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TAX COMPETITION AMONG LOCAL GOVERNMENTS: EVIDENCE FROM A PROPERTY TAX REFORM IN FINLAND *

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ABSTRACT: This paper uses a Finnish policy intervention to study tax competition among local governments. Changes in the statutory lower limits to the property tax rates are used as a source of exogenous variation to estimate the responses of municipalities to tax rates in their neighbouring municipalities. I do not find evidence of interdependence in property tax rates among Finnish municipalities. The results are in contrast to the earlier empirical literature, using data from other countries, that has mainly found positive interdependence in tax rates. I compare the causal estimates based on the policy change to the commonly used Spatial Lag estimates and Spatial Instrumental Variables estimates, which are based on highly restrictive assumptions. The comparisons suggest that the standard spatial econometrics methods may have a tendency to overestimate the degree of interdependence in tax rates.

JEL Codes: H20, H71, H77

Keywords: Property tax, tax competition, fiscal interaction, instrumental variables, spatial econometrics

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1. Introduction

The theoretical literature on fiscal interaction among local governments is fairly well developed and has identified several potential sources for interdependence in taxation and spending decisions. The implications of fiscal interaction for the efficiency of public service provision and the allocation of resources across jurisdictions have been studied in various settings (see Wilson, 1999, and Wilson and Wildasin, 2004, for reviews). By contrast, empirical research on fiscal interaction among jurisdictions is still relatively scarce and the identification strategies used do not generally meet the standard required for the results to have a causal interpretation.

The estimation of the responses of jurisdictions to taxes and spending in other jurisdictions is fraught with endogeneity issues. Firstly, the interdependence of taxation and spending decisions among neighbouring jurisdictions leads to two-way causality, which renders Ordinary Least Squares (OLS) estimates of the reaction functions inconsistent. Secondly, tax rates in neighbouring municipalities may be driven by spatially correlated unobserved factors that lead to spurious correlation in tax rates. This paper studies municipal property taxes in Finland and utilizes a Finnish policy change as a source of exogenous variation in tax rates to overcome these identification problems. The purpose of the paper is to estimate the responses of Finnish municipalities to property tax rates in neighbouring municipalities. In addition, the causal estimates based on the policy change are compared with standard spatial econometrics methods that have been commonly used in the literature.

In Finland, municipalities choose property tax rates within limits set by the central government. In the year 2000, the lower limits to the general property tax rate and the residential building tax rate were raised. The reform caused imposed increases in tax rates that can be used to estimate the effect of tax rates in nearby municipalities on the tax rate choices of municipalities. Changes in property tax rates are regressed on changes in the average property tax rate of neighbouring municipalities by Two-Stage Least Squares (2SLS) regression. Imposed increases in neighbours' tax rates are used as an instrument for the actual change in neighbours' tax rates.

Earlier empirical studies fall into two main categories based on how they have tried to address the issue of simultaneous determination of policy choices (see Brueckner, 2003, for a review). The first group uses the so called *Spatial Lag* (SL) models that estimate reaction functions using non-linear regression and maximum likelihood methods.[1] The estimation of neighbourhood effects by SL models hinges on the assumption that the determinants of tax rates, apart from neighbours' tax rates, are exogenous. Moreover, the SL method imposes restrictive distributional and functional form assumptions. The second group, termed *Spatial*

[1] For example Allers and Elhorst (2005), Bordignon et al. (2003), Brueckner and Saavedra (2001) and Revelli (2001) estimate tax rate reaction functions with the SL model.

Instrumental Variables (SIV) models in this paper, estimates the reaction functions by Instrumental Variables regression using neighbours' attributes, such as age structure and income, as instruments for their tax rates.[2] Like the SL method, the SIV method also assumes that the jurisdiction attributes used as the determinants of tax rates are exogenous. For example endogenous sorting of individuals to communities with different combinations of taxes and services will bias the standard SIV estimates as well as the SL estimates (Brueckner, 2003).

Gibbons and Overman (2010) analyse identification issues in spatial econometrics models and argue that reliable estimation of causal spatial interaction parameters requires quasi-experimental settings that provide exogenous variation in the variable of interest. This paper is, along with Eugster and Parchet (2011)[3], the first study using a quasi-experimental design to estimate tax competition reaction functions.[4]

The empirical results of this study suggest that there is no significant interaction in property tax rate choices among Finnish municipalities. While this finding is consistent with the theoretical literature discussed in Section 2, it is in contrast with the previous empirical literature that has mainly found the dependence of tax rates in neighbouring jurisdictions to be positive. Allers and Elhorst (2005) provide a table of nearly twenty empirical studies on local tax competition including studies using the SL and SIV methods. In their list, the median estimate for the response to a percentage point increase in tax rates in neighbouring jurisdictions is 0.4 percentage points and most estimates fall between 0.2 and 0.6. I compare the estimates based on the policy change to SL and SIV estimates with Finnish data. The comparisons suggest that the SL and SIV models may have a tendency to give upward biased estimates of the degree of fiscal interaction.

Section 2 of this paper summarizes theoretical literature on the sources of tax competition and discusses the relevance of different theories for the Finnish setting. Section 3 provides a description of the Finnish property tax system and discusses the reform of 2000 which will be utilized in the empirical analysis. Section 4 presents the empirical strategy. Section 5 reports the empirical results. Section 6 concludes.

2. Theoretical background

2.1. Sources of tax competition

[2] Papers estimating tax-reaction functions with the Spatial IV model include Besley and Case (1995), Buettner (2001), Revelli (2002) and Edmark and Ågren (2008).

[3] Eugster and Parchet (2011) use a regression discontinuity approach to study tax competition in Swiss municipalities around the French/German language border.

[4] Dahlberg and Edmark (2008) use a Swedish policy intervention as a source of exogenous variation in welfare benefit levels to study "race-to-the-bottom" in welfare benefits.

Wilson (1999) surveys theoretical literature on tax competition and divides tax competition models into two main categories. As a benchmark category he uses Tiebout (1956) type models of public service provision that assume that there are many small jurisdictions providing public services funded by non-distorting taxes so as to maximize land value in the jurisdiction. Households are mobile and choose jurisdictions that provide their preferred bundle of taxes and services. Intergovernmental competition benefits consumers by creating a variety of tax-service bundles for consumers to choose. The sorting of different households into different communities leads to an efficient level of public services and improves efficiency compared with the situation where taxation and service provision are centralized. Accordingly, these models are often referred to as models of efficient tax competition. Subsequent work has generalized these models to apply to firms (see Richter and Wellisch, 1996). In the efficient tax competition models there is no strategic interaction at a localized level since each jurisdiction is small relative to the economy. Households or firms are fully mobile and there are no externalities or distortions related to local taxation and the provision of local public goods. The second category of tax competition models includes models that depart from the idealized setting of the Tiebout type models in one way or another that may lead to strategic interaction among jurisdictions. Three main sources of strategic fiscal interaction identified in the literature are 1) benefit spillovers 2) distorting taxes on mobile tax base 3) political economy considerations and information asymmetries.

Benefit spillovers arise if residents of a jurisdiction can benefit from services provided by other jurisdictions. Benefit spillovers will lead to negative dependence in tax rates since higher spending in a jurisdiction reduces the need to spend in other jurisdictions (see Case et al., 1993). The level of services will be inefficiently low since municipalities do not take into account the positive fiscal externality for others. Benefit spillovers can arise if for instance access to parks and other amenities cannot be restricted to the residents of the jurisdiction providing the amenity. Negative spending spillovers are naturally possible and will lead to positive tax rate interaction. For example, higher police spending in one jurisdiction may give rise to a negative externality if criminals respond by moving their activity to other jurisdictions where committing crimes is less risky.

The second class of tax competition models departs from the efficient tax competition setting by assuming that lump sum taxes are not available and services are funded by distorting taxes. Typically, these models study capital taxes or property taxes that fall at least partly on capital which is mobile across jurisdictions. Mobility of capital leads to downward pressure on tax rates since a lower tax rate in one jurisdiction attracts tax base from other jurisdictions and forces them to lower their tax rate. Competition for mobile tax base leads to an inefficiently low level of public services since jurisdictions have to take into account the negative effect of higher taxes on their tax base. In other words, higher taxes in one jurisdiction cause a positive fiscal externality for others. In the competitive versions of tax competition models there are many relatively small jurisdictions that take the net return of capital as given, and hence, strategic behaviour is absent (e.g. Zodorow and Mieszkowski, 1986). If jurisdictions are sufficiently large to affect the net rate of return, tax rates are set strategically taking into account tax rates in other jurisdictions (e.g. Wildasin 1988).

For the purposes of empirical work on local taxes it is important to note that strategic tax competition among jurisdictions in the same region requires that capital is not fully mobile but to some extent fixed to the region (Brueckner and Saavedra, 2001).[5] Another issue with important implications for empirical work concerns the heterogeneity of preferences for local public services. With identical households, a tax cut in one jurisdiction causes other jurisdictions to bid down their tax rates as they compete for the tax base. However, heterogeneous preferences and the sorting of high and low demand residents into different municipalities may give rise to negative interdependence in tax rates. A tax decrease in a low demand jurisdiction may induce high demand jurisdictions to increase their tax rates even further in an attempt to retain high service levels. Drawing on Brueckner (2000), Brueckner and Saavedra (2001) combine heterogeneous preferences and locally fixed tax base and show that in a model with two jurisdictions competing for a fixed amount of capital, the relationship between capital tax rates in the jurisdictions may be positive or negative (or flat).

The third type of tax competition takes place if voters use tax rates in their jurisdiction relative to other jurisdictions as a yard-stick to evaluate how well their government is performing. The underlying assumption is that politicians and civil servants are at least partly motivated by self-interest and may use public funds for their own benefit. So called yard-stick competition or tax mimicking arises if the true costs of providing public services are known only by the local government and not observed by voters but tax rates are common knowledge (Besley and Case, 1995). In this setting, voters may utilize the fact that the costs of providing services in their jurisdiction are likely to be correlated with other jurisdictions in the area to assess the performance of their government. Relatively high taxes may indicate that the government is inefficient or rent seeking and should be voted out of office. As a result, governments are forced to imitate their neighbours in order to stay in office.

2.2. Discussion on the relevance for the Finnish setting

Arguably, benefit spillovers are unlikely to be an important source of fiscal interaction in the Finnish setting since the bulk of services provided by the municipalities are publicly provided private goods, such as schools, health care, nurseries and elderly care. Residents of other municipalities can be easily excluded from these services. Some local amenities, such as parks, may generate benefit spillovers but the budget share of non-excludable amenities is very small compared to excludable services. Competition for tax base and politically motivated yardstick competition are more potential sources of spatial interdependence in tax rates in Finland.

The next section discusses the Finnish property tax system and argues that the property taxes studied here fall partly on business and housing capital. A higher property tax rate lowers the profitability of investment in the municipality and may cause capital to locate in other municipalities, which makes competition with tax rates in an attempt to attract capital

[5] Brueckner and Saavedra (2001) argue that some industries are likely tied to specific regions, and that part of a region’s capital stock is oriented towards serving the local population (e.g. retail establishments).

possible. As shown by Brueckner and Saavedra (2001), the sign of tax rate interaction due to the tax base competition mechanism is ambiguous a priori.

Yardstick competition may be relevant to the Finnish case since Finnish municipalities are governed by elected councils. Information on tax rates is easily available, but comparing the efficiency of service provision across municipalities is difficult. Municipalities provide a wide range of services and there are no commonly used performance rating systems. Hence, voters may use tax rates as a benchmark when evaluating the performance of their council relative to other councils in the area.

As the observed patterns of tax rate interaction with Finnish data are likely to be a combination of tax base competition (sign ambiguous), yardstick competition (positive) and possibly benefit spillovers (positive), the expected relationship between tax rates in nearby municipalities is ambiguous.

3. Institutional setting and the policy intervention

3.1. The Finnish property tax system

Property taxation was introduced in Finland in 1993 to replace a disintegrated system of fees and charges on real property. Property taxes are collected by local municipalities which are responsible for the provision of the bulk of public services, such as elementary schools, basic health care, day care for children and elderly care.[6] Municipal expenditure is roughly 20 % of GDP and municipalities employ almost 20% of the labour force.

The two main components of the Finnish property tax system are the *general property tax* and the *residential building tax*.[7] The general property tax is applied to both residential and commercial land and commercial buildings. The taxable value of land is based on the estimated market value of a similar undeveloped site, regardless of whether the site is actually developed. Hence, the taxable value of land is independent of the development decisions of the land owner and the general property tax is a neutral land tax, to the extent that it is applied to land (Lyytikäinen, 2009). However, the general property tax is also levied on commercial buildings, valued at the estimated construction cost less depreciation. The part of the general property tax that falls on buildings makes investment less profitable and may cause capital to relocate implying a lower tax base in the long run. Hence, municipalities may use the general property tax as a means to attract business capital.

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[6] See Moisio, Loikkanen and Oulasvirta (2010) for a more detailed description of the Finnish local public finance and service provision system.

[7] In addition, municipalities can apply differential tax rates to un-developed residential lots, non-permanent dwellings (essentially vacation homes) and power stations. Non-profit organisations may be exempt from property taxes.

Residential buildings are taxed at a separate tax rate, which is lower than the general rate. The assessed value of residential buildings is based on estimated construction costs less depreciation, similar to commercial buildings. A higher residential building tax rate, other things constant, makes housing investment in the municipality less profitable and may lead to a lower tax base over time. Therefore, the residential property tax could be used as an instrument in the competition for housing capital.

The local flat rate income tax and grants from central government are the most important sources of income for municipalities. Property taxes are relatively unimportant in terms of revenue accounting for less than 5 % of local revenues, but the fact that property taxes fall partly on capital makes property taxation important for competition for capital. Attracting investment to the municipality not only increases the property tax base but also affects municipal revenues indirectly through the national corporate tax, part of which is redistributed to municipalities where the firms are located. In addition, higher business capital may benefit the residents of the municipality by improving employment possibilities, which in turn boosts municipal income tax revenues.

The Finnish grant system includes an equalization component which dampens the incentives to compete for tax base. The system is based on imputed revenues that are calculated applying the average municipal income tax rates and property tax rates to the tax base of each municipality. The system then allocates revenues from rich municipalities with imputed revenue above an equalization limit (roughly 90% of average imputed per capita revenue) to poorer municipalities below the equalization limit. Municipalities above the equalization limit give up about 60% of their imputed revenue exceeding the limit and this revenue is used to raise the imputed revenues of poorer municipalities to the limit. The system weakens incentives to attract tax base, but municipalities above the limit still benefit from a higher tax base as they can keep 40% of the increase in imputed revenues. For a municipality below the limit an increase in the tax base may have little direct effect on revenues[8], but it may benefit from higher business capital indirectly through, for example, better employment opportunities.

3.2. Property tax limits and the reform of 2000

Municipalities choose property tax rates within limits which are set by central government. The initial allowed range in 1993 for the general property tax rate was 0.2 – 0.8% and 0.1 – 0.4% for the residential building tax. In 1999, the upper limit for the general property tax rate was raised from 0.8% to 1% and the upper limit for the residential building tax rate was raised from 0.4% to 0.5%. This reform was relatively unimportant as the upper limit to the general property tax was binding for only a handful of municipalities and the upper limit to the residential building tax was binding for none of the municipalities.

[8] If the tax rate of the municipality below the equalization limit is above the average tax rate used to calculate the imputed revenue, higher tax base increases revenues by the amount exceeding the increase in imputed revenue of the municipality.

In 1999 the government decided to raise the lower limits for the year 2000. The lower limit to the general property tax rate rose from 0.2% to 0.5% and the lower limit to the residential building tax rose from 0.1% to 0.22%. Graph 1 shows the distribution of tax rates in the year 1999 before the reform. The residential building tax is on the horizontal axis and the general property tax is on the vertical axis. The size of the circle is proportionate to the number of municipalities in the cell. The lower limits for both tax rates in the years 1999 and 2000 are indicated with lines. The new limit to the general property tax was binding for approximately 40% of the municipalities and the new lower limit to the residential building tax was binding for roughly 30% of the municipalities. Before the reform, less than 5% of the municipalities applied tax rates corresponding to the lower limits. The graph shows that the reform implied large forced increases in tax rates for many municipalities. Section 4 describes how these imposed tax increases triggered by the reform are utilized to construct an instrumental variable for changes in neighbours' tax rates.

[Graph 1 here]

4. Empirical strategy

4.1. Empirical model

Empirical studies on fiscal interaction are concerned with estimating reaction functions that give the value of the decision variable of a jurisdiction as a function of spatially weighted decisions of other jurisdictions (see Brueckner, 2003, for a review). The empirical model estimated in this study is written as

(1) $$T_{it} = \beta \sum_{j \neq i} w_{ij} T_{jt} + \gamma X_{it} + k_t + m_i + e_{it} \ .$$

The dependent variable T_{it} is the property tax rate in municipality i in year t. The explanatory variable of interest is the weighted average tax rate of other municipalities j weighted by spatial weights w_{ij}. An often used weighting scheme gives neighbours positive weights and zero weights to other municipalities. I use the nearest neighbour weight matrix as the base specification but test the robustness of the findings to alternative weight matrices discussed in Section 4.6. The vector X_{it} includes time-varying municipality attributes affecting tax rate choices, such as age structure and income. The model includes year fixed effects k_t which capture time variant unobserved factors that are common to all municipalities. Municipality fixed effects m_i include municipality specific time invariant factors.

OLS estimates of the slope of the reaction function (parameter β) will be biased because, with non-zero β, the simultaneous determination of tax rates makes neighbours' tax rates endogenous. I address this endogeneity issue by using the policy intervention described in Section 3 as a source of exogenous variation in neighbours' tax rates. A further challenge is spatially correlated omitted variables giving rise to spurious spatial correlation in tax rates. I address this issue by differencing the data over time to control for time invariant unobserved heterogeneity. Before describing the empirical strategy in detail, I briefly discuss the standard spatial econometrics methods used in much of the previous literature. In Section 5, I compare the policy change based estimates with the standard spatial econometrics estimates.

4.2. Standard spatial econometrics methods

In previous studies the simultaneity of tax rates has been addressed by estimating the so called Spatial Lag (SL) models and Spatial Instrumental Variables (SIV) models discussed for example in Anselin (2001).

The SL model is derived by first writing (1) in matrix form. Assuming that the error term is i.i.d. normally distributed with constant variance makes it possible to solve the reduced form equation for the vector of tax rates and write the likelihood function. The spatial lag parameter β is then estimated by maximum likelihood. The SL models rely on highly restrictive assumptions regarding the error distribution and the functional form of the reaction function. Crucially, consistent estimation of β requires that the socio-economic attributes used as tax rate determinants are exogenous to tax rates (Brueckner, 2003). This assumption is unlikely to hold because of omitted variables and because the attributes used typically include characteristics like income and age structure that are endogenously determined in Tiebout (1956) type models of sorting. Moreover, even if the X's are exogenous, spatially correlated error terms or direct effects of neighbours' X's on T make the standard SL inconsistent. The latter two issues have been addressed by testing alternative specifications or specifying more complicated models incorporating the direct effects of neighbours' exogenous attributes and/or spatially correlated errors.[9] Identification of β in an expanded model containing spatially correlated errors and direct effects of neighbours X's is in principle possible assuming that the specified model corresponds to the true data generating process, but it is based on a combination of cross-coefficient restrictions and the structure given to the spatial weight matrix (Gibbons and Overman, 2010).[10]

The main alternative to the SL model is the SIV model which uses the spatial lags of socio-economic determinants of tax rates (the X variables in equation (1)) as instruments for the spatial lags of tax rates.[11] The model can be estimated by standard 2SLS. The identifying assumption behind the SIV model is that neighbours' X variables are uncorrelated with the error term. This assumption is violated if own X's are correlated with own error term and the

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[9] Brueckner and Saavedra (2001), among others, provide a robust test for spatial autocorrelation in the error term. Case et al. (1993) specify a model that incorporates spatial autocorrelation in the error term.

[10] In the peer effects literature it has long been recognized that the correlation of errors within peer groups or a direct effect of group's X's on individual outcomes makes it impossible to identify the effect of the groups' outcomes on individual outcomes (Manski, 1993). In spatial econometrics models identification is in principle possible because typical spatial weight matrices are such that two neighbours do not have identical 'peer groups' (they weight each other differently). In technical terms, identification is possible because spatial weight matrices are typically not idempotent (Gibbons and Overman, 2010).

[11] Higher order spatial lags are sometimes used in addition to the first order lags (e.g. Buettner, 2001).

error terms are spatially correlated (Gibbons and Overman, 2010). Thus any spatially correlated omitted factors that are correlated with the *X*'s would render the SIV estimates inconsistent. It is easy to come up with economic mechanisms giving rise to bias in the SIV estimates. In tax competition applications, the instruments typically include characteristics like income and age structure that are endogenously determined in Tiebout (1956) type models of sorting, and hence, the *X*'s are likely correlated with the error term (Brueckner, 2003). Spatial autocorrelation in the error term arises, for example, through sorting on unobservables (e.g. unobserved taste for public services) or causal linkages between between unobservables (e.g. through mobility between neighbours).

A further problem of the SIV approach is that the predictive power of the instrumental variables is often low leading to a weak instrument problem, especially in a panel data fixed effects setting, which means that even weak correlation between the instruments and the error term may lead to a large bias. Accordingly, studies using SIV with panel data and controlling for fixed effects are rare.[12]

Gibbons and Overman (2010) provide a more formal and extensive analysis of the identification issues related to spatial econometrics models including the SIV and SL models. They argue that more convincing identification strategies are needed to obtain plausible estimates for spatial interaction. In other areas of applied empirical economics it has become standard to utilize policy interventions, discontinuities in policy rules and other quasi-experimental settings that provide a source of exogenous variation in the explanatory variable of interest to identify its effect on the outcome variable. This paper is, along with Eugster and Parchet (2011), the first to use quasi-experimental data to estimate tax competition reaction functions. In order to assess the performance of the standard spatial econometrics methods, I will compare the SL and SIV estimates with the quasi-experimental estimates. I will use both cross-sectional and fixed effects variants of the SL and SIV methods.

4.3. Policy change based IV strategy

The Finnish property tax reform of 2000 described in Section 3.2 provides an opportunity to study the causal relationship between tax rates in Finnish municipalities. My empirical strategy is similar to the SIV approach discussed in the previous subsection. The crucial difference is that I utilize the policy intervention to replace the municipality attributes *X*, which are unlikely to be valid instruments, with an arguably exogenously determined variable affecting changes in tax rates.

I use the panel property of the data and difference the equation (1) to get the following estimating equation

$$T_{it} - T_{it-1} = \beta \sum_{j \neq i} w_{ij} (T_{jt} - T_{jt-1}) + \gamma (X_{it} - X_{it-1}) + l_t + u_{it} \quad (2)$$

[12] Besley and Case (1995) and Revelli (2001) use differenced data to control for jurisdiction fixed effects.

Municipality fixed effects cancel out in the differencing. Hence, I control for time-invariant unobserved heterogeneity, which can be arbitrarily correlated with neighbours' tax rates.

The model (2) is written in a general form, but the empirical analysis exploits tax rate changes from 1999 to 2000 generated by the policy change. As described in Section 3.2 the reform created imposed increases in the tax rates of many municipalities in the year 2000. Actual imposed increases are not observable because we do not know which tax rates municipalities would have chosen had there not been increases in the lower bounds for the tax rates. I construct a measure of *predicted imposed increase* in the tax rate and, similarly as in the SIV approach, I use the spatially lagged predicted imposed increase as an instrument for the spatially lagged tax rate change in equation (2). I define the predicted imposed tax rate increase in municipality *i* in year 2000 as

(3) $$Z_{i2000} = D(\underline{T}_{2000} > T_{i1998})(\underline{T}_{2000} - T_{i1998}) .$$

In equation (3), $\underline{T}$ denotes the lower limit to the property tax rate and $D(\underline{T}_{2000} > T_{i1998})$ is a dummy variable that gets the value one if the municipality had a tax rate below the lower limit of the year 2000 in the year 1998. Thus, predicted imposed increase is zero if the tax rate in 1998 is above the lower limit of year 2000 and positive if $T_{i1998} < \underline{T}_{2000}$. I use the year 1998 as the base year for defining the predicted imposed increase, because it is close enough to the year of policy reform to provide a strong prediction but not causally linked with the error term of equation (2). Year 1999 cannot be used as the base year since both the error term of equation (2) and the predicted imposed increase would then depend on the error term of the level equation (1), which would mean that the instrument is not valid. Moreover, I include the own imposed tax rate increase in municipality *i* in the model to control for the direct effect of the policy change on the municipality. Controlling for own imposed increases is important because, due to spatial correlation in tax rate levels, municipalities with large imposed increases in their neighbourhood are likely to experience an imposed increase too. Not controlling for own imposed increase would imply that the instrument is correlated with the error term of (2) and bias estimation.

I use spatially lagged predicted imposed increases as an instrument for neighbours' actual tax rate changes in 2000 and is written as

(4) $$\sum_{j \neq i} w_{ij} Z_{j2000} = \sum_{j \neq i} w_{ij} D(\underline{T}_{20000} > T_{j1998})(\underline{T}_{2000} - T_{j1998}) .$$

Variation in the instrument is driven by predetermined tax rates of neighbours T_{j1998} and the new lower bound $\underline{T}_{2000}$ set by the central government. For example, consider municipality A which has two neighbours B and C with general property tax rates T_{B1998} = 0.4% and T_{C1998} = 0.6%. In the year 2000, the lower limit to the general property tax rate rises from 0.2% to $\underline{T}_{2000}$ = 0.5%. Thus, the predicted imposed increase for municipality B is Z_{B1998} = 0.1% and Z_{C1998} = 0%. The value of the instrument for municipality A is the weighted average of these imposed increases (0.05%). The instrument is not a perfect predictor, albeit a very strong one, of actual tax rate changes in the neighbourhood because municipalities adjust their tax rates for other reasons too – and because tax rates in 1998 are used as the base year to rule out endogeneity.

A good instrument has to be both relevant (a strong predictor of tax rate changes) and valid (orthogonal to the error term). The empirical analysis confirms the relevance of the instrument. I argue that the validity condition is very likely to hold as well because the instrument is based on a policy change which can be considered exogenous to individual municipalities. The identifying assumption is that the instrument is uncorrelated with the error term of equation (2). Correlation of the instrument with trends or shocks in unobserved factors could violate this assumption. In Section 5.3 I evaluate the likely validity of the instrument through a placebo treatment type methodology by using tax rate changes in pre-policy change years as the dependent variable. The placebo tests suggest that the instrument is valid.

A potential weakness of the first differenced model is that it presumes a contemporaneous reaction to neighbours' tax rate changes. In order to allow for more sluggish responses, I estimate models with 2-5 year differences for the dependent variable, in addition to model (2).

4.4. Corner solutions

The fact that many municipalities are likely to be constrained by the new lower limit in 2000 complicates the analysis. The reaction functions of municipalities that end up in a corner solution are latent. This may bias the estimation because municipalities for which the new lower bound is a binding constraint appear not to respond to tax rate changes in other municipalities even if in an unconstrained situation they would respond. Figure 1 illustrates this issue and depicts the reaction functions of two municipalities A (horizontal axis) and B (vertical axes). The dashed lines represent the lower limits to their tax rates in 1999 and 2000. Before the reform in 1999 the equilibrium tax rates are given by the point where the straight reaction lines $T_A(T_B)$ and $T_B(T_A)$ cross. The reform forces municipality A to raise its tax rate to $\underline{T}_{2000}$ and municipality B responds by raising its tax rate to the value where the vertical line at $\underline{T}_{2000}$ crosses its reaction function. Municipality A is forced off its reaction function which becomes vertical up to the point where $T_A(T_B) > \underline{T}_{2000}$. Hence, the responses of municipality A may not be informative of the slope of the unconstrained reaction function.

[Figure 1 here]

In order to eliminate the possible bias due to corner solutions I omit municipalities that, in 1999, had a tax rate below the new lower limit of the year 2000. The remaining sub-sample contains municipalities for which the new lower bound in the year 2000 was not likely to be a binding constraint. The presence of the lower bound may still work against finding a negative response to neighbours' tax rates but positive responses will be detected. Neighbours' tax rates are still calculated using the whole sample.

4.5. Heterogeneous effects

In Figure 1 the slopes of the reaction functions of the two municipalities are linear and more or less the same. If reaction functions differ significantly across municipalities or the slope varies over the range of neighbours' tax rates, the policy change IV estimates may not be generalised to apply to the whole population of municipalities. The policy change based IV strategy estimates a variable treatment intensity version of the Local Average Treatment Effect (LATE) termed the Average Causal Response (ACR) in Angrist and Imbens (1995).

ACR is the weighted average of responses of municipalities to a unit change in neighbours' tax rates, for municipalities whose neighbours' tax rates were affected by the policy change. Municipalities whose neighbours were greatly affected by the policy change get larger weights. As discussed in Section 4.4., the basic experimental design is such that the reactions by low-tax jurisdictions are not observed because they are equally subject to the country-wide policy change. If low tax municipalities are more responsive to neighbours' tax rates, this implies that the policy change based ACR estimate will be a downward biased estimate of the average causal response in the whole population. In other words, the omission of municipalities likely to end up in a corner solution means that municipalities with very low tax rates get zero weights. An additional potential issue is that the identifying variation in neighbours' average tax rates comes from low tax municipalities being forced to raise their tax rates. This may bias estimates if municipalities respond differently to tax rate changes by their low tax neighbours and high tax neighbours.

It should be noted that also the SIV method produces a version of ACR weighted by the various attributes of neighbours in a complicated way. Thus, the policy change based IV and the SIV methods estimate different parameters. If differences in the reaction functions are insignificant, ACR's estimated with different (valid) instruments are the same, but heterogeneity in responses may imply that the policy change based IV estimates and the SIV estimates are not directly comparable.

From Figure 1 it is also evident that the policy change based IV strategy implicitly assumes that reaction functions for imposed increases and voluntary increases are similar. In section 6, I provide further discussion on the possibility that the reactions to voluntary and involuntary tax rate changes could be different.

4.6. Spatial weights

The choice of the spatial weight matrix that aggregates tax rates in other jurisdictions into a single number is an important part of empirical studies on tax competition. Table 1 describes spatial weight matrices used in this study. I use the simple nearest neighbour (first order contiguity) matrix W_a as the base specification. Matrix W_a gives positive weights to nearest neighbours and zero weights to other municipalities. In other words, if municipality i shares a border with n_i municipalities, all of its neighbours get weights $1/n_i$ and other municipalities get zero weights. Because the choice of the weight matrix is somewhat arbitrary, I test the robustness of the results to three alternative weight matrices. Matrix W_b differs from W_a by weighting nearest neighbours by their population in 1998. Both W_a and W_b assume that tax competition is limited to nearest neighbours but matrices W_c and W_d allow for a larger spatial scale. Matrix W_c gives nearest neighbours weight 1 and neighbour's neighbours weight 0.5 and matrix W_d weights additionally by population in 1998. All the weight matrices are row-normalized so that each row sums up to unity and the resulting aggregate tax rate is a weighted average.

[Table 1 here]

5. Empirical analysis

5.1. Data and descriptive analysis

I use panel data on Finnish municipalities from 1993 to 2004. There were altogether 444 municipalities in 2004, but the sample size reduces to 411 after dropping municipalities with missing data (notably the autonomic area of Åland Island) and municipalities that merged with other municipalities over the period. In the policy change based 2SLS regressions, I use data from 1999 onwards because all the identifying variation in the instrument took place between 1999 and 2000. The data includes information on property tax rates and socio-economic attributes such as population, age structure, income and unemployment. Also, information on central government grants and on the position of the municipality in the tax base equalization system is included. Table 2 reports summary statistics for variables used in the analysis. In Table 2 neighbours' tax rate changes are calculated using a nearest neighbour spatial weight matrix (W_a in Table 1). The average general property tax rate in 2000 was roughly 0.6% and the average imposed tax increase was 0.07%-points. Thus the average proportional increase in the general property tax rate induced by the reform was roughly 12%. The residential building tax rates are lower (mean 0.27%) and the average imposed increase was 0.02%-points. Outside Table 2, it is worth mentioning that neighbours' imposed tax rate changes are positive for the bulk of municipalities (85% for the general property tax and 95% for the residential building tax).[13] Thus, the policy change based IV estimation uses variation from a significant share of municipalities. Finally, Table 2 shows that municipalities are highly heterogeneous in terms of population, age structure, unemployment rate, disposable income and grants.

[Table 2 here]

Map 1 shows the property tax rates in 1998. From the maps it is clear that property tax rates are spatially correlated. In order to answer the question whether this cross-sectional correlation is spurious correlation due to spatial autocorrelation in the underlying determinants of tax rates or an outcome of localized strategic interaction, I use the empirical strategy outlined in Section 4.

[13] The share of municipalities with strictly positive neighbours' imposed increases is slightly lower in the sub-samples of municipalities unlikely to end up in a corner solution (81% for the general property tax and 94% for the residential building tax).

[Map 1 here]

5.2. Policy change based 2SLS estimates

Tables 3-5 report the main results of this study. Table 3 contains the 2SLS results for the first differenced equation (2) for the general property tax and Table 4 reports corresponding estimates for the residential building tax. Table 5 reports specifications with 2-5 year differences for the dependent variable for both tax rates. All the tax rate variables are measured in percentage points. Tables 3-5 use the simple nearest neighbour spatial weight matrix W_a. Table A3 in the Appendix shows results with alternative spatial weights W_b, W_c and W_d.

In Table 3, the dependent variable is the change in the general property tax rate between 1999 and 2000. The explanatory variable of interest is neighbours' tax rate change between 1999 and 2000, which is instrumented with the predicted imposed increase in neighbours' tax rates. The first stage regressions for Table 3 are reported in Table A1 of the appendix. The instrument is positive and highly significant with a coefficient of about 0.7-0.8 in all the first stage regressions. The Kleinbergen-Paap F statistics indicate that the predicted imposed increase is a very strong instrument.

The first two columns of Table 3 report results with data including all municipalities. The first column shows results for a specification that only includes the predicted own imposed increase and a dummy variable for a strictly positive predicted own imposed increase as controls. The coefficient on neighbours' tax rate change is positive but small and statistically insignificant. Taken at face value, the point estimate would imply that a percentage point increase in the neighbourhood tax rates would lead to a 0.045%-point increase in the tax rate. In the second column, differenced municipality attributes are added as control variables. The attributes include grants from central government, disposable income per capita, unemployment rate and age structure (shares of under 15, 65-74 and over 74 years old). The inclusion of the municipality attributes leads to a slightly higher but still small and insignificant coefficient for neighbours' tax rate change. Own imposed increase, which captures the direct effect of the policy change on the municipality, is positive and highly significant in columns 1 and 2 indicating that the policy change was an important determinant of tax rate changes in the year 2000.

Next I address the corner solution problem discussed in Section 4.4 by dropping from the sample municipalities that in 1999 had a tax rate below the new lower limit of the year 2000. The results from this sub-sample are reported in columns 3 and 4 of Table 3. Predicted own imposed increase is not included in control variables because it is not meaningful for the sub-sample. In column 3, the coefficient on neighbours' tax rate change is -0.089 and insignificant, and remains virtually unchanged in column 4 where control variables are added. Overall, the results indicate that there is no spatial interaction in general property tax rates.

[Table 3 here]

Table 4 reports the results of the first differenced specifications, analogous to Table 3, for the residential building tax. The first stage regressions are reported in appendix Table A2. The instrument is positive and highly significant in all specifications. The Kleinbergen-Paap F statistics indicate that the predicted imposed increase is a strong instrument, albeit somewhat weaker than for the general property tax. In Table 4, the coefficient on neighbours' tax rates varies from -0.15 to 0.11 and is statistically insignificant in all specifications. The results suggest that there is no interaction in the residential building tax rate choices. However, standard errors are larger than for the general property tax, and hence, the results are less conclusive than for the general property tax.

[Table 4 here]

The regressions in Tables 3 and 4 assume that municipalities respond to contemporaneous tax rate changes in their neighbour municipalities. It could be that actual reactions take place with a lag. In order to allow for lagged reactions, I repeat the analysis using longer differences for the dependent variable. Table 5 shows the results for both the general property tax and the residential building tax. Columns 1-4 use 2-5 year differences respectively. The explanatory variable of interest is the same as before (neighbours' tax rate changes from 1999 to 2000). The sample used is the unconstrained subsample. The tax interaction coefficient is small and insignificant in all specifications for both the general property tax and the residential building tax.

[Table 5 here]

Taken together, Tables 3-5 provide strong evidence against interaction in tax rate choices among nearby municipalities in Finland. All the specifications give estimates that are close to zero. Moreover, the standard errors are relatively small and tax interaction coefficients of the order of 0.4 – 0.5 found in many earlier studies, using the standard SL and SIV methods, can be ruled out for the Finnish data. This raises the question whether the discrepancy in the results is likely to be explained by differences in institutional settings or differences in the empirical methods used. Section 5.5 addresses this question. Before turning to the comparison of the standard spatial econometric estimates and the policy change based estimates, the validity of the policy change based IV and the robustness of the results are evaluated in Sections 5.3 and 5.4.

5.3. Placebo tests

The identifying assumption behind the policy change based IV estimates is that the instrument is uncorrelated with the error term of equation (2). The assumption does not hold if, due to some unobserved factors, municipalities with large imposed increases in neighbours' tax rates would have changed their tax rates differently from other municipalities in the absence of the policy change. Suggestive evidence on the likelihood that the identifying assumption holds can be obtained by using a placebo treatment type methodology for tax rate changes in pre-policy change years. In Table 6, I regress tax rate changes in 1999, 1998 and 1997 on neighbours' tax rate change in 2000 (instrumented similarly as before).

Trends or shocks in unobserved factors correlated with the instrument would result in coefficients significantly different from zero. However, the coefficients are low and insignificant varying around zero for both the general property tax rate and the residential building tax rate showing that the instrument is not correlated with unobserved factors driving tax rates before the policy change took place. This suggests that the instrument can be considered exogenous also in the post-policy change years and increases confidence in the main results.

[Table 6 here]

5.4. Robustness checks

Table A3 in the appendix analyses the robustness of the results to alternative spatial weighting schemes (W_b, W_c and W_d in Table 1). Panels A and B show the results for the general tax rate and the residential rate respectively. I allow for lagged responses by using one to five year differences for the dependent variable. The coefficients on neighbours' tax rate change are insignificant with all the weight matrices in all specifications.

One potential reason for the apparent lack of interaction in property tax rates found in Tables 3-5 is that the equalization component of the grant system weakens incentives to compete for tax base. In Section 3 I argue that the incentives to attract tax base are higher for municipalities above the so called equalization limit. In order to test for the importance of incentives created by the equalization system, I interact neighbours' tax rate change with a dummy variable that gets the value one if the municipality was above the equalization limit in 1998.[14] I use the 1998 value and not differenced values since changes in the position of municipalities in the equalization system are rare. If the equalization system has influence on the reaction functions of municipalities, one would expect the interaction term to get a positive value. I use the same instrument as earlier for the neighbourhood tax rates. The interaction of the instrument with the dummy for the equalization status is used as an additional instrument for the interaction term. Table A4 reports the results for both taxes for specifications with one and two year tax rate differences as the dependent variable. Both the main effect of the neighbourhood tax rate change and its interaction with the dummy for being above the equalization limit are close to zero and insignificant in all specifications. The results indicate that even municipalities with higher incentives to compete for tax base choose their general property tax rates independently of their neighbours' tax rates.

5.5. Comparisons with standard spatial econometrics methods

Next I apply the SL and SIV methods that have been used in earlier studies and compare the results with the policy change based causal estimates reported in Tables 3-5. The purpose is not to provide a comprehensive analysis of the sources of bias in these methods but rather to check if the easily applicable standard SL and SIV methods give estimates that are close to

[14] Edmark and Ågren (2008) find that in Sweden the correlation between neighbour municipalities' income tax rates was weaker after a reform which reduced incentives to compete for tax base.

the policy change based estimates. I estimate both cross-sectional and municipality fixed effects variants of the SL and SIV models.

Table 7 contains the SIV estimates for both the general property tax (columns 1-2) and the residential building tax (columns 3-4). I use data from 1993-1999 before the policy change when few municipalities were constrained by the tax rate limits. Spatially lagged municipality attributes (shares of under 15, 65-74 and over 74 years old, grants from the central government, disposable income per capita and unemployment rate) are used as instruments for the spatial lag of tax rates. The first column reports pooled cross-sectional estimates without municipality fixed effects. The coefficient on neighbours' general property tax rate is 0.26 and highly significant. The first stage F indicates that the instruments are strong predictors of neighbours' tax rates but the exogeneity test suggests that the instruments can not be excluded from the second stage regression. The cross-sectional SIV and SL models are the standard methods used in the tax competition literature and few earlier studies control for jurisdiction fixed effects. Nevertheless, in order to facilitate the comparability with the policy change based estimates, I add municipality fixed effects in the model in the second column.[15] This reduces the strength of the instruments and the first stage F is indicative of a weak instrument problem. The coefficient is roughly 0.5 but only weakly significant.

Turning to the SIV estimates for the residential property tax in columns 3-4, the coefficient on neighbours' tax rate is 0.35 and highly significant in the pooled cross-sectional specification. Adding municipality fixed effects increases the coefficient to 0.63. Unlike for the general property tax, the instruments are reasonably strong also in the fixed effect specification and the estimates are relatively precise.

[Table 7 here]

Table 8 shows the SL estimates for both tax rates.[16] Municipality attributes included in the model are the same as before. Starting from the general property tax, the tax rate interaction coefficient is 0.45 and highly significant in the first column reporting the standard cross-sectional SL estimates. Even though previous SL tax competition studies do not use jurisdiction fixed effects, the second column controls for municipality fixed effects, for the sake of comparability, through first differencing and the third column uses 5 year differences.[17] The estimates are 0.16 and 0.1 respectively. Hence, when fixed effects are controlled for through differencing, the SL estimates are similar to the policy change based

[15] I also estimated first differenced specifications, but the instruments were too weak for the estimates to be meaningful.

[16] The SL estimations were carried out with STATA using the spatial data analysis tool package *spatreg* by Maurizio Pisati.

[17] I report results using a cross-section of differenced data instead of time demeaned data or municipality dummy variables because within estimation imposes an additional restrictive assumption that observations are independently distributed within a municipality.

IV for the general property tax. For the residential building tax (columns 4-6), the SL estimates are positive and highly significant even in the differenced specifications.

[Table 8 here]

It should be noted that the discussion on heterogeneous effects in Section 4.5 implies that the comparisons of estimates with different methods should be interpreted cautiously. However, the comparison of the widely used SIV and SL estimates with the policy change IV estimates casts doubt on the reliability of the SIV and SL methods. Both cross-sectional and municipality fixed effects variants of the SIV and SL models tend to give positive estimates of tax rate interaction while the policy change IV estimates are consistent with flat reaction functions. Especially for the residential building tax, both SIV and SL estimates are in stark contrast with the policy change based IV estimates. For the general property tax, the cross-sectional SIV estimates are large and positive and become even larger but imprecise once fixed effects are added to the model. The standard cross-sectional SL method gives large and positive coefficients for the general property tax, but when controlling for fixed effects the coefficient reduces and becomes insignificant.

6. Conclusions

This paper utilizes a Finnish policy intervention to study tax competition between local governments. The findings indicate that there is no strategic interaction in property tax rates among neighbouring municipalities.

The empirical findings are consistent with the theoretical literature discussed in Section 2. The theoretical prediction for the slope of the tax rate reaction function is ambiguous because the reduced form reaction functions estimated in this paper are likely affected by potentially opposing forces. The Tiebout/tax competition models with mobile residents and heterogenous preferences may yield flat or negative reaction functions as well as positive (Brueckner and Saavedra, 2001), yard-stick competition gives rise to positive interdependence, and positive (negative) benefit spillovers lead to negative (positive) interaction.

Naturally, there are other potential explanations for the lack of localized strategic interaction in Finland. Firstly, it may be that the fiscal equalization system dampens incentives to compete for tax base. However, I do not find evidence of significant tax competition even above the equalization threshold, where municipalities benefit significantly if they manage to attract more investment within their borders. Secondly, it may be that municipalities compete on business and housing capital on a wider geographical level than the neighbourhood level used in this study. Localized tax competition among neighbours requires the tax base to be, at least to some extent, locally fixed and not freely mobile (Brueckner and Saavedra, 2001). Thirdly, it may be that Finnish municipal politicians are not largely motivated by self interest and voters trust that tax revenues are not wasted on useless bureaucracy. This could explain the lack of `yardstick competition` between neighbouring municipality councils. However, it should be noted that the policy change used to derive the instrumental variable is not ideal for testing for yardstick competition. Tax rate increases imposed by the central government may be less relevant for yardstick competition than voluntary tax rate changes. Voters may understand that the imposed increase in their neighbour municipality is not related to an increase in the costs and demand for services in the area, and hence, politicians may be less keen on mimicking imposed tax rate changes than voluntary changes. Nevertheless, one would expect that in the long run, when the reasons for the imposed tax increases are distant, the yardstick competition mechanisms would trigger responses to even imposed tax increases. I do not find evidence of significant responses to neighbours’ tax increases even after five years.

While flat tax rate reaction functions are compatible with the theoretical literature, the finding of no tax rate interaction is in contrast with most other empirical studies that have generally found the tax rates of neighbouring local governments to be positively related. Naturally, the absence of interaction may be specific to the Finnish setting where property taxes are a relatively unimportant source of revenue. However, the comparison of the estimates based on the policy change to the SL and SIV estimates showed that the methods used in earlier literature tend to give positive estimates for spatial interdependence in tax rates even with Finnish data. In particular, the cross-sectional SL and SIV model gave consistently upward biased estimates for the reactions to tax rates in other municipalities. The discrepancies between the policy intervention based estimates and the SL and SIV estimates suggest that the standard spatial econometrics methods may not give reliable estimates of the fiscal interaction parameters of interest. More empirical research on different types of fiscal interaction using quasi-experimental data for different countries is needed to get better estimates of the interaction parameters and to better understand the strengths and limitations of the commonly used spatial regression techniques.

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TABLES

Table 1
Spatial weight matrices used

	Nearest neighbours	Neighbours' neighbours	Other Municipalities
Matrix W_a	1	0	0
Matrix W_b	Pop_{1998}	0	0
Matrix W_c	1	0.5	0
Matrix W_d	Pop_{1998}	$0.5*Pop_{1998}$	0

All matrices are normalized so that each row sums up to one.

Table 2
Descriptive statistics (year 2000)

	Mean	Std. Dev.	Min	Max
General property tax rate (%)				
Tax rate	0.593	0.120	0.500	1.000
Tax rate change	0.069	0.085	-0.100	0.300
Own imposed tax rate change	0.070	0.094	0.000	0.300
Neighbours' tax rate change	0.056	0.052	-0.009	0.300
Neighbours' imposed tax rate change	0.060	0.057	0.000	0.300
Residential building tax rate (%)				
Tax rate	0.265	0.048	0.220	0.400
Tax rate change	0.030	0.040	-0.100	0.200
Own imposed tax rate change	0.021	0.030	0.000	0.120
Neighbours' tax rate change	0.027	0.024	-0.021	0.174
Neighbours' imposed tax rate change	0.024	0.023	0.000	0.120
Municipality attributes				
Population (1000's)	12.51	35.05	0.24	555.47
Grants/capita (1000's)	1.34	0.48	0.10	3.09
Disposable income/capita (1000's)	11.24	2.42	7.13	31.65
Unemployment rate	0.133	0.046	0.037	0.284
Age 0-15	0.198	0.032	0.110	0.341
Age 61-74	0.146	0.029	0.059	0.239
Age 75-	0.082	0.024	0.019	0.144

Table 3

General property tax: policy change based 2SLS estimates for first differenced specification

Dep. var: Tax rate change ($\Delta_{2000\text{-}1999}$)	All municipalities		Unconstrained sub-sample	
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.045	0.069	-0.089	-0.103
	[0.077]	[0.078]	[0.087]	[0.092]
Own imposed increase	0.825***	0.828***		
	[0.062]	[0.059]		
Non-zero own imposed increase (1/0)	-0.018*	-0.019*		
	[0.010]	[0.010]		
Per capita grants ($\Delta_{1999\text{-}1998}$)		-0.003		0.011
		[0.042]		[0.053]
Per capita income ($\Delta_{1999\text{-}1998}$)		0.000		-0.001
		[0.003]		[0.003]
Unemployment rate ($\Delta_{1999\text{-}1998}$)		-0.274		0.29
		[0.329]		[0.363]
Age 0-15 ($\Delta_{1999\text{-}1998}$)		0.616		-0.031
		[0.574]		[0.736]
Age 61-75 ($\Delta_{1999\text{-}1998}$)		0.495		0.291
		[0.793]		[0.847]
Age 75- ($\Delta_{1999\text{-}1998}$)		0.738		2.004
		[1.271]		[1.638]
Kleibergen-Paap F	237.6	241.8	83.1	90.9
R-squared	0.611	0.614	0.001	0.003
Observations	411	411	258	258

Neighbours' expected imposed increase used as an instrument for neighbours' tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table 4
Residential building tax: policy change based 2SLS estimates for first differenced specification

Dep. var: Tax rate change ($\Delta_{2000\text{-}1999}$)	All municipalities		Unconstrained sub-sample	
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.060	0.106	-0.146	-0.057
	[0.191]	[0.191]	[0.159]	[0.161]
Own imposed increase	0.642***	0.638***		
	[0.093]	[0.091]		
Non-zero own imposed increase (1/0)	0.003	0.003		
	[0.004]	[0.004]		
Per capita grants ($\Delta_{1999\text{-}1998}$)		-0.051*		-0.015
		[0.029]		[0.039]
Per capita income ($\Delta_{1999\text{-}1998}$)		-0.005***		-0.004*
		[0.002]		[0.002]
Unemployment rate ($\Delta_{1999\text{-}1998}$)		0.229		0.227
		[0.162]		[0.234]
Age 0-15 ($\Delta_{1999\text{-}1998}$)		0.093		-0.132
		[0.388]		[0.543]
Age 61-75 ($\Delta_{1999\text{-}1998}$)		0.381		0.503
		[0.444]		[0.626]
Age 75- ($\Delta_{1999\text{-}1998}$)		1.155		1.327
		[0.915]		[0.976]
Kleibergen-Paap F	97.9	87.1	27.3	24.1
R-squared	0.308	0.333	0.001	0.029
Observations	411	411	218	218

Neighbours’ expected imposed increase used as an instrument for neighbours’ tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (Wa).

Table 5

Policy change based 2SLS estimates for 2–5 year differences of the dependent variable

Panel A: General property tax				
Dep. var: Long term tax rate change	$\Delta_{2001-1999}$	$\Delta_{2002-1999}$	$\Delta_{2003-1999}$	$\Delta_{2004-1999}$
Neighbours' tax rate change ($\Delta_{2000-1999}$)	-0.079	0.061	0.133	0.135
	[0.100]	[0.150]	[0.178]	[0.176]
Municipality attributes	Yes	Yes	Yes	Yes
Kleibergen-Paap F	90.9	90.9	90.9	90.9
R-squared	0.015	0.043	0.045	0.029
Observations	258	258	258	258
Panel B: Residential building tax				
Dep. var: Long term tax rate change	$\Delta_{2001-1999}$	$\Delta_{2002-1999}$	$\Delta_{2003-1999}$	$\Delta_{2004-1999}$
Neighbours' tax rate change ($\Delta_{2000-1999}$)	0.003	0.114	-0.027	-0.161
	[0.172]	[0.234]	[0.251]	[0.255]
Municipality attributes	Yes	Yes	Yes	Yes
Kleibergen-Paap F	24.1	24.1	24.1	24.1
R-squared	0.026	0.053	0.063	0.07
Observations	218	218	218	218

Neighbours' expected imposed increase used as an instrument for neighbours' tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table 6

Placebo effects in pre-treatment years

	General property tax			Residential building tax		
Dep. var: Past tax rate change	$\Delta_{1999-1998}$	$\Delta_{1998-1997}$	$\Delta_{1997-1996}$	$\Delta_{1999-1998}$	$\Delta_{1998-1997}$	$\Delta_{1997-1996}$
Neighbours' tax rate change ($\Delta_{2000-1999}$)	-0.13	0.042	0.102	-0.032	0.068	-0.046
	[0.163]	[0.117]	[0.078]	[0.297]	[0.178]	[0.087]
Municipality attributes	Yes	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap F	75.9	84.6	85.7	22.7	26.9	23.8
R-squared	0.018	0.049	0.021	0.022	0.016	0.023
Observations	258	258	258	218	218	218

Neighbours' expected imposed increase used as an instrument for neighbours' tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table 7
Spatial IV estimates

Dep. Var: Tax rate	General property tax		Residential building tax	
Neighbours' tax rate (t)	0.257***	0.555*	0.354***	0.632***
	[0.093]	[0.309]	[0.123]	[0.168]
Per capita grants (t-1)	0.012	-0.038**	0.005	-0.003
	[0.015]	[0.019]	[0.005]	[0.011]
Per capita income (t-1)	0.024***	-0.014***	-0.002**	-0.007***
	[0.006]	[0.005]	[0.001]	[0.002]
Unemployment rate (t-1)	0.578***	0.136	0.067**	0.031
	[0.095]	[0.083]	[0.030]	[0.048]
Age 0-15 (t-1)	-0.973***	-0.727**	0.137**	0.121
	[0.231]	[0.287]	[0.061]	[0.163]
Age 61-75 (t-1)	-0.969***	0.118	0.146**	0.187
	[0.233]	[0.283]	[0.072]	[0.174]
Age 75- (t-1)	0.397	-0.669*	0.191*	0.539*
	[0.287]	[0.390]	[0.101]	[0.315]
Year fixed effects	Yes	Yes	Yes	Yes
Municipality fixed effects		Yes		Yes
Kleibergen-Paap F	59.5	8.0	24.0	13.0
Hansen's J (p-value)	0.000	0.559	0.000	0.777
R-squared	0.278	0.118	0.183	0.14
Observations	2466	2466	2466	2466

Sample period 1993 - 1999.
Spatial IV uses neighbours’ characteristics as instruments for neighbours’ tax rate change.
Standard errors clustered at municipality level in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table 8
Maximum Likelihood Spatial Lag estimates

	General property tax			Residential building tax		
Dep. Var: Tax rate	level 1999	$\Delta_{1999-1998}$	$\Delta_{1999-1994}$	level 1999	$\Delta_{1999-1998}$	$\Delta_{1999-1994}$
Neighbours' tax rate	0.449***	0.160**	0.104	0.361***	0.201***	0.312***
	[0.054]	[0.072]	[0.076]	[0.059]	[0.069]	[0.060]
Per capita grants	0.000	0.000	0.000	0.000	0.000	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Per capita income	0.000	0.000	0.000	0.000	0.000	-0.000*
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Unemployment rate	0.007***	0.007*	0.002	0.001	0.001	0.000
	[0.002]	[0.004]	[0.002]	[0.001]	[0.002]	[0.001]
Age 0-15	-0.019***	-0.013	-0.010*	0.000	-0.003	0.003
	[0.004]	[0.010]	[0.005]	[0.002]	[0.005]	[0.003]
Age 61-75	-0.015***	-0.013	0.003	0.001	-0.006	0.005*
	[0.005]	[0.011]	[0.005]	[0.002]	[0.006]	[0.003]
Age 75-	-0.008	-0.011	-0.017**	0.000	0.007	0.005
	[0.006]	[0.015]	[0.008]	[0.003]	[0.008]	[0.004]
Log-likelihood	240.1	502.3	359.9	596.9	786.9	639.2
Observations	411	411	411	411	411	411

Covariates differenced similarly as the dependent variable.
Standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

GRAPHS, FIGURES AND MAPS

Graph 1
Property tax rates in 1999 and the reform of 2000

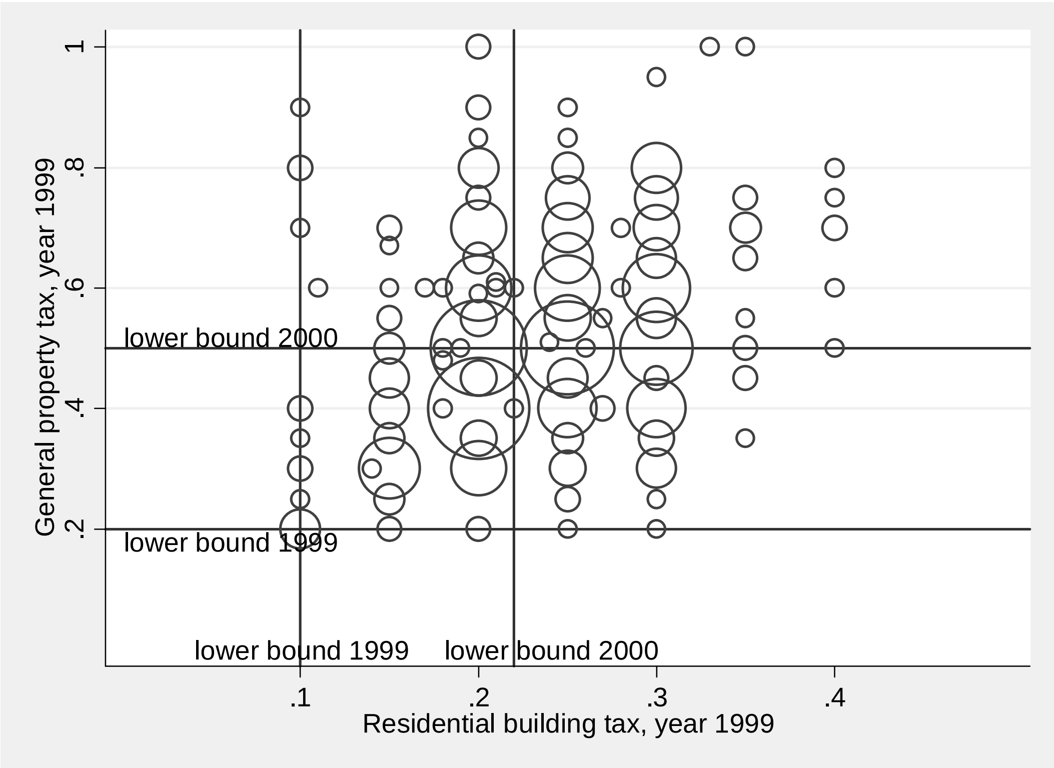
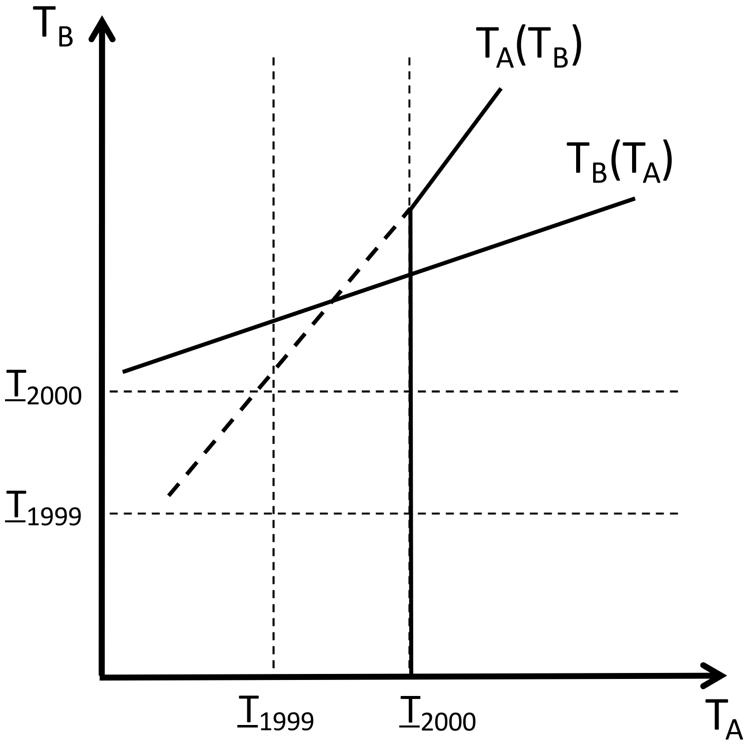
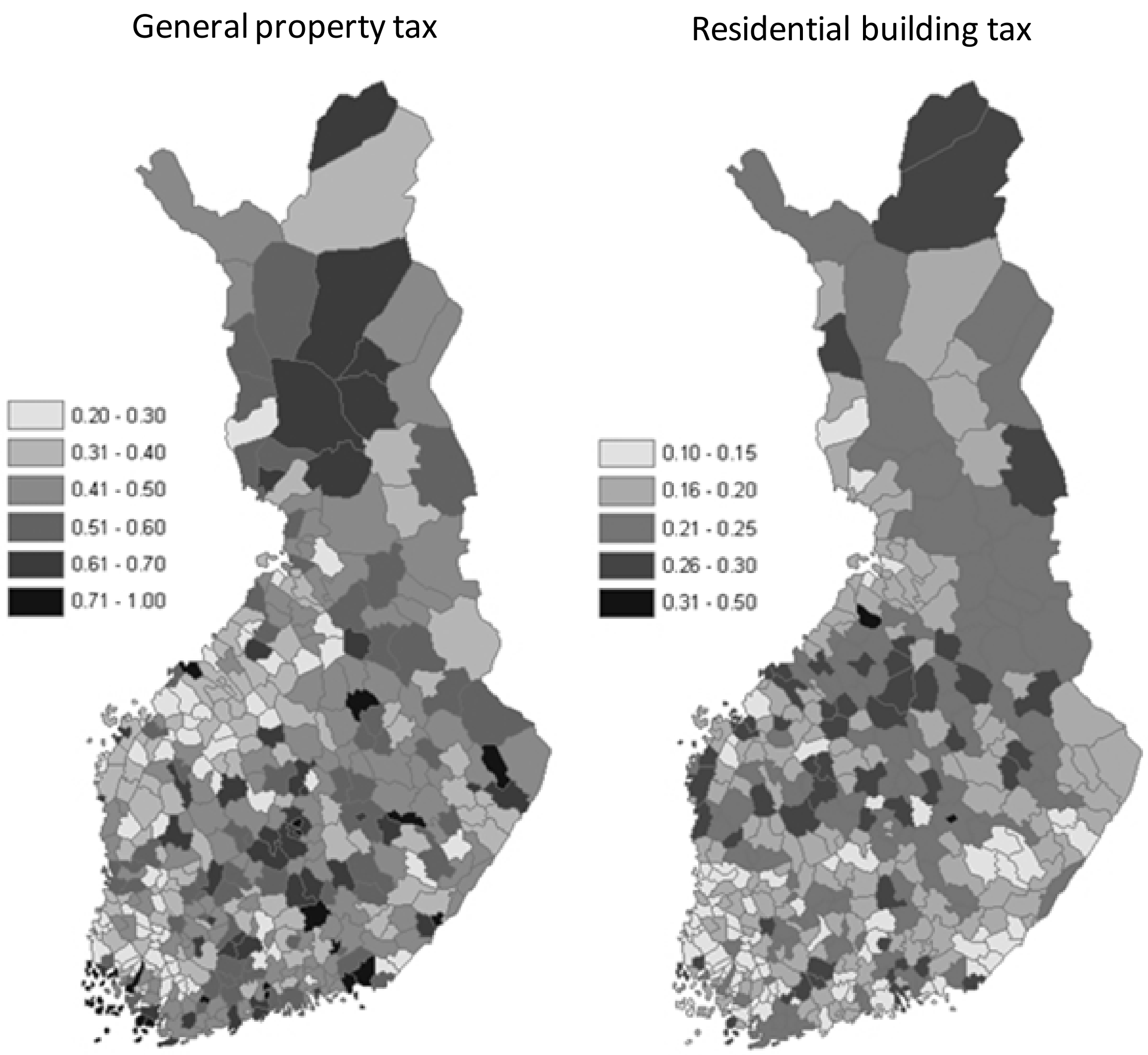


Figure 1
Reaction functions and tax rate limits



Map 1
Property tax rates in 1998



APPENDIX TABLES

Table A1
First stage regressions for the general property tax (cf. Table 3)

Dep var: Neighbours' tax rate change ($\Delta_{2000-1999}$)	All municipalities		Unconstrained sub-sample	
Neighbours' imposed increase	0.744***	0.755***	0.683***	0.693***
	[0.048]	[0.049]	[0.075]	[0.073]
Own imposed increase	0.010	0.010		
	[0.029]	[0.029]		
Non-zero own imposed increase (1/0)	0.000	0.001		
	[0.005]	[0.005]		
Per capita grants ($\Delta_{1999-1998}$)		-0.028		-0.054*
		[0.021]		[0.030]
Per capita income ($\Delta_{1999-1998}$)		0.006**		0.007***
		[0.003]		[0.003]
Unemployment rate ($\Delta_{1999-1998}$)		-0.042		0.100
		[0.163]		[0.224]
Age 0-15 ($\Delta_{1999-1998}$)		-0.089		-0.004
		[0.468]		[0.664]
Age 61-75 ($\Delta_{1999-1998}$)		0.149		0.456
		[0.511]		[0.733]
Age 75- ($\Delta_{1999-1998}$)		-0.014		0.905
		[0.716]		[1.004]
Kleibergen-Paap F	237.6	241.8	83.1	90.9
R-squared	0.647	0.657	0.492	0.517
Observations	411	411	258	258

Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table A2
First stage regressions for the residential building tax (cf. Table 4)

Dep var: Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	All municipalities		Unconstrained sub-sample	
Neighbours' imposed increase	0.665***	0.677***	0.631***	0.621***
	[0.067]	[0.073]	[0.121]	[0.127]
Own imposed increase	0.008	0.013		
	[0.045]	[0.045]		
Non-zero own imposed increase (1/0)	-0.001	-0.001		
	[0.002]	[0.002]		
Per capita grants ($\Delta_{1999\text{-}1998}$)		-0.017		-0.019
		[0.012]		[0.015]
Per capita income ($\Delta_{1999\text{-}1998}$)		0.002*		0.002
		[0.001]		[0.001]
Unemployment rate ($\Delta_{1999\text{-}1998}$)		0.027		0.035
		[0.082]		[0.104]
Age 0-15 ($\Delta_{1999\text{-}1998}$)		-0.052		0.148
		[0.250]		[0.339]
Age 61-75 ($\Delta_{1999\text{-}1998}$)		0.231		-0.164
		[0.236]		[0.269]
Age 75- ($\Delta_{1999\text{-}1998}$)		0.344		-0.148
		[0.411]		[0.398]
Kleibergen-Paap F	97.9	87.1	27.3	24.1
R-squared	0.429	0.437	0.338	0.349
Observations	411	411	218	218

Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

Table A3
Policy change based 2SLS estimates with alternative spatial weights

Panel A: General property tax					
Dep. var: Tax rate change	$\Delta_{2000\text{-}1999}$	$\Delta_{2001\text{-}1999}$	$\Delta_{2002\text{-}1999}$	$\Delta_{2003\text{-}1999}$	$\Delta_{2004\text{-}1999}$
Spatial weights: W_b					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	-0.061	-0.02	0.172	0.243	0.149
	[0.088]	[0.098]	[0.152]	[0.184]	[0.178]
Spatial weights: W_c					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.012	0.138	0.304	0.279	0.165
	[0.149]	[0.165]	[0.285]	[0.317]	[0.296]
Spatial weights: W_d					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	-0.107	-0.07	0.111	0.097	0.098
	[0.120]	[0.132]	[0.241]	[0.266]	[0.250]
Panel B: Residential building tax					
Dep. var: Tax rate change	$\Delta_{2000\text{-}1999}$	$\Delta_{2001\text{-}1999}$	$\Delta_{2002\text{-}1999}$	$\Delta_{2003\text{-}1999}$	$\Delta_{2004\text{-}1999}$
Spatial weights: W_b					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	-0.056	0.002	0.137	0.094	0.006
	[0.130]	[0.151]	[0.197]	[0.208]	[0.211]
Spatial weights: W_c					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.209	0.169	0.084	-0.056	-0.193
	[0.161]	[0.174]	[0.204]	[0.253]	[0.218]
Spatial weights: W_d					
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.159	0.154	0.178	-0.015	-0.222
	[0.158]	[0.168]	[0.235]	[0.269]	[0.253]

All specifications include the same municipality attributes as control variables as Table 5.
Neighbours' expected imposed increase used as an instrument for neighbours' tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: See Table 1.

Table A4
Interaction with the position in the equalization system

	General property tax		Residential building tax	
Dep. var: Tax rate change	$\Delta_{2000\text{-}1999}$	$\Delta_{2001\text{-}1999}$	$\Delta_{2000\text{-}1999}$	$\Delta_{2001\text{-}1999}$
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	-0.117	-0.074	-0.039	0.034
	[0.097]	[0.109]	[0.182]	[0.196]
Neighbours' tax rate change ($\Delta_{2000\text{-}1999}$)	0.046	-0.018	-0.066	-0.112
*Dummy(Above equalization limit)	[0.106]	[0.116]	[0.122]	[0.142]
Municipality attributes	Yes	Yes	Yes	Yes
Kleibergen-Paap F	41.6	41.6	9.9	9.9
R-squared	0.008	0.014	0.031	0.03
Observations	258	258	218	218

Neighbours' expected imposed increase used as an instrument for neighbours' tax rate change.
Robust standard errors in brackets.
Significance levels are denoted by * p<0.1, ** p<0.05, *** p<0.01.
Spatial weights: nearest neighbours with equal weights (W_a).

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