0.2 in Flanders. For both Brussels and Flanders, the elasticity of the local property tax to the average rate of the closest neighbours is 0.2.

Another important result comes from the comparison of the interactions between municipalities located in the same region and the interactions between municipalities located in different regions. A Wald test shows that, for the local income tax, the interactions between Flemish municipalities and municipalities located in the other regions are significantly weaker than the interactions between municipalities located in the same region. The same test shows that this difference does not hold for the local property tax.

Table 4 - Interactions between municipalities: interregional differences

Type of interaction	Proximity rank	Matrix[6]	Local Income Tax (LIT)	Local Property Tax (LPT)
Within Flanders	1-10	$W^{1,FF}$	0.189**	
	11-24	$W^{2,FF}$	0.061	
	25-44	$W^{3,FF}$	0.208**	
	1-24	$W^{1,FF}+W^{2,FF}$		0.221**
Within Wallonia	1-10	$W^{1,WW}$	0.478**	
	11-24	$W^{2,WW}$	0,076	
	25-44	$W^{3,WW}$	-0,0297	
	1-24	$W^{1,WW}+W^{2,WW}$		0.168**
Within Brussels	1-24	W^{4}	0,520**	0.213*
Between Flanders and the other two regions[7]	1-10	$W^{1,FB}+W^{1,FW}$	0.171**	0.211**
All regions	25-44	W^{3}		0.164**
All regions	45-72	W^{4}	0.112**	

Notes: Coefficients without asterisk are not significantly different from zero at the 5% level.
*: 5% significant, **: 1% significant.

[6] When there is no significant differences between the coefficients estimated for two matrices, these two matrices have been grouped. For example, if the hypothesis $\rho^{1,FF} = \rho^{2,FF}$ can be accepted, then instead of using $\rho^{1,FF} W^{1,FF} + \rho^{2,FF} W^{2,FF}$ we use a single coefficient multiplying $W^{1,FF} + W^{2,FF}$. Therefore, all the 24 closest municipalities have the same impact.

[7] There is no significant difference between Brussels and Wallonia regarding interactions with Flanders. We did not introduce interactions between Wallonia and Brussels since Brussels Region is entirely surrounded by Flemish municipalities.

3.3. The impact of control variables and the direction of the trend

Finally, Table 5 shows the estimation results for the four models, i.e. with the local income tax and the local property tax as endogenous variables and using the *within* and the *between* transformations, with spatial dependence. Table 6, in Appendix, shows the same results when there is no spatial dependence. Differences between the two sets of estimations are not important.

Table 5 - ML estimation results of within and between models (with spatial lag dependence)

Dependent var.	Local Income Tax (LIT)		Local Property Tax (LPT)	
Estimator	Within	Between	Within	Between
Population density	0.023 (0.615)	0.016* (3.42)	0.022 (0.386)	0.001 (0.00)
Unemployment rate	0.015*** (15.9)	0.080*** (12.8)	−0.024*** (28.3)	0.196*** (33.1)
Income per capita	0.099*** (23.4)	−0.265*** (12.5)	0.060** (5.48)	−0.331*** (15.2)
Election year t-1	−0.011*** (17.1)		−0.013*** (16.1)	
Election year t	−0.016*** (39.7)		−0.024*** (53.0)	
Election year t+1	−0.008*** (10.1)		−0.017*** (27.8)	
Trend	−0.002* (4.2)		0.006*** (31.8)	
Intercept		3.34*** (56.4)		4.92*** (91.8)
Initial log likelihood	9780	−693	8221	−795
Final log likelihood	10202	−688	8784	−696
Observations	11191	589	11191	589

Notes: *: 10% significant, **: 5% significant, ***: 1% significant; Wald statistics between brackets; variables are log-transformed (except dummies and trend).

We obtain the expected positive sign for the *population density* but, in most cases, it is not significant. As for the *unemployment rate*, apart for the within estimator on the local property tax, we get a positive sign highlighting the fact that unemployed people call for some extra local expenditures – in Belgium part of the initiatives against unemployment are under the responsibility of the municipalities, like the local agencies for employment – that might increase local taxation. The parameter associated with *income per capita* is positive for both local tax rates in the *within* model, as in the empirical literature where the demand for public services is very often positively correlated with income. It is however negative in the *between* model, supporting the view that higher income municipalities can obtain the same amount of revenues with smaller rates. Dummy variables for the years around election years seem to support the view of an *electoral cycle*. Finally, we get a negative sign for the *trend* in the local income tax but a positive sign for the local property tax which is in line with the view of putting the tax burden on the more immobile tax base and to non-voting persons as well (remember that owners pay that tax where the good is located, not where they vote).

4. Conclusion

In this paper, we first show that Belgian municipalities interact with each other over the two main local tax rates, the local surcharge on the individual income tax, which is primarily a local tax on labour income, and the local surcharge on the property tax. That first result is consistent with those of previous studies, especially Heyndels and Vuchelen (1998), which proposes a cross section analysis, and Richard, Tulkens and Verdonck (2002), which, on the same period, uses a dynamic model where the slope of the reaction function is not directly estimated. Using tools of spatial econometrics and an original methodology for specifying weights matrices, we find out that municipalities are sensitive to tax rates set by their close neighbours only.

Second, we explore the effects of the proximity in terms of language on the empirical evidence of tax interdependence. Then, we reject the hypothesis that the language does not matter for interactions among nearby jurisdictions. Especially, for the local income tax rate, in the within model, the intensity of interactions is shown to be lower between municipalities speaking different languages than between municipalities speaking the same language. That observation is particularly relevant for today Belgium and might be viewed as a contribution to the ongoing debate on the regionalisation of some taxes.

In that prospect, the fact that the difference in terms of interaction occurs for the local income tax, which is levied on a residence principle, rather than for the tax on immovable property, levied on a source base, is *per se* an interesting result; it supports the view that providing the regions with more fiscal autonomy is less likely to generate externalities if that autonomy focuses on a tax levied according to the residence principle and related to the personal taxpayer location decision than on a tax levied according to the source principle and related to the location decision of taxpayer’s wealth.

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Appendix

Table 6: OLS estimation results of within and between models

(without spatial lag dependence)

Dependent var.	Local Income Tax (LIT)		Local Property Tax (LPT)	
Estimator	Within	Between	Within	Between
Population density	0 (0)	0.016** (2.36)	0 (0)	0.048*** (5.73)
Unemployment rate	0.033*** (8.2)	0.079*** (4.43)	-0.062*** (-13.4)	0.070*** (3.32)
Per capita income	0.166*** (7.72)	-0.247*** (-3.78)	0.207*** (8.4)	-0.861*** (-11.1)
Election year t-1	-0.022*** (-8.27)	-	-0.026*** (-8.29)	-
Election year t	-0.036*** (-13.5)	-	-0.048*** (-15.5)	-
Election year t+1	-0.018*** (-6.9)	-	-0.036*** (-11.8)	-
Trend	-0.001* (-1.57)	-	0.009*** (8.88)	-
Intercept	-	3.23*** (8.38)	-	8.11*** (17.7)
Log lik.	9780	-693	8221	-796
Observations	11191	589	11191	589

Notes: *: 10% significant, **: 5% significant, ***: 1% significant. T-statistics in parentheses. Variables are log-transformed (except dummies and trend).

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