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Working Paper

## Decentralization and Progressive Taxation

CESifo Working Paper, No. 8862

**Provided in Cooperation with:**

Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

*Suggested Citation:* Berset, Simon; Schelker, Mark (2021) : Decentralization and Progressive Taxation, CESifo Working Paper, No. 8862, Center for Economic Studies and Ifo Institute (CESifo), Munich

This Version is available at:

<https://hdl.handle.net/10419/232459>

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# Decentralization and Progressive Taxation

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## **Impressum:**

CESifo Working Papers

ISSN 2364-1428 (electronic version)

Publisher and distributor: Munich Society for the Promotion of Economic Research - CESifo GmbH

The international platform of Ludwigs-Maximilians University's Center for Economic Studies and the ifo Institute

Poschingerstr. 5, 81679 Munich, Germany

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Editor: Clemens Fuest

<https://www.cesifo.org/en/wp>

An electronic version of the paper may be downloaded

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# Decentralization and Progressive Taxation

## Abstract

The traditional normative literature on fiscal federalism argues that redistributive policies should be centralized in order to avoid welfare- or tax-induced migration. However, recent evidence shows that even in a setup where the progressivity of the income tax schedule is centralized to an upper-layer government and local governments are involved in tax competition with only a tax shifter, local mobility induces income sorting. Hence, despite centralized redistributive taxation, the resulting effective tax schedule is less progressive than what is set in the tax code. We argue that upper-layer governments anticipate the impact of local income sorting and strategically adjust their statutory tax schedules. We analyze Swiss panel data and apply causal machine learning methods to identify the effects of decentralization on the statutory tax structure. We provide evidence that more decentralized cantons reduce the tax burden for lower and intermediate income classes and hence implement more redistributive statutory tax schedules. This strategic adjustment is limited by the mobility of the tax base.

JEL-Codes: H730, H770, H710.

Keywords: fiscal federalism, decentralized taxation, redistribution, progressive income taxes.

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We thank Raphaël Parchet as well as Kay Axhausen and his team for providing data. We are grateful for helpful comments and suggestions by Jim Alt, Reiner Eichenberger, Lars Feld and Jon Fiva on an early version of this manuscript and Sonia Paty, Christoph Schaltegger, Andreas Kyriacou, Kim Hyuna, and the participants in the seminars and conferences at University of Fribourg, EPCS (Cambridge), IIPF (Lugano), SSES (Basle), Bodensee Forum, Assistentenkonferenz (Freiburg), Colloque Réseau finances publiques locales (Paris), ISNIE (Cambridge, MA) on the actual version of this paper. This study has been realized using the data collected by the Swiss Household Panel, which is based at the Swiss Centre of Expertise in the Social Sciences FORS. The project is financed by the Swiss National Science Foundation.

## 1 Introduction

It is often feared that fiscal decentralization undermines welfare policies or at least leads to inefficiently low levels of redistribution through the competitive pressure it puts on local governments (Persson and Tabellini 1996; Dixit and Londregan 1998; Wheaton 2000). To preserve efficient levels of redistribution, already the seminal normative contributions by Tiebout (1956), Stigler (1957), Musgrave (1971) and Oates (1972) argue that the redistributive function of the public sector must be centralized. However, recent contributions have shown that even with a centralized definition of a progressive income tax scheme, income sorting might undermine effective income redistribution (e.g., Feld and Kirchgässner 2001; Hodler and Schmidheiny 2006; Schmidheiny 2006a; Schaltegger, Somogyi, and Sturm 2011). If the tax base is mobile, high-income individuals with high statutory tax rates would sort into jurisdictions with on overall lower exploitation of the tax base.

We argue that policymakers in upper-level governments might internalize the effects of income sorting and the resulting flattening of the effective tax schedule. Accordingly, they define statutory tax schedules, which are more redistributive than without such income sorting. We analyze the impact of different degrees of fiscal decentralization on the structure of statutory income taxes. We take advantage of the Swiss institutional environment where 26 upper-layer governments (cantons) define the degree of autonomy provided to their local governments (municipalities). The cantons define the income tax schedule, while municipalities levy a tax shifter (tax multiplier) on that same tax scheme. Hence, it is an upper-level government which decides on the redistributive part of taxation (progressivity), while local governments decide on a surcharge only (level). We estimate how different degrees of fiscal decentralization affect the statutory tax structure (level and progressivity).

We find that fiscal decentralization tends to reduce the relative statutory tax burdens overall, and, more interestingly, in particular for the lower to intermediate income groups of low mobility households (such as households with children). These results are consistent with our hypothesis that cantonal decision-makers internalize potential income-sorting effects at the local level, which might undermine effective income redistribution via the tax system. As a result, they implement more redistributive statutory tax schemes for the less-mobile taxpayer segments, where sorting remains incomplete.

The rest of the paper is structured as follows. Section 2 reviews the related literature. Section 3 states the testable hypothesis. Section 4 provides a description of the institutional environment with particular attention to Swiss fiscal federalism and to the natural persons' income taxation. Section 5 presents the empirical strategy. After the description of our dataset, we discuss our

identification strategy and the empirical models. Section 6 presents the results. To illustrate our findings, we use our estimation results to calculate the counterfactual tax schedule of a centralized region if it were to become—*ceteris paribus*—more fiscally decentralized. Section 7 is the conclusion.

## 2 Literature review

### 2.1 Level effects of fiscal decentralization on taxation

The early public finance literature on the impact of decentralization on efficiency has established some of the classic ideas, which still today affect our thinking. According to Tiebout's famous 'voting-by-feet' hypothesis, decentralization allows citizens to choose the jurisdiction which best corresponds to their preferences for local public goods and services given a specific tax price (Tiebout 1956). Oates' similarly famous decentralization theorem holds that decentralized public goods provision is more efficient than a centralized organization (Oates 1972, 1999). The Public Choice critique of traditional public finance argues that decentralization prevents self-serving and intrusive governments (leviathans) to overly exploit their tax base (Brennan and Buchanan 1980). These core ideas laid the ground for subsequent models. Key drivers of these models pertain to a comparatively small number of assumptions, such as the mobility of the tax base, the degree of preference heterogeneity, whether or not there are interjurisdictional spillovers (externalities), and the nature and form of governments.

The models by Wilson (1986) and Zodrow and Mieszkowski (1986) marked the beginning of a rich literature on tax competition.<sup>1</sup> They demonstrate that decentralized taxation creates fiscal externalities (a tax increase in jurisdiction  $i$  induces a tax base inflow in jurisdiction  $j$ ) and that those are not internalized by subcentral jurisdictions. As a consequence, the tax rates are set at an inefficiently low level. Wildasin (1991) shows that the same conclusion is valid as far as welfare policies are concerned. Following the conclusion of these models, the tax decisions should be centralized. When the same tax base is taxed by several layers of governments, Keen and Kotsogiannis (2002) note that another type of fiscal externality appears. Whereas horizontal tax competition makes jurisdictions underestimate the positive externality induced by a tax increase, vertical tax competition has the opposite effect. For instance, a tax increase decided by the central government has a negative externality on the subcentral government since it will drive away part of the tax base. From this viewpoint, tax rates might be set at an inefficiently

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<sup>1</sup> For a review of this literature, see Wilson (1999) or Brueckner (2003) for a literature review of all government interactions.

high level. In both scenarios (horizontal and vertical tax competition), the size of the externality depends on the tax price elasticity of taxpayers, i.e., the mobility of the tax base.

In contrast, Besley and Case (1995) take a politico-economic perspective and argue that jurisdictions may react to fiscal policies implemented by neighboring jurisdictions even if the tax base is immobile. This phenomenon is referred to as yardstick competition and is closely related to political competition. According to this hypothesis, the tax interaction comes from the ability of voters to compare the performance of their policymakers with the neighboring jurisdictions. This gives an incentive to the local incumbents seeking reelection to mimic each other.

Although both sources of tax interaction—tax competition and yardstick competition—are not mutually exclusive, they have different policy implications.<sup>2</sup> Whereas in tax competition models decentralization results in inefficient outcomes, in yardstick competition models decentralization enhances the efficiency of the political system since it conveys information to voters. From an empirical perspective, both strands of the literature would formulate the same testable hypothesis: Fiscal decentralization has a negative *level effect* on the tax schemes. Given the competitive pressure, the average tax rates are relatively lower in decentralized environments. A number of empirical studies observe that fiscal decentralization is indeed associated with a smaller public sector in terms of expenditures and revenues (e.g., Oates 1985; Shadbegian 1999; Feld, Kirchgässner, and Schaltegger 2010).<sup>3</sup>

## 2.2 Redistributive effects of fiscal decentralization in taxation

The *redistributive* effect of fiscal decentralization is more ambiguous. On the one hand, fiscal decentralization may affect how governments define the statutory structure of the tax schedule. One of the main arguments is that tax competition induces governments to try to attract higher-income groups and discourage lower-income groups that might qualify for social transfers (e.g., Moffitt 1992; Kirchgässner and Pommerehne 1996). This argument depends crucially on the mobility of the tax base. Low mobility costs provide strong incentives for tax and welfare migration, undermining redistributive spending and taxation. By and large, the theoretical

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<sup>2</sup> Among other authors, Bordignon, Cerniglia, and Revelli (2003) or Edmark and Ågren (2008) attempt to discriminate yardstick competition from other types of interactions. See also Allers and Elhorst (2005), who discuss the literature on yardstick competition and distinguish yardstick from other forms of fiscal competition.

<sup>3</sup> Note that the impact of fiscal decentralization on the public sector size might depend on the type of fiscal decentralization that is implemented. Decentralization with limited local taxing power or based on vertical grants might produce an opposite effect. For instance, in an EU-15 cross-country study, Cassette and Paty (2010) find that vertical imbalance tends to increase the aggregated size of the public sector. They further show that revenue decentralization reduces the size of the central government but increases the size of the subcentral jurisdiction to a greater extent.

literature seems to reach a certain consensus in predicting that decentralization limits the implementation of decentralized redistribution (Inman and Rubinfeld 1996). A limit to such dynamics would be to centralize the redistributive decision at higher levels of government, across which mobility costs are higher and tax and welfare migration are less likely (e.g., Musgrave 1971, 1997; Sinn 2003).

On the other hand, decentralization might undermine effective redistribution via progressive taxation even when the definition of a redistributive tax schedule is centralized. The underlying assumption is that fiscal decentralization induces sorting of individuals not only by their preferences for public goods but also by income and tax burden (e.g., Ellickson 1971; Westhoff 1977; Ross and Yinger 1999; Epple and Nechyba 2004; Schmidheiny 2006b, 2006a; Schaltegger, Somogyi, and Sturm 2011). Hodler and Schmidheiny (2006) investigate the effect of income sorting on the progressivity of the effective tax schedule in the highly decentralized canton of Zurich. In the Swiss setting, the definition of the tax structure is centralized at the higher-level jurisdiction (cantons), while local jurisdictions compete among each other by setting a tax surcharge on the cantonal tax schedule to finance local public goods. Hence, tax competition among local governments cannot directly affect the statutory tax schedule. However, taxpayers are mobile and can sort into different local municipalities, which are able to set different tax multipliers. Hodler and Schmidheiny (2006) describe and model a mechanism of local income sorting which depends on the trade-off between local taxation and the housing prices. They show that if preferences of taxpayers are homogenous, income sorting is complete and the statutory tax progression is *de facto* neutralized. Rich households (poor households) locate in local jurisdictions with low (high) tax shifters and high (low) housing prices, which undermines redistributive income taxation. However, heterogeneous preferences make sorting incomplete, and some level of redistribution through income taxes prevails.

Overall, the theoretical implications for the efficiency of redistributive policies are mixed. They typically depend on a few crucial assumptions such as the utility function that is attributed to the government and the mobility of households.<sup>4</sup> In the presence of benevolent governments, decentralization leads to inefficiently low levels of redistribution. With Leviathan governments, decentralization reduces the inefficiently high levels of redistribution, which improves efficiency.<sup>5</sup> In most theoretical models, the key component is sensitivity to the redistributive

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<sup>4</sup> For instance, see Wilson and Wildasin (2004) for a review of the efficiency and distributive implications of tax competition models.

<sup>5</sup> Assuming a Leviathan government, Wilson (2005) and Wilson and Wildasin (2004) argue that in response to efficiency-enhancing competition, the demand for redistribution might increase, which leads to an increase in public sector size.



policies of both the beneficiaries and contributors, often modeled through their mobility. Local redistribution is theoretically only possible if the mobility of the taxpayers is limited or if the insurance character of income redistribution leads to incentive compatibility between beneficiaries and contributors at the postconstitutional stage (Feld 2000). The propensity to respond to redistributive policies, for instance by migrating, depends on the mobility costs of taxpayers and on their location preferences.

Empirical evidence on the distributive effects of fiscal decentralization is still scarce. In the context of Switzerland, where a substantial part of redistributive policies are implemented by subcentral governments, Kirchgässner and Pommerehne (1996) and Feld (2000) find no evidence supporting a “race to the bottom”.

Recent evidence of the income segregation hypothesis shows that fiscal decentralization can provide incentives for individuals to sort by income and tax burden (e.g., Hodler and Schmidheiny 2006; Schmidheiny 2006b, 2006a; Schaltegger, Somogyi, and Sturm 2011; Roller and Schmidheiny 2016). Specifically, Hodler and Schmidheiny (2006) show that in a decentralized jurisdiction, the observed effective progression is lower than the statutory tax scheme. Their findings indicate that centralizing the definition of a progressive tax schedule (while leaving local autonomy over a tax shifter) does not prevent a flattening of statutory progressivity, resulting in a lower degree of effective progression if taxpayers self-sort along the income dimension. However, despite the fact that the effective tax progression is inferior to the statutory progression, they show empirically that even within the metropolitan area of Zurich with very low mobility costs, the effective tax burden remains progressive and redistributive taxation remains possible.

### **3 Hypotheses**

We expect fiscal decentralization to affect the tax schemes in several ways: Firstly, it should have a level effect. As emphasized in the “first generation” literature (Tiebout 1956; Musgrave 1971; Oates 1972; Brennan and Buchanan 1980), decentralization is expected to offer gains in terms of efficiency.<sup>6</sup> Moreover, stronger local tax as well as yardstick competition should reduce municipal tax shifters (Wilson 1986; Zodrow and Mieszkowski 1986; Besley and Case 1995). Hence, our level hypothesis states that the average tax rates should be relatively lower in decentralized than centralized cantons.

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<sup>6</sup> Usually, the gains in terms of efficiency are expected to translate into tax decreases. However, a more efficient provision of public goods might lead to an increase in the demand for public goods. In the latter case, the impact on taxation is ambiguous.

H.1: Fiscal decentralization leads to lower overall levels of income taxation.

Secondly, upper-level governments might anticipate that income sorting undermines actual income redistribution. Rational upper-level governments would react to the behavior of their tax base and strategically set the statutory tax structure to accommodate the flattening effects of income sorting by adapting the statutory tax schedule to achieve their distributional objectives. Of course, such strategies can only be successful with either heterogeneous preferences along the income dimension or—more intuitively in our application—limited mobility of the tax base, i.e., higher mobility costs.<sup>7</sup>

H.2: To counteract the flattening effect of income sorting on effective tax progression, decision-makers in more decentralized cantons adapt their statutory tax schedule to achieve their distributional objectives in the case of less-mobile tax bases.

We test these hypotheses with data at the Swiss cantonal and local level. The data at our disposal allow us to observe the cantonal and municipal statutory tax schemes. We observe the statutory tax burden of cantonal and local income taxes by income class. The available data distinguish four types of taxpayers facing different mobility costs (single, married, married with two children, retired). Given our data, we can test the level-effect hypothesis (H.1) as well as the “statutory tax progression” hypothesis (H.2).<sup>8</sup>

## 4 Institutional setup

### 4.1 Fiscal federalism in Switzerland

Switzerland is a federal state with a highly decentralized political structure that consists of three hierarchical government layers: The Confederation (central government), the cantons (the equivalent of U.S. states) and the municipalities (the local governments). The country counts 26 cantons and 2'294 local municipalities (in January 2016).<sup>9</sup> Looking at the relative importance of each layer of government, we note that the Confederation is responsible for about

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<sup>7</sup> In a recent paper, Ly and Paty (2020) use a 2010 French local tax reform, which reduced the degree of mobility of the tax base, to investigate the effect of capital mobility on local tax rates in France. In line with the argument that decision-makers internalize taxpayers' mobility when defining tax schemes, they find that local governments increased their tax rates in response to this reform.

<sup>8</sup> Note that we cannot test to what extent more progressive statutory tax schemes affect the effective progressivity of taxation. The estimation of the impact of decentralization on the effective tax progression would require observing the income distribution at the municipal level. Due to data restriction concerning the income distribution at the Swiss municipal level, we are not able to extend the test to include the effective tax progression. We have to refer to Hodler and Schmidheiny (2006) and Roller and Schmidheiny (2016) who observe a significant, though not perfect, flattening of the effective tax schedule.

<sup>9</sup> The number of municipalities has substantially decreased since the mid-1990s. In some cantons, municipalities engaged in amalgamations. Consequently, the number of municipalities went from 2'975 in 1995 to 2'294 in 2016. Our empirical analysis is based on the universe of municipalities existing at the end of 2010.

34%, the cantons together for about 43% and the municipalities together for about 23% of public expenditures and revenues (own calculation based on Federal Finance Administration, FFA, 2015) .

The cantons are responsible for all tasks which are not jointly delegated to the federal government (bottom-up), and they can independently decide to delegate some to their municipalities (top-down). If not delegated to the municipal level, cantons are, for instance, in charge of education, public security, health services, cultural matters, the implementation of the federal legislations in specific areas, etc. In the present study, we focus on the distribution of competences between cantons and their municipalities.<sup>10</sup> Although the degree of local autonomy varies greatly, the general institutional environment can be described as rather unified. Overall, citizens enjoy an important degree of political participation rights via instruments of direct democracy, such as voter initiatives and different forms of referenda, as well as via the election of local officials.<sup>11</sup>

The cantonal and municipal autonomy over spending decisions goes hand in hand with the responsibility to raise the necessary revenues. Financial transfers from one government layer to another represent only a small part of the respective revenues of the three government layers. For instance, less than 15% of the total annual current receipts of municipalities come from transfers from other layers of government (FFA, 2015). The three government layers have access to different sources of revenue, over which they enjoy a certain degree of sovereignty. The Confederation raises more than 50% of its annual current receipts from consumption taxes (mostly the value-added tax and the mineral oil taxes), and direct taxes on incomes of natural persons and profits of legal entities both represent less than 15%. In contrast, cantons and municipalities do not have access to consumption taxes and rely mostly on direct taxes. About 55% of the cantons' annual current receipts stem from direct taxes on the income and wealth of natural persons as well as on the profits of legal entities. The annual current receipts of municipalities mainly stem from direct taxes on natural persons' income and wealth (about 45% together) and on legal entities (about 10%), and different receipts from exchange transactions (about 20%).

Redistributive policies can be implemented on both the revenue and expenditure sides. On the revenue side, redistribution is mainly achieved through progressive income taxes at all three

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<sup>10</sup> For further details about the competences of municipalities, see Ladner (1994).

<sup>11</sup> Given the federal structure, the modalities related to direct democratic participation rights differ across cantons and municipalities. For further details about the impact of the instruments of direct democracy, see for instance Feld and Matsusaka (2003), Frey and Stutzer (2000), and Funk and Gathmann (2011).

levels. However, it is by far the cantonal and the municipal levels that redistribute the most in absolute terms.<sup>12</sup> On the expenditure side, the three layers share competencies. For instance, whereas the pension system is mainly regulated by the Confederation, cantons provide, on a voluntary basis, supplementary pensions to their poor retirees. In addition, cantons and municipalities are responsible for the provision and the financing of social assistance. Feld (2000) concludes that the Swiss redistribution system can be considered as rather decentralized. Hence, if fiscal competition and low mobility costs of taxpayers were to easily provoke a collapse of redistributive policies, we should observe it in Switzerland.

#### 4.2 The natural persons' income tax

Our empirical analysis focuses on the cantonal and municipal taxation of natural persons' annual income. Cantons individually define three parameters of the income tax scheme. First, they define the income tax base  $y$  (within a federal framework) by setting the amount of tax allowances (or tax deductions). Formally,  $y = y^g - (d_1 + d_2 + \dots + d_n)$ , with  $y^g$  being the gross income and  $d_1 + \dots + d_n$  the tax deductions. Secondly, they define the progressivity of the tax scheme in their cantonal tax law. Thirdly, they fix periodically a tax surcharge (or tax shifter).<sup>13</sup> Hence, in canton  $i$ , the cantonal tax burden  $T_i$  is a function of the taxable income  $y$  and corresponds to:

$$T_i(y) = t_i r_i(y) y,$$

with  $t_i$  being the cantonal tax shifter and  $r_i$  the cantonal tax schedule, which is a function of the taxable income. It can be modeled as a continuous and progressive function ( $r(y) < 0$  and  $r'(y) > 0$ ). Taking the parameters of the cantonal income tax as given, a municipality  $j$  can levy a surcharge  $t_j$ , which is a multiplier on the cantonal tax scheme. The municipal income tax burden corresponds to:

$$T_j(y) = t_j r_i(y) y$$

Hence, the cantons define the structure of taxation, i.e., the progressivity of the tax scheme. At that point, two important aspects must be kept in mind. Firstly, cantons define the degree of progressivity not only through the tax schedule but also through tax allowances and deductions. Secondly, married households face joint taxation, and their incomes are added up. This method of calculation can lead to a comparatively higher tax burden on married households if the tax schedule is progressive and both spouses earn an income. To correct that, most cantons allow

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<sup>12</sup> The Confederation levies a small but highly progressive income tax.

<sup>13</sup> Three cantons do not use a tax shifter and define only a tax scale that is directly applied to the taxable income. For further details on the cantonal specificities, see FTA (2015).

special deductions combined with preferential rates for married couples.<sup>14</sup>

The analysis of the cantonal and municipal taxation together allows taking into account the systematic substitution effect among cantonal and municipal spending and taxation due to the varying division of responsibilities between both government layers (Eichenberger 1994). The cantonal and municipal tax burden  $T_{ij}(y)$  can be formulated as follows:

$$T_{ij}(y) = (t_i + t_j)r_i(y)y$$

The dependent variables used in our estimations are built upon the cantonal and municipal statutory tax burden  $T_{ij}(y)$ . They consist of the aggregated cantonal and municipal tax burden expressed in percent of gross income for various intervals of gross income. In our analysis, we focus mainly on the tax rates of twelve gross income classes ranging from CHF 20'000 to CHF 1'000'000. Formally, this corresponds to:

$$\frac{T_{ij}(y)}{y^g} = \frac{(t_i + t_j)r_i(y)y}{y^g}$$

For a given level of gross income, the average tax rate accounts for the cantonal tax schedule  $r_i(y)$  and the cantonal and municipal tax multipliers  $t_i$  and  $t_j$ . Moreover, it also includes canton-specific tax allowances  $d_1 + \dots + d_n$ . The inclusion of tax allowances allows computing the average statutory tax rates of different types of taxpayers or households. The Swiss Federal Tax Administration computes and publishes the tax rates for four types of households: single households, married households, married households with two children, and retired households.

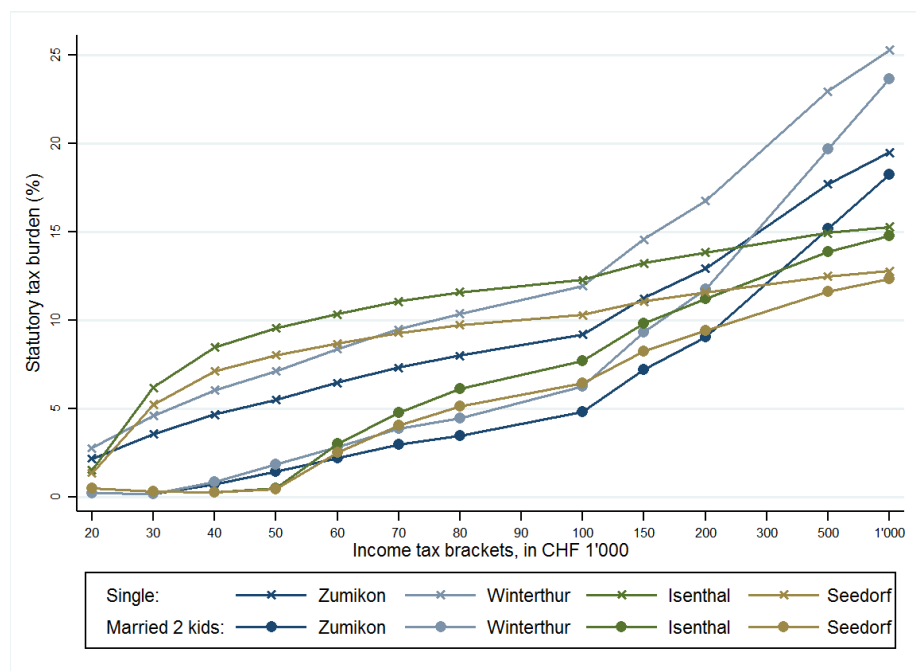
As an illustration of how the tax schedules vary across cantons and how the municipal tax shifters affect the tax schemes, Figure 1 plots the 2010 average statutory tax rate for two types of households (single and married with two children) in four municipalities that belong to two different cantons. Zumikon and Winterthur belong to the canton of Zurich, where fiscal decentralization is highest. Isenthal and Seedorf (UR) are municipalities of the canton of Uri, one of the most centralized cantons. We note that different households face different tax schemes within *and* across cantons. Within a canton, the tax differences between household types emanate from differences in the municipal tax shifter, differences in the statutory tax schedule (i.e., single *versus* married), and differences in applicable tax allowances.<sup>15</sup>

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<sup>14</sup> Some cantons introduced a so-called “splitting” of total income. In addition, all cantons, except Thurgau, allow extra allowances for households in which both spouses earn an income.

<sup>15</sup> For instance, within a canton, only the tax allowance for children differentiates a married couple with two children from a married couple (holding the level of gross income constant).

Figure 1: Example of four tax schemes.



Data source: Swiss Federal Tax Administration, Berne.

## 5 Empirical strategy

### 5.1 Data

We built a panel dataset at the municipal level for 1983 to 2010.<sup>16</sup> Because of the extensive decentralization in Switzerland, our database combines data from various sources and contains a wide range of economic, socio-demographic, and geographic municipal, as well as cantonal, characteristics. Control variables are further described in Subsection 5.2.

#### *Outcome variables: tax rates*

We are interested in the impact of fiscal decentralization on the statutory natural persons' tax schemes. The dependent variables used in each of our empirical specifications consist of the municipality-specific tax rates. These tax rates correspond to the aggregated cantonal and municipal statutory tax burden relative to gross income. The tax rates are available for different

<sup>16</sup> Panels of municipalities present an obvious risk-of-attrition bias due to the amalgamation of municipalities over the years. In our case, Switzerland counted 3'023 municipalities in 1983 and 2'584 in 2010. We decided to deal with this problem by artificially merging municipalities for periods prior to their amalgamation, thus simulating the universe of municipalities existing in our last period over the entire period. This construction requires making some assumptions regarding "synthetic backward amalgamations" but allows keeping as much information as possible and avoiding potential selection bias.

income brackets going from CHF 20'000 to CHF 1'000'000 and for different household types (see Appendix A1 for descriptive statistics of the outcome variables).<sup>17</sup>

The distinction between household types allows accounting for cantonal differences in cantonal tax allowances, which affect the statutory tax progression. In addition, different household types are likely to reflect different degrees of mobility. Mobility tends to be correlated with income, household size, the number of children, and age. Households with higher incomes and younger individuals are more mobile, while larger household and those with children are less so. We speculate that single households are the most mobile, followed by married couples without children, married couples with children, and retired. In comparison to married households, single households can optimize on average over fewer persons. Households with children must consider various additional child-specific constraints, such as childcare and schooling, which differ across cantons and increase the costs of relocation, especially across cantonal borders.

Data from the Swiss Household Panel (SHP) confirm this intuitive mobility ranking. Looking at the occurrences of relocation within the SHP between 1999 and 2014, we observe higher mobility within cantonal borders than across. The comparison of the probability of moving of each type of household confirms our expectations in that the category “single, no children” shows the highest degree of mobility with a probability of moving (within cantonal borders) of 16.13%. Then comes the category “married, no children” (7.22%), “married, with children” (5.48%) and “retired, married” (2.67%). The same ranking, yet with lower values, is obtained when focusing only on relocations across cantonal borders.

The same data do not reveal clear-cut differences in the probability of moving, depending on income. The observed probability of moving within, as well as across cantons, is relatively homogenous across income classes. One noticeable observation is that lower-income households are more likely to move within the cantonal borders, while higher-income households are more likely to move across cantonal borders.

#### *Variable of interest: fiscal decentralization*

For our purpose, the variable of interest is a measure of fiscal decentralization. To proxy the degree of local autonomy within the Swiss cantons, we use, like most studies, a measure taking a budgetary perspective.<sup>18</sup> We calculate the expenditure decentralization ratio, which is

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<sup>17</sup> The municipality-specific tax burden is computed by the Federal Tax Administration. For the fiscal periods from 1983 to 2000, we took advantage of the work of Parchet (2019), who digitalized the data and made it available for the present research project.

<sup>18</sup> In the framework of a meta-analysis of 31 studies investigating the relationship between fiscal decentralization and economic growth, Baskaran, Feld and Schnellenbach (2016) point out that almost 70 percent of the estimated models use a ratio of subnational spending or revenues to total government spending or revenues.

obtained by taking the municipal total expenditures divided by the aggregated municipal and cantonal total expenditures. This provides us with an annual measure of fiscal decentralization for each canton. A score of 1 would indicate complete fiscal decentralization, whereas 0 would be equivalent to complete centralization.

The measures may fall short of providing a complete picture of the degree of local autonomy.<sup>19</sup> Nonetheless, we chose to use it for two reasons: On the one hand (and in contrast to cross-country studies), our analysis takes place in a context where the cantonal decision of decentralizing is made within a rather homogenous institutional environment, in which jurisdictions, laws, rules, and measures are comparable. On the other hand, the decentralization ratio presents the obvious advantage of being easily comparable and consistent across cantons. Note also that the expenditure decentralization ratio is highly correlated with alternative measures.<sup>20</sup>

## 5.2 Identification strategy

Endogeneity is obviously a concern. It could be that cantonal governments simultaneously decide on decentralization and taxation based on some other factor or that issues related to the tax structure drive decentralization in a reversed causal direction.<sup>21</sup> In our specific case in which we focus on the statutory tax burden (instead of effective tax burden), reverse causality might be a lesser concern than simultaneity. We see at least two potentially important channels of endogeneity that have to be addressed.

First, the pressure of intercantonal tax competition might affect how cantons define the relationship with their municipalities and, ultimately, the degree of fiscal decentralization. Intercantonal competition pushes cantons to be efficient, and, depending on how cantons perceive the ability of their municipalities to provide public goods efficiently, fiscal decentralization could be more or less pronounced. The degree to which intercantonal tax competition puts pressure on cantonal governments depends on the mobility cost across cantonal borders. If the mobility of taxpayers or certain groups of taxpayers is high, intercantonal tax competition is a restriction that policymakers must consider. We argue that the mobility of taxpayers is correlated with geographical distance. The further away an

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<sup>19</sup> See, for instance, Rodden (2004), Stegarescu (2005), Wilson and Janeba (2005) or Martinez-Vazquez, Lago-Peñas, and Sacchi (2015).

<sup>20</sup> On the basis of the available data, we calculate the correlation of alternative measures, such as the revenue decentralization ratio, and ratios considering only the current expenditure or some specific expenditures typically subject to important degrees of decentralization (education spending, for instance).

<sup>21</sup> For instance, Wilson and Janeba (2005) develop a model of tax competition between two countries, where the intensity of fiscal decentralization serves as a strategic tool to balance the mix of horizontal and vertical externalities.



individual has to relocate to avoid the reach of some cantonal tax schedule, the higher the mobility costs. Therefore, we control for the average travel time by public and private transportation from each municipality to the next municipality in a different canton. Data on bilateral municipal travel time between 1980 and 2010 were generously provided by Axhausen et al. (2015) and by the Federal Office for Spatial Development. We compute a measure corresponding to the average bilateral travel time using private transportation from one specific municipality to the nearest municipalities of the neighboring cantons. For instance, in 2010, it took an average of 50.75 minutes to drive from the municipality Bulle to the nearest municipalities of the neighboring cantons (Bern, Vaud, and Neuchâtel).

Secondly, a particularly salient mechanism in the Swiss context is the instruments of direct democracy. They might be a source of endogeneity affecting the degree of fiscal decentralization, as they restrict cantonal centralization tendencies (Matsusaka 1995; Feld, Schaltegger, and Schnellenbach 2008; Funk and Gathmann 2011). To account for potential endogeneity channeled through direct democracy, we include a dummy variable that equals 1 for cantons that feature a mandatory budget referendum (0 otherwise). It is a standard measure of direct democracy when fiscal policy is concerned (Feld and Matsusaka 2003; Funk and Gathmann 2011).<sup>22</sup>

The traditional solution to such endogeneity issues consists of applying instrument variable (IV) techniques. In the literature, we find previous attempts at instrumenting fiscal decentralization. For instance, Canavire-Bacarreza, Martinez-Vazquez, and Yedgenov (2017) used geographic diversity as an IV, and La Porta et al. (1999) focused on country's legal origin. Unfortunately, none of these IVs are good candidates in our case, as they are time fixed and thus absorbed by the fixed effects and because the exclusion restriction is violated for obvious reasons.

Ultimately, our identification has to rely on a conditional independence assumption (e.g., Wooldridge 2002), which requires us to control for the relevant covariates. This comes with a trade-off between two types of potential bias: Controlling for as many observed factors as possible minimizes the risk of omitted variable bias but increases the risk of overfitting. We approach this challenge in two different ways.

First, we follow a rather traditional approach and estimate a relatively simple and sparse specification including our decentralization measure, the two covariates related to our main channels of potential endogeneity discussed above, the median income as a measure of the tax

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<sup>22</sup> Note that we observe only five changes to the mandatory budget referendum in the entire period. The cantons of Berne, Neuchâtel, Obwalden, Valais, and Zurich abolished it during this period.

base, the population size, the share of older and younger inhabitants, and a full set of municipal and time fixed effects, controlling for time and municipality-invariant unobserved characteristics, respectively. This approach ignores other potential sources of bias.

Second, we resort to causal machine learning methods in which we leverage the fact that we dispose of a large number of covariates characterizing our municipalities. To avoid choosing arbitrarily between one or the other, we use the post-double-selection method (Belloni, Chernozhukov, and Hansen 2014) based on the LASSO estimator (Tibshirani 1996). This machine learning estimation method consists of a data-driven process of covariate selection. The LASSO is a variable shrinkage algorithm which selects the relevant controls among a large pool of potential covariates.<sup>23</sup> In a first step, the algorithm selects the covariates that best predict the outcome variable. The second step is similar but selects the best predictors of the causal variable, i.e., our fiscal decentralization ratio. In the third step, we estimate the full model using the union of the selected covariates from the two previous steps in a simple OLS regression.

Although the covariate selection relies on the LASSO algorithm, one must pay attention to the set of potential covariates that are made available to avoid the inclusion of bad controls (Angrist and Pischke 2009). A good example of a bad control would be a measure of income inequality such as the Gini coefficient. Our theoretical mechanism implies that fiscal decentralization affects the income distribution through income sorting. Hence, the Gini coefficient is itself an outcome of the causal effect of fiscal decentralization and should not be included in the set of available covariates.

Table A2 presents the descriptive statistics of the set of potential covariates. It includes a wide range of municipal covariates, ranging from geographic information, demographic characteristics, socio-economic covariates, and municipality-specific time trends. To account for time- as well as cross-section-invariant unobserved heterogeneity, our identification relies on the within canton variation, and, thus, we chose never to penalize municipal and year fixed effects. All estimations include robust standard errors clustered at the municipal level (Moulton 1986, 1990; Bertrand, Duflo, and Mullainathan 2004).

### **5.3 Estimated models**

To estimate the impact of fiscal decentralization on the cantonal and municipal statutory income tax schemes, we estimate a tax reaction function using the cantonal decentralization ratio as our

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<sup>23</sup> See Table A2 in the Appendix.

main explanatory variable. We regress the municipal and cantonal average statutory tax burden on the cantonal decentralization ratio and relevant control variables.

According to hypothesis H.1, fiscal decentralization leads to an overall lower tax burden. In order to test this hypothesis, we generate a measure of the *average* statutory municipal tax burden across all income classes and household types and regress it on the decentralization ratio and municipal and cantonal controls. The calculation of an adequate measure of average tax burden across income classes is not trivial. Our database neither contains information on the income distribution at the municipal level nor information on the composition of taxpayers with respect to household types. For this reason, we construct two different measures: a total average tax burden between 20'000 CHF and 1'000'000 CHF and a “centered” average tax burden between 40'000 CHF and 200'000. Each measure is then used as the dependent variable in the following empirical model:

$$\ln(\bar{T}_{ijt}) = \alpha + \beta \ln(\text{Decentralization}_{jt}) + \mathbf{X}_{it}\boldsymbol{\theta} + \vartheta_i + \tau_t + \epsilon_{it},$$

where  $\bar{T}_{ijt}$  corresponds to one of the two measures of average tax burden across income classes in year  $t$  in municipality  $i$  that belongs to canton  $j$ . The specification includes the matrix of selected covariates ( $\mathbf{X}_{it}$ ), municipal ( $\vartheta_i$ ) and time ( $\tau_t$ ) fixed effects. Finally,  $\epsilon_{it}$  refers to the error term.

More importantly, we are interested in whether or not the statutory tax schedules are adapted to compensate potential sorting effects. Hypothesis H.2 posits that for different levels of mobility, policymakers may choose a corresponding statutory tax scheme to counteract the distributive effects due to income sorting.

Instead of regressing on one single measure of progressivity, we take full advantage of our data and estimate the effect of fiscal decentralization on all income classes and household types individually. We run one regression for each income class (10 classes from CHF 40'000 to CHF 1'000'000)<sup>24</sup> and household type (single, married, married with two children, and retired, married). This presents two main advantages: Firstly, it is not trivial to define a single progressivity measure that captures adequately the shape of the tax scheme. Secondly, given that there are not only differences in tax rates across income classes and household types but also differences in tax allowances and deductions, we want to use all available information and avoid smoothing over such differences. Formally, we estimate the following model:

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<sup>24</sup> Our database contains in total 14 intervals of gross income. Given the information we have regarding the distribution of income at the national level, we exclude the two lowest classes since it concerns a relatively small share of taxpayers, especially in married categories. In addition, we exclude the income classes CHF 90'000 and CHF 300'000 which only exist in a few cantons (see Table A1).

$$\ln(T_{ijcht}) = \alpha + \beta_{ch} \ln(\text{Decentralization}_{jt}) + \mathbf{X}_{it}\boldsymbol{\theta} + \vartheta_i + \tau_t + \epsilon_{it}$$

Except for the dependent variable and the indices  $c$  and  $h$ , which correspond respectively to the income class and the household type, the right-hand side of the model remains identical to the previous model. Based on the estimated coefficients of interest ( $\beta_{ch}$ ), we are able to determine whether the impact of fiscal decentralization is homogenous over all income classes or not.

## 6 Results and interpretation

### 6.1 Level effects

To begin, we estimate the level effect of fiscal decentralization. Columns 1 and 2 of Table 1 show a standard specification including only the most important covariates. These are the decentralization measure (ln), the median net income (ln) as a measure for the tax base, the population size (ln), the age structure (< 25 years, > 65 years), the two measures reflecting potential sources of endogeneity which are the bilateral travel times by private transportation (ln) between a municipality and its nearest neighbor in a different canton and the mandatory budgetary referendum, and a full set of fixed effects. Columns 3 and 4 show the estimated coefficients obtained by using the post-double selection LASSO procedure.

Table 1: Estimated level effect of fiscal decentralization on taxation.

	(1) Ln(average total tax burden)	(2) Ln(average centered tax burden)	(3) Ln(average total tax burden)	(4) Ln(average centered tax burden)
Ln(decentralization)	-0.042*** [0.011]	-0.047*** [0.012]	-0.025** [0.010]	-0.025** [0.011]
Controls	incl.	incl.	LASSO	LASSO
Municipality-specific time trends	-	-	LASSO	LASSO
Municipal FE	incl.	incl.	incl.	incl.
Year FE	incl.	incl.	incl.	incl.
Observations	64'253	64'253	64'253	64'253
Number of municipalities	2'584	2'584	2'584	2'584

Cluster robust standard errors in parentheses, \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . In specification (1) and (2), the included covariates are median net income (ln), population (ln), share of < 25 y.o., share of > 65 y.o., bilateral travel times to a municipality in neighboring canton (ln), and mandatory budgetary referendum.

The estimated coefficients of fiscal decentralization are in line with H.1 and the results of the previous literature (e.g., Feld, Kirchgässner, and Schaltegger 2010). A higher degree of fiscal

decentralization is associated with lower average tax rates. In our log-log specification, the interpretation of the coefficients is straightforward: A one percent increase in the decentralization ratio leads to a 0.025 to 0.047 percent decrease in the average statutory tax burdens. The LASSO estimates are smaller than the effects of conventional specifications. The negative correlation is statistically significant regardless of the specification.

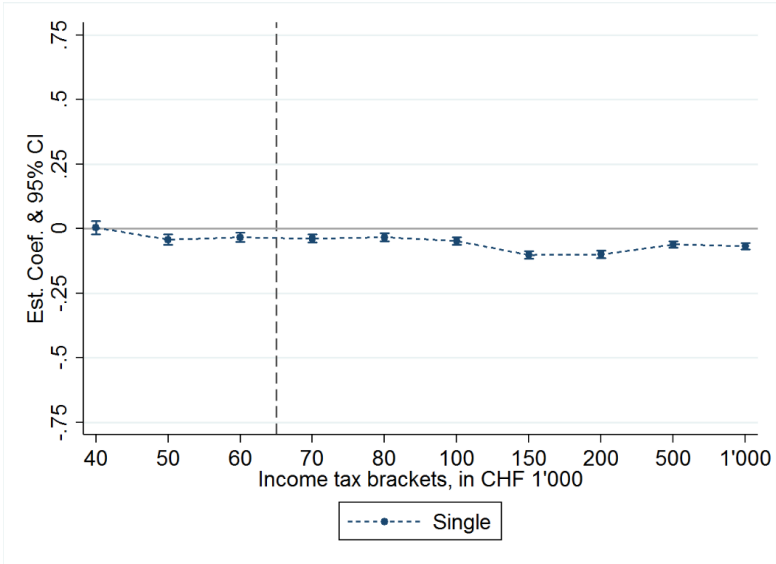
**6.2 Structural effects**

Let us now turn to our main research question and H.2: How does fiscal decentralization affect the statutory tax structure? The estimated effects of fiscal decentralization on the tax rate of each income class and each household type ( $\beta_{ch}$ ) are plotted in the following Figures 2 to 6. The bars represent the 95% confidence intervals of the respective coefficient tested against zero. To provide a minimum of information on the actual income distribution, we add an indication of the median gross income overall (CHF 65'000 in 2010) and of married taxpayers (CHF 95'000).

*Single households*

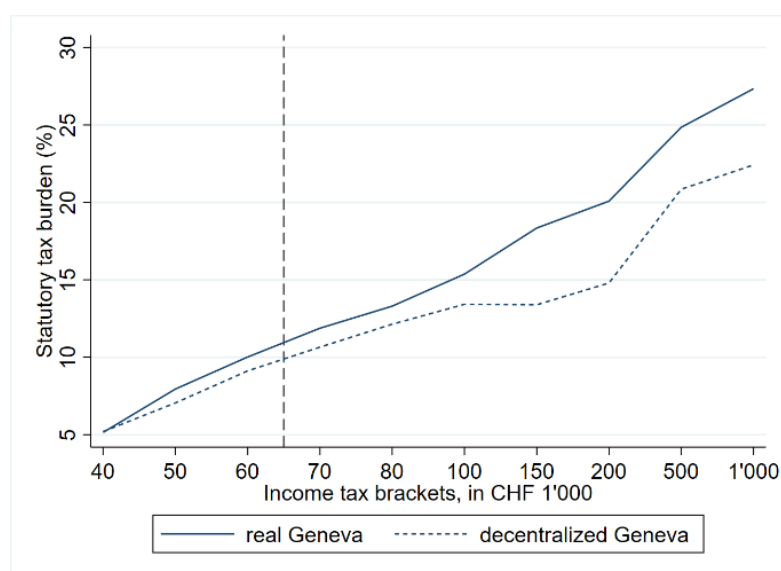
The estimated coefficients of decentralization on the statutory tax burden of single households across all income classes are plotted in Figure 2. We observe small negative and mostly significant elasticities overall between decentralization and statutory average tax burdens. The negative effect becomes slightly more pronounced for the income classes with annual gross incomes above CHF 100'000. The estimation results are fairly in line with hypothesis H.2. in that we do not observe huge differences in the tax structure beyond a general level effect for this most mobile household type.

Figure 2: The effect of fiscal decentralization on the statutory tax structure: single households.



To exemplify and illustrate the overall impact of decentralization on the statutory tax scheme, we plot a real statutory tax schedule of the relatively centralized canton of Geneva against its counterfactual tax schedule as if it were as decentralized as the canton of Zurich. While Geneva is the second-least decentralized canton in Switzerland (decentralization ratio in 2010: 0.19), Zurich is the most decentralized canton of the country (decentralization ratio in 2010: 0.50). Specifically, we use the tax schedule of the municipality of Geneva and calculate—*ceteris paribus*—the counterfactual, decentralized municipality of Geneva tax schedule for 2010. Obviously, this just serves as an illustration based on a back-of-the-envelope calculation and a strong *ceteris paribus* assumption.

Figure 3: Real Geneva vs. counterfactual decentralized Geneva: single households.



According to this illustration, tax progression evolves more slowly in counterfactual decentralized Geneva for smaller incomes up to CHF 100'000 annual gross income, becomes flat between CHF 100'000 and 150'000 and, then, progresses more strongly up to CHF 500'000, to flatten somewhat in comparison for incomes above that number. Mechanically, due to the progressive tax regime and the relatively stable estimated elasticities (Figure 2), the overall differences become more pronounced as incomes increase.

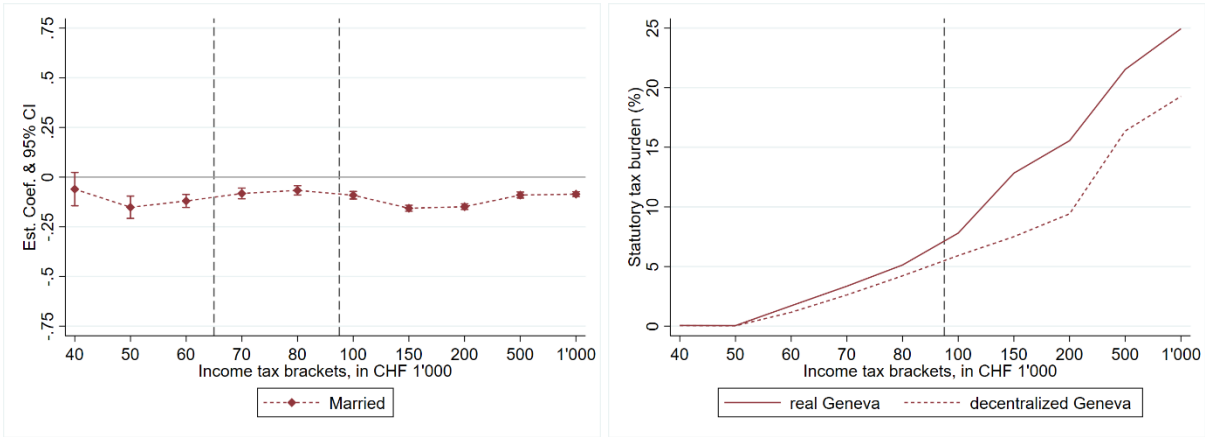
#### *Married households, no children*

Figure 4a illustrates that the overall dynamics of the estimated elasticities are similar but slightly more pronounced compared to single households (Figure 2). Figure 4b indicates that counterfactual decentralized Geneva would keep the tax burden lower and less progressive up to gross incomes of about CHF 200'000, at which point stronger progression kicks in up to CHF 500'000. As this household type is expected to still be fairly mobile—but less so than

single households—these more pronounced patterns of delayed but then somewhat stronger progressivity up to the second highest incomes could be interpreted as being in line with our stated hypothesis H.2.

Figure 4: The effect of fiscal decentralization on the statutory tax structure: married households, no children.

a. Decentralization and statutory tax structure      b. Geneva vs. decentralized Geneva



*Married households, 2 children*

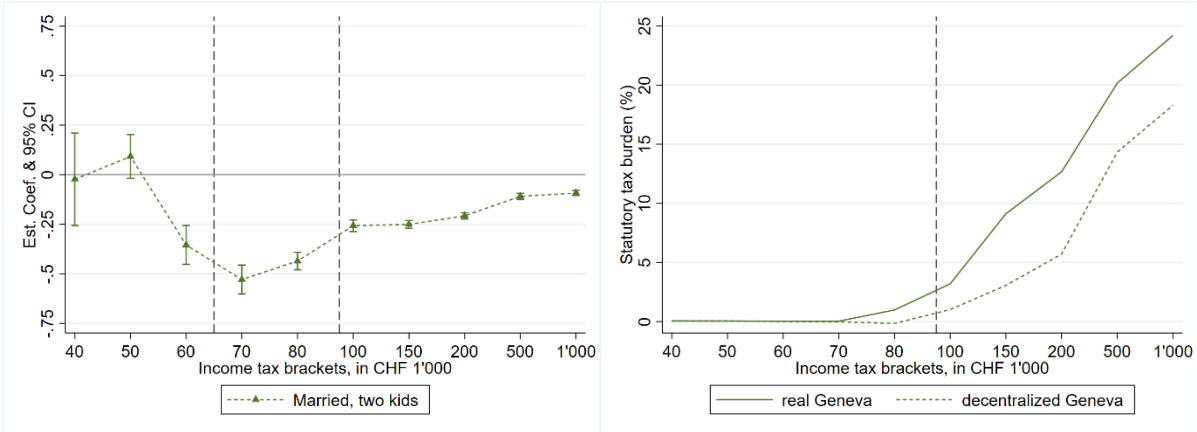
Most obvious is the relatively different evolution in the tax structure between centralized and decentralized cantons in the income classes up to CHF 100'000 gross annual income (Figure 5a). Below CHF 60'000, when the tax burden for families is close to zero in any case, decentralization does not matter much, and the estimated coefficients are insignificant and close to zero. However, there appear to be marked differences for gross incomes from CHF 60'000. There are relatively large negative elasticities for incomes between CHF 60'000 and 100'000 which phase out for gross annual incomes beyond CHF 100'000. The estimated effects converge towards those from married households without children. The convergence of the effects concerning married households with and without children for higher-income classes reflects that the underlying statutory tax rates are the same, but child-related deductions are offered to one group.

When focusing on the comparison of a real and counterfactual tax schedule for Geneva (Figure 5b), we observe again that tax progression remains lower up to a gross income of CHF 200'000 in decentralized Geneva. The larger negative elasticities for low-income classes observed in Figure 5b affect only very small tax rates and, mechanically, have a limited absolute effect on tax burdens in this example. Decentralization extends the extremely low income tax burdens beyond annual incomes of CHF 70'000. Progression rates pick up much more slowly than in real, more centralized, Geneva, and only accelerate beyond CHF 200'000.

In comparison to the two previous household types of single and married households, this particular household type of married couples with two children is—according to our conjectures and suggestive evidence from the mobility patterns in the SHP—the least-mobile group and features the clearest evidence in line with hypothesis H.2. We observe relatively stronger elasticities for lower incomes, which delay the increase in tax burdens up to the intermediate to higher incomes (CHF 200'000), after which the progression increases and converges towards the previously observed difference for the other more-mobile household types. Again, the highest income classes tend to be the most mobile across cantonal borders, which might limit the extent to which differences can be sustained.

Figure 5: The effect of fiscal decentralization on the statutory tax structure: married households, 2 children.

a. Decentralization and statutory tax structure      b. Geneva vs. decentralized Geneva



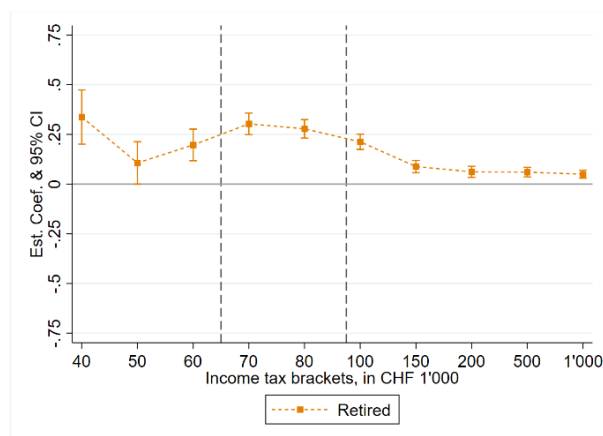
*Retired households*

The pattern for retired households looks very different. The underlying tax schedule of this household type is based on the tax rates applied to married couples. The big difference for this category is the missing deductions for job-related activities. For retired households, there are only very few deduction possibilities remaining (primarily for donations and debt service). Most of the documented decentralization effects come from differences in the definition of the underlying tax rates. With respect to retired households, decentralized cantons tend to define more progressive tax schedules for income classes up to CHF 100'000. Beyond that point, the differences fade out, and tax schedules become fairly similar, which could be a phenomenon driven—again—by the higher mobility of richer households.

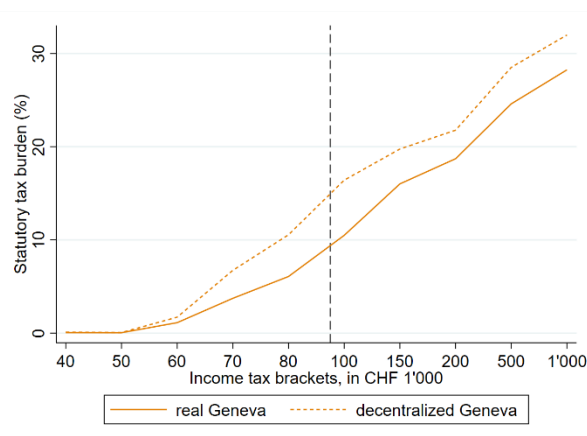


Figure 6: The effect of fiscal decentralization on the statutory tax structure: retired households.

a. Decentralization and statutory tax structure



b. Geneva vs. decentralized Geneva



### 6.3 Summary and interpretations

There are two main take-aways from our results. First, the estimated differences between centralized and decentralized cantons fade with higher incomes. Across household types, the estimated differences become smaller and smaller for income classes above the intermediate to higher range of CHF 200'000 gross annual income. The relative convergence in terms of effect dynamics for the upper-income classes could be due to the relatively higher mobility of richer households across cantonal borders.<sup>25</sup> This would induce direct competition between cantons for these individuals and limit the potential tax differences across cantons, decentralized or not. Second, lower incomes—with the exception of retired households—are taxed more moderately and less progressively in more decentralized cantons up to the intermediate-to-higher income groups, beyond which progression kicks in. The patterns are more pronounced for the least-mobile household types.<sup>26</sup> More-mobile household types (for example, single households) show fewer differences in estimated elasticities in relation to decentralization compared to less-mobile ones (for example, married households with children). Note that most of the observed differences are driven by differences in deductions rather than statutory tax rates.

Our hypothesis H.2 states that more decentralized cantons should adapt their statutory tax schedules to internalize and counteract the effects of income sorting. Such a strategy is only feasible for relatively immobile tax bases. Even though the results are not entirely unambiguous, the patterns in the estimated elasticities tend to be in line with this conjecture. The statutory tax schedules are similar (i.e., the estimated difference is constant) for the most-

<sup>25</sup> Descriptive statistics from the SHP also indicate that higher income households are more likely to move across cantons.

<sup>26</sup> Descriptive statistics from the SHP indicate that the probability of moving is the highest for “single households”, then come the households “married, no kid”, “married with at least one kid” and “retired, married”.

mobile household types (single) and for the highest-income groups (beyond CHF 500'000). The redistributive effects of decentralization are largest for the seemingly least-mobile household types in the lower-to-intermediate income classes. The estimated elasticities are the largest for the lower-to-intermediate incomes of married households with children. For intermediate-to-higher incomes of these same households, the statutory tax schedules show that progression kicks in later (at comparatively higher incomes) but becomes steeper.

## **7 Conclusion**

The motivation for this paper comes from the theoretical ambiguity surrounding the relationship between fiscal decentralization and redistributive policies. The standard literature on fiscal federalism argues that centralizing redistributive policies allows the implementation of targeted rates of progression. However, recent evidence shows that even in such a design, effective redistribution might be undermined by income sorting at the local level. We focus on the natural persons' income tax in Switzerland, in which cantons define the tax schedule and municipalities only levy a tax shifter and take advantage of the varying degrees of local autonomy among Swiss cantons. In this setup, we empirically investigate whether, and to what extent, cantonal policymakers—in charge of the definition of statutory tax structures—internalize income sorting at the local level and adapt the statutory tax schedule accordingly.

After a review of the related literature, we discuss the theoretical impact of fiscal decentralization on the income tax scheme. First, according to the literature, we should observe a general level effect. More decentralized jurisdictions should implement lower tax burdens. This could be due to the higher efficiency of decentralized structures or due to inefficiently low taxes due to tax competition. Secondly, we argue that if policymakers have rational expectations regarding the flattening effect of income sorting in decentralized jurisdictions, they should internalize this effect by adapting their statutory tax schedule to achieve their distributional objectives. This, however, is only possible when the tax base is not perfectly mobile.

Our empirical investigation provides evidence supporting both hypotheses. Firstly, regarding the efficiency hypothesis, the evidence confirms that fiscal decentralization is negatively correlated with the average statutory tax burden. Secondly, the estimation of the impact of decentralization on specific groups of taxpayers over a wide range of income classes appears to be instructive. Fiscal decentralization seems to affect the structure of the tax schemes. In comparison to more centralized jurisdictions, we observe that the statutory tax schedule implemented in decentralized cantons tends to be lower and less progressive for lower incomes and the least-mobile tax bases.

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## Appendix

Table A1: Descriptive statistics of outcome variables.

Income brackets	Obs.	Mean (Std. Dev.)	Min.	Max.	Obs.	Mean (Std. Dev.)	Min.	Max.	Obs.	Mean (Std. Dev.)	Min.	Max.	Obs.	Mean (Std. Dev.)	Min.	Max.
	<i>Single</i>				<i>Married</i>				<i>Married, two children</i>				<i>Retired</i>			
CHF 20,000	70,875	3.80 (2.34)	0.00	10.91	70,875	1.62 (1.71)	0.00	8.39	70,875	0.40 (0.73)	0.00	4.67	70,875	1.27 (1.5)	0.00	8.39
CHF 30,000	70,875	6.97 (2.62)	0.37	14.68	70,875	3.78 (2.55)	0.00	12.97	70,875	1.56 (1.93)	0.00	9.63	70,875	3.97 (2.63)	0.00	16.79
CHF 40,000	70,875	9.52 (2.47)	2.71	17.69	70,875	5.80 (2.82)	0.00	16.25	70,875	3.03 (2.68)	0.00	12.91	70,875	6.57 (3.03)	0.00	19.97
CHF 50,000	70,875	11.51 (2.38)	3.05	19.98	70,875	7.61 (2.84)	0.00	18.50	70,875	4.70 (3.08)	0.00	15.58	70,875	8.63 (3.41)	0.05	22.48
CHF 60,000	70,875	13.04 (2.39)	3.47	21.89	70,875	9.21 (2.87)	1.52	20.51	70,875	6.31 (3.24)	0.00	17.77	70,875	10.25 (3.59)	0.04	24.14
CHF 70,000	70,875	14.25 (2.45)	3.78	23.07	70,875	10.53 (2.92)	2.46	21.65	70,875	7.79 (3.31)	0.04	19.55	70,875	11.46 (3.58)	2.65	25.45
CHF 80,000	70,875	15.23 (2.53)	4.07	24.27	70,875	11.59 (2.98)	2.69	23.03	70,875	9.08 (3.38)	0.79	21.16	70,875	12.48 (3.57)	3.05	26.85
CHF 100,000	70,875	16.86 (2.65)	4.55	26.89	70,875	13.37 (3.08)	3.26	25.77	70,875	11.20 (3.44)	1.87	24.06	70,875	14.20 (3.62)	3.37	29.65
CHF 150,000	70,875	19.61 (2.8)	5.20	30.96	70,875	16.53 (3.12)	4.30	30.22	70,875	14.80 (3.45)	3.05	29.06	70,875	17.28 (3.76)	3.94	33.14
CHF 200,000	70,875	21.21 (2.82)	5.53	31.48	70,875	18.62 (3.07)	4.86	31.03	70,875	17.16 (3.37)	4.40	30.29	70,875	19.25 (3.9)	4.41	33.46
CHF 500,000	70,875	24.91 (3.09)	5.95	33.69	70,875	23.86 (3.13)	5.87	33.39	70,875	23.17 (3.18)	5.72	33.21	70,875	23.71 (4.19)	5.28	34.35
CHF 1,000,0000	70,875	26.04 (3.37)	6.06	35.32	70,875	25.61 (3.36)	6.02	35.17	70,875	25.31 (3.37)	5.95	35.07	70,875	25.18 (4.43)	5.40	35.00

Source: Swiss Federal Tax Administration.

Table A2: Descriptive statistics of available covariates.

Variable	Obs.	Mean (Std. Dev.)	Min.	Max.
Population	72,352	2,770.73 (10,449.79)	15	368,677.00
Population growth	72,352	0.97 (1.43)	-35.82	87.12
Foreigners	72,352	540.89 (3,016.44)	0	112,429.00
Share of foreigners	72,352	0.11 (0.09)	0	0.65
Population < 25 y.o.	72,352	821.85 (2,597.77)	0	92,260.00
Share of population < 25 y.o.	72,352	0.31 (0.05)	0	0.74
Population between 25 and 65 y.o.	72,352	1,516.75 (5,967.91)	0	223,694.00
Share of population between 25 and 65 y.o.	72,352	0.53 (0.05)	0	1.00
Population > 65 y.o.	72,352	415.93 (1,876.68)	0	72,473.00
Share of population > 65 y.o.	72,352	0.15 (0.05)	0	0.57
Total area	72,352	1,547.62 (2,538.07)	30	28,397.00
Housing and infrastructure areas	72,352	110.65 (176.78)	1	5,466.00
Housing and infrastructure growth areas	72,352	0.95 (1.48)	-14.29	100
Share of housing and infrastructure areas	72,352	12.88 (13.51)	0.1	98.65
Agricultural areas	72,352	585.48 (748.19)	0	10,607.00
Share of agricultural areas	72,352	46.99 (19.5)	0	93.46
Wooded areas	72,352	495.06 (725.15)	0	7,842.00
Mean taxable income in CHF	65,652	52,383.21 (21,385.11)	10,542.00	997,660.00
Median taxable income in CHF	65,652	42,462.99 (11,625.55)	2,200.00	119,600.00
Mean net income in CHF	65,652	59,084.03 (21,948.49)	13,115.00	1,003,789.00
Median net income in CHF	65,652	48,880.48 (12,537.48)	2,200.00	132,500.00
Average travel time by private trans. to neighboring canton	72,352	68.03 (23.37)	21.07	175.76
Average travel time by public trans. to neighboring canton	72,352	157.51 (53.86)	44.56	468.29
Dummy for mandatory fiscal referendum at the cantonal level	72,352	0.52 (0.50)	0	1

Sources: Federal Statistical Office for demographic and geographic characteristics; Federal Tax Administration for measures of mean and median income. We computed the measures of average travel time with a matrix of distances between municipalities provided by Axhausen et al. (2015) and the Federal Office for Spatial Development for distances, and by Lutz and Strohmann (1998) and Trechsel and Serdült (1999) for the dummy variable for mandatory fiscal referendum.