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WORKING PAPER

Local tax interaction with multiple tax instruments: evidence from Flemish municipalities

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Abstract:
We investigate the long run result of strategic interaction among local jurisdictions using multiple tax instruments. Most studies about local policy interaction only consider a single policy instrument. With multiple tax instruments, however, tax interaction is more complex. We construct a simple theoretical framework based on a basic spillover model, with two tax rates and immobile resources. We show that the signs of within and cross tax interaction crucially depend on the extent to which a jurisdiction mimics the other jurisdiction's budget, and the extent to which the preference for one tax instrument is affected by the level of the same or the other tax instrument in the other jurisdiction.
Its specific institutional setting makes of Flanders (Belgium) a unique region to evaluate multiple tax interaction. Municipalities in Belgium are free to set two important local tax rates: the local property tax rate and the local income tax rate. We estimate whether years of strategic interaction between Flemish municipalities, of which the division is stable since 1983, has resulted in municipalities mimicking their neighbors' tax structure. We do so by between estimating income and property tax reaction functions for the period 1992-2004, each of which simultaneously includes the neighboring municipalities' income ànd property tax rate.
We find that the property (income) tax rate of a municipality is significantly higher if the property (income) tax rate in other municipalities is high, and that the coefficient is higher if the possible impact of the other municipalities' income (property) tax rate is accounted for. The cross impact of the other municipalities' income (property) tax rate on the property (income) tax rate is always negative, though the significance is higher for the property tax than for the income tax reaction function. The result suggests that municipalities are keener on competing each other's tax structure than on mimicking the neighboring municipalities' budget.

Keywords: tax competition; yardstick competition; local tax rates; spatial econometrics; multiple taxes; tax structure.

1. Introduction

A growing number of scholars have shown that local budgets and local tax rates are determined by strategic considerations vis-à-vis other jurisdictions, in addition to socio-economic variables. Empirical evidence for the US, Canada, and many European countries[1] indicates positive spatial correlation of local budgets and tax rates. The three theoretical reasons brought forward for this strategic interaction are yardstick competition, expenditure spillovers, and tax competition. In the case of yardstick competition, tax interaction stems from voters' evaluation of the performance of local politicians relative to the neighboring jurisdictions. This performance evaluation induces politicians to mimic their neighbors in order to be reelected (Besley and Case 1995). In case of expenditure spillovers, residents of a jurisdiction may be affected by public expenditure in other jurisdictions as well as from their own jurisdiction, leading to spatially correlated expenditures and taxes (see for example Case et al. 1993). In case of tax competition, jurisdictions compete for a mobile tax base through their tax rates relative to other jurisdictions (see Wilson (1999) for an overview).

Most studies about local policy interaction only consider a single policy instrument. They investigate the spatial dependency of either the most important local tax rate or the aggregate local budget or tax revenues. If the institutional setting of a country consists of a single local tax instrument, a spatially correlated budget automatically implies spatial correlation of the tax instrument. If local jurisdictions dispose of multiple tax instruments, however, tax interaction is more complex. A high rate of one of the taxes in the other jurisdictions could -depending on the citizens' preferences- be associated with a high rate of the same tax, high rates of all taxes, or high rates of some and low rates of other taxes, …

[1] For example: US: Brueckner and Saavedra (2001), Ladd (1992); Canada: Brett and Pinkse (2000), Brett and Tardif (2005); Belgium: Gerard et al. (2009), Geys (2006), Heyndels and Vuchelen (1998), Richard et al. (2005); the Netherlands: Allers and Elhorst (2005); UK: Revelli (2001); France: Charlot and Paty (2007), Racoboy and Reulier (2009); Switzerland: Feld and Reulier (2009), Italy: Bordignon et al. (2003), Santolini (2008); Spain: Sollé Ollé (2003); Sweden: Edmark and Agren (2008); Norway: Fiva and Rattso (2007); Germany: Buettner (2001).

We first present a simple theoretic construct to show that the signs of within and cross tax interaction crucially depend on the extent to which a jurisdiction mimics the other jurisdiction's budget, and the extent to which the preference for one tax instrument is affected by the level of the same or the other tax instrument in the other jurisdiction. The empirical sign of the spatial interaction coefficients within the same and across different tax instruments therefore provides useful information about the dynamics of citizens' preferences for one or the other tax, given the municipality's budget constraint, and the tax rates and the budget in other municipalities.

Including multiple tax instruments in the reaction function is also important from an econometric perspective. Focusing on one tax instrument could cause an omitted variable bias on the estimation of the tax interaction coefficient. In this respect we are interested in comparing our results with both Heyndels and Vuchelen (1998) and Gerard et al. (2009) who estimate separate tax reaction functions for the local property tax rate and the local income tax rate in Belgium, ignoring possible cross tax interactions.

We empirically investigate strategic interaction among Flemish municipalities[2] in a multiple tax instrument setting. The specific institutional setting makes Flanders (Belgium) a unique region to evaluate multiple tax interaction. Municipalities in Belgium are free to set two important local tax rates: the local property tax rate and the local income tax rate. Both tax instruments are almost equally important in terms of revenue raised, each accounting for approximately 40% of local tax revenues. With the tax base defined at the federal level[3] and municipalities only deciding on rates, the tax rates are easily comparable across jurisdictions. Additionally, municipalities are also institutionally homogenous with equal responsibilities.

The division of municipalities has not changed since 1983, when the number of Flemish municipalities was fixed to 308. As a result, the current distribution of local income and property tax rates over space is the result of many years of strategic tax interaction among

[2] Flanders is the Northern region of Belgium.
[3] The local income tax rate is a surcharge on the federal income tax payments; the local property tax rate is a surcharge on the regional property tax.

municipalities. This has resulted in a long run equilibrium that changes little over time. The fact that Flemish local tax rates vary little over time (as compared to over space), and the finding by Gerard et al (2010) that there is no evidence of spatial interaction in the short run (using *within* municipalities estimation) within one tax instrument in Flanders, confirm the stability of the long run equilibrium. We estimate the long run impact of the other municipalities' tax rates on a municipality's income and property tax rate, by *between* estimating income and property tax reaction functions. We do so for the period 1992-2004, and for the legislature (sub)-periods. Each reaction function simultaneously includes the neighboring municipalities' income ànd property tax rate.

Our results confirm the existence of positive tax interaction within the local property tax rate and within the local income tax rate in the long run. However, we find higher estimates of within tax interaction if cross tax interaction is accounted for. Moreover, we find evidence of negative cross interaction between a municipality's property tax rate and other municipalities' income tax rates. Further we find that a municipality's income tax rate reacts negatively on other municipalities' property tax rates, although the evidence is less convincing. A possible interpretation of these results is that local jurisdictions mimic each other's tax *structure*, giving more (less) importance to the tax instrument that is more (less) important in the neighboring jurisdictions. We believe that the budget constraint plays an important role in the interplay determining the level of the tax instruments.

Previous studies dealing with strategic interaction using multiple policy instruments are fairly limited to our knowledge. Frederikson et al. (2004) examine the strategic interaction within and across three US state-level policy instruments: corporate taxation, infrastructure spending, and pollution control standards. Devereux et al. (2008) analyze within and cross interaction for the corporate effective marginal tax rate and the statutory tax rate for multinationals in OECD countries. Because these studies only consider policy instruments that affect mobile capital, they rely on pure tax competition models. Local jurisdictions, on the other hand, tax less mobile economic units –unless they use benefit taxation- for efficiency reasons (Oates and Schwab

1991). As a result yardstick or spillover models, which justify strategic interaction without tax base mobility, gain weight in a local setting. We show that also in this context cross tax interaction should be considered.

In section 2 we present a simple theoretical framework to evaluate within and cross tax interaction in yardstick or spillover models. Section 3 explains the methodology, data, and institutional particularities of Belgium and Flanders. Section 4 presents the results that are summarized and discussed in section 5.

2. Theoretical framework

We develop a simple theoretical framework to interpret the sign of strategic interactions within and cross multiple tax instruments. We start from a basic spillover model with two jurisdictions based on Brueckner (2003) that applies to models of expenditure spillovers as well as yardstick competition[4]. We start developing the model under the assumption of a single local tax rate and then relax this assumption and include two tax instruments.

Each government chooses the level of public goods to maximize its citizens' utility

$$U(C,G;X) \qquad (1)$$

where *C* is private consumption, *G* is the level of public goods or the government's budget, and *X* is a vector of municipality characteristics that determine preferences. Utility is increasing and concave in *C* and *G*. If the public good is financed by a single tax rate, the tax revenue is $T = tY$, the private budget restriction is $C = Y - T$, and the government's budget restriction is $G = T$, with *Y* the income level. In the spillover model, the tax base is assumed to be immobile and exogenous. Maximization results in the following first order condition:

$$U_G=0, \qquad (2)$$

Here, we assume that the spillovers cause the marginal utility of public goods U_G to increase with the level of public goods in the other jurisdiction *G**, thus $U_{GG*}>0$[5]. As a result, differentiating first order condition (2) we get a positive interaction between the level of public goods or the tax rate in one jurisdiction and the level of public goods or the tax rate in the other jurisdictions. This gives:

[4] The general name is spillover model because either it concerns expenditure spillovers or information spillovers (in case of yardstick competition) (Brueckner 2003).

[5] This assumption can be either based on an expenditure spillover models or on the yardstick competition model.

$$G = R(G^*; X)$$
$$\frac{dG}{dG^*} = \rho > 0 \qquad (3)$$
$$\frac{dt}{dt^*} = \frac{Y^*}{Y}\rho > 0$$

This is the basis of studies on local policy interaction with a single local policy variable. Positive outcomes on local interactions found in the studies mentioned in the introduction justify the assumption of a positive ρ.

Next, we extend the model to include two local tax instruments. We call them *P* and *I*, referring to the local Property tax rate (P) and the local Income tax rate (I) in Flanders. The tax revenue function can the n be written as:

$$T = Px_P + Ix_I \qquad (4)$$

Both tax bases x_P and x_I are assumed immobile and exogenous[6]. As a result, the government now not only needs to decide on the level of the budget *G*, but also needs to decide on how to finance it. With a single tax instrument as in (3), both decisions coincide; but with two tax instruments as in (4) a decision on the relative levels of the tax instruments is needed. For simplicity, assume that the budget level decision is independent from the financing decision[7]. Therefore, the decision about the budget level depends on the own local preferences and on the other municipality's budget, and not on how the budget is financed in either municipality. The decision on how to finance the budget, however, does depend on the way the budget is financed in the other municipality. After determining the budget *G*, the local government will set *I* and *P* to maximize *V*, the utility function representing the tax preferences:

$$V(I, P, I^*, P^*; X) \qquad (5)$$

[6] This is because we are working in a spillover model. We provide evidence in the data section that the immobility of tax bases is highly realistic in the case of Flanders.

[7] This does not mean that the choice of the budget level and the way it is financed cannot be correlated. They can still be correlated because exogenous preferences that determine the level of the budget can also determine the way the budget is financed.

Where *I** and *P** are the tax rates in the other municipality. V is decreasing in *I* and *P*. The first order conditions can be reduced to:

$$\frac{V_I}{V_P} = \frac{x_I}{x_P} \qquad (6)$$

$$G = Px_P + Ix_I \qquad (7)$$

The second order conditions for a maximum are:

$$\begin{aligned} \frac{d^2V}{dI^2} &= -\frac{x_I}{x_P}V_{PI} + V_{II} < 0 \\ \frac{d^2V}{dP^2} &= -\frac{x_P}{x_I}V_{IP} + V_{PP} < 0 \end{aligned} \qquad (8)$$

Differentiating first order conditions (6) and (7) and combining them with the budget reaction function (3), we obtain the following within and cross derivatives for *P* and *I* to the other municipality's *P** (holding *I** constant) and *I** (holding *P** constant):

$$\frac{dP}{dP^*} = \frac{\rho\frac{x_P^*}{x_I}(x_P V_{II} - x_I V_{PI}) + (x_P V_{IP*} - x_I V_{PP*})}{(x_I V_{PP} - x_P V_{IP}) + \frac{x_P}{x_I}(x_P V_{II} - x_I V_{PI})} \qquad (9)$$

$$\frac{dI}{dI^*} = \frac{\rho\frac{x_I^*}{x_P}(x_I V_{PP} - x_P V_{IP}) + (x_I V_{PI*} - x_P V_{II*})}{(x_P V_{II} - x_I V_{PI}) + \frac{x_I}{x_P}(x_I V_{PP} - x_P V_{IP})} \qquad (10)$$

$$\frac{dP}{dI^*} = \frac{\rho\frac{x_I^*}{x_I}(x_P V_{II} - x_I V_{PI}) + (x_P V_{II*} - x_I V_{PI*})}{(x_I V_{PP} - x_P V_{IP}) + \frac{x_P}{x_I}(x_P V_{II} - x_I V_{PI})} \qquad (11)$$

$$\frac{dI}{dP*}=\frac{\rho\frac{x_P^*}{x_P}(x_IV_{PP}-x_PV_{IP})+(x_IV_{PP*}-x_PV_{IP*})}{(x_PV_{II}-x_IV_{PI})+\frac{x_I}{x_P}(x_IV_{PP}-x_PV_{IP})} \qquad (12)$$

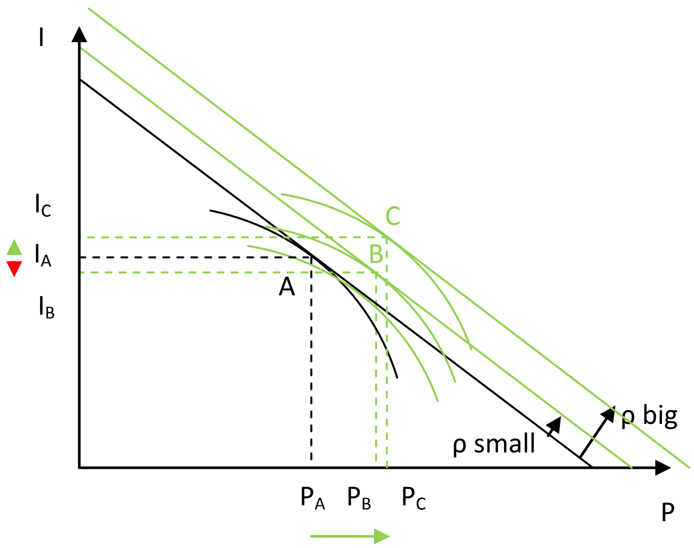
The second order conditions (8) imply that the denominators and the first term of the numerators must be negative in all four expressions (9)-(12). Therefore the signs of the four derivatives depend on the relative magnitudes of the first and second term in the numerators. The resulting derivatives thus can be either negative or positive.

Even though the derivatives' signs are ambiguous, one can infer useful information about the possible causes of a positive or negative signs. First, the stronger (more positive) a local government's budget reacts to the budget of the other municipality, i.e. the higher ρ, the more likely that both within and cross partial derivates are positive, because ρ decreases the numerators and the denominator is negative. Intuitively, the higher the spatial dependency of the budget, the more likely a higher budget will be financed by an increase in both tax rates, independent from the financing of the higher budget in the other municipality. Second, the within partial derivatives are more likely to be positive, the higher V_{II*} (V_{PP*}) is relative to V_{PI*} (V_{IP*}). The cross partial derivatives on the other hand are more likely to be positive, the higher V_{PI*} (V_{IP*}) is relative to V_{II*} (V_{PP*}). V_{II*} (V_{PP*}) indicates the extent to which the preference for *I* (*P*) is larger as *I** (*P**) in the other jurisdiction is higher. V_{PI*} (V_{IP*}) represents the extent to which the preference for *P* (*I*) is higher as *I** (*P**) in the other jurisdiction is higher. Although we have no information about the relative magnitudes of V_{II*} (V_{PP*}) compared to V_{PI*} (V_{IP*}), it seems reasonable to assume that the preference for a tax instrument is more sensitive to the level of the same tax instrument in the other jurisdiction than to the level the other tax instrument in the other jurisdiction because it is easier for citizens to compare the rates of the same instrument. In other words, it is more likely that V_{II*} (V_{PP*}) is relatively large compared to V_{PI*} (V_{IP*}), than vice versa. If this holds, the within partial derivatives are more likely to be positive than the cross partial derivatives.

In figure 1, we illustrate possible within and cross interaction dynamics when the other municipality has a higher property tax rate. On the axes, the income tax rate *I* and the property tax rate *P* are set out. We assume V_{IP} positive in order to have indifference curves concave to the origin[8]. In starting point A, the local government maximizes the citizens' utility by choosing I_A and P_A given the budget constraint. Now, if the other municipality has a higher budget G^*, financed through a higher property tax rate P^*, this has two consequences for our jurisdiction. First, through the spatial reaction function (3) a higher budget in the other municipality will induce a higher budget *G* in our municipality. The bigger ρ, the further the budget constraint shifts away from the origin. Second, a higher P^* also has an impact on the own municipality indifference curve. The bigger V_{PP^*} is relative to V_{IP^*}, the closer the indifference curve shifts to the P-axis, because we assume that our preference for P is relatively more sensitive to the level of P* than our preference for I is to the level of P*. As a result, depending on the magnitude of ρ, we could end up in the new optimum B or C. In both cases we end up with a higher property tax rate (P_B and P_C), or dP/dP^* is positive. However, in case B we end up with a lower income tax rate (I_B) corresponding to a negative dI/dP^*, while in case C we end up with a higher income tax rate (I_C),) corresponding to a positive dI/dP^*.

[8] In Flanders, this assumption is realistic since all except two municipalities levy both taxes. In case of convexity we would only get extreme cases with only the income tax or only the property tax. Although beyond the scope of this paper, the use of multiple tax instruments could stem from for example: the maximization of the number of votes from voters with *heterogeneous preferences for taxes and public goods*, given a budget constraint (Hettich and Winer (1988)), or *fiscal illusion* by which taxpayers are more likely to underestimate the tax burden associated with public programs when the revenue system is more complex (Oates 1988).

Figure 1: illustration of within and cross tax interaction



3. Data and methodology

3.1. Tax reaction function specifications

The theoretical framework produces two reaction functions for the municipal tax rates. They can be written as $P = R_P(P^*, I^*; X)$ and $I = R_I(I^*, P^*; X)$. Following the literature, we elaborate on those to obtain our final estimation specification. First, because in reality there are N instead of two municipalities, the tax rates in the other municipality are replaced by a weighted average of the tax rates in the other municipalities. The reaction functions become

$$P_i = R_P(\sum_{i \neq j} \omega_{ij} P_j, \sum_{i \neq j} \omega_{ij} I_j; X_i) \qquad (13)$$

$$I_i = R_I(\sum_{i \neq j} \omega_{ij} I_j, \sum_{i \neq j} \omega_{ij} P_j; X_i) \qquad (14)$$

where ω_{ij} is the weight municipality *i* attaches to another municipality *j*, $\sum_{i \neq j} \omega_{ij} I$ and $\sum_{i \neq j} \omega_{ij} P$ are then weighted averages of the income and property tax rate in the other municipalities. Due to lack of degrees of freedom weights are imposed ex ante. Second, we make a linear approximation of the reaction functions and impose that the interaction coefficients are equal for all municipalities. As a result, the system of equations to be estimated (in matrix notation) is:

$$I = \beta_I WI + \delta_I WP + \gamma_I X + \varepsilon_I \qquad (15)$$

$$P = \beta_P WP + \delta_P WI + \gamma_P X + \varepsilon_P \qquad (16)$$

W is the (NxN) weight matrix of row normalized elements ω_{ij}. Of particular interest are the within tax interaction coefficients β_I and β_P, and the cross tax interaction coefficients s δ_I and δ_P.

Regarding the choice of the weight matrix *W*, we follow the literature in assuming that geographically close jurisdictions are likely to interact more intensely. In the light of our model this can be justified by the fact that information and expenditure spillovers fade away with geographical distance. Therefore, the first weight matrix gives a value of 1 to the elements ω_{ij} of *W*, if municipalities *i* and *j* are first or second order neighbours. We include the second order neighbours because Belgian municipalities are small (44 km^2 on average). We prefer this weight matrix over the simple first order weight matrix because we find that the instruments based on it (which we need below) are more relevant than the instruments based on the first order weight matrix. We also test a second weight matrix that gives the value $\omega_{ij} = 1$ if municipality *j* is within the radius of 15 km of municipality *i*. Contrary to the first weight matrix this weight matrix creates circles of equal radius around each municipality. The average number of neighbours is about 14 for the 15 km radius weight matrix and 17 for the first and second order weight matrix. Using the 15 km weight matrix municipalities with bigger surfaces (such as big cities) will have fewer neighbours, while municipalities with small surfaces will have more neighbours. A small municipality with a big neighbour is less likely to give weight to other neighbours of the big neighbour. Note that weight matrices are row normalized.

3.2. Institutional settings and data

3.2.1. Institutional settings

Belgium is a federal country that consists of three regions: Flanders in the north, Brussels in the center and Wallonia in the south. Flanders is the only region where Dutch is the only official language. The regions are in charge of matters related to the territory, one of which is the supervision of municipalities. The latter autonomy and the difference in language between regions incite us to only concentrate on one region, Flanders. Furthermore, Gerard et al. (2009) find that tax interaction in Belgium is different between municipalities of the same region than between municipalities of different regions.

Institutionally, municipalities in Flanders are very homogenous. First, they have the same considerable autonomy in raising tax revenues and they assume important responsibilities on the expenditure side. Major expenditure categories include transport infrastructure, culture and entertainment, urban development, general administration, education, economics, social aid, and safety. Tax revenues are an important part of municipalities' revenues. Between 1991 and 2004 the share of tax revenues in total revenues evolved from 41% to almost 50%. The other revenues come from federal or regional funds, and allowances and own means. With its local tax revenue shares Belgium ranks high among other European countries[9]. However, when measured as a share of the country's total tax revenues, Belgium (Flanders) ranks low. In 2006, only 7.3% of total tax revenues were local, compared to 17.8% on average in the EU15 (VVSG, 2007). In short, Flemish municipalities have relatively low budgets that are to a large extent financed by local taxes.

Second, municipal elections take place on the same day, once every six years[10], following the same electoral procedures in all municipalities. Following the election, the party (or coalition of parties) that controls a majority of seats in the council decides on the composition of the executive board, thereby choosing the Mayor and Aldermen among their council-members. The meetings of the city council are open to the public. This is important for yardstick competition because it assumes that it is easy for voters to know the voting behavior of the various parties.

Third, In Belgium (and Flanders) the division of municipalities has been stable since 1983[11]. Since then Flanders has 308 municipalities. This is important because it means that Flemish municipalities have been interacting strategically over a long period of time with no institutional changes that affected some and not other municipalities. This makes it more likely that Flemish municipalities have evolved to a long run equilibrium.

3.2.2. Tax variables

[9] In 2002, the share of tax revenues in the neighboring countries was 46% in France, 33% in Luxemburg, 23% in Germany, and 8% in the Netherlands.

[10] The second Sunday of October; for our sample in 1994 and 2000.

[11] The big merger was in 1979, but in 1983, Antwerp was merged with 7 small neighboring municipalities.

Within the local tax revenues, the local income tax and the local property tax are by far the two major sources of tax revenue, each - on average - accounting for approximately 40% of the local tax revenue. A big advantage concerning the local income and property tax in Belgium is that they are levied on a federally defined tax base. As a result, the municipality's only decision variable is the tax rate. This allows us to concentrate on the strategic interaction of tax rates.

Both tax rates are surcharges. The local income tax rate (*I*), expressed as a percentage, is a surcharge on the federal tax. The municipality levies the local income tax rate on the federal income tax payments of its residents. Consequently, the local income tax is as progressive as the federal income tax, affecting the rich proportionally more than the poor. The local property tax rate is a surcharge on the regional property tax. The tax base, the property value, is federally defined. The local property tax rate is expressed in 'centimes', while the regional (Flemish) property tax rate is expressed as a percentage. For example, with a local property tax rate of 1000, combined with the Flemish rate of 2.5%, the municipality eventually charges 25% of the property's cadastral income to the property owner. We use the combined property tax rate (*P*) (i.e. the 25% of the example) in our regressions because its scale is more similar to that of the local income tax rate. The property tax rate is levied on all property owners, companies included. The share of companies in the total property tax revenue is estimated at 40% on average (VOKA (2005), VVSG (2007)). The property tax rate is likely to be more visible than the income tax rate since the property tax return comes in a separate letter to the citizens, while the income tax return is part of the federal income tax return, which is withheld by the employer. Another difference between the two taxes is the timing of the revenues they yield. A change of the property tax rate in year t has implications for the budget in year t+1, while a change in the income tax rate only has implications for the budget in year t+2[12].

Table 1 shows summary statistics of *I* and *P*. Overall, the income tax rate ranges from 0 percent to 9.5 percent over the period 1991-2004. The two municipalities without local income tax revenues are Koksijde and Knokke, two municipalities along the coast. Because of the high

[12] Since the taxes are collected at a higher government level (federal or regional), the revenues are only reimbursed the year after. For the income tax there is already a lag of 1 year for the federal budget, leading to a lag of two years for the municipal budget.

demand for property at the coast (and consequently high property values) they solely rely on property taxation[13]. Despite these two outliers the standard deviation of the income tax rate is limited to 1.1. The variance of *I* is low compared to the variance of the local property tax rate. *P* ranges from 6.5 to 57.5, with a standard deviation of 7.83.

Given the panel structure of our data, we are interested in the descriptive statistics of the between and within components of the tax variables. Table 1 and the box plots in figure 2 clearly show that the between component has a higher variance than the within component. This observation points to a relatively high variability of the tax rates across municipalities and a relatively stable tax rates over time within municipalities.

The low variance within municipalities over time is also visible in figure 3 that shows the evolution of the tax rates over the period 1992-2004 in box plots. The median income tax rate remains constant up to 2000 and then rises slightly in the last legislature. The median property tax rate rises more smoothly from 23.75 in 1992 to 32.5 in 2004, with upward shifts after the election years 1994 and 2000.

The election cycle is more apparent from figure 4, where the positive black bars denote the share of municipalities raising their tax rate and the negative white bars denoting the share of municipalities lowering their tax rate. Obviously, increasing the tax rate is politically less costly in the years following the election years 1994 and 2000, while decreasing the tax rate is most advantageous in the years shortly preceding the elections.

3.2.3. Yardstick or tax competition?

In many cases it is not clear whether strategic tax interaction stems from tax competition, yardstick competition or both, because the reduced form spatial reaction function of both theories is exactly the same (Brueckner, 2003). However, we have strong indications that yardstick competition is the major source of local tax mimicking in Flanders. First, European studies investigating which theory is the most likely source of local tax interaction point to

[13] Doing so, they partly export taxation to people with a second property at the coast.

yardstick competition[14]. Heyndels and Vermeir (2006) present evidence of yardstick voting in Flanders. They show that incumbents are punished for higher tax rates, and that electoral punishment also depends on tax rates in neighbouring municipalities.

Second, several facts and figures about Flanders point to the same direction. The crucial difference between resource flow (such as tax competition) and spillover (such as yardstick competition) models is that resource flow models assume mobility of the tax base. Although distances between municipalities in Flanders are small, citizens are not likely to be mobile across municipalities for local tax reasons. As mentioned above local tax revenues only account for 7% of total tax revenues, and for 2.4% of GDP, much below European averages. As a result, the gains from moving from the municipality with the highest local tax burden to the municipality with the lowest local tax burden are low, even for high income households[15]. The mobility for tax reasons is further lowered if differences in the tax burden are capitalized in the property values (Yinger et al., 1988). Moreover, Flemish households are known for being home-loving. Although strong arguments for Flemish citizens voting with their feet are absent, the apparent election cycle in figure 4 suggests that incumbents nevertheless do take account of their citizens' voice. Therefore the particular situation of Flanders offers more arguments in favour of a theoretical framework based on the spillover model than the resource flow model.

3.2.4. Other variables

In the theoretical framework we stated that the local government's budget and tax rates depend on a vector of municipality characteristics (*X*) that determine budgetary preferences or needs. Also the income and property tax base are important parameters for setting the tax rates. To capture the local income tax base, i.e. the federal income tax payment, we calculate the revenue per resident of one percent local income tax (*IBASE*). This is a better measure than

[14] See for example Allers and Elhorst (2005) for an overview. More recently, Edmark and Agren (2008) find weak evidence of tax competition effects in the setting of local tax rates in Sweden.

[15] We found a gain of 633 euro's per year when a 75th percentile income, with a 75th percentile property value, moves from the highest to the lowest tax burden municipality, not including the costs of moving.

the average income per resident because our measure takes into account the progressiveness of the federal income tax[16]. Analogously, the local property tax base is measured as the revenue per resident of one percent local property tax (*PBASE*).

With respect to the budgetary needs, we have to be careful to adopt enough variables that can explain differences across municipalities. We first adopt the twelve socio-economic municipality classification dummies of Dessoy (1998). Dessoy (1998) constitutes twelve Flemish socio-economic clusters, applying a factor analysis and a cluster analysis based on variables related to the allocation of territory, the level of income, economic activity, demographic structure and level of attractiveness. The classification is based on data from the 1991 census in Belgium. Table 2 describes the twelve municipality categories. The advantage of the twelve dummies is that they are exogenous because of the timing. The variables proof very useful explaining a large part of the budgetary needs for our sample period 1992-2004 because local budgets are rather sticky. One of the categories contains the touristic municipalities bordering the coast. Consequently, it deals with the fact that these municipalities heavily tax the second homes through the property tax rate.

In order to explain the time varying part of the budgetary needs we use population (*POP*), labour density (*LABDENS*) measured as hundred times the ratio of workers over population, percentage of young (*YOUNG*) and old (*OLD*) population[17], and the unemployment rate (*UNEMPL*) measured as hundred times the ratio of unemployed over population between 20 and 64.

Table 3 shows the summary statistics of the control variables, except the dummies. The municipality of Voeren is left out of the analysis because it has no Flemish neighbours, leaving 307 observations over 13 years. Since the local budget decision is taken towards the end of the previous year, at the time of the tax rate decision, the local incumbents only have information on the variables in year t-1. Therefore, we include the lagged values of the X variables.

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[16] The revenue per resident of one percent local income tax is calculated by dividing the total income tax revenue in year of the municipality in year t by the local income tax rate of year t-1 and by the number of residents in year t-2. We do so because the municipality only receives in year t the taxes based on the incomes earned in year t-2 and the tax rate valid in year t-1.

[17] Young is defined as under 20, old is defined as over 64.

3.3. Econometric issues

To estimate this model, several econometric challenges need to be tackled. The most important is the simultaneous determination of the tax rates in all municipalities. This introduces endogeneity of *WI* and *WP* in both equations and implies that OLS would produce inconsistent and biased estimates of β_I , β_P , δ_I and δ_P . We also need to bear in mind the possible bias of the interaction coefficients due to spatial error correlation. To address these issues we use the instrumental variables approach of Kelejian and Prucha (1998) which ensures consistent estimates in the presence of spatial autocorrelation[18]. Following Kelejian and Prucha (1998), we select a subset of the weighted control variables *X* of the other municipalities as instruments[19]. We construct the instruments by pre-multiplying the vector *X* with the same weight matrix *W* that was used to weigh the tax variables, giving *WX*. Out of *WX*, we carefully select instruments that have sufficiently strong prediction power to pass the weak identification test, while not being rejected by the standard test of over-identifying restrictions. The soico-economic classification dummies of Dessoy (1998) play an important role for the instruments. They are exogenous and their spatial lags explain an important deal of the spatially lagged tax rates.

The small variance of the within component of the tax variables, forces us to exploit the variance of the cross sectional component of the data. Due to the small variance of the within component of the tax variables, we are not able to find a selection of instruments *WX*, that satisfies the orthogonality conditions and is strong enough - according to the weak identification test - to explain the ‘within’ variance of the instrumented variables *WI* and *WP*.
The small variance over time, and the institutional stability since 1983, points to municipalities located in a relatively stable long run equilibrium with respect to the strategic setting of local income and property tax rates. This view is confirmed by the fact that Gerard et al (2010), who

[18] Note that because we have two interaction variables per equation, we cannot rely on the spatial MLL methodology of Anselin (1988).
[19] This approach was also followed by Buettner (2001), Edmark and Agren (2008), Heyndels and Vuchelen (1998), Revelli (2001), and Sollé Ollé (2003).

find no evidence of strategic interaction among Flemish municipalities in the short run, exploiting the within component of the tax variables.

Applied studies using panel data find that the within estimator based on the time series component tends to give short run estimates, while between estimator based on the cross sectional component tends to give long run estimates (Baltagi 2008, p219). We use the between estimator that measures how strong municipalites have interacted on multiple taxes in the long run. We estimate the model 'between' for the whole period, for every legislature separately, and year by year.

Like the within estimates, the between estimates are only consistent as long as the disturbances are uncorrelated with explanatory variables (Baltagi 2008). Because of this important condition, we only present results for which the instruments of the spatially lagged tax variable satisfy the orthogonality condition[20].

The tax bases *IBASE* and *PBASE* may be endogenous if tax competition and income sorting are at work. Although by taking the lag and by their definition *IBASE* and *PBASE* are not affected by current tax rates, we test for the exogeneity of this subset of variables using a difference in Sargan or C statistic. This test is robust to various violations of conditional homoskedasticity, and equal to the Hausman test statistic under condicitional homoskedasticity (Baum and Schaffer 2003, p24-27). For this test we use the same control variables and instruments as in the main regressions. Finally, we take account of heteroskedasticity by reporting t-statistics robust to the presence of heteroskedasticity.

4. Results

Before presenting the results, we explain the statistics found at the bottom of the tables that testify of the carefulness with which we selected instruments for *WI* and *WP*. First, to make sure that the instruments are relevant we present the Anderson Canonical correlation likelihood test. A rejection of the null ($P<0.1$) indicates that the instruments are not

[20] Determined by the 'difference-in-Sargan' or C statisitic. See Baum and Schaffer (2003) p18.

underidentified. Additionally, we use the Cragg-Donald F-statistic for the presence of weak instruments. All results presented below are with instruments that have a high joint explanatory power. Second, for instrumental variables to be independent from the unobservable error process, we use the Hansen J statistic, which is robust to heteroskedasticity. Acceptance of the null (P>=0.1) implies that the instruments satisfy the orthogonality condition. In all our regressions the instruments pass this test, except for a few borderline cases. Third, although from the definition we expect the variables *IBASE* and *PBASE* to be exogenous, we explicitly test for their exogeneity using the C statistic. We can accept the *IBASE* and *PBASE* orthogonality (P>=0.1) in almost all cases.

4.1. Between estimation whole period

We start with the estimation of the between model over the full period 1992-2004. This gives the long run estimates of the spatial interaction and control variable coefficients. The first four columns of table 4 present the estimation results with the first and second order neighbours weight matrix; the next four columns use the 15 km radius weight matrix. The dependent variable is displayed on top of each column. The odd columns contain results for within interaction, ignoring cross spatial interaction, as found in the bulk of literature. The even columns add the cross spatial interaction term. To save space, results on the 12 socio-economic municipality classification dummies are not reported, although they are crucial in reducing the noise in the error term and as instruments in their spatially lagged form.

In the first and the third column, our results confirm the existence of spatial interaction within local tax rates. A one percent point higher income tax rate in the neighbouring municipalities translates in a 0.468 percent higher income tax rate in our municipality, while a one percent point higher property tax rate is reflected in a 0.549 percent point higher property tax rate. This result is consistent with existing empirical work on local tax interactions using IV estimation. For example Heyndels and Vuchelen (1998) find coefficients between 0.5 and 0.7 for the local income tax rate and the local property tax rate in Belgium for the year 1991. Compared to them and other Belgian studies, we explain a higher share of the variance of I and P, indicated by the higher R^2 of 0.42 and 0.67. This is primarily due to the inclusion of the socio-economic municipality classification dummies of Dessoy (1998). The inclusion of these variables is reducing the omitted variable bias and finding relevant instruments for WI and WP that satisfy the orthogonality condition.

Columns two and four show the impact of adding the cross spatial interaction term to the equation. In the local income tax equation we observe that the within spatial interaction coefficient (on *WI*) rises from 0.486 to 0.764. In the local property tax equation, the within spatial interaction coefficient (on *WP*) rises from 0.549 to 0.703. In both equations this is due to the negative entrance of the cross spatial interaction term. In the income tax equation *WP* does not enter significantly with a coefficient of -0.038, but in the property tax equation *WI* enters significantly at the 5 % level, with a coefficient of -2.741. Note that the level of the cross spatial interaction coefficients is not comparable between the income and property tax equation because the property tax rate has a higher scale than the income tax rate.

The same holds using the 15 km radius weight matrix. The results are qualitatively similar: the cross spatial interaction terms enter negatively and the within spatial interaction terms' coefficients rise considerably if cross spatial interaction is allowed for. Only the coefficient and significance level for the within spatial interaction in the local income tax equation is somewhat lower.

The results point to an underestimation of within spatial interaction when ignoring cross spatial interaction, although the new point estimates remain within the 95% confidence intervals of the previous estimates. This points to an omitted variable bias when estimating spatial interaction with only one tax variable when local jurisdictions actually dispose of (multiple) other tax instruments.

Looking at the control variables, the tax bases *IBASE* and *PBASE* have the expected negative sign, since higher tax bases require lower tax rates. Concerning the budgetary need variables, population (*POP*) slightly increases the tax rates, though not always significantly at the 10%

level. Labour density (*LABDENS*) does not enter significantly in any estimation. The share of young people (*YOUNG*) increases the tax rates and is particularly significant for the income tax rate. The share of old people (*OLD*) increases both tax rates significantly at the 1 % significance level. The unemployment rate (*UNEMPL*) seems to have no impact. The unreported municipality classification dummies also have important explanatory power.

4.2. Between estimation per legislature

In Belgium (and Flanders) local elections take place every six years. Therefore local municipalities may draw budgets at the background of a six year period in office and voters may judge incumbents based on the whole legislature. Further yardstick competition is a plausible cause of tax interaction in Flanders. Therefore we also present between estimates for each of the three legislatures in our dataset separately. The first and the last legislature are partial and the middle one complete: 1992-1994, 1995-2000, and 2001-2004.
Table 5 gives the results using the first and second order neighbours weight matrix, while table 6 shows the results based on the within 15 km weight matrix. The tables have the same structure as table 4. The legislature is mentioned on top of each column.

The odd columns of table 5 confirm that municipalities strategically interact with each other within the same tax instrument in every legislature. We find significantly positive within spatial interaction coefficients of the same order for both tax instruments: between 0.534 and 0.583 for the income tax rate, and between 0.534 and 0.581 for the property tax rate. When the cross spatial interaction is accounted for, we observe that a one percent point higher income tax rate of the neighbours now translates into a 0.792 to 0.862 higher income tax rate, and a one percent point higher property tax rate of the neighbours entails a 0.626 to 0.739 higher property tax rate. The cross interaction terms enter negatively again. *WI* is significant in the property tax equation in the first and the second legislature, but *WP*, although consistently negative, is not significant at the 10% level in the income tax equations. The control variables behave very similar as in the between estimations for the whole period.

In table 6, we show the results using the weight matrix that considers as neighbours the municipalities within a radius of 15km. As for between estimations for the whole period, the within spatial interaction is lower than with the first and second order neighbour weight matrix for the income tax rate, but similar for the property tax rate. The cross interaction point estimates are again negative for all estimated equations. In the local property tax equations, *WI* is now significantly negative in all three legislatures. *WP* is just significant at the 10% level in the local income tax equation in the first legislature.

4.3. Estimation by year

Finally, we estimate the reaction functions year by year. This is a useful robustness check and can be motivated by the fact that the municipality has to make a decision on the local tax rates every year, and that the budgets are institutionally made on an annual basis. The yearly estimates also make our results with multiple taxes more comparable with the many existing studies that estimate single year cross section reaction functions with a single tax. Estimating year by year also allows to analyze the possible evolution of spatial tax interaction over time.

Figure 5 visualizes the results of the spatial interaction coefficient estimates using the first and second order neighbour weight matrix. Squares indicate the point estimates and the vertical lines the 90% confidence intervals. Black squares refer to within spatial interaction only estimates, white squares to within and cross spatial interaction estimates. Estimates are reported in table 7, control variables are not reported to save space. Panel a of figure 5 shows the estimates for spatial interaction within the income tax rate. We clearly observe that each year the point estimates are lower if cross spatial interaction is ignored, indicated by the black squares, than when cross interaction is accounted for, indicated by the white squares. In the first (black) case, the within income interaction coefficient varies between 0.503 in 1995 and 0.728 in 1997, while in the second (white) case we get values between 0.669 in 1995 and 0.962 in 1992. Note that when allowing for cross spatial interaction the confidence intervals are wider. This stems from the fact that the instrumental variables are weaker when used to instrument both the within and the cross interaction term, which is apparent from the Cragg Donald F statistics. The coefficients are significantly positive for all years. There is no clear evolution pattern over time, nor is there a sign of stronger competition just before or after election years 1994 and 2000. Note, in this respect, that comparison over time is blurred because the instrument set may change over time to satisfy the instrument tests[21].

Panel c of figure 5 shows a similar story for the within spatial interaction of the local property tax rate. Coefficient estimates are always significantly positive and higher if cross spatial interaction is accounted for (white squares). There is no strong evolution pattern or election cycle. The narrower confidence intervals point to higher significance levels for the property tax equation than the income tax equation.

Turning to panel b for the income tax equation and panel d for the property tax equation, we notice only negative point estimates of the cross spatial interaction coefficients. As in the between estimations, the negative sign of cross spatial interaction is more significant in the property tax equation than in the income tax equation, as illustrated by the confidence intervals.

Using the 15 km radius weight matrix, the year by year estimates, illustrated in figure 6 and displayed in table 8, demonstrate that the between estimates are robust and representative for the whole period. This is additional evidence of our presumption that strategic interaction between Flemish municipalities using the local income tax rate and the local property tax rate has been stable over the long run.

[21] However, within one year the same set of instruments is used for the equations with and without the cross spatial interaction term.

5. Discussion and conclusion

The particular situation of Flanders where local municipalities freely decide on the rate of two local tax instruments, the local property tax and the local income tax, provides a unique opportunity to investigate the strategic interaction within and cross multiple tax instruments. We find that over the long run, the levels of tax rates across Flemish municipalities are not randomly spread. Using two weight matrices, we show that the property tax rate of a municipality is significantly positively affected by the property tax rate in the neighboring municipalities. We also find that the estimates of within property tax interaction are stronger when we take account of the possible impact of the other municipalities' income tax rate. Concerning strategic interaction across different tax instruments we find that, for both weight matrices and estimating the reaction function between or year by year, the impact of the other municipalities' income tax rate on the property tax rate is always negative, and significant most of the time.

Regarding the income tax reaction function the results are equivalent with respect to the sign but less robust with respect to the significance levels. Using the first and second order neighbor weight matrix within income tax rate interaction is positive and significant; using the 15 km radius weight matrix, within income tax rate interaction is only significant in some of the year by year estimations. Also here, point estimates are remarkably higher when allowing for cross tax interaction. With respect to the cross spatial impact of the other municipalities' property tax rate on the income tax rate, all results show negative interaction coefficients, be it insignificant in most cases.

How can we interpret the high and positive within spatial interaction coefficients and the negative cross spatial interaction coefficients? A high property tax rate in the neighbouring municipalities leads to a high property tax rate and a low income tax rate in the own municipality, a high income tax rate in the neighbouring municipalities causes a high income tax rate and a low property tax rate in the own municipality. This suggests that municipalities strongly compete within one tax rate, at the expense of the other tax rate. The municipalities have three instruments at their disposal: the income tax rate, the property tax rate and the budget. For a given budget, a low property tax rate (income tax rate) is only possible in combination with a high income tax rate (property tax rate). The presence of the income tax rate (property tax rate) allows the municipalities to more easily compete on the property tax rate (income tax rate) without having to alter the budget. The result suggests that municipalities are keener on competing on a tax instrument than on mimicking the neighbouring municipalities' budget.

According to our theoretical framework, the positive within spatial interaction combined with negative cross spatial interaction must be the result of either one or the combination of two factors. First, the citizens' preference for one tax rate is relatively highly correlated with the level of the same tax rate in the other municipality and relatively lowly correlated with the level of the other tax rate in the other municipality ($V_{II*}>V_{PI*}$, $V_{PP*}>V_{IP*}$). This makes it politically more rewarding for a municipality to compete within one tax rate rather than across tax rates. Second, the extent to which a municipality mimics the other municipalities' budget is rather small (small ρ).

Why these two conditions can be fulfilled falls outside the model. Our interpretation is that the higher visibility of the tax rates than of the total budget enhances the level of competition on the tax rates. The fact that strategic interaction is stronger on the property tax, knowing that the property tax rate is also more visible - since it is filed separately, while the local income tax is withheld together with the federal income tax – supports this view. In addition, the easier comparability within tax rates than across tax rates enhances competition within tax instruments. The consequence of this dynamics is that municipalities copy each others' tax structure.

This paper shows that cross policy interaction, in the case of multiple tax instruments, is important and should not be ignored. Not only because its sign tells us something about the mechanism behind tax interaction, but also because ignoring it causes an omitted variable bias of the estimation of the within interaction coefficients.

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Figure 2: box plots of the tax variables overall, between and within.

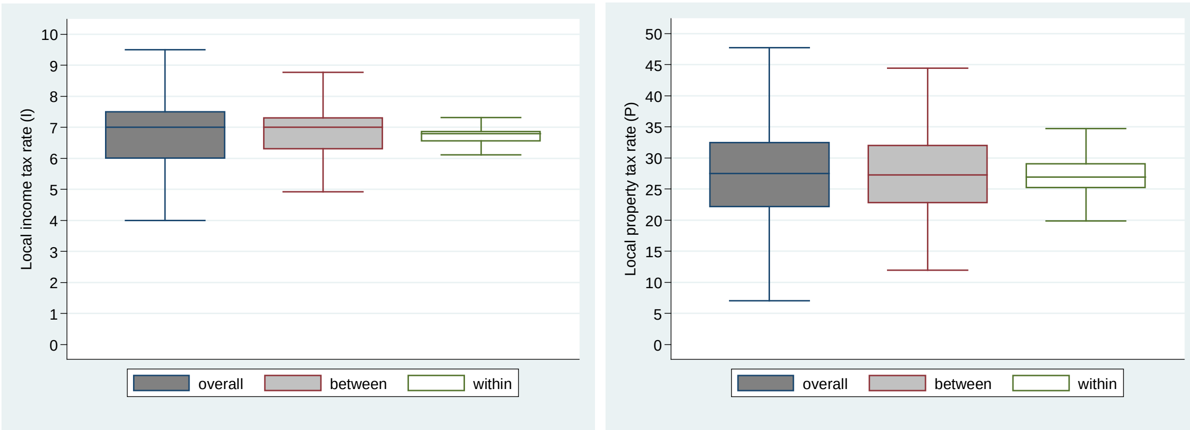


Figure 3: box plots showing the evolution of the tax variables over time.

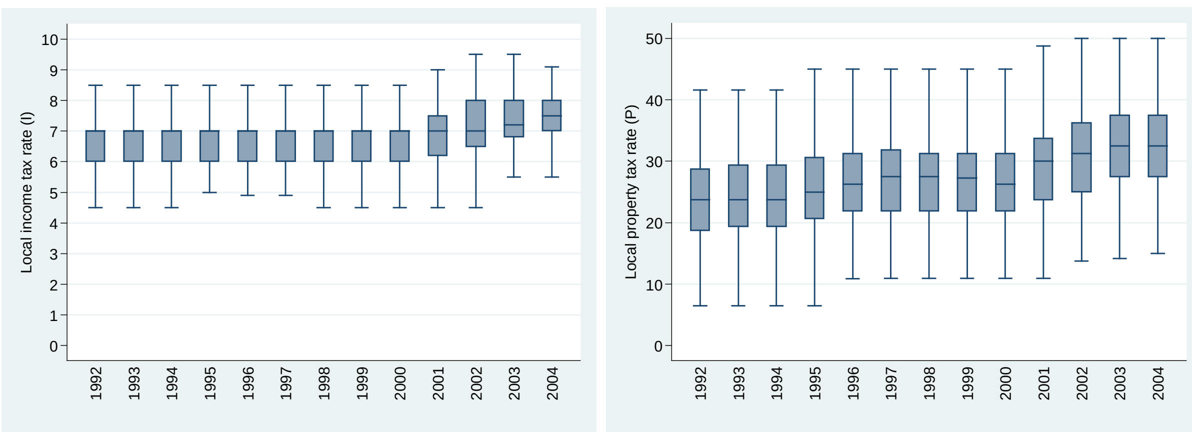


Figure 4: share of municipalities raising or lowering tax rates.

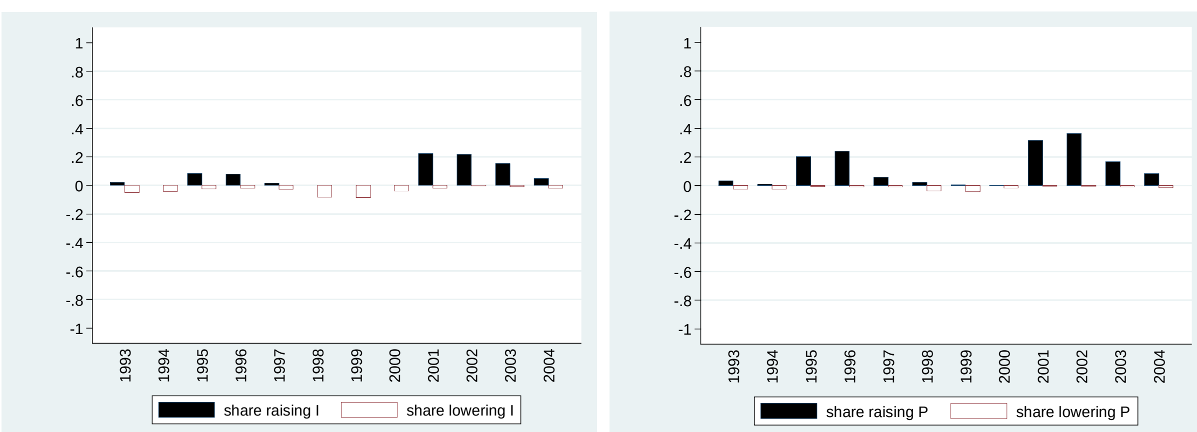
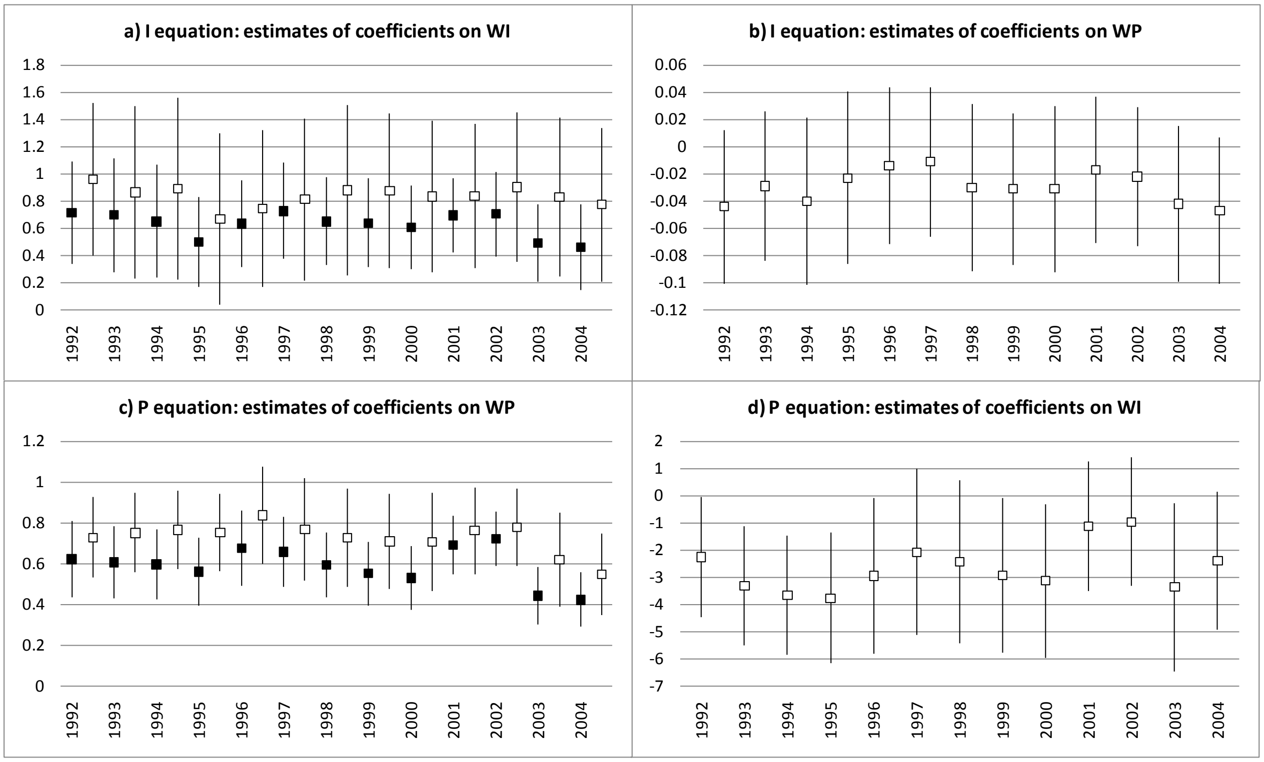
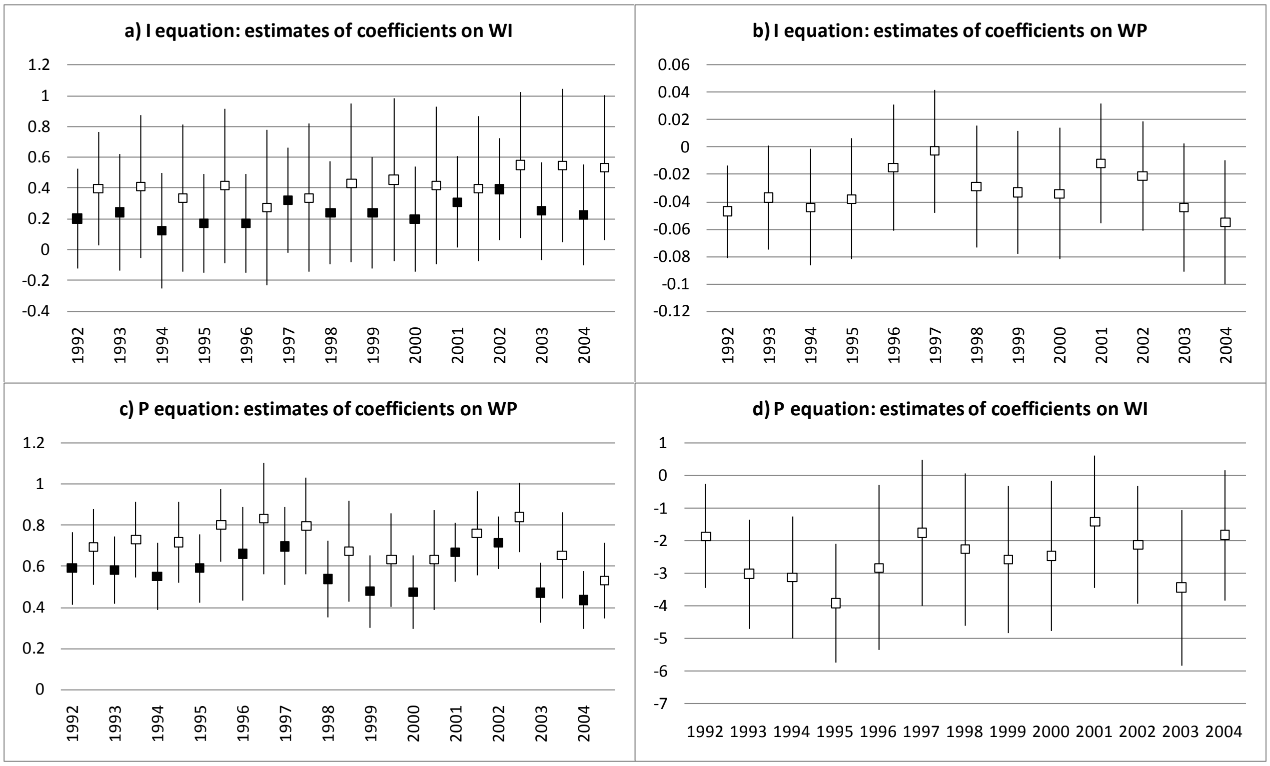


Figure 5: year by year point estimates and 90% confidence intervals using the first and second order neighbors weight matrix.



Black squares: coefficient estimates of equations with only within spatial interaction.
White squares: coefficient estimates of equations with within and cross spatial interaction.

Figure 6: year by year point estimates and 90% confidence intervals using the 15 km radius weight matrix.



Black squares: coefficient estimates of equations with only within spatial interaction.
White squares: coefficient estimates of equations with within and cross spatial interaction.

Table 1: summary statistics tax variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
Income tax rate I					
overall	3991	6.79	1.10	0.00	9.50
between	3991	6.79	1.01	0.00	8.77
within	3991	6.79	0.44	3.64	9.14
Property tax rate P					
overall	3991	27.52	7.84	6.50	57.50
between	3991	27.52	6.77	11.95	48.37
within	3991	27.52	3.95	14.25	42.14

Table 2: summary statistics other variables.

Variable	Obs	Mean	Std. Dev.	Min	Max
IBASE (t-1)	3978	54.50	14.85	19.48	121.44
PBASE (t-1)	3978	13.07	5.60	3.09	61.68
POP (thousends) (t-1)	3978	19.24	31.00	0.96	467.88
LABDENS (t-1)	3978	39.21	25.49	8.13	319.86
YOUNG (t-1)	3978	24.00	2.12	17.56	32.57
OLD (t-1)	3978	15.33	2.71	6.88	25.51
UNEMPL (t-1)	3978	4.03	1.75	1.00	11.94

Table 3: description of municipality categories according to the classification of Dessoy (1998).

Category:	**Description:**
C1	Agricultural municipality with average agricultural activity
C2	Agricultural municipality with strong agricultural activity
C3	Residential municipality with income below regional average
C4	Residential municipality with income above regional average and rural character
C5	Residential municipality with average income
C6	Residential municipality with high income
C7	Residential municipality with high income and strong economic activity
C8	Urban municipality, small town
C9	Urban municipality, regional town
C10	Urban municipality, big town
C11	Industrial municipality
C12	Touristic municipality

Table 4: between estimation whole period 1992-2004.

Weight matrix:	1st and 2nd order neighbor W					15 km radius W			
Dependent variable:	I	I	P	P		I	I	P	P
WI	0.468***	0.764**		-2.741**		0.257	0.512		-2.864***
	(2.65)	(2.08)		(-2.01)		(1.32)	(1.64)		(-2.88)
WP		-0.038	0.549***	0.703***			-0.038	0.568***	0.735***
		(-1.08)	(6.84)	(6.18)			(-1.41)	(6.86)	(7.08)
IBASE	-0.009	-0.015	-0.180***	-0.161***		-0.011	-0.017	-0.180***	-0.152***
	(-1.10)	(-1.40)	(-3.84)	(-3.28)		(-1.25)	(-1.55)	(-3.89)	(-3.05)
PBASE	-0.111***	-0.112***	-0.234***	-0.256***		-0.114***	-0.113***	-0.242***	-0.278***
	(-4.41)	(-4.38)	(-2.92)	(-3.23)		(-4.31)	(-4.28)	(-3.20)	(-3.66)
POP	0.003*	0.003*	0.007	0.005		0.003	0.003	0.008	0.006
	(1.85)	(1.90)	(1.35)	(0.86)		(1.59)	(1.55)	(1.48)	(0.97)
LABDENS	0.005	0.004	-0.008	-0.008		0.005	0.004	-0.004	-0.004
	(1.44)	(1.37)	(-0.50)	(-0.47)		(1.46)	(1.36)	(-0.29)	(-0.29)
YOUNG	0.081**	0.100***	0.321*	0.216		0.077**	0.098***	0.271	0.149
	(2.53)	(2.94)	(1.70)	(1.07)		(2.43)	(2.87)	(1.43)	(0.76)
OLD	0.074***	0.090***	0.692***	0.633***		0.076***	0.096***	0.659***	0.571***
	(2.73)	(3.04)	(4.25)	(3.65)		(2.81)	(3.45)	(3.99)	(3.31)
UNEMPL	0.026	-0.017	0.014	0.228		0.033	-0.010	0.055	0.273
	(0.60)	(-0.28)	(0.05)	(0.74)		(0.73)	(-0.18)	(0.19)	(0.90)
Constant	2.377	1.240	5.899	21.381*		3.839*	2.879	6.693	23.441**
	(1.23)	(0.54)	(0.66)	(1.75)		(1.94)	(1.31)	(0.77)	(2.17)
Observations	306	306	306	306		306	306	306	306
R-squared	0.44	0.42	0.67	0.67		0.44	0.42	0.68	0.68
Anderson LR[a] (P-value)	0	0	0	0		0	0	0	0
Cragg-Donald F test[b]	32.06	21.16	96.66	25.53		30.90	15.26	93.70	21.45
Hansen J test[c] (P-value)	0.115	0.182	0.123	0.347		0.127	0.222	0.117	0.433
C statistic[d] (P-value)	0.474	0.905	0.138	0.412		0.282	0.635	0.382	0.915

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term
The 12 socio-economic municipality classificaiton dummies are included in the estimation
The instruments are a selection of WX satisfying the tests
[a] Anderson Canonical correlation likelihood test for relevance of instruments
[b] weak identification test for instruments
[c] test of overidentifying restrictions for instruments
[d] endogeneity test for IBASE and PBASE

Table 5: between estimation per legislature, first and second order neighbor weight matrix.

Legislature:	1992-1994				1995-2000				2001-2004			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.583**	0.862**		-3.169**	0.529***	0.792**		-2.941*	0.534***	0.806**		-1.581
	(2.50)	(2.32)		(-2.41)	(2.94)	(2.18)		(-1.74)	(3.14)	(2.39)		(-1.12)
WP		-0.046	0.581***	0.727***		-0.034	0.575***	0.739***		-0.033	0.534***	0.626***
		(-1.38)	(5.52)	(6.17)		(-0.96)	(6.02)	(5.31)		(-1.00)	(6.53)	(5.15)
IBASE	-0.018	-0.025	-0.233***	-0.209***	-0.005	-0.009	-0.150***	-0.138**	-0.010	-0.015	-0.190***	-0.179***
	(-1.17)	(-1.54)	(-3.42)	(-3.01)	(-0.67)	(-0.90)	(-2.85)	(-2.52)	(-1.22)	(-1.48)	(-4.46)	(-4.03)
PBASE	-0.119***	-0.120***	-0.048	-0.088	-0.106***	-0.108***	-0.154*	-0.167*	-0.097***	-0.097***	-0.254***	-0.267***
	(-2.99)	(-2.96)	(-0.45)	(-0.85)	(-4.19)	(-4.22)	(-1.79)	(-1.94)	(-5.62)	(-5.56)	(-3.51)	(-3.60)
POP	0.004***	0.004***	0.011*	0.010	0.003**	0.003**	0.010*	0.007	0.001	0.001	-0.003	-0.004
	(3.49)	(3.41)	(1.68)	(1.34)	(2.17)	(2.21)	(1.85)	(1.24)	(0.57)	(0.53)	(-0.36)	(-0.52)
LABDENS	0.004	0.004	-0.032*	-0.033*	0.005*	0.005*	-0.012	-0.013	0.002	0.002	-0.003	-0.003
	(1.10)	(1.04)	(-1.85)	(-1.93)	(1.74)	(1.69)	(-0.68)	(-0.70)	(0.57)	(0.50)	(-0.22)	(-0.18)
YOUNG	0.050	0.065*	0.253	0.236	0.081**	0.097***	0.234	0.138	0.090***	0.117***	0.404**	0.278
	(1.30)	(1.69)	(1.20)	(1.10)	(2.45)	(2.97)	(1.13)	(0.62)	(2.71)	(2.71)	(2.18)	(1.29)
OLD	0.042	0.055	0.658***	0.670***	0.079***	0.093***	0.715***	0.677***	0.059**	0.080**	0.533***	0.447***
	(1.17)	(1.49)	(3.17)	(3.18)	(2.79)	(3.25)	(3.94)	(3.57)	(2.03)	(2.30)	(3.57)	(2.59)
UNEMPL	-0.039	-0.076	0.001	0.123	0.015	-0.019	0.033	0.230	0.108*	0.061	0.044	0.212
	(-0.83)	(-1.45)	(0.00)	(0.56)	(0.33)	(-0.31)	(0.11)	(0.71)	(1.82)	(0.75)	(0.09)	(0.43)
Constant	3.353	2.609	5.545	21.412*	1.605	0.504	3.682	19.967	1.790	0.465	10.242	21.440*
	(1.40)	(0.99)	(0.56)	(1.82)	(0.87)	(0.24)	(0.39)	(1.43)	(0.82)	(0.18)	(1.21)	(1.67)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.32	0.31	0.60	0.60	0.40	0.37	0.59	0.58	0.46	0.44	0.65	0.65
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	26.48	17.45	79.55	17.08	29.82	21.13	85.57	21.30	30.52	18.65	86.35	46.67
Hansen J test[c] (P-value)	0.159	0.380	0.256	0.699	0.126	0.191	0.253	0.493	0.138	0.143	0.0608	0.0407
C statistic[d] (P-value)	0.232	0.798	0.257	0.663	0.673	0.942	0.320	0.650	0.344	0.585	0.0431	0.0522

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term

The 12 socio-economic municipality classificaiton dummies are included in the estimation

The instruments are a selection of WX satisfying the tests

[a] Anderson Canonical correlation likelihood test for relevance of instruments

[b] weak identification test for instruments

[c] test of overidentifying restrictions for instruments

[d] endogeneity test for IBASE and PBASE

Table 6: between estimation per legislature, 15 km radius weight matrix.

Legislature:	1992-1994				1995-2000				2001-2004			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.161	0.361		-2.691***	0.138	0.313		-2.770**	0.231	0.453		-2.274**
	(0.77)	(1.39)		(-2.68)	(0.71)	(1.02)		(-2.15)	(1.26)	(1.59)		(-2.12)
WP		-0.044*	0.561***	0.704***		-0.027	0.609***	0.771***		-0.033	0.630***	0.767***
		(-1.96)	(5.73)	(6.37)		(-0.98)	(5.91)	(5.95)		(-1.24)	(8.25)	(7.42)
IBASE	-0.018	-0.026	-0.234***	-0.201***	-0.007	-0.010	-0.148***	-0.131**	-0.012	-0.018*	-0.173***	-0.152***
	(-1.20)	(-1.57)	(-3.48)	(-2.85)	(-0.84)	(-1.02)	(-2.82)	(-2.36)	(-1.51)	(-1.68)	(-4.10)	(-3.38)
PBASE	-0.126***	-0.125***	-0.079	-0.128	-0.110***	-0.111***	-0.158*	-0.180**	-0.101***	-0.100***	-0.248***	-0.273***
	(-3.08)	(-3.05)	(-0.75)	(-1.22)	(-4.23)	(-4.24)	(-1.89)	(-2.11)	(-5.64)	(-5.64)	(-3.63)	(-3.91)
POP	0.004***	0.003***	0.011*	0.010	0.003*	0.003*	0.011*	0.009	0.001	0.001	0.001	-0.002
	(3.32)	(3.22)	(1.75)	(1.38)	(1.79)	(1.75)	(1.94)	(1.43)	(0.36)	(0.28)	(0.11)	(-0.19)
LABDENS	0.004	0.004	-0.026	-0.029*	0.005*	0.005*	-0.008	-0.009	0.002	0.002	-0.001	-0.001
	(1.05)	(0.93)	(-1.59)	(-1.68)	(1.72)	(1.66)	(-0.46)	(-0.52)	(0.58)	(0.51)	(-0.07)	(-0.05)
YOUNG	0.054	0.071*	0.235	0.221	0.077**	0.092***	0.175	0.068	0.072**	0.097**	0.331*	0.139
	(1.41)	(1.80)	(1.12)	(1.05)	(2.36)	(2.75)	(0.84)	(0.31)	(2.20)	(2.51)	(1.77)	(0.67)
OLD	0.053	0.069*	0.661***	0.647***	0.087***	0.101***	0.664***	0.605***	0.051*	0.074**	0.482***	0.332*
	(1.48)	(1.90)	(3.23)	(3.12)	(3.10)	(3.67)	(3.56)	(3.13)	(1.72)	(2.40)	(3.12)	(1.93)
UNEMPL	-0.036	-0.072	0.034	0.127	0.024	-0.001	0.078	0.251	0.119*	0.070	0.160	0.436
	(-0.77)	(-1.50)	(0.16)	(0.59)	(0.52)	(-0.02)	(0.26)	(0.78)	(1.95)	(0.91)	(0.35)	(0.91)
Constant	5.838***	5.484**	6.394	19.773*	4.158**	3.421*	4.351	20.337	4.503*	3.520	7.984	24.661**
	(2.77)	(2.53)	(0.66)	(1.91)	(2.22)	(1.69)	(0.46)	(1.61)	(1.90)	(1.40)	(0.95)	(2.16)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.34	0.33	0.62	0.61	0.41	0.39	0.60	0.59	0.46	0.45	0.66	0.66
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	19.97	17.09	61.00	17.09	27.07	20.17	69.95	18.10	43.18	21.33	99.47	23.46
Hansen J test[c] (P-value)	0.156	0.283	0.293	0.645	0.599	0.654	0.253	0.396	0.135	0.128	0.0637	0.148
C statistic[d] (P-value)	0.109	0.312	0.610	0.317	0.625	0.926	0.428	0.618	0.173	0.321	0.220	0.468

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term
The 12 socio-economic municipality classificaiton dummies are included in the estimation
The instruments are a selection of WX satisfying the tests
[a] Anderson Canonical correlation likelihood test for relevance of instruments
[b] weak identification test for instruments
[c] test of overidentifying restrictions for instruments
[d] endogeneity test for IBASE and PBASE

Table 7: estimation per year, first and second order neighbor weight matrix.

Year:	1992				1993				1994			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.962***	0.718***	-2.252*		0.865**	0.698***	-3.314**		0.894**	0.651***	-3.646***	
	(2.83)	(3.16)	(-1.68)		(2.26)	(2.74)	(-2.51)		(2.21)	(2.59)	(-2.75)	
WP	-0.044		0.729***	0.623***	-0.029		0.751***	0.607***	-0.040		0.766***	0.598***
	(-1.29)		(6.12)	(5.54)	(-0.87)		(6.38)	(5.68)	(-1.08)		(6.55)	(5.79)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.31	0.32	0.59	0.59	0.28	0.29	0.59	0.59	0.28	0.29	0.60	0.60
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	17.27	24.97	17.35	72.11	19.45	27.53	18.55	87.65	17.74	26.13	16.40	82.86
Hansen J test[c] (P-value)	0.767	0.453	0.735	0.400	0.469	0.438	0.637	0.199	0.402	0.305	0.761	0.268
C statistic[d] (P-value)	0.890	0.291	0.781	0.488	0.792	0.552	0.782	0.159	0.690	0.363	0.650	0.164

Year:	1995				1996				1997			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.669*	0.503**	-3.758***		0.746**	0.635***	-2.937*		0.813**	0.728***	-2.069	
	(1.76)	(2.51)	(-2.58)		(2.13)	(3.30)	(-1.69)		(2.26)	(3.40)	(-1.12)	
WP	-0.023		0.754***	0.561***	-0.014		0.838***	0.677***	-0.011		0.770***	0.658***
	(-0.60)		(6.60)	(5.61)	(-0.40)		(5.84)	(6.07)	(-0.33)		(5.09)	(6.28)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.36	0.37	0.60	0.60	0.33	0.34	0.54	0.55	0.37	0.37	0.53	0.54
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	22.96	29.15	24.77	98.21	21.76	28.59	25.58	100.5	22.77	34.27	21.51	89.16
Hansen J test[c] (P-value)	0.395	0.317	0.523	0.115	0.262	0.281	0.699	0.385	0.533	0.590	0.209	0.154
C statistic[d] (P-value)	0.643	0.370	0.775	0.196	0.451	0.636	0.664	0.300	0.336	0.333	0.963	0.734

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term
All control variables are included in the estimation
The instruments are a selection of WX satisfying the tests
[a] Anderson Canonical correlation likelihood test for relevance of instruments
[b] weak identification test for instruments
[c] test of overidentifying restrictions for instruments
[d] endogeneity test for IBASE and PBASE

Table 7 (continued): estimation per year, first and second order neighbor weight matrix.

Year:	1998				1999				2000							
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P				
WI	0.881**	0.651***	-2.414		0.877**	0.641***	-2.925*		0.834**	0.610***	-3.127*					
	(2.33)	(3.33)	(-1.33)		(2.55)	(3.26)	(-1.70)		(2.47)	(3.26)	(-1.83)					
WP	-0.030		0.728***	0.594***	-0.031		0.710***	0.553***	-0.031		0.708***	0.531***				
	(-0.81)		(4.96)	(6.15)	(-0.92)		(4.99)	(5.83)	(-0.84)		(4.83)	(5.58)				
Observations	306	306	306	306	306	306	306	306	306	306	306	306				
R-squared	0.34	0.36	0.56	0.57	0.33	0.35	0.57	0.58	0.34	0.36	0.57	0.59				
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0				
Cragg-Donald F test[b]	21.68	28.84	20.49	83.04	21.97	28.05	21.35	86.41	22.20	27.59	21.81	78.00				
Hansen J test[c] (P-value)	0.199	0.156	0.428	0.292	0.165	0.163	0.478	0.271	0.267	0.254	0.500	0.306				
C statistic[d] (P-value)	0.524	0.287	0.525	0.381	0.287	0.222	0.781	0.503	0.283	0.214	0.735	1.000				
Year:	2001				2002				2003				2004			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.840***	0.695***	-1.116		0.903***	0.707***	-0.957		0.831**	0.495***	-3.350*		0.775**	0.462**	-2.389	
	(2.61)	(4.24)	(-0.77)		(2.71)	(3.76)	(-0.67)		(2.34)	(2.88)	(-1.79)		(2.27)	(2.41)	(-1.56)	
WP	-0.017		0.762***	0.691***	-0.022		0.778***	0.724***	-0.042		0.620***	0.443***	-0.047		0.550***	0.424***
	(-0.52)		(5.93)	(7.98)	(-0.71)		(6.80)	(8.97)	(-1.21)		(4.48)	(5.22)	(-1.45)		(4.53)	(5.25)
Observations	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.40	0.41	0.58	0.58	0.39	0.41	0.62	0.62	0.40	0.42	0.61	0.62	0.41	0.43	0.63	0.63
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	24.32	33.81	30.01	84.53	19.32	28.78	22.12	72.15	23.70	45.30	21.55	91.52	24.40	39.12	26.48	131.9
Hansen J test[c] (P-value)	0.134	0.145	0.390	0.386	0.118	0.127	0.102	0.114	0.141	0.118	0.640	0.309	0.263	0.218	0.442	0.372
C statistic[d] (P-value)	0.810	0.716	0.308	0.263	0.189	0.157	0.507	0.546	0.399	0.135	0.565	0.210	0.611	0.252	0.988	0.445

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term
All control variables are included in the estimation
The instruments are a selection of WX satisfying the tests
[a] Anderson Canonical correlation likelihood test for relevance of instruments
[b] weak identification test for instruments
[c] test of overidentifying restrictions for instruments
[d] endogeneity test for IBASE and PBASE

Table 8: estimation per year, 15 km radius weight matrix.

Year:	1992				1993				1994			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.396*	0.201	-1.858*		0.409	0.242	-3.010***		0.334	0.123	-3.116***	
	(1.76)	(1.03)	(-1.92)		(1.45)	(1.06)	(-2.96)		(1.15)	(0.54)	(-2.76)	
WP	-0.047**		0.696***	0.591***	-0.037		0.731***	0.582***	-0.044*		0.718***	0.552***
	(-2.30)		(6.22)	(5.51)	(-1.61)		(6.57)	(5.86)	(-1.71)		(6.04)	(5.51)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.34	0.34	0.60	0.60	0.30	0.31	0.60	0.61	0.31	0.32	0.61	0.62
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	18.81	21.46	18.81	54.16	17.22	21.56	17.22	66.26	17.08	20.65	17.86	77.02
Hansen J test[c] (P-value)	0.396	0.180	0.901	0.592	0.423	0.300	0.654	0.273	0.225	0.155	0.521	0.113
C statistic[d] (P-value)	0.477	0.151	0.350	0.974	0.611	0.287	0.722	0.554	0.396	0.184	0.609	0.218
Year:	1995				1996				1997			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.416	0.173	-3.917***		0.272	0.172	-2.825*		0.337	0.320	-1.750	
	(1.37)	(0.89)	(-3.55)		(0.89)	(0.89)	(-1.84)		(1.16)	(1.54)	(-1.29)	
WP	-0.038		0.801***	0.591***	-0.015		0.832***	0.661***	-0.003		0.797***	0.698***
	(-1.42)		(7.50)	(5.89)	(-0.54)		(5.09)	(4.82)	(-0.11)		(5.59)	(6.06)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.36	0.38	0.61	0.61	0.35	0.36	0.54	0.56	0.38	0.38	0.55	0.55
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	19.07	24.26	19.53	74.78	18.84	28.01	18.46	89.31	20.88	28.53	17.55	77.05
Hansen J test[c] (P-value)	0.485	0.271	0.417	0.152	0.728	0.734	0.352	0.229	0.596	0.672	0.248	0.272
C statistic[d] (P-value)	0.659	0.297	0.896	0.161	0.914	0.994	0.814	0.433	0.561	0.683	0.362	0.489

Robust z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1
Even columns exclude cross spatial interaction term, uneven columns include cross spatial interaction term
All control variables are included in the estimation
The instruments are a selection of WX satisfying the tests
[a] Anderson Canonical correlation likelihood test for relevance of instruments
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[d] endogeneity test for IBASE and PBASE

Table 8 (continued): estimation per year, 15 km radius weight matrix.

Year:	1998				1999				2000			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.432	0.238	-2.260		0.454	0.239	-2.575*		0.416	0.199	-2.465*	
	(1.38)	(1.18)	(-1.59)		(1.41)	(1.09)	(-1.89)		(1.34)	(0.97)	(-1.77)	
WP	-0.029		0.674***	0.538***	-0.033		0.632***	0.478***	-0.034		0.633***	0.475***
	(-1.07)		(4.57)	(4.74)	(-1.21)		(4.56)	(4.44)	(-1.17)		(4.30)	(4.36)
Observations	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.35	0.37	0.57	0.58	0.34	0.36	0.58	0.59	0.35	0.37	0.58	0.59
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	18.30	25.03	20.00	105.6	17.61	27.70	19.61	88.83	17.81	26.17	20.66	97.92
Hansen J test[c] (P-value)	0.547	0.475	0.130	0.123	0.617	0.573	0.228	0.150	0.640	0.564	0.108	0.0946
C statistic[d] (P-value)	0.454	0.200	0.458	0.241	0.458	0.285	0.339	0.405	0.646	0.459	0.421	0.238

Year:	2001				2002				2003				2004			
Dependent variable:	I	I	P	P	I	I	P	P	I	I	P	P	I	I	P	P
WI	0.396	0.309*	-1.409		0.551*	0.393**	-2.128*		0.546*	0.251	-3.433**		0.532*	0.226	-1.819	
	(1.39)	(1.72)	(-1.14)		(1.91)	(1.96)	(-1.95)		(1.81)	(1.30)	(-2.37)		(1.86)	(1.14)	(-1.50)	
WP	-0.012		0.762***	0.670***	-0.021		0.840***	0.715***	-0.044		0.654***	0.472***	-0.055**		0.531***	0.436***
	(-0.45)		(6.12)	(7.69)	(-0.87)		(8.21)	(9.19)	(-1.55)		(5.16)	(5.38)	(-1.99)		(4.76)	(5.07)
Observations	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306	306
R-squared	0.41	0.41	0.57	0.58	0.39	0.40	0.63	0.63	0.40	0.42	0.63	0.63	0.42	0.43	0.63	0.63
Anderson LR[a] (P-value)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cragg-Donald F test[b]	22.78	33.36	23.75	74.57	16.60	39.28	18.64	79.00	18.97	43.29	17.28	90.65	21.29	40.47	23.56	112.3
Hansen J test[c] (P-value)	0.329	0.381	0.317	0.272	0.191	0.195	0.432	0.287	0.202	0.171	0.483	0.117	0.134	0.0996	0.420	0.371
C statistic[d] (P-value)	0.842	0.819	0.877	0.619	0.118	0.0749	0.814	0.720	0.355	0.141	0.786	0.119	0.446	0.160	0.524	0.796

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