Työpapereita
Working Papers

275

The impact of inequality on the municipal income tax in Finland

Eero Lehto

PALKANSAAJIEN TUTKIMUSLAITOS LABOUR INSTITUTE FOR ECONOMIC RESEARCH

PALKANSAAJIEN TUTKIMUSLAITOS • TYÖPAPEREITA

LABOUR INSTITUTE FOR ECONOMIC RESEARCH • DISCUSSION PAPERS

275

The impact of inequality on the municipal income tax in Finland*

Eero Lehto**

*This study is funded by Employee's Foundation and The Foundation for Municipal Development. I am grateful for this financial support. I am also grateful for Petri Böckerman and Jukka Pirttilä for very useful comments.

**Labour Institute for Economic Research, Helsinki

Helsinki 2012

TYÖPAPEREITA 275
DISCUSSION PAPERS 275

Palkansaajien tutkimuslaitos
Pitkänsillanranta 3 A
00530 Helsinki
Puh. 09–2535 7330
Faksi 09–2535 7332
www.labour.fi

ISBN 978–952–209–101–7 (pdf)
ISSN 1795–1801 (pdf)

ABSTRACT

This study addresses the determination of the municipal income tax rate. In the theoretical public choice model introduced in this study we specify the central hypothesis, which says that low-income earners using their voting power tend to take advantage of high-income taxpayers. Our findings indicate that the median income earner will raise the municipal income tax rate the harder, the larger the difference is between the mean income and the median income. The evidence for this impact becomes stronger when it is conditioned on the voting rate. According to this, only if the voting rate exceeds a certain limit – which is quite close to the average voting rate – does inequality start to work in the direction expected. The larger inequality then raises the municipal income tax rate.

Keywords: income inequality, municipal income tax rate, median voter

JEL classification: D31, D72, H22, H24

TIIVISTELMÄ

Tämä tutkimus keskittyy analysoimaan ensisijaisesti kunnallisveroasteen määräytymistä. Tarkastelu ulottuu koskemaan myös kiinteistöverojen määräytymistä. Tähän tutkimukseen sisältyvä tilastollinen analyysi testaa teoreettista hypoteesia, jonka mukaan enemmistöasemaan päässeen mediaanituloisten tuloluokan edut vaikuttavan kunnallisveron asettamiseen. Mediaanitulo saadaan, kun kaikki tulonsaajat laitetaan tulojen mukaan suuruusjärjestykseen. Mediaanitulo on tällöin keskimmäisen tulonsaajan tulo. Näin ollen mediaanituloinen ja kaikki, joiden tulot ovat mediaanituloja pienemmät, ovat kunnassa enemmistönä. Keskitulo taas saadaan laskemalla yhteen kaikkien tulonsaajien tulot ja jakamalla näin saatu summa tulonsaajien määrällä. On huomionarvoista, että kaikissa kunnissa mediaanituloisen tulot ovat keskituloja pienemmät. Niinpä jos kuntalaiset äänestävät oman tuloluokkansa edustajia ja jos äänestysprosentti olisi sata, mediaanituloinen pääsisi enemmistöasemaan päättämään kunnallisverosta. Meltzerin ja Richardin (1981) ovat osoittaneet, että mediaanituloisen kannattaa tuolloin nostaa (kunnallis)veroprosenttia sitä enemmän, mitä suurempi on keskitulon ja mediaanitulojen erotus eli mitä vinompi on tulojakauma. Tässä tutkimuksessa näkökulmaa laajennetaan ottamaan huomioon myös äänestyskäyttäytyminen. On ilmeistä, että mitä alempi on äänestysprosentti, sitä suurempituloisille siirtyy äänivalta kunnissa. Tämä pohjautuu havaintoihin siitä, että pienituloiset ovat keskimääräistä laiskempia äänestäjiä. Niinpä, jos äänestysprosentti on matala, on ilmeistä, ettei mediaanituloinen pääse enemmistöasemaan ja siten vaikuttamaan kunnallisveroprosenttiin haluamallaan tavalla.

Tutkimuksen keskeisin tulos on, että tuloerot kunnallisverotuksen alaisissa tuloissa, joita mitataan joko keski- ja mediaanitulojen erotuksella tai gini-kertoimella, pyrkivät nostamaan kunnallisveroprosenttia, mutta taas laskemaan vakituisen asuinrakennuksen kiinteistöveroprosenttia. Tällainen vaikutus syntyy, koska silloin, kun kaikki äänestävät, enemmistövalta kunnanvaltuustossa pyrkii keskittymään niille, joiden tulot yltävät korkeintaan mediaanitasolle. Tämä ryhmä on tulonjaon vinouden vuoksi suurempi kuin se ryhmä, jonka tulot ylittävät esimerkiksi keskitulot. Tutkimus vahvistaa tältä osin Meltzerin and Richardin (1981)[1] jo aiemmin esittämän hypoteesin, jonka mukaan tuloerojen kasvaessa enemmistövaltaa käyttävä mediaanituloinen nostaa veroastetta. Kunnallisverotukseenkin tämä pätee, koska erilaiset vähennykset tekevät siitä progressiivisen. Niinpä tuloerojen kasvaessa yhä suurempi osa veroista koituu suurempituloisten maksettavaksi. Se, että vakituisen asuinrakennuksen kiinteistövero reagoi tuloerojen kasvuun päinvastaisella tavalla, kertonee siitä, että kunnallisveron muutoksen vaikutuksia pyritään vaimentamaan verolla, jota ei kerätä ansiotulojen perusteella.

Tuloerojen vaikutuksen osalta edellä saadut tulokset olivat tilastollisesti verraten vahvoja, mutteivät tilastollisin kriteerein aivan kiistattomia. Muun muassa tämän vuoksi tutkittiin erikseen sitä, riippuuko tuloerojen vaikutus kunnallisvero- ja vakituisen asunnon kiinteistöveroprosenttiin äänestysaktiivisuudesta. Tämän tutkimista motivoi tieto siitä, että pienempituloiset ovat laiskempia äänestämään. Onkin ilmeistä, että äänestysprosentin aleneminen siirtää enemmistövaltaa kunnassa suurempituloisille. Niinpä osoittautuikin, että mainitut tulonjaon vaikutukset kunnallisveroprosenttiin riippuvat keskeisesti äänestysprosentista. Tyypillisesti tuloerojen kasvu alkaa nostaa kunnallisveroprosenttia vasta silloin, kun äänestysprosentti ylittää runsaat 60 prosenttia. Tämän mukaan noin puolet väestöstä elää kunnissa, joissa äänestysprosentti jää tämän rajan alapuolelle. Vakinaisen asuinrakennuksen kiinteistöveron määräytyminen ei ole yhtä selvästi ehdollinen äänestyskäyttäytymiselle.

Ennakko-olettamusta, jonka mukaan äänestysprosentin nousu vahvistaa pienituloisten ja siten mediaanituloisen valtaan pääsyä, tukevat havainnot äänestysprosentin suorasta vaikutuksesta veroprosentteihin. Saatujen tulosten mukaan äänestysprosentin nousu nostaa kunnallisveroprosenttia ja taas laskee vakituisen asuinrakennuksen kiinteistöveroprosenttia.

[1] Katso myös Persson and Tabellini, 2002.

1. INTRODUCTION

This study addresses the determination of the municipal income tax rate. In the theoretical public choice model introduced in this study we specify the central hypothesis, which says that low-income earners using their voting power tend to take advantage of high-income taxpayers. This hypothesis was originally introduced by Meltzer and Richard (1981), who considered the linkage between the income distribution in a majority voting and the level of redistributive government spending. This study also empirically tests whether the municipal level mean and medium incomes affect the municipal income tax rate in a presumed way. The data covers the years 1995–2006 of 431 Finnish municipalities.

In the public choice model considered, individuals are assumed to maximize their utility with respect to their consumption and mortgage investments regarding the level of income as given. In this respect, our model is close to the approach of Borge and Rattsö (2004). In the model considered, individuals optimize their behaviour in the first phase, and in the second phase the medium voter fixes the communal income and mortgage tax rates, subject to individuals' optimizing behaviour. In these respects, this study follows a standard public choice approach which is introduced, for example, in Persson and Tabellini (2002).2

Empirical support for the Meltzer-Richard hypothesis has been rather vague. Meltzer and Richard (1983), who used US state level times series data themselves, could show that in accordance with the hypothesis the ratio of mean income to median income is positively related to governmental spending for redistribution. Later, Perotti (1996), using cross-country data, and Rodriguez (1999), using panel data across US states, found hardly any support for the consistent relationship between inequality and redistribution. Neither did Basset at al. (1999) obtain evidence for the Meltzer-Richard hypothesis. Alesina et al. (2000), however, discovered that, in the United States, public employment is significantly higher in cities where income inequality and ethnic fragmentation are higher. Recently, Khan et al. (2009) also obtained support for the Meltzer-Richard hypothesis, using human capital inequality as a measure of inequality. The data set of their study includes 108 countries from 1960-2000.

The results obtained using the municipalities data are, in that sense, more reliable in that municipalities of a given country resemble the same socio-economic background which limits

[2] Unlike us, Person and Tabellini (2002) assume that leisure is included in the utility function and that labour-input and leisure are fixed in the first-phase decision.

omitted-variable bias. This makes the findings of Borge and Rattsö (2004) especially interesting. They discovered that unequal income distribution makes an upward shift in the property tax rate in the model in which Norwegian municipalities also finance their economy via a fixed utility charge.

The rather weak evidence for the Meltzer-Richard hypothesis is seen to reflect low-income individuals' problems in political participation. Firstly, low-income earners are probably inefficient in participation, as Frey (1971) states. From this it follows that the low-income median voter does not necessarily capture the majority position in a democratically chosen city council. In addition, relatively high participation costs, for example high costs to acquire relevant information, lower the voting rates of low-income individuals (Jones and Cullis, 1986). Barnes (2005) also focuses on this point. Owing to all this, the median voter's income tends to be above the median income. In addition, in the municipal context at least, the preferences for municipal services are not necessarily homogeneous. The wealthier have possibly acquired voluntary accident and health insurances relatively frequently, which have made them independent of municipally financed services. Heterogeneousness in this respect could have its own impact on the determination of the municipal income tax rate, the sign of this impact being conditional on the nature of the majority position as to whether it is either a median-income individual or a higher-income individual who is in power.

Using panel data on 431 Finnish municipalities from 1995–2006, this study investigates the validity of the Meltzer-Richard hypothesis. The estimation results of the econometric model verify, to some degree, the standard hypothesis, according to which an uneven income distribution within a municipality creates an upward bias in a municipal tax rate. But more specifically, according to the results obtained in this study an increase in the difference between mean and medium incomes (inequality measure) on the communal tax rate is conditional on voting behaviour. The increasing income dispersion starts to create upward pressure on the municipal income tax rate only if the voting rate exceeds a certain limit. This indicates that on the average the medium voter's income is higher than a medium income or that the actual decision-making power is in the hands of individuals with higher incomes than a median voter's income.

2. THEORETICAL MODEL

We consider a community which comprises N voters. An individual's i's utility U_i has an equation

(2.1) $$U_i = c_i^{\alpha} h_i^{1-\alpha} g^{\chi}$$

subject to

(2.2) $$y_i = c_i + t(y_i - y_c) + h_i + kh_i,$$

where c_i denotes i's consumption and h_i i's income from housing investment and g is the consumption of communal services per capita. In (2.1) the preferences for private goods (c_i and h_i) and the public consumption g are weakly separable so that the marginal substitution between c_i and h_i becomes independent of g, which is crucial for the analytical tractability.

In (2.2) t is the communal income tax rate, k is the communal real estate tax rate and yc is a tax allowance, owing to which communal income taxation becomes progressive. Let ym denote median income, so that ym > yc > 0. Owing to the existence of yc, the maximized utility (in the second stage) will become non-linear in the median income ym, which is important for the existence of the optimal solution in terms ym. The same effect could have been obtained by replacing the equation (22.2) by the equation $y_i = c_i + ty_i + h_i + kh_i - F$, where F is a lump sum income transfer per capita (like social assistance). For simplicity, F, which also characterizes the Finnish system, is, however, omitted.

The municipal economy is constrained by the equation

(2.3) $$g = t(y_a - y_c) + kh_a,$$

where the subscript a denotes the mean value over all individuals i in the municipality. Then y_a denotes mean income. In the first stage, an individual i maximizes their utility with respect to c_i and h_i. From the first order conditions one obtains the equations

(2.4) $$c_i = \alpha[(1-t)y_i + ty_c]$$

(2.5) $$h_i = \frac{(1-\alpha)}{1+k}[(1-t)y_i + ty_c]$$

for c_i and h_i. Using (2.3), (2.4) and 2.5) and assuming that the median-income individual – whose income is y_m – is the median voter whose preferences become the collective choice. The maximized utility W^{max} can then be written in the form

$$(2.6) \qquad W^{\max} = \alpha^{\alpha}(1-\alpha)^{(1-\alpha)}(1+k)^{(\alpha-1)}[(1-t)y_m + ty_c][(t(y_a - y_c) + \frac{k((1-t)y_a + ty_c)(1-\alpha)}{(1+k)}]^{\chi}.$$

Maximizing W^{max} in (2.6) with respect to tax rates t and k, the following first order conditions are obtained:

$$(2.7) \qquad -(y_m - y_c)[t(y_a - y_c) + \frac{k(1-\alpha)}{(1+k)}((1-t)y_a + ty_c)] + \chi((1-t)y_m + ty_c)\frac{(1+\alpha k)}{(1+k)}(y_a - y_c) = 0$$

$$(2.8) \qquad -(y_a - y_c)t(1+k) - k(1-\alpha)((1-t)y_a + ty_c) + \chi((1-t)y_a + ty_c) = 0$$

It is noteworthy that the income distribution (in the data considered) implies that $y_a > y_m$. Analysing (2.7) and (2.8) it can be proved (the proof is presented in Appendix 1) that

$$(2.9) \qquad \frac{dt}{dy_m} < 0 \text{ and } \frac{dt}{dy_a} > 0.$$

These results already imply that a decrease in y_m given y_a or an increase in (y_a – y_m) given y_a increases income tax rate t. In other words, an increase in an inequality (the Meltzer-Richard hypothesis) raises the tax rate. The fact that $\frac{dt}{dy_a} > 0$ follows from the implicitly assumed positive income elasticity of public services.

It also follows from (2.7) and (2.8) that

$$(2.10) \qquad \frac{dk}{dy_m} > 0 \text{ and } \frac{dk}{dy_a} < 0.$$

In the model considered, the real estate rate reacts in the opposite way to the change in y_m to what income tax rate t does. If inequality increases, the majority voter benefits from the shifting of the tax burden from real estate taxation to income taxation.

Let yv denote the majority voter's income. Insofar as, it has been assumed that yv = ym, where ym is the medium income. Owing to a low voting rate, however, yv can be remarkably higher than ym. Yet our theoretical model produces the following results

$$\frac{dt}{dy_v} < 0 \text{ and , } \frac{dt}{dy_a} > 0$$

even if ym < ya < yv. According to this, an increase in yv or in yv – ya given ya would lead to a decrease in the tax rate. In this case, an increase in yv does not necessarily reflect the fact that income distribution (given the voting rate) becomes more dispersed. The lowering of the voting rate alone may also raise yv. So, a decrease in tax rate t can be related to an increase in the voting power of the wealthiest. So the original Meltzer-Richard hypothesis becomes revised.

In the empirical analysis of this study yv is unobservable. If ym is, however, close to yv, the Meltzer-Richard hypothesis is valid. The larger the difference between ya and ym, the more the majority voter shifts the burden of taxes onto the shoulders of the higher income community members. Therefore the sign of dt/dym is negative. That yv may, however, differ remarkably from ym creates a major problem of the empirical analysis. It is possible that, instead, ya is close to yv. In this situation the hypothesis derived cannot then be necessarily verified when one uses ya and ym as explanatory variables. It is then possible that the more ya rises in relation to ym, the more the majority voter tends to decrease the tax rate in order to lighten his or her own tax burden. This could turn the sign of dt/dya negative. To cope with this problem in the empirical analysis we control the municipal voting rate, too. One can expect that the higher the voting rate is, the closer the observed ym is to the unobserved yv so that the results (2.9) are valid.

Insofar as, we have assumed that municipalities are homogeneous in their preferences. This reflects more or less a situation in which municipalities differ from each other only in the income distributions but not so much in mean incomes. In fact, the differences in mean incomes are, however, remarkable. This is relevant, because in Finland, too, the wealthiest citizens tend to rely more on private services – especially in healthcare – which make them more reluctant to support the provision of public services. This could reflect in the behaviour of majority voters in two ways. The higher the majority voter's income is, the less they prefer public services, which would lower the tax rate. In addition to that, the higher the income of the other members in a municipality is, the less they demand public services. For the self-interested majority this would create an opportunity for cost savings and the lowering of income tax. The mean income represents the income level of others. Abstracted from income distribution effects, the municipalities with higher means would then fail to lower the municipal tax rate. Suppose that an increase in ya decreasing χ in (2.1) could capture this effect. In Appendix 1 it is shown that $dt/d\chi > 0$ and that the sign of $dk/d\chi$ is ambiguous. In principal, it could then be possible that an increase in the mean income makes the medium voter decrease the municipal tax rate, given the income distribution (mean income minus median income).

3. DATA AND THE ESTIMATED MODEL

This study uses the panel data for 431 Finnish communes from the years 1995–2006. The income distribution statistics of Statistics Finland provides information about the municipal level median and mean income and gini coefficients. From the statistics for the economy of municipalities provided by Statistics Finland (Finances and activities of municipalities and joint municipal boards) we have obtained information about the municipal tax rates and income sources. Information about municipalities' population structure has been extracted from the population statistics of Statistics Finland. In addition, various items of information about municipal features – such as population density, industrial structure, and geographic characteristics – have been acquired from the statistics provided by the Association of Finnish Local and Regional Authorities.[3]

In this study we focus on the determination of the municipal income tax rate (*ctax*). Being aware that this tax interacts with real estate tax and its income, we control some municipal-level variables which are thought to have an impact on real estate taxes. We also report estimates from a model which includes three real estate tax tariffs, which determine taxes for land, permanent residence and other buildings (mostly summer cottages). Municipalities can set these tariffs within certain limits. These variables are regarded as endogenous.

For the municipal income rate tax (*ctax*) the simultaneous equation system (2.7)–(2.8) produces a reduced form equation

$$(3.1) \qquad ctax = c_1 + \alpha_1 \log(y_a) + \beta_1 med + \Pi_1 X_i .$$

Taking into account the impact of the voting rate we also estimate an enlarged equation

$$(3.2) \qquad ctax = c_1 + \alpha_1 \log(y_a) + \beta_1 med + \beta_2 (med * vr) + \beta_3 vr + \Pi_1 X_i .$$

[3] The data also includes information about households' consumption habits at the municipal level which is obtained from the consumption surveys of Statistics Finland. The municipal level variables from this data, however, were not considered reliable.

Above

y_a = mean income

y_m = median income

med = $\log(y_a) - \log(y_m)$

vr = municipal voting rate

X_i = the vector of controlling variables

Estimating this model one can test whether inequality lowers the municipal tax rate. According to the basic Meltzer-Richards hypothesis it is hypothesized that in (3.1) $\beta_1 > 0$ and that $\alpha_1 + \beta_1 > 0$. In (3.2) these effects are contingent on the voting rate. So it is expected that if vr exceeds a certain limit, $\beta_1 + \beta_2 vr > 0$ and $\alpha_1 + \beta_1 + \beta_2 vr > 0$.

To investigate the robustness of the results and to clarify the possible ambiguousness of the results an alternative measure of inequality is also used. The variable med above is then replaced by municipality-level gini coefficient (*gini*).

Out of the three real estate tax tariffs, the one that concerns permanent residence is analogous to the housing tax which is analysed in the theoretical model. The tax is collected directly from the community member on the basis of this tariff, unlike the rest of the real estate taxes. So we also empirically investigate the determination of this tariff – denoted below restax – in the following models:

(3.3) $$restax = d_1 + \delta_1 \log(y_a) + \lambda_1 med + \Lambda_1 X_i$$

(3.4) $$restax = d_1 + \delta_1 \log(y_a) + \lambda_1 med + \lambda_2 (med * vr) + \phi_3 vr + \Lambda_1 X_i .$$

On the basis of the theoretical analysis, we expect that in (3.3) $\delta_1 < 0$ and $\delta_1 + \lambda_1 < 0$. It is possible that the voting rate plays a central role here, too. If the medium income earner can use the majority power only when the voting is high enough, it is possible that in model (3.4) $\lambda_1 + \lambda_1 vr < 0$ and $\delta_1 + \lambda_1 + \lambda_1 vr < 0$ only if *vr* exceeds a certain limit.

In the basic models (3.1)–(3.2)[4] the following variables are included in the vector X_i:

log of debt per inhabitant, euros

log of a municipality's share of corporate tax revenue per inhabitant, euros

log of state aid per inhabitant, euros

[4] Estimating models (3.3.) and (3.4.) the set of controllers is almost the same as in models (3.1.9 and (3.2).

log of mean of capital income in state taxation, euros

the share of population under 15 years

log of the size of population

YEAR = year dummies.

The first three financial variables above describe the municipality's financial situation and are thus closely linked to the needs to set the municipal income tax rate on an appropriate level. Indebtedness is directly related to the municipality's need to strengthen its economy by means of a high income tax rate. Therefore the expected impact of this variable on *ctax* is positive. The municipality's share of the corporate tax income (collected by the state) variable tells us about substitutive incomes from other sources. Its impact on *ctax* is assumed to be negative. The standards for state aid are determined by the municipality's age, income and industrial structure, being independent of the chosen income tax rate. A large amount of state aid tells us that a municipality has economic problems and so has a need to keep *ctax* on a high level. But, on the other hand, state aid as an income source is a substitute for income tax revenue. Therefore the sign of its estimated effect on *ctax* is ambiguous.

The social assistance expenditure per inhabitant, whose standard is set by the state and which is therefore primarily out of municipal-level control, was also included in the controlling variables. Owing to a non-significant explanation, this variable was, however, omitted.

The hypothesized effect from the income distribution on the municipal tax rate was solved from the two-equation model which included the setting of both the municipal tax rate and the municipal level estate tax tariffs. Therefore it is relevant to also take into account the factors which impact on the real estate tax income. The municipal level mean of capital income – which is not part of the tax base in municipal income taxation – is a good proxy for the real estate tax base. The real estate tax revenues are a substitute for income tax revenue and therefore it is expected that the impact of the average capital income on *ctax* will be negative.

The underage population increases communal expenses and generates upward pressure on taxes. The anticipated effect of the share of the population under 15 years on *ctax* is therefore positive. The larger size of population is assumed to represent a greater potential to internalize the economies of scope, which is thought to create an opportunity for savings on expenditure and therefore for a lower municipal tax rate.

In the basic case, variables y_a, med (= $y_a - y_m$) and the voting rate and all the other controlling variables are treated as being exogenous. In this approach it is thus assumed that the mean income and income distribution in a municipality and the municipality's economy do not react in a remarkable way to the municipal tax rate. The possible endogeneity of municipal level income variables and fiscal variables concerning the municipality's economy addresses the feed-back mechanism which arises if a change in a municipal income tax rate affects income or fiscal variables directly or indirectly, for example, through in- or out-commuting.

The fact that one does not regard the impact of in- and out-immigration on the municipality's economy as being remarkable in Finland (see Helin et al., 1998) supports the exogeneity assumption. On the other hand, Kangasharju and Moisio (2006) have obtained a result according to which neighbouring tax rates have a positive impact on a municipality's income tax rate in Finland. This and even more profound evidence of mimicking in tax-setting and spending decisions in England (see Revelli, 2002) shows that the municipalities, however, in their decisions, take into account the existence of some kind of feedback mechanism, which may work out through immigration. This justifies the use of the method of instrumental variables in the estimation of models (3.1.) and (3.2). In their empirical study concerning tax and fee setting in Norway Borge and Rattsö (2004) thought that tax decisions had a response on other fiscal variables which had an effect on immigration and finally on income distribution and mean income. To tackle the endogeneity problem, we estimate the model with the instrumental variables approach using the two-stage GLS random effects estimator. To check the robustness the results are also reported from OLS, fixed effects and GMM regression.

The choice of instruments was dictated by the nature of the variables. Describing geography, the age structure of the population and the industrial structure, the variables are thought of as being exogenous. Such variables were chosen as instruments which had an influence on endogenous variables in the first stage estimation but whose direct impact on the explained tax rate in the second stage was not remarkable. In the GMM estimation the validity of the over-identification restriction was a central criterion for the choice of instruments.

Estimating models (3.1) and (3.2) with random effect IV regression the following instruments are then used:

the share of population of 75 years and over
the share of population between 65 and 74 years
the number of summer cottages per permanent inhabitant
concentration rate (the share of those who live in population centres)
log of population density
workplace self-sufficiency

the share of industrial production and construction

the share of service production.

It turned out that, for example, the share of population of 75 years and over, which had a statistically significant impact on some endogenous explanatory variables, had no impact on the tax rate. So this variable as well as the share of population between 65 and 74 years is used as an instrument. Part of the real estate taxes are collected from those who own summer cottages. In fact, summer cottages are used as an instrument because they have a remarkable impact on real estate tariffs and real estate income, which is an alternative income source for municipal income tax revenue. The instruments mentioned so far vary within time, while the latter five instruments include only a cross-sectional variation corresponding to the situation in the year 2004. These instruments describe a municipality's regional and industrial structure. These variables are thought to shape the municipalities' income structure and voting behaviour without having any impact on the taxing behaviour. It is remarkable that the concentration rate variable may have high values, even if the density is low.

The with-one-year lagged dependent variable and endogenous explanatory variables are also used as instruments.

Models (3.3) and (3.4) are estimated only with the instrumental variable approach. The summer cottages are then regarded as an exogenous variable, but the other instruments are the same as in the models in Table 2. The dependent variable is then the real estate tariff for the permanent resident. The method is basically the same as in the estimation of models (3.1.) and (3.2).

4. RESULTS

The data which is used in the analysis is described in Table A1 in Appendix 2. The income distribution is typically skewed to the right so that the income inequality variable (med) has positive values in almost all cases. In fact, out of 4 925 observations only in four cases has med a negative value.

The results from the random effects panel data estimation – in which all the municipal level income and financial variables are regarded as exogenous – are reported in Table 1. The estimation results from the models – which do not include voting behaviour – in the first and fourth columns of Table 1 show that the difference between mean and median income (med) has an anticipated positive impact on the municipal tax rate. The impact of mean income is, however, negative and not positive as the theoretical model would suggest. The results can be interpreted to show that the municipal income tax rises in an expected way as inequality increases. As a sign of the shift in preferences away from public services, the respective tax rate, however, decreases when mean income increases. The results obtained from estimating the model in the fifth column in Table 1 support this interpretation. In this model the income inequality according to the gini coefficient has a positive impact on the municipal income tax rate. The mean income still has the same impact as in the basic model (in Columns 1 and 4).

Adding the voting rate and the interactive variable between the voting rate and the difference of *med* (= log of mean income minus log of median income) in the model gives a sharper picture of the municipalities' behaviour.

The second and third columns in Table 1 report the estimation results from the situation – model (3.2) – which includes voting behaviour.

Table 1. Model (3.1), panel data estimator, GLS, random effects model, dependent variable: municipal tax rate.

Explanatory variables						
Med (= log mean income minus log median income)	0.463*** (0.140)	-3.754*** (0.961)	-3.110*** (0.959)	0.594*** (0.141)		
Log mean income	-1.082*** (0.105)	-1.173*** (0.106)	-1.135*** (0.123)	-1.147*** (0.123)	-1.129*** (0.124)	-1.109*** (0.123)
Med*voting rate		6.061*** (1.356)	5.312*** (1.356)			
Gini					1.713*** (0.408)	-6.702*** (2.098)
Gini*voting rate						12.044*** (2.940)
Voting rate		-0.018*** (0.003)	-0.018*** (0.003)			-0.066*** (0.014)
Log corporate tax revenue per inhabitant			-0.036** (0.014)	-0.027* (0.014)	-0.027* (0.014)	-0.040*** (0.014)
Log Debt per inhabitant			0.072*** (0.006)	0.076*** (0.006)	0.076*** (0.006)	0.073*** (0.006)
Log Capital income per inhabitant			-0.098*** (0.024)	-0.091*** (0.024)	-0.097*** (0.024)	-0.107*** (0.024)
Log State aid per inhabitant			0.098*** (0.022)	0.088*** (0.022)	0.087*** (0.022)	0.104*** (0.022)
Share of population under 15 years			4.101*** (0.498)	4.193*** (0.498)	4.315*** (0.498)	4.057*** (0.503)
Log Size of population			-0.044* (0.024)	-0.004 (0.023)	-0.007 (0.023)	-0.038 (0.025)
Years dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-sq within	0.552	0.555	0.577	0.573	0.573	0.577
R-sq between	0.195	0.201	0.363	0.367	0.360	0.364
R-sq overall	0.320	0.323	0.426	0.427	0.424	0.428
Number of observations	4979	4979	4873	4873	4873	4873

Notes: Standard errors in parentheses: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

The impact from the median incomes (ym) is then the sum of the coefficients of the med and the interactive variable med*voting rates. For example, in the model in which the coefficients are reported in the second column, log Ym has a negative impact on the municipal tax rate, if –3.754*med + 6.061*(voting rate*med) > 0, which requires that the voting rate exceeds 61.9 per cent. In the third column model the corresponding limit is 58.5 per cent. The model in the sixth column includes an interactive variable between the gini coefficient and the voting rate. The gini coefficient has an anticipated positive impact on the municipal income tax rate, if the voting rate exceeds 55.6 per cent.

The average voting rate (from the years 1992, 1996, 2000 and 2004) has been 66.7 per cent, but the population size weighted average has been only 61.7 per cent. This means that in several municipalities, especially in larger municipalities, the medium income earner is not the majority voter. In the models with an interactive variable the impact of the log of mean income could also turn out to be positive (as we originally expected), if the voting rate is high enough. But the voting rate should then exceed 78.4 per cent (second column model) or 79.9 per cent (third column model). On average, the voting rate is above 78.3% in only 15 municipalities out of 431.

According to the coefficient estimates of the model in the third column of Table 1, the rise in the voting rate will increase the municipal income tax rate, if 5.312*meds – 0.018 > 0. This requires that meds > 0.003, which is almost always true in our data. This condition is not valid in only a few cases out of almost five thousand. In the model in Column 2 this condition is even less restricted. In the model which includes a gini-coefficient (Column 6) the voting rate raises the municipal income tax rate, if the gini-coefficient is above 0.005, which is always true.

The impacts of financial variables correspond to our expectations. The corporate tax revenue collected by the state is partly paid to municipalities. The obtained negative coefficient of this variable corresponds to our expectations. If these revenues grow, the need to collect taxes by raising the income tax rate is reduced. Capital income is not part of the income tax base, but it is a good proxy for financial wealth and also for the real estate tax base. So, in municipalities with a high mean of capital income the real estate tax revenues are also relatively large, which reduces the need to collect income tax revenue. The negative coefficient of the capital income variable is thus rather anticipated. State aid is a substitute income source for income taxes, which could lead one to expect that the coefficient of this variable is negative. The positive coefficient may tell us that state aid is not too generous and that the municipalities who are aided have financial problems. The negative impact of debt on the income tax rate shows that highly indebted municipalities have to keep the income tax rate at a high level.

The size of the population under 15 years of age increases expenditures and so also the tax rate. That the size of the population has a negative impact points to the existence of scale economies in producing municipal services.

Table 2 reports the results from the instrumental variables regression. Income variables, financial variables about the municipality’s economy and the voting rate – variables from the 2nd to the tenth rows in Table 2 – have been endogenized. The exogenous variables which, by their nature, are thought as being independent of other variables in the model are the share of the population under 15 years of age and the log of the population size. The other population age variables did not turn out to have statistically significant explanatory power in the second stage estimation. In the first stage, endogenous variables were explained by exogenous variables and by additional instruments which are the lagged values of endogenous explanatory variables and some variables about the population and the industrial structure. The relevance of the first-stage instruments is satisfied because each of them is statistically significant in several first-stage equations.

The results from the models in Table 2 are parallel with the results reported in Table 1. The mean income still has a negative impact on the municipal income tax rate. That the impact from the median income on the municipal income tax rate is negative – as expected – in the models in Table 2 (second and third columns) requires that the voting rate exceeds 68.2 and 61.4 per cent. Limits are then a little higher than in the standard random effects regression in Table 1. The respective limit for the log of mean income to have a positive impact on the tax rate is now 78.4 and 73.3 and so a little lower than in the models reported in Table 1. The gini coefficient still has a positive impact and with the respective interactive variable its positiveness rate hinges on the voting activity. It (the model in the 6th column) now requires the voting rate to exceed 59.0 per cent. The IV regression also yields the finding that the voting rate has a positive impact on the municipal income tax rate.

Table 2. Models (3.1) and (3.2.), second stage regression, G2SLS random effect IV regression, dependent variable: municipal tax rate, Income and financial variables instrumented.

Explanatory variables						
Med (= log mean income minus log median income)	-0.038 (0.256)	-10.161*** (2.134)	-6.698*** (2.145)	0.723** (0.263)		
Log mean income	-1.479*** (0.164)	-1.524*** (0.166)	-1.299*** (0.198)	-1.262*** (0.195)	-1.144*** (0.213)	-1.149*** (0.214)
Med*voting rate		14.904*** (3.067)	10.915*** (3.085)			
Gini					2.445*** (0.805)	-17.647*** (4.811)
Gini*voting rate						29.926*** (7.001)
Voting rate		-0.033*** (0.006)	-0.027*** (0.006)			-0.153*** (0.034)
Log corporate tax revenue per inhabitant			-0.064** (0.031)	-0.067** (0.031)	-0.066** (0.031)	-0.083*** (0.032)
Log debt per inhabitant			0.139*** (0.011)	0.143*** (0.011)	0.144*** (0.011)	0.139*** (0.011)
Log capital income per inhabitant			-0.357*** (0.071)	-0.373*** (0.071)	-0.419*** (0.076)	-0.418*** (0.076)
Log state aid per inhabitant			0.019 (0.045)	0.004 (0.045)	-0.003 (0.045)	0.034 (0.045)
Share of population under 15 years			4.090*** (0.548)	4.046*** (0.548)	4.152*** (0.546)	3.825*** (0.556)
Log size of population			-0.065** (0.029)	-0.025 (0.026)	-0.020 (0.026)	-0.071** (0.029)
Years dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-sq within	0.554	0.554	0.562	0.556	0.552	0.557
R-sq between	0.223	0.222	0.420	0.435	0.430	0.416
R-sq overall	0.338	0.337	0.451	0.458	0.454	0.449
Number of observations	4564	4564	4431	4431	4431	4431

Notes: Standard errors in parentheses: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

In the models in Table 2 the impacts of other controllers is almost the same as in the random effects regression. Exceptionally, the positive impact of the state aid variable has disappeared.

Table A2 in the Appendix includes the estimation results from pooled data OLS regression and panel data fixed effects regression. The results are mainly in line with the results reported in Tables 1 and 2. In the OLS models (2nd column) the negativity of the median income variable, however, requires that the voting rate exceeds 76.7 per cent, which is more than in the models in Table 1 and 2. In the fixed effects model (4th column) the respective voting rate limit is 52.5 per cent and so even lower than in the other models. On the whole, it is a little surprising that the fixed effect estimates are so close to the previous estimates (reported in Table 1 and 2), because one could have believed *a priori* that the within time variation of the fixed effects regression would not alone specify the hypothesized effects of income distribution.

The estimation results from a dynamic model have been reported in Table A3 in appendices. In this model it is thought that the municipal tax rate adjusts slowly. The inclusion of a lagged dependent variable creates an endogeneity problem, and so the model is estimated using a dynamic panel estimator known as a system GMMM estimator (see Roodman, 2009). This estimator is designed for a situation with a small number of time periods and a great number of observed groups (municipalities). The System GMM creates an equation system in levels and in first differences.[5] The contemporaneous values of the municipal-level financial variables (log of corporate tax revenue, log of debt, log of capital income and log of state aid) are specified as being endogenous, while with one period lagged income variables and the voting rate (med, log mean income, med*voting rate and voting rate) are classified as being predetermined variables independent of current disturbances but influenced by past ones. Year dummies, the share of population under 15 years and the log size of population are considered as strictly exogenous variables which serve as standard IV instruments. The choice of endogenous and predetermined variables is dictated by the need to increase the significance of the model (F-test) without violating the joint validity of instruments (according to the Sargent/Hansen test for over-identifying restrictions). For equations in differences, the specified model uses, as instruments, exogenous variables and the lags of other regressors (GMM instruments) in levels dated from t-1 up to t-3 (to restrict the number of instruments). In the equations in levels the instruments are the respective first differences and also the contemporaneous value of differenced predetermined variables. The results that are reported in Table A3 show that the income variable *med* is insignificant in the model which does not include voting behaviour. In the model with voting the central results are close to the results which are reported in Tables 1 and 2. The median income decreases the municipal income tax rate when the voting rate exceeds 66.4 per cent. For the mean income to have a hypothised positive impact on the tax rate, the voting rate must be over 69.5 per cent. According to the AR tests, the presence of the first-order autocorrelation cannot be rejected (as is expected) but, more importantly, the absence of the second-order autocorrelation cannot be rejected either, which suggests that no residual serial correlation is present in the models. The other test statistics of the model in the second column of Table A3 indicate that the GMM and IV instrument subsets are valid jointly and apart[6]. The

[5] The use of forward orthogonal deviations rather than first differences is motivated by the need to save observations (see Roodman, 2009).

[6] The Hansen test about ”excluding group” shows dropping out either GMM-instruments (the lagged values of endogenous variables) or IV-instruments deteriorates the over-identification restrictions, so the instruments in question can be regarded as valid. Similarly, the other test difference-in-Hansen test called “difference” shows that redefining GMM- or IV-instruments as endogenous would create a loss to the over-identification restrictions (see Baum et al., 2003).

instruments can be considered as relevant owing to their significance in the first-stage equations in the G2SLS random effect IV regression whose results are reported in Table 2.

Table 3 reports the estimation results of models (3.3) and (3.4) in which the dependent variable is the real estate tax tariff for permanent residence. The hypotheses derived would suggest that median income had a positive impact and mean income a negative impact on the real estate tax rate. The estimation results largely support this hypothesis, although in the IV regression the inclusion of other controllers makes the impact of median income on the real estate tax tariff statistically not different from zero. The behavioural pattern of the real estate rate tax for permanent residence mirrors that of the municipal income tax rate as far as the impact of voting activity is concerned. The voting rate thus seems to lower the real estate tax rate in question.

Table 3. Models (3.3) and (3.4), regular GLS random effect and IV (G2SLS) random effect regression, dependent variable: real estate tax tariff for permanent residence.

Explanatory variables	Random effects (GLS)			IV (G2SLS)		
Med (= median income minus mean income)	-3.351** (1.140)	-0.580 (9.667)	-2.718* (1.456)	-5.463** (2.473)	-5.157 (20.791)	0.240 (2.669)
Log mean income	-6.504*** (0.944)	-7.473*** (0.955)	-6.799*** (1.238)	-7.913*** (1.219)	-9.671*** (1.265)	-9.241*** (1.979)
Med*voting rate		-3.681 (13.656)			2.429 (2.992)	
Voting rate		-0.155*** (0.028)			-1.898*** (0.544)	
Log corporate tax revenue per inhabitant			-0.044 (0.149)			-0.855*** (0.316)
Log debt per inhabitant			0.341*** (0.066)			0.609*** (0.108)
Log capital income per inhabitant			-0.095 (0.244)			-1.028 (0.708)
Log state aid per inhabitant			0.198 (0.229)			-0.687 (0.108)
Share of population under 15 years			-2.969 (5.068)			-2.791 (5.563)
Log size of population			0.775*** (0.258)			0.953*** (0.207)
Log number of summer cottages per inhabitant			0.378* (0.201)			0.385* (0.207)
Years dummies	Yes	Yes	Yes	Yes	Yes	Yes
R-sq within	0.535	0.541	0.539	0.538	0.542	0.537
R-sq between	0.086	0.086	0.158	0.085	0.090	0.171
R-sq overall	0.312	0.315	0.341	0.305	0.306	0.338
Number of observations	4979	4979	4872	4564	4564	4430

Notes: Standard errors in parentheses: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

5. CONCLUSION

On the whole, the results obtained are finally in line with the results suggested by the theoretical literature (see for example, Persson and Tabellini, 2002). Insofar as the tax setting is conditioned on the voting performance, our results are, however, novel in the empirical literature. Although the theoretical model of this study is, in some respect, similar to the model introduced by Borge and Rattsö (2004), the empirical findings are not comparable. In their model, property tax plays the same role as the municipal income tax in our model. Borge and Rattsö (2004) discovered that unequal income distribution created a standard upwards impact on the property tax in their model in which the Norwegian municipalities also finance their economy via a fixed utility charge. Our findings indicate that in the Finnish system the median income earner tends to raise the municipal income tax rate the harder, the larger the difference is between the mean income and the median income. This is partly mirrored by the setting of the real estate tax tariff, which is, however, fiscally far less important than income tax. We discovered that the validity of the Meltzer-Richard hypothesis in the communal framework is, however, conditional on the voting rate. According to this, only if the voting rate exceeds a certain limit – which is quite close to the average voting rate – does inequality start to work in the direction expected. The larger inequality then raises the municipal income tax rate. Furthermore, we found that increasing voting activity has a tendency to raise the municipal income tax rate and lower the real estate tax rate for permanent residence.

LITERATURE

Alesina, A., Baqir, R. and Easterly, W. (2000), Redistributive public employment, *Journal of Urban Economics* 48, 219–241.

Barnes, L. (2005), the Income distribution of voters – literature review and research plan, Manuscript 21.12.2005.

Basset, W., Burkett, J. and Putterman, L. (1999), Income distribution, government transfers, and the problem of unequal influence. *European Journal of Political Economy* 15, 207–228.

Baum, C., Schaffer, M. and Stillman, S. (2003), Instrumental variables and GMM: Estimation and testing, Working Paper No. 545, Boston College.

Borge, L-E. and Rattsö, J. (2004), Income distribution and tax structure: Empirical test of Meltzer-Richard hypothesis, *European Economic Review* 48, 805–826.

Frey, B.S. (1971), Why do high income people participate more in politics?, Public Choice 11, 101–105.

Helin, H., Laakso, D., Lankinen, M. and Susiluoto, I. (1998), Migration and municipalities (in Finnish: Muuttoliike ja kunnat), Kunnallisalan kehittämissäätiön tutkimusjulkaisut nro 15, Vammala.

Jones, P.R. ja Cullis, J.G. (1986), Is democracy regressive?: A comment on political participation, *Public Choice* 51, 101–107.

Kangasharju, A. and Moisio, A. (2006), Tax competition among municipalities in Finland, Urban Economic Review numero 005, Universidade de Santiago de Compostela, 12–23.

Khan, M.J., Javid, A., Ahmed, U. and Farooq, S. (2009), Size of government spending and human capital inequality: evidence from cross sectional and panel data analysis, *European Journal of Social Sciences* 9, 300–322.

Meltzer, A.H. and Richard, S.F. (1981), A rational theory of the size of government. *Journal of Political Economy* 89, 914–927.

Meltzer, A.H. and Richard, S.F. (1983), Tests of a rational theory of the size of government. *Public Choice* 41, 403–418.

Perotti, R. (1996), Growth, income distribution and democracy: What the data say. *Journal of Economic Growth* 1, 149–188.

Persson, T. and Tabellini, G. (2002), Political economics and public finance, in Auerbach, A. and Feldstein, M. (eds.) *Handbook of public economics – volume 3*, Elsevier, New-York.

Revel, F. (2002), Testing the taxmimicking versus expenditure spill-over hypotheses using English data, *Applied Economic* 34, 1723–1731.

Rodriguez, F.C. (1999), Does distributional skewness lead to redistribution? Evidence from the United States, *Economics and Politics* 11, 171–199.

Roodman, D. (2009). How to Do xtabond2: An Introduction to "Difference" and "System" GMM in Stata. *Stata Journal* 9(1): 86–136.

APPENDIX 1.

Let A denote the left hand side of the equation (2.7). Then

(a1) $$\frac{\partial A}{\partial t} = -(y_m - y_c)(1+\chi)\frac{(1+\alpha k)}{(1+k)}(y_a - y_c) < 0$$

and

$$\frac{\partial A}{\partial k} = -(y_m - y_c)\frac{(1-\alpha)}{(1+k)^2}[(1-t)(y_a + ty_c] - [(1-t)y_m + ty_c]\chi\frac{(1-\alpha)(y_a - y_c)}{(1+k)^2} < 0.$$

Using (2.7) the latter equation transforms into

(a2) $$\frac{\partial A}{\partial k} = -\frac{(y_m - y_c)y_a(1-\alpha)}{(1+k)(1+\alpha k)} < 0.$$

From (2.7.) one also obtains

(a3) $$\frac{\partial A}{\partial y_m} = -t(y_a - y_c)y_c - [(1-t)y_a + ty_c]y_c\frac{k(1-\alpha)}{(1+k)} < 0$$

and

(a4) $$\frac{\partial A}{\partial y_a} = (y_m - y_c)\frac{y_c k(1-\alpha)}{(y^a - y_c)(1+k)} > 0.$$

The left hand side of the equation (2.8) is denoted by B; then

(a5) $$\frac{\partial B}{\partial t} = -\frac{(y_a - y_c)[(1+k(1-t)y_a + kty_c]}{[(1-t)y_a + ty_c]} < 0,$$

(a6) $$\frac{\partial B}{\partial k} = -(y_a - y_c)t - (1-\alpha)[(1-t)y_a + ty_c] < 0,$$

(a6) $$\frac{\partial B}{\partial y_m} = 0$$

and

(a7) $$\frac{\partial B}{\partial y_a} = -t^2(1+k)y_c < 0.$$

The necessary second-order conditions for this optimization problem – which maximizes W^{max} in (2.6) – requires that $\frac{\partial A}{\partial t} < 0$, $\frac{\partial B}{\partial k} < 0$ and that $\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t} > 0$. The expressions (a1) and (a6) show that the two first-mentioned conditions are valid. To prove that $\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t} > 0$ is also valid, we write this condition in the form

(a8)

$$(y_m - y_c)(y_a - y_c)y^a \frac{(1-\alpha)\alpha k[1+\alpha k+\chi(2+\alpha k)]}{(1+k)(1+\alpha k)} + (y_a - y_c)\alpha t(y_m - y_c)[(y_a - y_c)\frac{(1+\alpha k)}{(1+k)} + y_c]$$
$$+ y_a(y_m - y_c)y_c(1-\alpha)(1+\gamma) > 0.$$

The inequality (a8) is valid and so the necessary second-order conditions are met.

Let us then explore the sign of $\frac{dt}{dy_m}$ and $\frac{dt}{dy_a}$. These expressions can be written in the form

(a9) $$\frac{dt}{dy_m} = \frac{\frac{\partial A}{\partial k}\frac{\partial B}{\partial y_m} - \frac{\partial A}{\partial y_m}\frac{\partial B}{\partial k}}{\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t}}$$

and

(a10) $$\frac{dt}{dy_a} = \frac{\frac{\partial A}{\partial k}\frac{\partial B}{\partial y_a} - \frac{\partial A}{\partial y_a}\frac{\partial B}{\partial k}}{\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t}}.$$

The sign of the left-hand side in the equations (a1) – (a7) and the validity of (a8) guarantee that $\frac{dt}{dy_m} < 0$ in (a9) and that $\frac{dt}{dy_a} > 0$ in (a10).

The derivatives $\frac{dk}{dy_m}$ and $\frac{dk}{dy_a}$ have the expressions

(a11) $$\frac{dk}{dy_m} = \frac{\frac{\partial A}{\partial y_m}\frac{\partial B}{\partial t} - \frac{\partial A}{\partial t}\frac{\partial B}{\partial y_m}}{\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t}}$$

and

(a12) $$\frac{dk}{dy_a} = \frac{\frac{\partial A}{\partial y_a}\frac{\partial B}{\partial t} - \frac{\partial A}{\partial t}\frac{\partial B}{\partial y_a}}{\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t}}.$$

The sign of the left-hand side in the equations (a1) – (a7) and the fact that the denominator is positive make us conclude that $\frac{dk}{dy_m} > 0$ in (a11) and that $\frac{dk}{dy_a} < 0$ in (a12).

Let us then explore the sign of $\frac{dt}{d\chi}$, which has an expression

(a13) $$\frac{dt}{d\chi} = \frac{\frac{\partial A}{\partial k}\frac{\partial B}{\partial \chi} - \frac{\partial A}{\partial \chi}\frac{\partial B}{\partial k}}{\frac{\partial A}{\partial t}\frac{\partial B}{\partial k} - \frac{\partial A}{\partial k}\frac{\partial B}{\partial t}}.$$

Above

(a14) $$\frac{\partial A}{\partial \chi} = ((1-t)y_m + ty_c)(y_a - y_c)\frac{(1+\alpha k)}{(1+k)} > 0$$

and

(a15) $$\frac{\partial B}{\partial \chi} = (1-t)y_a + ty_c > 0.$$

Using the equation (2.8) it is obtained from (2.7) that

$$(1-t)y_m + ty_c)(y_a - y_c)\frac{(1+k\alpha)}{(1+k)} = (y_m - y_c)\frac{((1-t)y_a + ty_c)}{t(1+k)}.$$

Using this result and expressions (a14) and (a15), the numerator of (a13) can be written in the form

$$\frac{(y_m - y_c)((1-t)y_a + ty_c)}{(1+k)(1+\alpha k)}((1-t)(y_a - y_c) + \alpha k(y_a - y_c)) > 0.$$

Because the denominator is positive as well, $\frac{dt}{d\chi} > 0.$

It will turn out that the sign of $\frac{dk}{d\chi}$ is ambiguous. With reasonable assumptions it will become negative. The details of this analysis are not reported.

APPENDIX 2.

Data description and auxiliary estimations

Table A1. Descriptive statistics.

Variable (and explanation)	Mean	Stand. v.	M	Max
Municipal income tax rate	18.28	0.72	15.0	21.0
Median of nominal taxable income in municipal taxation	10453	2805	4393	23596
Mean of nominal taxable income in municipal taxation	12123	2861	6644	40562
Med (= log mean income – log median income)	0.159	0.077	-0.022	0.772
Gini coefficient of nominal taxable income in municipal taxation	0.477	0.037	0.390	0.719
Voting rate (Municipal elections were held in years 1992, 1996, 2000 and 2004. The voting rate e.g. in year 2000 is given also for years 2001, 2002 and 2003.)	65.1	6.8	45.6	89.5
Municipality's share of the nominal corporate taxes per inhabitant, € (These taxes are collected by the state.)	230	173	3	2809
Nominal debt stock per inhabitant, € (at the end of the year)	973	722	0.3	8650
Capital income per inhabitant (in state .ation), €	1334	986	232	26839
Nominal state aid per inhabitant, € (State aid is determined by the commune's geographical and economical characteristics and it also implements the levelling of the commune's computational (not real) tax revenue)	1327	613	0.2	5689
Real estate tax tariff for permanent residence, % (This tariff is fiscally the second most important.)	0.255	0.062	0.1	0.5
Size of population (at the end of the year)	11894	31098	233	564521
Share of population under 15 years [1] (Corresponds to the situation at the end of the year.)	0.185	0.032	0.099	0.336
Share of population 75 years and over[1]	0.082	0.025	0.016	0.167
Share of population between 65 and 74 years[1]	0.101	0.022	0.030	0.180
Number of summer cottages per inhabitant	1042	892	0	6196
Urbanization rate (the share of those who live in population centres) [2]	59.8	21.3	0	99.0
Log Population density[2]	2.61	1.38	-1.60	8.01
Share of industrial production and construction[2]	26.6	11.0	4.0	56.5
Share of service production[2]	56.3	10.2	29.1	90.3
Workplace self-sufficiency[2]	85.0	18.3	41.1	147.9

[1]The data includes information about the municipal age structure only from the years 1995, 1998, 2001 and 2006. The missing observations for the rest of the years are obtained by linear interpolation.
[2]The same value, corresponding to the situation at the end of 2005, for all years

Table A2. Model (3.1) and (3.2), OLS and panel data fixed effects estimator, dependent variable: municipal tax rate.

Explanatory variables	OLS	OLS	GLS, fixed effects	GLS, fixed effects
Med (= log mean income minus log median income)	-0.413*** (0.137)	-5.130*** (0.972)	0.775*** (0.157)	-2.262** (1.003)
Log mean income	-0.930*** (0.083)	-1.015*** (0.087)	-0.886*** (0.181)	-0.801*** (0.180)
Med*voting rate		6.692*** (1.395)		4.308*** (1.413)
Voting rate		-0.003 (0.003)		-0.020*** (0.003)
Log corporate tax revenue per inhabitant	-0.021 (0.017)	-0.004 (0.016)	-0.032** (0.015)	-0.042*** (0.015)
Log Debt per inhabitant	0.173*** (0.008)	0.150*** (0.008)	0.066*** (0.006)	0.063*** (0.006)
Log Capital income per inhabitant	-0.248*** (0.022)	-0.234*** (0.021)	-0.035 (0.025)	-0.050* (0.025)
Log State aid per inhabitant	0.227*** (0.024)	0.184*** (0.023)	0.054** (0.023)	0.064*** (0.023)
Share of population under 15 years	1.559*** (0.295)	2.233*** (0.295)	5.631*** (0.830)	5.521*** (0.829)
Log Size of population	-0.054*** (0.010)	-0.051*** (0.011)	-0.156 (0.150)	-0.184 (0.149)
Years dummies	Yes	Yes	Yes	Yes
R-sq within			0.575	0.579
R-sq between			0.244	0.251
R-sq overall (adjusted R-sq)	(0.487)	(0.527)	0.353	0.360
Number of observations	4873	4873	4873	4873

Notes: Standard errors in parentheses: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.

Table A3. Model (3.2), system GMM estimators, dependent variable: municipal tax rate.

Explanatory variables		
Municipal tax rate $_{t-1}$	0.797*** (0.045)	0.737*** (0.047)
Med$_{t-1}$ (= log mean income minus log median income)	-0.048 (0.415)	-6.156* (3.161)
Log mean income$_{t-1}$	-0.521*** (0.173)	-0.289 (0.198)
(med*voting rate)$_{t-1}$		9.268* (4.870)
Voting rate$_{t-1}$		-0.001 (0.009)
Log Share of corporate tax revenue$_t$ per inhabitant	-0.107** (0.050)	-0.022 (0.053)
Log corporate tax revenue$_{t-1}$ per inhabitant	0.002 (0.052)	-0.026 (0.051)
Log Debt$_t$ per inhabitant	-0.027 (0.050)	-0.013 (0.059)
Log Debt$_{t-1}$ per inhabitant	0.055 (0.051)	0.052 (0.056)
Log Capital income$_t$ per inhabitant	-0.282*** (0.093)	-0.289*** (0.095)
Log Capital income$_{t-1}$ per inhabitant	0.075 (0.100)	-0.033 (0.097)
Log State aid $_t$ per inhabitant	0.082 (0.104)	0.082 (0.104)
Log State aid$_{t-1}$ per inhabitant	-0.228** (0.103)	-0.227** (0.103)
Years dummies	Yes	Yes
AR(1), pr > z	0.000	0.000
AR(2), pr > z	0.462	0.749
Hansen test for over-identifying restrictions, prob > chi2	0.140	0.405
Difference-in-Hansen tests of exogeneity of instrument subsets:		
GMM instruments for levels Hansen test excluding group, Prob > chi2 Difference (null = instruments are exogeneous), Prob > chi2	 0.459 0.012	 0.558 0.144
IV instruments Hansen test excluding group, Prob > chi2 Difference (null = instruments are exogeneous), Prob > chi2	 0.117 0.433	 0.216 0.915
Number of observations	4431	4431

Notes: Standard errors in parentheses: * Significant at 10%, ** Significant at 5%, *** Significant at 1%.