Multilevel taxation, competition, and sorting: Evidence from regional borders

Federico Revelli*° Roberto Zotti*

*Department of Economics and Statistics *Cognetti de Martiis*, University of Torino
°CESifo

May 2019

Introduction

- *Tax policy* can affect *income distribution* and reduce *inequality* through *progressive* personal income taxation, i.e., *average* tax rates *rising* with income

Introduction

- *Tax policy* can affect *income distribution* and reduce *inequality* through *progressive* personal income taxation, i.e., *average* tax rates *rising* with income

1. flat income tax rates combined with personal allowances/deductions

Introduction

- *Tax policy* can affect *income distribution* and reduce *inequality* through *progressive* personal income taxation, i.e., *average* tax rates *rising* with income

1. flat income tax rates combined with personal allowances/deductions
2. multiple increasing marginal tax rates

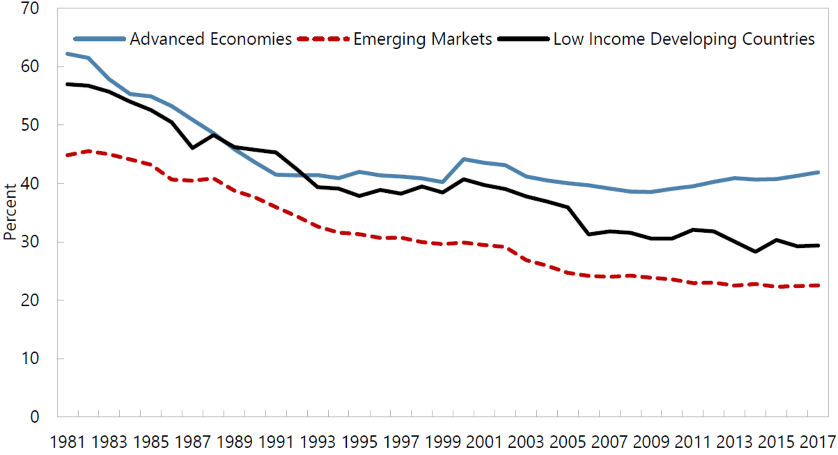
Introduction

- *Tax policy* can affect *income distribution* and reduce *inequality* through *progressive* personal income taxation, i.e., *average* tax rates *rising* with income

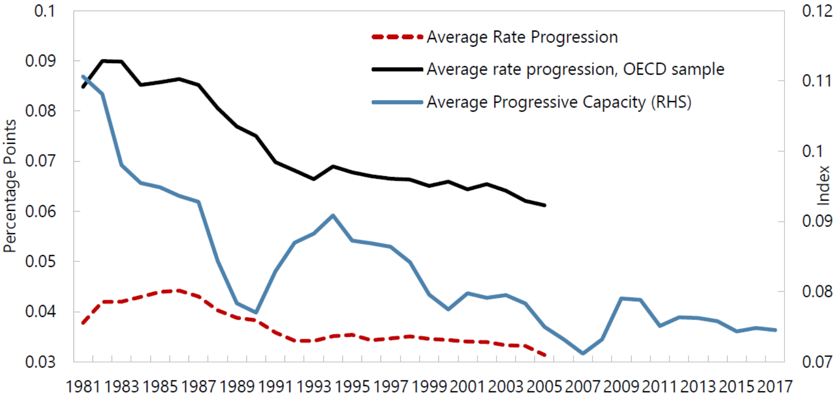
1. flat income tax rates combined with personal allowances/deductions
2. multiple increasing marginal tax rates

- Across the world, the degree of personal income tax progressivity has declined sharply in the 1980s and 1990s, and has remained broadly stable since then

Top personal income tax rates (IMF, 2018)



Tax progressivity (IMF, 2018)



Framework of this paper

- A number of countries keep on relying on the progressivity of the personal income tax as the main instrument for income redistribution

Framework of this paper

- A number of countries keep on relying on the progressivity of the personal income tax as the main instrument for income redistribution
- In Italy, the national personal income tax structure is progressive; in addition, local governments are allowed to set progressive personal income tax surcharges

Framework of this paper

- A number of countries keep on relying on the progressivity of the personal income tax as the main instrument for income redistribution
- In Italy, the national personal income tax structure is progressive; in addition, local governments are allowed to set progressive personal income tax surcharges
- Regions (20) and municipalities ($\sim 8,000$) set progressive surcharges (0-5%) that add to the progressive national income tax schedule (23-43%)

Italy: regional and municipal borders

Questions

- Do (wealthy) taxpayers sort according to local income tax differentials?

Questions

- Do (wealthy) taxpayers sort according to local income tax differentials?
- Does rich taxpayers' tax-induced mobility put a constraint on the ability of local governments to redistribute income?

Questions

- Do (wealthy) taxpayers sort according to local income tax differentials?
- Does rich taxpayers' tax-induced mobility put a constraint on the ability of local governments to redistribute income?
- How do local governments behave in the presence of taxpayers' mobility?

Questions

- Do (wealthy) taxpayers sort according to local income tax differentials?
- Does rich taxpayers' tax-induced mobility put a constraint on the ability of local governments to redistribute income?
- How do local governments behave in the presence of taxpayers' mobility?
- Is it a good idea to assign ability-to-pay (redistributive) taxes to local governments? Or benefit taxes (charges, fees for service consumption) would be preferable?

Objectives of this paper

1. First, estimate the response of individual location decisions (high-income taxpayers) to local income tax differentials in complex multi-tiered fiscal structures like the Italian one

Objectives of this paper

1. First, estimate the response of individual location decisions (high-income taxpayers) to local income tax differentials in complex multi-tiered fiscal structures like the Italian one
2. Second, explore the potential consequences of taxpayers' mobility on local government fiscal choices (tax competition)

Methodology

- Basic aim of the paper is to compare the results that are obtained when employing different econometric approaches ('traditional' versus 'new') to the estimation of: a) response of taxpayers' location to local taxes; b) fiscal reaction functions

Methodology

- Basic aim of the paper is to compare the results that are obtained when employing different econometric approaches ('traditional' versus 'new') to the estimation of: a) response of taxpayers' location to local taxes; b) fiscal reaction functions
- these are challenging empirical exercises because of: I) simultaneity of decisions of potentially mobile taxpayers and governments at different spatial locations; II) presence of several potential confounders (quality of public services, amenities, labour and housing markets)

Outline of presentation

1. Brief literature review

Outline of presentation

1. Brief literature review
2. Theoretical set-up: multilevel income taxation (*multiple fiscal federations structure*)

Outline of presentation

1. Brief literature review
2. Theoretical set-up: multilevel income taxation (*multiple fiscal federations structure*)
3. Income tax base mobility

Outline of presentation

1. Brief literature review
2. Theoretical set-up: multilevel income taxation (*multiple fiscal federations structure*)
3. Income tax base mobility
4. Fiscal reaction functions

Outline of presentation

1. Brief literature review
2. Theoretical set-up: multilevel income taxation (*multiple fiscal federations structure*)
3. Income tax base mobility
4. Fiscal reaction functions
5. Estimation results

Outline of presentation

1. Brief literature review
2. Theoretical set-up: multilevel income taxation (*multiple fiscal federations structure*)
3. Income tax base mobility
4. Fiscal reaction functions
5. Estimation results
6. Conclusions

1. Literature

- Taxation of personal income can exert an influence on the location of households, particularly those at the upper end of the income distribution

1. Literature

- Taxation of personal income can exert an influence on the location of households, particularly those at the upper end of the income distribution
- But evidence is scant: Kleven et al., *Journal of Economic Perspectives*, forthcoming

1. Literature

- Taxation of personal income can exert an influence on the location of households, particularly those at the upper end of the income distribution
- But evidence is scant: Kleven et al., *Journal of Economic Perspectives*, forthcoming
- *Data limitations*: information on migration patterns & reliable measures of earnings & detailed fiscal structures at possible locations (rates, exemptions, special provisions, ...)

1. Literature

- Taxation of personal income can exert an influence on the location of households, particularly those at the upper end of the income distribution
- But evidence is scant: Kleven et al., *Journal of Economic Perspectives*, forthcoming
- *Data limitations*: information on migration patterns & reliable measures of earnings & detailed fiscal structures at possible locations (rates, exemptions, special provisions, ...)
- *Identification challenges*: ideally one needs to find local tax variation that is orthogonal to all other factors affecting individual location choices, such as local labor markets conditions, local amenities and public goods

Income tax base mobility: recent works

- Martinez (2017): *difference-in-differences approach*: regressive income tax reform in the canton of Obwalden (Switzerland), using nearby cantons as controls; share of high-income taxpayers and taxable income raise after the reform.

Income tax base mobility: recent works

- Martinez (2017): *difference-in-differences approach*: regressive income tax reform in the canton of Obwalden (Switzerland), using nearby cantons as controls; share of high-income taxpayers and taxable income raise after the reform.
- Basten et al. (2017): *border-discontinuity approach*: compare Swiss neighborhoods facing different local income taxes because of being located on either side of a municipal border; high-income households are willing to pay higher rents for residing in neighborhoods that are wealthier and have lower income taxes

Income tax base mobility: recent works

- Martinez (2017): *difference-in-differences approach*: regressive income tax reform in the canton of Obwalden (Switzerland), using nearby cantons as controls; share of high-income taxpayers and taxable income raise after the reform.
- Basten et al. (2017): *border-discontinuity approach*: compare Swiss neighborhoods facing different local income taxes because of being located on either side of a municipal border; high-income households are willing to pay higher rents for residing in neighborhoods that are wealthier and have lower income taxes
- Agrawal and Foremny (2019): *regional pairwise origin-destination approach*: fiscal decentralization reform in Spain; significant impact of regional taxes on high-income taxpayers' location choices

Income tax reaction functions

- Eugster and Parchet (2019): Switzerland: even if nearby jurisdictions have differences in preferences that should lead to different income tax policies, being close reduces tax differentials through competition for mobile individuals: smooth tax gradient from strategic behavior of local governments anticipating fiscally-induced sorting.

Income tax reaction functions

- Eugster and Parchet (2019): Switzerland: even if nearby jurisdictions have differences in preferences that should lead to different income tax policies, being close reduces tax differentials through competition for mobile individuals: smooth tax gradient from strategic behavior of local governments anticipating fiscally-induced sorting.
- Parchet (2019): estimates a local income tax reaction function in a multi-tiered structure of government, finding a negative slope (local tax rates strategic substitutes)

2. Theoretical set-up: multilevel income taxation

- Structure of government: multiple ($\overline{R} \geq 2$) two-tiered fiscal federations (Agrawal, 2016). Each is made of an upper-tier (regional) authority $R = 1, ..., \overline{R}$ producing public good g_R, and of N_R lower-tier (municipal) governments $m(R)$ producing public good $g_{m(R)}$

2. Theoretical set-up: multilevel income taxation

- Structure of government: multiple ($\overline{R} \geq 2$) two-tiered fiscal federations (Agrawal, 2016). Each is made of an upper-tier (regional) authority $R = 1, ..., \overline{R}$ producing public good g_R, and of N_R lower-tier (municipal) governments $m(R)$ producing public good $g_{m(R)}$
- Household preferences: strictly quasi-concave utility function $u(c_{m(R)}, h_{m(R)}, g_R, g_{m(R)})$, where $c_{m(R)}$ denotes composite numeraire private consumption and $h_{m(R)}$ denotes housing consumption of a taxpayer residing in locality $m(R)$

2. Theoretical set-up: multilevel income taxation

- Structure of government: multiple ($\overline{R} \geq 2$) two-tiered fiscal federations (Agrawal, 2016). Each is made of an upper-tier (regional) authority $R = 1, ..., \overline{R}$ producing public good g_R, and of N_R lower-tier (municipal) governments $m(R)$ producing public good $g_{m(R)}$
- Household preferences: strictly quasi-concave utility function $u(c_{m(R)}, h_{m(R)}, g_R, g_{m(R)})$, where $c_{m(R)}$ denotes composite numeraire private consumption and $h_{m(R)}$ denotes housing consumption of a taxpayer residing in locality $m(R)$
- Regional and municipal public goods funded respectively by income taxes set at each tier on residents' gross income y: $i_R(y)$ and $i_{m(R)}(y)$ are the tax schedules, with: $i'_R(y), i'_{m(R)}(y) \geq 0$; $\bar{i}_R(y)$ and $\bar{i}_{m(R)}(y)$ denote average rates

- Taxpayer's budget constraint:

$$p_{m(R)}h_{m(R)} + c_{m(R)} \leq y\left[1 - \bar{i}_R(y) - \bar{i}_{m(R)}(y)\right]$$

where $p_{m(R)}$ price of housing

- Taxpayer's budget constraint:

$$p_{m(R)}h_{m(R)} + c_{m(R)} \leq y\left[1 - \bar{i}_R(y) - \bar{i}_{m(R)}(y)\right]$$

where $p_{m(R)}$ price of housing

- Indirect utility function of a resident in locality m in region R:

$$\begin{aligned} u(c^*_{m(R)}, h^*_{m(R)}) &= v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) \\ &= \frac{1}{\alpha}y^\alpha\left[\bar{k}_{m(R)}(y)\right]^\alpha - \frac{1}{\beta}p^\beta_{m(R)} + \frac{1}{\rho}g^\rho_R + \frac{1}{\mu}g^\mu_{m(R)} \end{aligned}$$

- Taxpayer's budget constraint:

$$p_{m(R)}h_{m(R)} + c_{m(R)} \leq y\left[1 - \bar{i}_R(y) - \bar{i}_{m(R)}(y)\right]$$

where $p_{m(R)}$ price of housing

- Indirect utility function of a resident in locality m in region R:

$$\begin{aligned} u(c^*_{m(R)}, h^*_{m(R)}) &= v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) \\ &= \frac{1}{\alpha}y^\alpha\left[\bar{k}_{m(R)}(y)\right]^\alpha - \frac{1}{\beta}p^\beta_{m(R)} + \frac{1}{\rho}g^\rho_R + \frac{1}{\mu}g^\mu_{m(R)} \end{aligned}$$

- where $c^*_{m(R)}$ and $h^*_{m(R)}$ are optimal consumption levels, and

$$\bar{k}_{m(R)}(y) \equiv 1 - \bar{i}_R(y) - \bar{i}_{m(R)}(y)$$

is the *average net-of-tax (retention) rate*

- with perfect mobility, utility must be equalized in all jurisdictions

$$v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) = v(y, p_{n(F)}, \bar{i}_F, \bar{i}_{n(F)}, g_F, g_{n(F)})$$

- with perfect mobility, utility must be equalized in all jurisdictions

$$v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) = v(y, p_{n(F)}, \bar{i}_F, \bar{i}_{n(F)}, g_F, g_{n(F)})$$

- housing market clears in each jurisdiction; housing prices are a function of income, taxes, public goods, and price elasticities of housing supply and demand

- with perfect mobility, utility must be equalized in all jurisdictions

$$v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) = v(y, p_{n(F)}, \bar{i}_F, \bar{i}_{n(F)}, g_F, g_{n(F)})$$

- housing market clears in each jurisdiction; housing prices are a function of income, taxes, public goods, and price elasticities of housing supply and demand
- under standard assumptions, public goods capitalise positively and average income tax rates capitalise negatively into housing prices

- with perfect mobility, utility must be equalized in all jurisdictions

$$v(y, p_{m(R)}, \bar{i}_R, \bar{i}_{m(R)}, g_R, g_{m(R)}) = v(y, p_{n(F)}, \bar{i}_F, \bar{i}_{n(F)}, g_F, g_{n(F)})$$

- housing market clears in each jurisdiction; housing prices are a function of income, taxes, public goods, and price elasticities of housing supply and demand
- under standard assumptions, public goods capitalise positively and average income tax rates capitalise negatively into housing prices
- where do high-income taxpayers prefer to live?

- Marginal rate of substitution between housing rent and average net-of-tax rate at location $m(R)$ is:

$$MRS_{p\overline{k}} = -\frac{\partial v / \partial \overline{k}}{\partial v / \partial p} = \frac{y^{\alpha} \left[\overline{k}_{m(R)}(y)) \right]^{\alpha - 1}}{p_{m(R)}^{\beta - 1}} > 0$$

- Marginal rate of substitution between housing rent and average net-of-tax rate at location $m(R)$ is:

$$MRS_{p\bar{k}} = -\frac{\partial v/\partial \bar{k}}{\partial v/\partial p} = \frac{y^{\alpha}\left[\bar{k}_{m(R)}(y))\right]^{\alpha-1}}{p_{m(R)}^{\beta-1}} > 0$$

- and it is unambiguously increasing in gross income y:

$$\frac{\partial MRS_{p\bar{k}}}{\partial y}$$

$$= \frac{\alpha y^{\alpha-1}\left[\bar{k}_{m(R)}(y)\right]^{\alpha-1}}{p_{m(R)}^{\beta-1}}\left[1 + \frac{(1-\alpha)y\left(\bar{i}'_R + \bar{i}'_{m(R)}\right)}{\alpha\bar{k}_{m(R)}(y)}\right] > 0$$

- Marginal rate of substitution between housing rent and average net-of-tax rate at location $m(R)$ is:

$$MRS_{p\bar{k}} = -\frac{\partial v/\partial \bar{k}}{\partial v/\partial p} = \frac{y^{\alpha}\left[\bar{k}_{m(R)}(y))\right]^{\alpha-1}}{p_{m(R)}^{\beta-1}} > 0$$

- and it is unambiguously increasing in gross income y:

$$\frac{\partial MRS_{p\bar{k}}}{\partial y} = \frac{\alpha y^{\alpha-1}\left[\bar{k}_{m(R)}(y)\right]^{\alpha-1}}{p_{m(R)}^{\beta-1}}\left[1+\frac{(1-\alpha)y\left(\bar{i}'_{R}+\bar{i}'_{m(R)}\right)}{\alpha\bar{k}_{m(R)}(y)}\right] > 0$$

- high-income taxpayers have higher willingness to pay for lower taxes

Empirical implications

1. First, the number of *high-income taxpayers* residing in any locality (and their *tax base*) is an increasing function of the average consolidated (municipal+regional) net-of-tax rate in that locality

Empirical implications

1. First, the number of *high-income taxpayers* residing in any locality (and their *tax base*) is an increasing function of the average consolidated (municipal+regional) net-of-tax rate in that locality
2. Second, the *optimal income tax policy* of a local authority depends on the tax policies of the other authorities

3. Tax base responsiveness

- Start from log-log specification in a panel data two-tiered structure framework:

$$\ln\left(y^h_{m(R)t}\right) = \lambda \ln\left(k^h_{m(R)t}\right) + \ln\left(\mathbf{x}_{m(R)t}\right)' \gamma + \varepsilon_{m(R)t}$$

3. Tax base responsiveness

- Start from log-log specification in a panel data two-tiered structure framework:

$$\ln\left(y^h_{m(R)t}\right) = \lambda \ln\left(k^h_{m(R)t}\right) + \ln\left(\mathbf{x}_{m(R)t}\right)' \gamma + \varepsilon_{m(R)t}$$

- where the *top consolidated marginal net-of-tax rate* is employed as a proxy of the *average consolidated net-of-tax rate:*

$$k^h_{m(R)t} = 1 - i^h_{Nt} - i^h_{Rt} - i^h_{m(R)t}$$

3. Tax base responsiveness

- Start from log-log specification in a panel data two-tiered structure framework:

$$\ln\left(y^h_{m(R)t}\right) = \lambda \ln\left(k^h_{m(R)t}\right) + \ln\left(\mathbf{x}_{m(R)t}\right)' \gamma + \varepsilon_{m(R)t}$$

- where the *top consolidated marginal net-of-tax rate* is employed as a proxy of the *average consolidated net-of-tax rate:*

$$k^h_{m(R)t} = 1 - i^h_{Nt} - i^h_{Rt} - i^h_{m(R)t}$$

- where i^h_{Nt} is the top national income tax rate, and $\varepsilon_{m(R)t}$ includes municipal fixed effects ($\ell_{m(R)}$) and region-year (s_{Rt}) fixed effects:

$$\varepsilon_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$$

3. Tax base responsiveness

- Start from log-log specification in a panel data two-tiered structure framework:

$$\ln\left(y^h_{m(R)t}\right) = \lambda \ln\left(k^h_{m(R)t}\right) + \ln\left(\mathbf{x}_{m(R)t}\right)' \gamma + \varepsilon_{m(R)t}$$

- where the *top consolidated marginal net-of-tax rate* is employed as a proxy of the *average consolidated net-of-tax rate:*

$$k^h_{m(R)t} = 1 - i^h_{Nt} - i^h_{Rt} - i^h_{m(R)t}$$

- where i^h_{Nt} is the top national income tax rate, and $\varepsilon_{m(R)t}$ includes municipal fixed effects ($\ell_{m(R)}$) and region-year (s_{Rt}) fixed effects:

$$\varepsilon_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$$

- $k^h_{m(R)t}$ endogenous? Reverse causality. Use $k^h_{m(R)t-1}$

4. Fiscal reaction function

Is the tax policy of a municipality influenced by the tax policies of neighboring authorities? Do they affect each other in income tax policy making?

$$i^h_{m(R)t} = \rho i^h_{-m(R)t} + \phi i^h_{Rt} + \delta i^h_{-Rt} + \psi_{m(R)t} \tag{1}$$

$$i^h_{-m(R)t} = \sum_{j \in R} w_{mj} i^h_{j(R)t} + \sum_{k \in F \neq R} w_{mk} i^h_{k(F)t}$$

$$\sum_{j \in R} w_{mj} + \sum_{k \in F \neq R} w_{mk} = 1$$

$$i^h_{-Rt} = \sum_{F \neq R} w_{mF} i^h_{Ft}$$

$$\sum_{F \neq R} w_{mF} = 1$$

Estimation: ‘traditional’ approaches

- How to estimate (1)? Write (1) in matrix form:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_R + \delta \mathbf{W}\mathbf{i}_R + \boldsymbol{\psi} \tag{2}$$

Estimation: 'traditional' approaches

- How to estimate (1)? Write (1) in matrix form:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_R + \delta \mathbf{W}\mathbf{i}_R + \boldsymbol{\psi} \tag{2}$$

- Invert the equation and estimate by <u>maximum likelihood</u> if willing to make hypotheses on $\boldsymbol{\psi}$:

$$\mathbf{i} = (\mathbf{I} - \rho \mathbf{W})^{-1} (\phi + \delta \mathbf{W}) \mathbf{i}_R + (\mathbf{I} - \boldsymbol{\rho} \mathbf{W})^{-\mathbf{1}} \boldsymbol{\psi} \tag{3}$$

Estimation: 'traditional' approaches

- How to estimate (1)? Write (1) in matrix form:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_R + \delta \mathbf{W}\mathbf{i}_R + \boldsymbol{\psi} \tag{2}$$

- Invert the equation and estimate by maximum likelihood if willing to make hypotheses on $\boldsymbol{\psi}$:

$$\mathbf{i} = (\mathbf{I} - \rho \mathbf{W})^{-1} (\phi + \delta \mathbf{W})\, \mathbf{i}_R + (\mathbf{I} - \boldsymbol{\rho} \mathbf{W})^{-\mathbf{1}} \boldsymbol{\psi} \tag{3}$$

- Instrumental variable: exogenous own determinant of top marginal tax rates in a locality (some variable in matrix **X** below) that has no direct effect on tax rates in nearby localities - **WX** does not appear in (4) - but only an indirect effect through tax policy:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_\mathbf{R} + \delta \mathbf{W}\mathbf{i}_\mathbf{R} + \mathbf{X}\beta + \boldsymbol{\psi} \tag{4}$$

Estimation: 'traditional' approaches

- How to estimate (1)? Write (1) in matrix form:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_R + \delta \mathbf{W}\mathbf{i}_R + \boldsymbol{\psi} \tag{2}$$

- Invert the equation and estimate by <u>maximum likelihood</u> if willing to make hypotheses on $\boldsymbol{\psi}$:

$$\mathbf{i} = (\mathbf{I} - \rho \mathbf{W})^{-1} (\phi + \delta \mathbf{W}) \mathbf{i}_R + (\mathbf{I} - \boldsymbol{\rho} \mathbf{W})^{-\mathbf{1}} \boldsymbol{\psi} \tag{3}$$

- <u>Instrumental variable</u>: exogenous own determinant of top marginal tax rates in a locality (some variable in matrix **X** below) that has no direct effect on tax rates in nearby localities - **WX** does not appear in (4) - but only an indirect effect through tax policy:

$$\mathbf{i} = \rho \mathbf{W}\mathbf{i} + \phi \mathbf{i}_\mathbf{R} + \delta \mathbf{W}\mathbf{i}_\mathbf{R} + \mathbf{X}\beta + \boldsymbol{\psi} \tag{4}$$

- Alternatively, use lags of **i** as instruments; or estimate a lagged reaction function:

$$i^h_{m(R)t} = \rho i^h_{-m(R)t-1} + \phi i^h_{Rt} + \delta i^h_{-Rt} + \psi_{m(R)t} \tag{5}$$

BDD (Parchet, AEJ: EP, 2019)

- Border discontinuity design: focus on municipalities located on a regional border, that have at least one neighbor municipality that is located on the other side of the border, in a different region (Swiss Canton).

BDD (Parchet, AEJ: EP, 2019)

- Border discontinuity design: focus on municipalities located on a regional border, that have at least one neighbor municipality that is located on the other side of the border, in a different region (Swiss Canton).
- Reaction function of municipality ($m(R)$) relative to a weighted average of *consolidated* (municipal+cantonal) marginal tax rates of *all* neighboring municipalities:

$$i^h_{m(R)t} = \rho \widetilde{i}^h_{-m(R)t} + \psi_{m(R)t} \tag{6}$$

$$\widetilde{i}^h_{-m(R)t} = \left[\sum_{j \in R} w_{mj} \left(i^h_{j(R)t} + i^h_{Rt} \right) + \sum_{k \in F} w_{mk} \left(i^h_{k(F)t} + i^h_{Ft} \right) \right]$$

$$\sum_{j \in R} w_{mj} + \sum_{k \in F \neq R} w_{mk} = 1$$

BDD (Parchet, AEJ: EP, 2019)

- (6) is a restricted (non-nested) version of (1).

BDD (Parchet, AEJ: EP, 2019)

- (6) is a restricted (non-nested) version of (1).
- Instrumental variable: top marginal tax rate of neighboring region (i^h_{Ft}), weighted by the share of adjacent municipalities that are located in the neighboring region

$$z_{m(R)t} = \sum_{k \in F} w_{mk} i^h_{Ft} = \frac{N_{mF}}{N_m} i^h_{Ft}$$

5. Estimation results: tax base response

$$\ln\left(y^h_{m(R)t}\right) = \lambda \ln\left(k^h_{m(R)t}\right) + \ln\left(\mathbf{x}_{m(R)t}\right)' \gamma + \varepsilon_{m(R)t}$$

	$\varepsilon_{m(R)t} = \ell_{m(R)} + \iota_t + u_{m(R)t}$		$\varepsilon_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$	
$k^h_{m(R)t}$	0.032 (0.306)		0.958 (0.826)	
$k^h_{m(R)t-1}$		0.842*** (0.326)		0.984 (0.817)
obs.	54,542	51,318	54,542	51,318

5. Estimation results: reaction function

Horizontal, vertical, and diagonal fiscal externalities

$$i^h_{m(R)t} = \rho \underbrace{i^h_{-m(R)t}}_{\text{horizontal}} + \phi \underbrace{i^h_{Rt}}_{\text{vertical}} + \delta \underbrace{i^h_{-Rt}}_{\text{diagonal}} + \psi_{m(R)t}$$

	$\psi_{m(R)t} = \ell_{m(R)} + \iota_t + u_{m(R)t}$		$\psi_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$	
	all	border	all	border
ρ	0.519***	0.496***	0.351***	0.353***
	(0.012)	(0.039)	(0.015)	(0.042)
ϕ	0.001	0.006		
	(0.002)	(0.005)		
δ	-0.003	0.005	-0.010*	-0.003
	(0.005)	(0.006)	(0.005)	(0.002)
obs.	110,782	14,294	110,782	14,294

5. Estimation results: reaction function

Lagged specification

$$i^h_{m(R)t} = \rho i^h_{-m(R)t-1} + \phi i^h_{Rt} + \delta i^h_{-Rt} + \psi_{m(R)t}$$

	$\psi_{m(R)t} = \ell_{m(R)} + \iota_t + u_{m(R)t}$		$\psi_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$	
	all	border	all	border
ρ	0.477***	0.459***	0.317***	0.331***
	(0.012)	(0.037)	(0.014)	(0.040)
ϕ	0.002	0.009		
	(0.002)	(0.006)		
δ	-0.002	0.009	-0.010*	-0.002
	(0.005)	(0.006)	(0.005)	(0.008)
obs.	110,782	14,294	110,782	14,294

5. Estimation results: reaction function

BDD (Parchet, 2019)

$$i^h_{m(R)t} = \rho \widetilde{i}^h_{-m(R)t} + \psi_{m(R)t} \tag{7}$$

	$\psi_{m(R)t} = \ell_{m(R)} + \iota_t + u_{m(R)t}$			
	IV	first stage	IV	first stage
$\widetilde{i}^h_{-m(R)t}$	-0.331***		-0.246***	
	(0.066)		(0.060)	
i^h_{Ft}		0.282***		
		(0.014)		
$\frac{N_{mF}}{N_m} i^h_{Ft}$				0.731***
				(0.028)
obs.	14,294			

5. Estimation results: reaction function

BDD (Parchet, 2019)

$$i^h_{m(R)t} = \rho \widetilde{i}^h_{-m(R)t} + \psi_{m(R)t} \tag{8}$$

	$\psi_{m(R)t} = \ell_{m(R)} + s_{Rt} + u_{m(R)t}$			
	IV	first stage	IV	first stage
$\widetilde{i}^h_{-m(R)t}$	-0.006 (0.020)		-0.019 (0.022)	
i^h_{Ft}		0.349*** (0.013)		
$\frac{N_{mF}}{N_m} i^h_{Ft}$				0.799*** (0.023)
obs.	14,294			

6. Conclusions

- income tax policy decentralization in multi-tiered government structures potentially creates the conditions for a number of fiscal externalities

6. Conclusions

- income tax policy decentralization in multi-tiered government structures potentially creates the conditions for a number of fiscal externalities
- empirically evaluating the direction and size of those externalities is an extremely challenging exercise

6. Conclusions

- income tax policy decentralization in multi-tiered government structures potentially creates the conditions for a number of fiscal externalities
- empirically evaluating the direction and size of those externalities is an extremely challenging exercise
- estimating the response of the income tax base to local tax differentials in a fragmented structure where local tax rates show strong positive spatial auto-correlation is an important and mostly unresolved issue

6. Conclusions

- income tax policy decentralization in multi-tiered government structures potentially creates the conditions for a number of fiscal externalities
- empirically evaluating the direction and size of those externalities is an extremely challenging exercise
- estimating the response of the income tax base to local tax differentials in a fragmented structure where local tax rates show strong positive spatial auto-correlation is an important and mostly unresolved issue
- border-discontinuity instrumental variable estimators that use cross-border upper-tier tax policies as instruments for lower-tier spatial lags generate results that crucially depend on unwarranted restrictions on the parameters of the fiscal reaction function