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Who Bears the Burden of Local Taxes?[†]

By Marius Brülhart, Jayson Danton,
Raphaël Parchet, and Jörg Schläpfer*

We study the distributional effects of local taxes. They turn out to be strikingly progressive. We calibrate a municipality-level structural model with quasi-experimental estimates of taxpayer mobilty by family type. Households with children are found to be less mobile than households without children and to have stronger preferences for locally provided public goods. Combined with capitalization of taxes into housing prices and nonhomothetic housing demand, this implies that the incidence of local income taxes mainly falls on high-income childless households. Increases in local income taxes, even if flat rate, turn out to be more progressive than property taxes. (*JEL* H22, H71, R21, R31)

The distributional effects of taxation are among the most prominent topics in public finance. Existing research has mainly focused on taxes at the national level. In this paper, we ask how local-level taxation affects the welfare of different household types. Local taxes account for important shares of public revenue in many countries. For example, taxes raised by cities, counties, school districts, or municipalities represent 16 percent of total tax revenue in Switzerland, 15 percent in the United States, 10 percent in Canada, 9 percent in Spain, and 8 percent in Germany.[1] Most local taxes are levied on the income or property of residents and are used to finance locally provided public goods—notably, schooling.[2] This in turn affects resident households differently depending on their family status and income.

* Brülhart: Department of Economics, HEC Lausanne, University of Lausanne and CEPR (email: marius.brulhart@unil.ch); Danton: Swiss National Bank, Financial Stability (email: jaysonmarc.danton@snb.ch); Parchet: Institute of Economics, Faculty of Economics, Università della Svizzera italiana (email: raphael.parchet@usi.ch). Schläpfer: Wüest Partner AG (email: joerg.schlaepfer@wuestpartner.com). Naomi Feldman was coeditor for this article. We thank two anonymous referees, Jan Brueckner, Pierre-Philippe Combes, Jonathan Dingel, Giacomo de Giorgi, Jessie Handbury, Christian Hilber, Patrick Kline, Michele Pellizzari, Jean-Paul Renne, Frédéric Robert-Nicoud, Mark Schelker, Kurt Schmidheiny, Sebastian Siegloch, David Wildasin, and numerous seminar and conference participants for helpful comments. Funding from the Swiss National Science Foundation (grants 147668, 159348, 182380, and 192546) is gratefully acknowledged. We are particularly indebted to the Swiss Federal Tax Administration, Wüest Partner, and to Laura Fontana-Casellini for granting us access to their data. The views, opinions, findings, and conclusions or recommendations expressed in this paper are strictly those of the authors. They do not necessarily reflect the views of the Swiss National Bank or Wüest Partner. The SNB and Wüest Partner take no responsibility for any errors or omissions in, or for the correctness of, the information contained in this paper.

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[1] Data are from the OECD Fiscal Decentralization Database for the period 2000–2017. This list includes only countries with a three-tier jurisdictional architecture. In some two-tier federations, the local share is even higher (e.g., 34 percent in Sweden, 28 percent in Denmark).

[2] In the United States, some 47 percent of local own-source general revenue is raised through property taxation, and some 3 percent is raised through income taxation. Primary and secondary education accounts for 40 percent of

We consider two distinctive aspects: at the local level, changes in taxation are typically linear or only weakly progressive, and tax bases are mobile—but not perfectly so. In addition, we allow preferences for housing and for locally funded public goods to be nonhomothetic. In this setting, distributional effects arise because capitalization of tax rates into housing prices affects different households differently and because households have unequal needs for locally funded public goods.[3]

We estimate a structural model using new panel data for Swiss municipalities, and we find substantial heterogeneity across family types in the incidence of municipal taxation and the associated local spending. For households without dependent children, the incidence of a 1 percent increase in the local tax rate ranges from $+0.50$ percent at the second income decile to -0.26 percent at the top income decile. When considering families with children, the incidence of a tax increase is more positive across all income classes, ranging from $+0.88$ percent for the poorest households to -0.12 percent at the top decile.

Underlying these welfare effects are two structural parameters that we estimate. First, we find mobility to be an order of magnitude higher for households without children than for households with children. Second, we find that families with children hold preferences for locally provided public goods that are about twice as strong as those held by households without children.

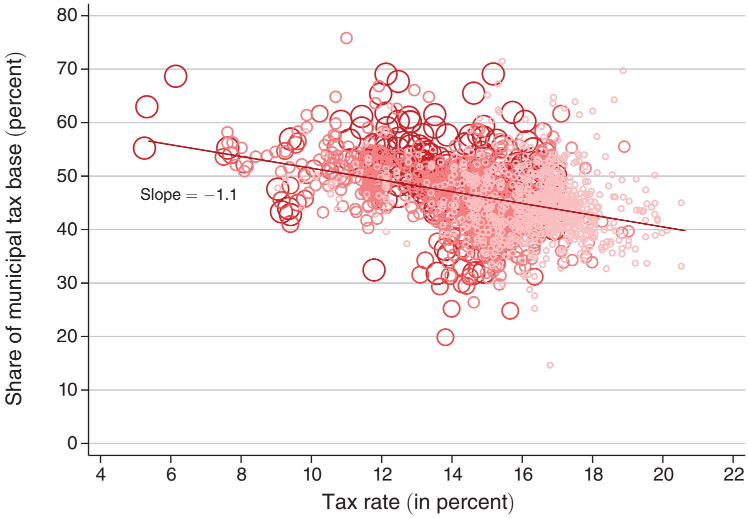
Our analytical framework allows us to consider scenarios that differ from our particular empirical setting, by simulating the incidence of other types of local taxes. Estimating the incidence of a property tax instead of the observed progressive-schedule local income tax or instead of a hypothetical proportional local income tax, we find that a local property tax is effectively less progressive than a local income tax.

The central mechanism we study can be summarized as follows. Consider a linear increase in a locality's (income) tax rate, associated with a corresponding increase in local expenditure—e.g., on elementary schooling or daycare facilities. Families with children—who may attach more weight to local public expenditure than childless households—will be attracted more (or repelled less) by the tax increase. As a result, the demographic composition of the jurisdiction shifts toward families with children. Suppose also that the tax increase leads to lower equilibrium housing demand and, thus, lower housing prices. If lower-income households with children spend a higher share of their budget on housing than higher-income childless households, then capitalization will reduce lower-income households' direct loss from the higher tax rate relatively more, and attract them (even more) to the higher-tax jurisdiction. Nonhomothetic housing demand can thus imply a heterogeneous effect of a tax increase according to both income and family status. As a result, a linear change in taxation will not be distributionally neutral. The ordering and even the sign of welfare effects on different household types will depend on their relative mobility

US local government spending (Annual Survey of State and Local Government Finances, Tax Policy Center 2020). In Switzerland, income and property taxation account for 43 percent and 5 percent of local governments' own revenue, respectively, and 27 percent of local expenditure is allocated to schooling (see Section IA). Municipalities account for 54 percent of spending on compulsory education (Education Finance, Swiss Federal Statistical Office 2020).

[3] In contrast, at the national level, the tax system most evidently redistributes through the progressivity of rate schedules and because of differential avoidance opportunities.

Panel A. Households without children



Panel B. Households with children

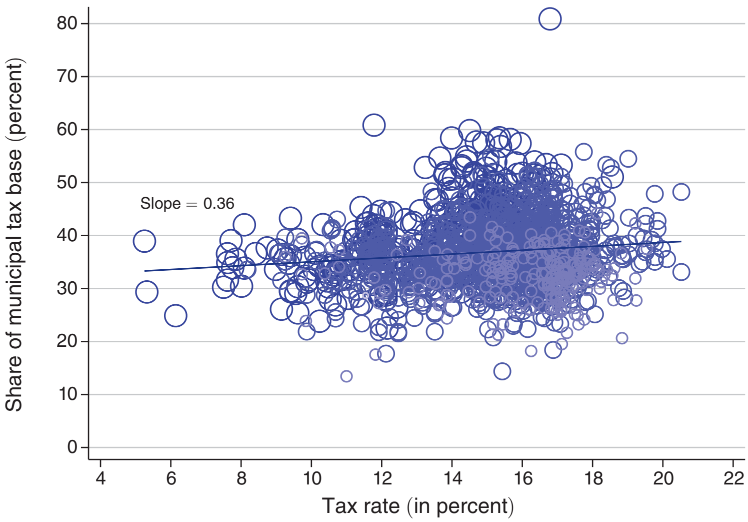


Figure 1. Revealed Locational Preferences: Family Status, Income, and Local Tax Rates

Notes: The figure presents the share of the municipal tax base accruing to working-age households without children (top panel) and with children (bottom panel). Within a panel, each circle represents a municipality. Municipalities are ranked according to the average tax rate on top 10 percent- ncome households. Circle size and color intensity vary with average income by family type and municipality. Larger circles represent higher-income municipalities. Four circle sizes are considered, denoting average incomes below CHF 50,000, between CHF 50,000 and CHF 75,000, between CHF 75,000 and CHF 100,000, and above CHF 100,000, respectively. Lines are OLS linear fits (robust standard error in both cases: 0.06). Data are for 2004.

and preferences for locally provided public goods (parameters that we estimate), and on their relative housing needs (a parameter that we calibrate).

Figure 1 provides prima facie evidence of revealed preferences that systematically differ by family status and income. Using our data for Swiss municipalities, we show the income share of working-age households without children (panel A) and with children (panel B). Family status is determined in our data by adult filers being granted child deductions, which are typically claimable for dependent children until the age of 17. Each circle represents a municipality, ranked horizontally by its average tax rate. Circle size and color intensity reflect average household incomes in the given municipality. Average incomes differ considerably across municipalities, ranging from US$32,000 to US$166,000.[4] The graph shows that poorer households of both types account for a larger population share in high-tax municipalities. Households with children sort disproportionately more into high-tax municipalities, while childless households sort more strongly into low-tax jurisdictions. Poorer households and families with children thus appear to be deterred less by high local taxes.

The patterns illustrated by Figure 1 are purely correlational, and the direction of causation could run from household composition to tax rates. For a more plausibly causal analysis of the effect of changing tax rates, we exploit the multilayer Swiss fiscal architecture, which allows us to instrument changes in local tax rates. We follow Parchet (2019a) by instrumenting municipal tax rates with neighboring state-level tax rates. We can thus estimate effects of changes in local taxes on income-class-specific municipal taxpayer counts, as well as on municipal housing prices inferred from 1.6 million transaction-level rental price postings between 2004 and 2014.

We find the sensitivity to local taxes to differ markedly across household types: tax base elasticities with respect to tax rates are positive for below-median income households (0.12 and 0.08 for households without and with children, respectively), strongly negative (-1.25) for top-quartile income households without children, and not significantly different from zero for top-quartile households with children. The housing price elasticity with respect to local income tax rates is -0.30.

In a next step, we use these reduced-form elasticity estimates to calibrate a model with nonhomothetic housing demand, household-type specific preferences for publicly provided goods, and household-type specific mobility in order to estimate those unobservable model parameters structurally. Residents are assumed to be imperfectly mobile and to rent housing from absentee landlords, with upward-sloping local housing supply. Households choose where to reside among jurisdictions that offer different public expenditure levels, financed by an income tax on residents. We allow residents' valuation of the locally provided public good to vary by family status, without imposing any prior restriction on this relationship. Household types are defined (i) in terms of the presence or absence of dependent children, to account for different needs for publicly provided goods and for different mobility, and (ii) in terms of income, to allow for nonhomothetic housing demand. In an extension, we in addition distinguish pension-age from working-age households. In this setting, the incidence of changes in local tax rates on households depends on their their type-specific "bid-rent" price—i.e., their marginal willingness to trade off taxes and public spending against housing prices. We use equilibrium conditions for location choices and for local housing markets to derive theoretical reduced-form

[4] We use the 2014 exchange rate of US$1.10 per CHF 1. The stated range corresponds to the first and the ninety-ninth percentile of the distribution of per capita net incomes across municipalities.

effects of a tax increase on the number of households per type and on housing prices. The theoretical reduced-form elasticities are determined by three key parameters: family-status-dependent preferences for the local public good, the price elasticity of housing supply, and the family-status-dependent dispersion of idiosyncratic locational preferences that captures residential mobility.

One specificity of our approach is that we focus on changes in local taxes *within* a given functional labor market or commuting area. We therefore treat wages as exogenous with respect to location choices.[5] This allows us to take account of residential mobility while assuming a constant labor income. The assumption of locally exogenous wages has empirical support: Löffler and Siegloch (2021) find no effect of local property taxes on local wages, which is all the more remarkable considering that their German sample municipalities are on average almost 20 times larger than our Swiss sample municipalities. Martínez, Saez, and Siegenthaler (2021) find earnings responses to changed tax rates to be very small in Switzerland.[6] Even though we analyze sorting and tax incidence at small spatial scale, however, we consider a utility cost of moving. This contrasts with much of the literature on subnational public finance, following Tiebout (1956) and Oates (1969), where residential mobility is costless (see Agrawal, Hoyt, and Wilson 2022 for a recent survey). With perfect mobility, the incidence of local taxes is fully borne by landowners, the immobile factor. In reality, moving is costly even at the local level, and hence the welfare of renter households will also be affected by changes in local taxation. We therefore assume households to have idiosyncratic prior preferences over locations and, thus, nonzero moving costs, even within a given labor market. These moving costs are allowed to depend on family status.

Our paper connects to four main strands of the literature. First, we build on and contribute to an active research program studying the incidence of subfederal taxation while taking careful account of capitalization effects. In a seminal paper, Suárez Serrato and Zidar (2016) use structural estimation to apportion the incidence of US state corporate tax rates to workers, landowners, and firm owners. They estimate that some 40 percent of the gain from state-level corporate tax cuts accrue to firm owners and 30–35 percent accrue to workers. The share of corporate tax incidence falling on workers has been found to be even higher in smaller jurisdictions. Based on reduced-form empirical moments, Fuest, Peichl, and Siegloch (2018) estimate that half of the gains from cuts to municipal business tax rates in Germany accrue to workers. This effect is mainly driven by small, single-plant (and, thus, immobile) firms. Löffler and Siegloch (2021) focus on local property taxation in Germany and find that property taxes are fully passed through on renter households.

Our paper differs from this work along the following main dimensions. Most importantly, we estimate distributional effects by disaggregating residents by family status and income (and, in an extension, age). To do so, we structurally estimate

[5] We also assume fertility decisions to be fixed. For a model of sorting, housing costs, and endogenous fertility decisions, see Coeurdacier et al. (2023).

[6] This is, of course, not to deny that labor supply and wages are affected by subfederal income taxation at larger spatial scales, such as that of US states (see, e.g., Zidar 2019).

the relationship between revealed public goods preferences and family status.[7] Methodologically, we address a key identification issue by instrumenting local tax rates. Moreover, we use housing demand shifters to estimate the housing supply elasticity—an important parameter governing the welfare effects of local policies (Kline and Moretti 2014).

Second, we contribute to a well-developed empirical literature on the capitalization of taxes into housing prices.[8] Like us, Basten, Ehrlich, and Lassmann (2017) draw on Swiss microgeographic data. In line with the empirical literature on the capitalization of local policies or amenities, they use a border discontinuity framework, assuming that, locally, households are perfectly mobile and housing demand is perfectly elastic.[9] Reduced-form estimates of house price responses then serve directly as a measure of willingness to pay (through housing prices), but the incidence of the tax is assumed to be fully borne by the immobile factor. Their analysis already shows that the willingness to pay for lower taxes differs by income, and they model heterogeneous location choices depending on a wide range of determinants. They do not, however, allow for heterogeneus preferences for local public goods. Focusing on the expenditure side of local jurisdictions, Schönholzer (2023) exploits housing price differences in close proximity of local government boundaries and finds evidence of substantial valuations, especially of high-quality public schooling. The perfect-mobility assumption is also implied in the discrete-choice framework developed by Bayer, Ferreira, and McMillan (2007), where housing and neighborhood characteristics are interacted with household characteristics. We take a structural approach to estimate the elasticities that need to be quantified for an analysis of incidence on different types of imperfectly mobile households. We take account not only of nonhomothetic demand for housing but also of heterogenous preferences for local public goods and differential mobility across household types.[10]

Third, we complement the empirical literature on the mobility response of households to tax changes.[11] This literature is largely focused on top-income taxpayers and leaves mobility responses of middle-income and lower-income households still to be explored. Tax-induced mobility has previously been found to be significant in the case of Switzerland, probably due to the combination of a high degree of fiscal decentralization and a small spatial scale.[12] We link type-specific

[7] Suárez Serrato and Wingender (2016) study the incidence of federal government spending at the local level and structurally estimate separate preference parameters for skilled and unskilled workers. Fajgelbaum et al. (2019) allow worker preferences for the public good to differ across US states. We also complement Eugster and Parchet (2019a), who use the Swiss language border to show the effect of culture on preferred tax levels, without, however, considering heterogeneity across household types.

[8] Seminal studies of the capitalization of property taxes include Epple and Zelenitz (1981) and Yinger (1982). See Ross and Yinger (1999) and Hilber (2015) for comprehensive surveys.

[9] See, e.g., Black (1999); Reback (2005); Bayer, Ferreira, and McMillan (2007); Fack and Grenet (2010); Cellini, Ferreira, and Rothstein (2010); Black and Machin (2011); Boustan (2013a); and Gibbons, Machin, and Silva (2013).

[10] The role of nonhomothetic preferences in sorting is also emphasized by Gaubert and Robert-Nicoud (2023). Kim (2023) develops a spatial equilibrium framework with residential mobility and commuting, which he leverages to estimate valuations of local government spending. He does not explore heterogeneous valuations across worker types.

[11] See, e.g., Kleven, Landais, and Saez (2013); Akcigit, Baslandze, and Stantcheva (2016); Moretti and Wilson (2017); Agrawal and Foremny (2019); and Kleven et al. (2020).

[12] See, e.g., Schmidheiny and Slotwinski (2018); Brülhart et al. (2022); Martínez (2022); and Widmann (2023).

tax base elasticities to taxpayers' marginal willingness to pay and study the distributional effects of local tax changes.

Fourth, our results shed light on the empirical relationship between local spending and the demographic composition of local populations. A considerable prior literature exists on this issue.[13] In those papers, heterogeneous preferences are allowed, but no attempt is made to estimate deep type-specific preference parameters. We back out those parameters. In doing so, we show that mobility and preferences for locally provided public goods differ substantially across family types.[14]

The paper proceeds as follows.[15] In Sections I and II, we present a model of local labor and housing markets as well as the data that will inform our empirical estimations. In Section III, we estimate reduced-form elasticities of tax bases and housing prices with respect to local tax rates. Section IV reports our baseline structural type-specific incidence estimates. In Section V, we present some extensions of the baseline estimations, and Section VI concludes.

I. Model

In this section, we develop a model of residential location choice, housing markets, and local public good provision. First, we assume a public sector that uses a proportional income tax to provide a potentially rival publicly provided good, and we characterize location choices and housing demand by households that differ by family status and income.[16] Second, we model housing supply in an absentee landlord setting. Third, we use the model to investigate the effect of tax rate changes on housing prices, on the number of residents in different family-status–income-class pairs ("household types"), and, most importantly, on the incidence of local taxes across household types.

A. *Housing Demand*

We assume a functional labor market that consists of $\mathcal{J}$ municipalities. This labor market is populated by a unit continuum of $\mathcal{I}$ households that rent dwelling space from atomistic absentee landlords and take housing prices as given. Households have identical preferences for housing and public goods but are heterogeneous in their family status (with/without children) and income.[17] We assume Stone-Geary preferences with minimum levels of housing and public good consumption that

[13] See, e.g., Harris, Evans, and Schwab (2001); Hilber and Mayer (2009); Aaberge et al. (2010); Figlio and Fletcher (2012); Aaberge et al. (2019); and Bertocchi et al. (2020).

[14] On residential income segregation by households with and without children, see, e.g., Epple, Romano, and Sieg (2012) and Owens (2016). For evidence on residential sorting by household type according to differences in exogenous local amenities (rather than local public goods), see, e.g., Chen and Rosenthal (2008) and Albouy and Faberman (2024).

[15] Supplemental Appendix A offers a schematic overview of the different building blocks of the paper.

[16] For simplicity, we use the term "public goods" as equivalent to "publicly provided goods." Our setting can easily be extended (i) to other residence-based taxes such as a property tax (as long as housing is modeled as a consumption good; see Section IVD and Supplemental Appendix G) and (ii) to homeowners as in, e.g., Epple and Romer (1991).

[17] When we take the model to the data, we shall in addition distinguish household types by age—that is, we consider three family statuses: nonpensioners without children, nonpensioners with children, and pensioners.

depend on family status, thus capturing different needs for residential space and public services by families with and without children. We also assume that households derive idiosyncratic utility from exogenously given local amenities.

Specifically, each of the $i \in \mathcal{I}$ renter households belongs to a discrete family status $f \in \mathcal{F}$ and income class $m \in \mathcal{M}$. Within an income class, everybody's income equals w_m. Households maximize the log Stone-Geary utility of residing in municipality $j \in \mathcal{J}$ by choosing consumption levels of a freely tradable numeraire composite good z_{fmj} and dwelling size h_{fmj}, at a rental price p_j, subject to their after-tax income $(1 - \tau_j) w_m$.

The indirect utility of household i with family status f and income w_m, based on its choice of location j, is

$$(1)\quad V_{ifmj} = \kappa + \ln\left(\left[1 - \tau_j\right] w_m - p_j \nu_h^f\right) - \alpha \ln(p_j) + \delta \ln\left(g_j - \nu_g^f\right) + \ln(A_{ifj}),$$

where κ is a constant, $\alpha \in (0,1)$ and δ are taste parameters for housing and the local public good, and $\nu_h^f \geq 0$ and $\nu_g^f \geq 0$ are Stone-Geary parameters capturing the family-type-specific minimum amount of housing and public good required, respectively, and A_{ifj} denotes local amenities.[18] The Stone-Geary parameters play an important role. First, unlike, e.g., a Cobb-Douglas function, they allow for a full range of housing demand elasticities with respect to the price of housing—i.e., $|\eta^{d,p}| \in (0, +\infty)$. Second, households with different family status and income have different expenditure shares on housing, such that the capitalization of higher tax rates into housing prices will affect them differently.[19] Third, ν_g^f allows for the fact that households with children have different needs than childless households in terms of goods such as schooling, and might therefore benefit more from an increase in the public good.

We furthermore assume a balanced budget for the public sector with $\tau_j \sum_f \sum_m w_m N_{fmj} = N_j^\theta g_j$, where $\theta \in [0,1]$ indicates the degree of rivalness in the consumption of the public good.[20] The number of residents, N_{fmj}, is defined below. We also assume local amenities A_{ifj} to be fixed.[21]

At this stage, it is useful to define the change in the housing price that a household with family status f and income w_m would require to be indifferent toward a given change in the local tax rate ("bid-rent" price change):

$$(2)\quad \left.\frac{dp_j}{d\tau_j}\frac{\tau_j}{p_j}\right|_{dV_{ifmj}=0} = -\left[\frac{\tau_j}{(1-\tau_j) S_{fmj}} - \frac{\delta}{\alpha}\left(\frac{g_j}{g_j - \nu_g^f}\right)\left(1 - \frac{\nu_h^f}{h_{fmj}^*}\right)\left(\frac{dg_j}{d\tau_j}\frac{\tau_j}{g_j}\right)\right],$$

[18] See Supplemental Appendix F for detailed derivations.

[19] See Supplemental Appendix Figure E1 and Figure 4 in Basten, Ehrlich and Lassmann (2017) for empirical evidence on the decreasing share of housing expenditure with income in our empirical setting. The pattern observed in Swiss data is very similar to those documented for the United States (Ganong and Shoag 2017) and France (Combes, Duranton, and Gobillon 2019).

[20] If $\theta = 0$, g_j is a pure public good. $\theta = 1$ in turn represents the fully rival case, where g_j is a publicly provided private good.

[21] The endogenous location-specific element of our model is the local publicly provided good, in contrast, for example, to Couture et al. (2024), who model an endogenous private amenity.

where $S_{fmj} \equiv p_j h^*_{fmj}/((1-\tau_j)w_m)$ represents the housing expenditure share and h^*_{fmj} is the household's Marshallian demand for housing space. $\frac{dg_j}{d\tau_j}\frac{\tau_j}{g_j}$ is the elasticity of public good provision with respect to the local tax rate. Using the balanced budget constraint, we have

$$\frac{dg_j}{d\tau_j}\frac{\tau_j}{g_j} = 1 + \sum_f \sum_m \left(\gamma_{fmj} - \theta s_{fmj}\right)\frac{dN_{fmj}}{d\tau_j}\frac{\tau_j}{N_{fmj}}, \tag{3}$$

where $\gamma_{fmj} \equiv w_m N_{fmj}/\left(\sum_f \sum_m w_m N_{fmj}\right)$ represents household type $\{f,m\}$'s share of municipality j's tax base, s_{fmj} is the proportion of households of type $\{f,m\}$, and $\frac{dN_{fmj}}{d\tau_j}\frac{\tau_j}{N_{fmj}}$ is the elasticity of the number of residents belonging to household type $\{f,m\}$ with respect to the local tax rate.

Expression (2) determines household type $\{f,m\}$'s marginal willingness to pay rent (MWPR) for a (small) tax rate change. It differs across household types $\{f,m\}$ through the family-status-specific minimum consumption of housing and public goods. In particular, if $\nu^f_h = \nu^f_g = 0$, then $S_{fmj} = \alpha$ and the MWPR becomes type invariant.

We incorporate imperfect residential mobility by modeling local amenities A_{ifj}, consisting of a common location-specific component $\bar{A}_j$ and a location-specific idiosyncratic preference component ξ_{ifj}. The household's objective is therefore to choose municipality j such as to maximize

$$V_{ifmj} = \underbrace{\kappa + \ln\left(\left[1-\tau_j\right]w_m - p_j \nu^f_h\right) - \alpha \ln(p_j) + \delta \ln\left(g_j - \nu^f_g\right) + \bar{A}_j}_{\equiv u_{fmj}} + \xi_{ifj}, \tag{4}$$

where household i will choose municipality j if their indirect utility is higher there than in any other municipality $j' \neq j$. The variable u_{fmj} defines the systematic valuation of municipality j, common to all households of type $\{f,m\}$.

We make the standard assumption that the idiosyncratic component ξ_{ifj} follows an iid Gumbel distribution with mean zero, variance σ^2_f, and scale parameter $\lambda_f = \pi/\left(\sigma_f\sqrt{6}\right)$. The scale parameter serves to model residential mobility. At one extreme, as $\lambda_f \to \infty$ $\left(\sigma_f \to 0\right)$, the idiosyncratic attachment to location disappears, and all households with family status f choose identically. At the other extreme, as $\lambda_f \to 0$ $\left(\sigma_f \to \infty\right)$, idiosyncrasies dominate the systematic valuation of locations u_{fmj}, and the population in each jurisdiction is fixed. We allow λ_f to vary by family status but not by income class.[22]

[22] Basten, Ehrlich, and Lassmann (2017, 677) show the marginal willingness to migrate to be "remarkably homogeneous" across income quartiles. Evidence for the United States also points toward relatively minor heterogeneity in worker mobility across income classes, conditional on the intensity of relevant localized demand shocks (e.g., Notowidigdo 2020; Suárez Serrato and Wingender 2016; Bayer et al. 2016).

The share of households of type $\{f,m\}$ who choose to reside in municipality j is then given by

$$N_{fmj} \equiv \Pr\left(V_{ifmj} > V_{ifmj'} \quad \forall j \neq j'\right) = \frac{\exp\left(\lambda_f u_{fmj}\right)}{\sum_{j'} \exp\left(\lambda_f u_{fmj'}\right)}, \tag{5}$$

with $\sum_j \sum_f \sum_m N_{fmj} = 1$. Aggregate demand for housing in municipality j is

$$H_j^d = \sum_f \sum_m N_{fmj} \cdot h_{fmj}^*, \quad \forall j \in J, \tag{6}$$

which is the sum of households across all types $\{f,m\}$ who choose to live in municipality j, multiplied by their corresponding Marshallian demands for housing.

B. *Housing Supply*

We model housing as a homogeneous good produced using capital and land. Housing is supplied by developers at increasing marginal cost and sold to atomistic absentee landlords who then rent it out to residents.

The total dwelling stock in municipality j is equal to

$$H_j^s = B_j p_j^{\eta_j^{s,p}}, \quad \forall j \in J, \tag{7}$$

where B_j is a constant and $\eta_j^{s,p}$ represents the housing supply elasticity with respect to housing prices. Housing supply is allowed to vary across locations according to the tightness of topographical and administrative constraints on construction (Saiz 2010; Hilber and Vermeulen 2016).

In this simple framework, housing supply does not depend on local income tax rates. This may not be an accurate representation of many empirical settings (ours included) in which, for example, rental income is taxed in the jurisdiction where the dwelling is located. In Supplemental Appendix B.1, we carefully address the implications of a dependence of housing supply on local income tax rates, used as demand shifters, for the empirical identification of $\eta^{s,p}$.

C. *Equilibrium*

The model's equilibrium is characterized by three main equations:

$$N_j = \sum_f \sum_m N_{fmj} \text{ with } N_{fmj} = \frac{\exp\left(\lambda_f u_{fmj}\right)}{\sum_{j'} \exp\left(\lambda_f u_{fmj'}\right)} \quad \forall j \in J, \tag{8a}$$

$$H_j^d = H_j^s \quad \forall j \in J, \tag{8b}$$

$$g_j = \tau_j N_j^{-\theta} \sum_f \sum_m w_m N_{fmj} \quad \forall j \in J, \tag{8c}$$

where (8a) describes the population, (8b) governs the housing market, and (8c) is the government budget constraint for each jurisdiction j.[23] In what follows, we concentrate on the first-order effects of a tax change in a jurisdiction j on its tax base and housing price. We therefore abstract from the effects of j's tax policy on housing prices and public good provision in other jurisdictions. Like in Suárez Serrato and Zidar (2016), this is consistent with households being "myopic": they do not anticipate the effect of their own and other households' location decision on public good provision and housing prices in other jurisdictions. Equivalently, one could assume an economy composed of an infinite number of small jurisdictions.

Totally log-differentiating these equations and stacking them into a system of equations yields

$$(9) \qquad \underset{(\mathcal{FM}+1)\times(\mathcal{FM}+1)}{\mathbf{A}_j} \times \underset{(\mathcal{FM}+1)\times 1}{\dot{\mathbf{y}}_j} = \underset{(\mathcal{FM}+1)\times 1}{\mathbf{B}_j} \times \underset{1\times 1}{\dot{\tau}_j},$$

where $\dot{\mathbf{y}}_j = \left[\dot{N}_{11j}, \cdots, \dot{N}_{1\mathcal{M}j}, \dot{N}_{21j}, \cdots, \dot{N}_{\mathcal{FM}j}, \dot{p}_j\right]'$ is the vector of endogenous variables and $\dot{\tau}_j$ is the exogenous variable.[24]

Premultiplying equation (9) by $\mathbf{A}_j^{-1}$ yields the reduced-form version of the system of equations, which is given by

$$(10) \qquad \dot{\mathbf{y}}_j = \mathbf{A}_j^{-1}\mathbf{B}_j\dot{\tau}_j,$$

where $\mathbf{A}_j^{-1}\mathbf{B}_j$ represents the reduced-form theoretical moments that will be used in the structural estimation of the household-type-specific parameters for public goods preferences, $\tilde{\delta}_f \equiv \delta\left(1 - \nu_g^f/g\right)^{-1}$, and interjurisdictional mobility, λ_f (see equation (16) below). For the moment, note that $\tilde{\delta}_f$ affects the utility that a household of family type f gets by living in a given jurisdiction, while λ_f multiplies the utility. $\tilde{\delta}_f$ will therefore be identified by the tax base elasticity, whereas λ_f will be identified by the differential tax base elasticity between (at least) two income groups.[25]

D. *Incidence*

We now have the elements in hand for analyzing welfare effects of local taxes on different household types.

We follow Kline and Moretti (2014) by defining aggregate renter household welfare as $\mathcal{W}^R \equiv \sum_f \sum_m s_{fm} \cdot E\left[\max_j\left\{u_{fmj} + \xi_{ifj}\right\}\right]$, where s_{fm} is the population share

[23] We provide evidence in Section VB that the balanced-budget assumption largely holds in Swiss municipalities.

[24] In this paper, we use the notation $\dot{x} \equiv dx/x$ for any variable x. The elements of matrices $\mathbf{A}_j$ and $\mathbf{B}_j$ are derived in Supplemental Appendix F. The diagonal elements of the upper block in matrix $\mathbf{A}_j$ represent how a given income class reacts to a tax rate shock, and off-diagonal elements in a given row represent how that same income class reacts to other income classes' location decision—i.e., they represent feedback effects among heterogeneous households through public good provision. The matrix $\mathbf{B}_j$ captures direct effects of tax rate changes on local tax bases and housing prices, holding fixed the between-equation interdependencies collected in matrix $\mathbf{A}_j$.

[25] To see this last point, we can use equation (8a) to write the differential tax base elasticity between households of type $\{f,m\}$ and $\{f,m'\}$ as $\frac{\dot{N}_{fmj}}{\dot{\tau}_j} - \frac{\dot{N}_{fm'j}}{\dot{\tau}_j} = \lambda_f\left(\frac{du_{fmj}}{\dot{\tau}_j} - \frac{du_{fm'j}}{\dot{\tau}_j}\right)$.

of household type $\{f, m\}$. Assuming location-specific idiosyncratic preferences to be Gumbel distributed, aggregate household welfare is then given by

$$(11) \qquad \mathcal{W}^R = \sum_f \sum_m s_{fm} \cdot \frac{1}{\lambda_f} \log\Big(\sum_j \exp\big(\lambda_f u_{fmj}\big)\Big).$$

Here, we concentrate on the effect of a small change in the income tax rate of municipality j on the welfare of household type $\{f, m\}$. The welfare effect is given by

$$(12a) \qquad \frac{d\mathcal{W}^R_{fm}}{d\ln\tau_j} = \alpha N_{fmj}\left(1 - \frac{\nu^f_h}{h^*_{fmj}}\right)^{-1}\left(MWPR_{fm} - \underbrace{\frac{dp^*_j}{\mathrm{d}\tau_j}\frac{\tau_j}{p^*_j}}_{\eta^{p,\tau^*}}\right),$$

$$(12b) \qquad \frac{d\mathcal{W}^R_{fm}}{d\ln\tau_j} = N_{fmj}\left[\underbrace{-\frac{\tau_j}{(1-\tau_j)}\left(\frac{1}{1 - S^{min}_{fmj}}\right)}_{direct\ effect\ <\ 0} + \underbrace{\delta\left(\frac{g_j}{g_j - \nu^f_g}\right)\left(\frac{dg_j}{d\tau_j}\frac{\tau_j}{g_j}\right)}_{public\ good\ effects\ >\ 0} - \underbrace{\left(\frac{S_{fmj}}{1 - S^{min}_{fmj}}\right)\left(\frac{dp^*_j}{\mathrm{d}\tau_j}\frac{\tau_j}{p^*_j}\right)}_{capitalization\ effect\ >\ 0}\right],$$

where $MWPR_{fm}$ is the marginal willingness to pay rent (defined by equations (2) and (3)) and η^{p,τ^*} is the change in the equilibrium housing price. The aggregate change in household welfare is then $d\mathcal{W}^R/d\ln\tau_j = \sum_f \sum_m s_{fm} \cdot \frac{d\mathcal{W}^R_{fm}}{d\ln\tau_j}$. We abstract from general equilibrium effects in other jurisdictions by assuming atomistic jurisdictions. Also, movers do not enter equation (12a) as a consequence of the envelope theorem (Busso, Gregory, and Kline 2013).[26]

Inspection of equation (12a) highlights that the sign of the incidence on a household of a given type $\{f, m\}$ is determined by the differential between the household's MWPR and the change in equilibrium rental prices. Household welfare increases if the drop in equilibrium housing prices induced by a rise in the tax rate (i.e., capitalization) is larger in absolute value than the household's bid-rent price.

The welfare effect of a linear tax increase can be decomposed into the direct effect of the tax increase and two indirect effects through changed public good provision and through capitalization into lower housing prices. To separate these effects, we can rewrite the welfare effect as equation (12b), where $S^{min}_{fmj} \equiv p_j\nu^f_h/((1-\tau_j)\,w_m)$ is the fraction of income spent on essential housing consumption.

[26]The intuition is as follows. At equilibrium in this model, when a household i moves to a municipality j after a positive shock to an observable characteristic of that municipality, the household is choosing a jurisdiction with a more favorable common valuation, $u_{fmj} > u_{fmj'}$. However, this is offset by a less favorable idiosyncratic valuation, $\xi_{fmj} < \xi_{fmj'}$ (see equation (4)). Second, movers differ in their idiosyncratic valuations. The indifferent household before the shock gains almost as much as the stayers, while, after the shock, the new indifferent household loses as she gives up her surplus of living in her most preferred municipality. For small shocks, the welfare effects on movers are negligible relative to those on stayers.

The direct effect of a tax increase is regressive, as low-income taxpayers spend a higher fraction of their income on essential housing. Higher public good provision partly compensates the negative direct effect. In our setting, the public good effect benefits rich and poor households equally but is allowed to be stronger for families with children. A second indirect effect operates through the capitalization of higher taxes into lower housing prices. This has a progressive effect, as lower-income households (especially with children) spend a higher share of their budget on housing than higher-income (childless) households.

The incidence of a linear local tax therefore depends on two parameters, the preferences for locally provided public goods (that we estimate) and housing needs (that we parameterize), and on two elasticities, the elasticity of public good provision with respect to the local tax rate and the elasticity of equilibrium housing prices with respect to the local tax rate, both of which we obtain by solving the system of equations (10).

Landlords' utility is defined as rental revenue less the cost of supplying location-j housing. The inverse supply curve is $p_j = \left(H_j^s/B_j\right)^{1/\eta_j^{s,p}}$. Producer surplus is therefore given by

$$\mathcal{W}^L = \int_0^{H^*}\left[p_j^* - \left(\frac{x}{B_j}\right)^{1/\eta_j^{s,p}}\right]dx = \frac{p^* H^*}{\left(1+\eta_j^{s,p}\right)}.$$

The change in landlords' welfare after a change in the local tax rate is then

$$\frac{d\mathcal{W}^L}{d\ln\tau_j} = p^* H^* \underbrace{\left(\frac{dp_j^*}{d\tau_j}\frac{\tau_j}{p_j^*}\right)}_{\eta^{p,\tau^*}}. \tag{13}$$

Landlords' welfare is entirely determined by changes in equilibrium housing prices: to the extent that changes in taxation capitalize into housing prices, their incidence is borne by the absentee owners.

E. *From Theory to Empirics*

The empirical analogue of equation (9) is

$$\mathbf{A}\dot{\mathbf{y}}_j = \mathbf{B}\dot{\tau}_j + \mathbf{e}_j, \tag{14}$$

where $\mathbf{e}_j$ represents structural error terms. The reduced-form version of the system of equations is given by

$$\dot{\mathbf{y}}_j = \underbrace{\mathbf{A}^{-1}\mathbf{B}}_{\equiv\boldsymbol{\eta}}\,\dot{\tau}_j + \mathbf{A}^{-1}\mathbf{e}_j, \tag{15}$$

where $\boldsymbol{\eta} = \left[\eta^{N_{11}}, \cdots, \eta^{N_{\mathcal{FM}}}, \eta^{p}\right]'$ is the vector of reduced-form moments.[27]

Two remarks are in order. First, the empirical estimates of reduced-form moments are j invariant. We therefore drop the subscript j on matrices **A** and **B**—i.e., our structural estimation is for a representative municipality. Second, while we can quite easily calibrate essential housing needs (ν_h^f), essential public goods needs (ν_g^f) for households with and without children are not observable. Recall that $\tilde{\delta}_f \equiv \delta\left(1 - \nu_g^f/g\right)^{-1}$ is the family-type-specific parameter for public goods preferences. We expect households with children to have greater needs than households without children for locally funded public services such as daycare and elementary schooling, such that $\tilde{\delta}_1 > \tilde{\delta}_0$, but we place no prior restriction on these structural parameters.

Our aim is to find the parameter vector $\boldsymbol{\vartheta} = \left[\tilde{\delta}_1, \ldots, \tilde{\delta}_{\mathcal{F}}, \lambda_1, \ldots, \lambda_{\mathcal{F}}\right]$ that best matches the moments $\mathbf{m}(\boldsymbol{\vartheta}) = \boldsymbol{\eta}$ to their reduced-form empirical counterparts $\hat{\boldsymbol{\eta}}$. For a given set of calibrated parameters, we use classical minimum distance structural estimation (Chamberlain 1984) to find

$$\hat{\boldsymbol{\vartheta}} = \underset{\boldsymbol{\vartheta} \in \boldsymbol{\Theta}}{\arg\min} \left[\hat{\boldsymbol{\eta}} - \mathbf{m}(\boldsymbol{\vartheta})\right]' \hat{\mathbf{V}}^{-1} \left[\hat{\boldsymbol{\eta}} - \mathbf{m}(\boldsymbol{\vartheta})\right], \tag{16}$$

where $\hat{\mathbf{V}}^{-1}$ is the inverse of the variance-covariance matrix from the reduced-form empirical estimation of the vector $\hat{\boldsymbol{\eta}}$.

This structural estimation relies on two building blocks:

(i) joint estimation of two responses to changes in taxation, contained in the vector $\hat{\boldsymbol{\eta}}$:

- the elasticity of the tax base with respect to the local tax rate (the "tax base elasticity") and
- the elasticity of the housing price with respect to the local tax rate (the "capitalization elasticity"),

and

(ii) the calibration of the elasticity of housing supply with respect to the housing price (the "housing supply elasticity", $\eta^{s,p}$).

We take advantage of the Swiss setting (Section II) to identify and jointly estimate tax base and capitalization elasticities while instrumenting local income tax rates (Section III). We also exploit (instrumented) local income tax variation as a demand shifter to estimate the housing supply elasticity (Supplemental Appendix B). The other parameters of matrices **A** and **B** $(\gamma_{mj}, s_{mj}, \nu_h^f/h^*_{mj}, \pi_{mj}, \rho_j,$ and $S_{mj})$ as well as income tax rates τ_j will be calibrated with observed values (Section IV). Supplemental Appendix A offers a schematic overview of the different building blocks of the paper.

[27] Hereinafter, reduced-form elasticities of a variable x with respect to τ are denoted η^x instead of $\eta^{x,\tau}$ to save on notation unless explicitly stated otherwise.

II. Empirical Setting

A. *Institutional Background*

Switzerland is a highly decentralized country composed of 26 cantons and 2,352 municipalities.[28] The three layers of government enjoy significant autonomy in taxation and public spending. According to the OECD Fiscal Decentralization Database, Switzerland has the OECD's highest local revenue share, followed by the United States and Canada. Gauged by the share of autonomously raised municipal taxes, Switzerland is the third-most decentralized OECD country, after Finland and Iceland, but with a somewhat higher local tax share than the United States, Canada, Spain and Germany.[29]

Our focus in this paper is on the municipal ("local") level. Most municipalities are small. In 2014, the average municipal population was 3,256, with a maximum of 382,000 (city of Zurich). Nonetheless, municipalities are important in fiscal terms. In 2014, municipal spending accounted for 23 percent of consolidated public expenditure and 34 percent of consolidated personal income tax revenue.[30] Municipalities are largely autonomous over most of their budget, including preprimary, primary, and secondary schooling (27 percent of average municipal expenditure, representing 53 percent of consolidated school funding), transport and environmental services (19 percent), general administration (11 percent), and recreation and culture (7 percent). In contrast, for some categories, the level of spending is mainly driven by canton-level or federal-level mandates. This primarily concerns social transfers (19 percent of municipal expenditure) and policing (6 percent).[31]

On the revenue side, municipalities have considerable decision-making powers as well. In 2014, some 64 percent of municipal revenue were raised through own taxes, of which 63 percent were personal income taxes. Property-related taxes, however, are relatively unimportant in international comparison, accounting for less than 5 percent of revenue.[32]

Municipal tax policy in most cases consists of setting a single number: a multiplier on the canton-level tax schedule that determines the municipal share of the subfederal tax take. Local tax multipliers can be adapted annually by municipal

[28] The municipality count refers to 2014, our final sample year. Due to municipal mergers, this number has been gradually decreasing. In 2004, our first sample year, the municipality count stood at 2,780.

[29] See Brülhart, Bucovetsky, and Schmidheiny (2015).

[30] The summary statistics cited in this and the following paragraphs are taken from Swiss Federal Statistical Office (2017b).

[31] The precise allocation of responsibilities between cantons and municipalities is complex and varied. The most comprehensive available overview has been provided by Rühli (2012). All municipal tasks are to some extent affected by canton-level regulations and cofinancing, but in only 2 of the 13 tasks identified in that study (policing and business development) does the average financial and executive weight of the canton dominate that of the municipalities. School districts perfectly overlap with municipalities in 21 of 26 cantons. In the remaining five cantons, this is also the case for the majority of school districts, with a recent trend toward further integration of schooling into the general-purpose municipal administrations. Compulsory schooling in Switzerland is free and therefore funded solely through general taxation. Rühli (2012) also documents a trend toward increasing intermunicipal cooperation, with close to 40 percent of municipal tasks being shared through formal agreements with neighbor municipalities. In terms of our study, this implies spatially correlated municipal policies.

[32] We can only state an upper bound for the share of property-related taxes, as the corresponding category in the financial statistics also includes tax revenue that is not related to property taxes.

parliaments or citizen assemblies. Hence, within-canton variation in local income tax rates is almost perfectly captured by municipal tax multipliers.[33]

Cantonal laws define statutory tax schedules and, combined with federal-level legislation, determine deductions and exemptions for the definition of the tax base. Municipalities, however, have no say over tax schedules, deductions, and exemptions. Canton multipliers applied to the basic statutory tax schedule are determined annually by cantonal parliaments. Changes to the definition of the tax base or tax schedule are more infrequent, as they imply changes in cantonal tax laws and are thus typically subject to referenda.

Unlike income taxes, housing-related tax rates are mostly set at the canton level, with revenue sharing between cantons and municipalities.[34] Three such taxes are applied: First, 19 of the 26 cantons levy an annual property tax, computed as a fraction of the assessed value of the property. The highest tax rate amounts to 0.3 percent of the assessed value (canton of Fribourg). Second, when property ownership is transferred, sellers pay a real-estate-specific capital gains tax at a rate that is decreasing in ownership tenure. This real estate capital gains tax is levied in all cantons. Third, 18 out of the 26 cantons apply a property transaction tax. The mean tax rate is 0.5 percent of the transaction price, with an upper bound of 3.3 percent (canton of Neuchâtel).

An important aspect of real estate taxation in all of Switzerland is that owner-occupiers pay income taxes on imputed rents. Imputed rents are generally set somewhat below estimated market values, with federal guidelines stipulating at least 70 percent of estimated market rent. Mortgage interest and maintenance costs are tax deductible. Hence, the implied tax subsidy for owning relative to renting is significantly smaller in Switzerland than in countries that do not tax imputed rents. Indeed, at a first approximation, the Swiss tax system can be considered roughly neutral between renting and owning.[35] Hence, our qualitative results should be generalizable, as they are informative not only for the considered population of renters but also for owner-occupiers, conditional on equal incomes and family status.

B. *Data*

We have assembled a new municipality-level dataset covering the period 2004–2014 (Brülhart et al. 2025). Our most important observed variables are personal income tax rates, housing prices, housing stocks, taxpayer counts by income bracket, and local public expenditure. Table 1 provides summary statistics for all

[33] We also take account of the fact that parishes levy their own (small) tax multipliers.

[34] Thus, housing tax rates largely cancel out in estimations featuring canton fixed effects. We will, however, have to take account of the minority of municipalities that set their own property tax rate.

[35] The relative effect of the taxation of imputed rents on owners and renter households depends on the mortgage interest rate. As valuations for tax purposes are adjusted every 15 years on average but the mortgage interest deduction changes annually along with actual payments, the system favors homeowners in periods of high interest rates but disadvantages them in periods of low interest rates. According to estimations by the Swiss Federal Tax Administration, the system is approximately neutral for interest rates in the range of 2.5–3.5 percent, which comprises Swiss mortgage rates over our sample period. This partly explains why, in Switzerland, rich and poor people have similar probabilities of living in rented accommodation, with household surveys suggesting roughly equal per capita renter shares across the four income quartiles (Swiss Federal Statistical Office 2014).

Table 1—Summary Statistics

	Main sample (border and nonborder municipalities)			Border sample			Border versus nonborder sample	
	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Diff. (SE)	*p*-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Housing prices and quantities								
Rental price (CHF/m^2)	16.70 (3.98)	4.15	43.72	16.23 (3.35)	6.00	34.63	−0.854 (0.158)	0.000
Dwelling space (m^2 ’000s)	191.44 (500.08)	3.15	16,304.11	167.14 (247.75)	3.15	3,820.08	−43.978 (21.812)	0.044
Panel B. Consolidated canton plus municipal plus church tax rates (%)								
Married with children								
Bottom 50%	3.52 (1.45)	0.26	7.39	3.74 (1.39)	0.26	7.39	0.407 (0.054)	0.000
50%–75%	5.91 (1.69)	0.88	10.35	6.08 (1.52)	0.90	9.91	0.304 (0.069)	0.000
Top 25%	11.31 (1.98)	2.65	16.67	11.38 (1.98)	2.70	16.50	0.120 (0.086)	0.165
Unmarried without children								
Bottom 50%	11.20 (1.89)	3.77	15.77	11.21 (1.93)	3.78	15.77	0.027 (0.086)	0.756
50%–75%	13.13 (2.00)	4.41	18.15	13.13 (2.10)	4.41	18.15	−0.008 (0.092)	0.931
Top 25%	17.17 (2.43)	5.62	23.07	17.09 (2.53)	5.62	22.85	−0.157 (0.110)	0.155
Pensioners								
Bottom 50%	8.65 (2.79)	0.38	14.42	8.52 (2.44)	0.38	13.71	−0.226 (0.125)	0.072
50%–75%	10.80 (2.70)	3.46	16.97	10.64 (2.50)	3.53	16.12	−0.297 (0.121)	0.014
Top 25%	15.46 (2.93)	4.57	22.20	15.06 (2.99)	4.57	21.59	−0.717 (0.129)	0.000
Average tax rate	14.62 (2.19)	4.84	20.53	14.56 (2.27)	4.84	19.78	−0.097 (0.100)	0.331

(*continued*)

municipality-level variables.[36] In columns 1–3, information is presented for the full sample of 1,814 municipalities for which we have housing price data in 2004–2005 and 2013–2014. Municipalities close to canton borders play a key role in our identification strategy. We therefore report separate summary statistics for this subsample of 812 municipalities in columns 4–6. In columns 7–8, we report differences between the sample means of border and nonborder municipalities.

We first need a measure of household *income* to attribute taxpayers to income classes. We use net household income according to the definition used for federal income taxation, which offers us a measure that is consistent across years and

[36] Data sources are listed in the notes below Table 1.

Table 1—Summary Statistics (*continued*)

	Main sample (border and nonborder municipalities)			Border sample			Border versus nonborder sample	
	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Diff. (SE)	*p*-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel C. Number of taxpayers								
Total	2,400.54 (7,618.27)	37	254,158	2,013.29 (3,328.69)	37	53,171	−701.07 (330.24)	0.034
With children								
Bottom 50%	93.66 (316.89)	0	11,075	75.01 (130.84)	0	2,111	−33.77 (13.47)	0.012
50%–75%	148.05 (369.77)	1	11,625	129.14 (186.91)	1	2,700	−34.24 (16.08)	0.033
Top 25%	272.62 (678.12)	0	23,557	241.26 (325.46)	0	4,150	−56.78 (29.35)	0.053
W/o children (bottom 50%)	1,096.15 (3,546.35)	13	111,521	885.04 (1,547.52)	13	25,003	−382.20 (153.71)	0.013
Nonpensioners	767.49 (2,452.94)	11	76,058	609.94 (1,030.62)	11	17,243	−289.96 (109.95)	0.008
Pensioners	341.89 (1,194.69)	1	35,463	263.14 (496.01)	1	8,819	−144.81 (53.15)	0.006
W/o children (50%–75%)	453.89 (1,554.00)	5	52,675	393.84 (706.90)	5	12,266	−108.72 (67.52)	0.108
Nonpensioners	323.02 (1,161.65)	3	39,635	277.16 (503.59)	4	9,074	−84.39 (52.38)	0.107
Pensioners	139.22 (445.80)	0	13,945	114.10 (201.18)	0	3,256	−46.21 (20.03)	0.021
W/o children (top 25%)	336.16 (1,224.09)	0	45,121	289.01 (494.85)	0	7,436	−85.37 (52.90)	0.107
Nonpensioners	249.67 (975.05)	0	36,570	213.54 (365.03)	0	5,351	−66.51 (43.82)	0.129
Pensioners	94.64 (307.05)	0	10,029	75.74 (145.02)	0	2,090	−34.75 (13.81)	0.012
Panel D. Public expenditure (in CHF million)								
Total	27.35 (209.25)	0.13	8,541.32	17.78 (39.22)	0.13	654.78	−18.815 (10.459)	0.072
Education	5.60 (25.89)	0.00	1,020.63	4.88 (9.14)	0.00	145.98	−1.432 (1.385)	0.301
Social	5.23 (37.79)	0.02	1,407.00	3.44 (8.29)	0.02	132.93	−3.594 (2.030)	0.077
Administration	2.74 (19.50)	0.03	832.37	1.86 (4.24)	0.03	88.54	−1.781 (0.992)	0.073
Roads	2.16 (26.05)	0.01	998.72	1.12 (3.60)	0.01	81.49	−2.344 (1.718)	0.173
Police	1.51 (15.88)	0.00	584.54	0.78 (2.56)	0.00	51.29	−1.453 (0.854)	0.089
Health	1.82 (27.82)	0.00	1,089.62	0.76 (4.51)	0.00	127.24	−2.412 (1.826)	0.187

(*continued*)

Table 1—Summary Statistics (*continued*)

	Main sample (border and nonborder municipalities)			Border sample			Border versus nonborder sample	
	Mean (SD)	Min	Max	Mean (SD)	Min	Max	Diff. (SE)	*p*-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel E. Time-invariant control variables (municipality level)								
Share of developed land	0.21	0.00	1.00	0.20	0.04	0.99	−0.047	0.000
	(0.18)			(0.15)			(0.008)	
Time to permit	−0.74	−3.60	19.04	−0.83	−2.29	5.09	−0.044	0.214
	(0.94)			(0.68)			(0.035)	
Accessibility	5.29	1.00	10.00	4.12	1.00	8.00	−1.295	0.000
	(2.28)			(1.76)			(0.094)	
Exposure to natural risks	5.43	1.00	10.00	5.71	1.00	10.00	0.810	0.000
	(2.35)			(2.33)			(0.112)	
Architectural heritage	6.39	1.00	30.00	6.39	1.00	30.00	−0.544	0.080
	(6.47)			(6.48)			(0.310)	
Hours of sunlight	6.43	0.00	8.10	7.04	0.00	8.10	0.547	0.000
	(1.83)			(1.03)			(0.065)	
Panel F. Local autonomy in property taxation (canton level)								
No common multiplier	0.86	0.00	1.00	0.86	0.00	1.00	0.068	0.000
	(0.34)			(0.35)			(0.018)	
Property tax	0.76	0.00	1.00	0.54	0.00	1.00	−0.263	0.000
	(0.43)			(0.50)			(0.022)	
Transaction tax	0.51	0.00	1.00	0.30	0.00	1.00	−0.104	0.000
	(0.50)			(0.46)			(0.022)	

Notes: The main sample consists of all border and nonborder municipalities for which rental prices are available in both 2004–2005 and 2013–2014. It includes 1,814 municipalities (1,602 for public expenditure data). The border subsample contains 812 municipalities (784 for public expenditure data). In panel C, the information on pension status is not available for all years; hence, means do not always add up. The share of developed land is the ratio of developed land to developable land (total surface minus unproductive areas, taking into account topography). Time-to-permit fixed effects are municipality fixed effect coefficients from a regression of building permit approval time on observable characteristics of the project, municipality, and year fixed effects. No common multiplier indicates municipalities that are allowed to set a different multiplier for their income tax and real estate capital gains taxes. Property tax and Transaction tax are dummy variables for municipalities that are allowed to levy a property tax or a real estate transaction tax, respectively. (SD) means standard deviation and (SE) means standard error. Standard errors in column 7 are clustered at the municipality level.

Sources: Swiss Federal Statistical Office (n.d.a) (for municipality definitions); Swiss Federal Statistical Office (n.d.b) to deflate nominal variables; Wüest Partner (2017c) (panel A); Parchet (2019b) (panel B); Swiss Federal Tax Administration (2022) (panel C); Fontana-Casellini (2022) (panel D); Swiss Federal Office of Topography (2016) and Swiss Federal Statistical Office (2017a) (panel E, Share of developed land); Wüest Partner (2017a) (panel E, Time to permit); Wüest Partner (2017b) (panel E, amenity variables)

cantons.[37] Our main focus is on three income classes: below-median income, the third quartile, and the top quartile. We determine quartiles annually using the universe of federal income tax records.[38] Importantly, we distinguish between households with

[37] Net income is defined as taxable income, to which standard federal-level deductions that depend on marital and family status have been added. As published tax rates are reported relative to gross income, we convert net income into gross income based on detailed deductions by income groups for the canton of Bern, as documented by Peters (2005), to obtain the tax rates shown in panel B of Table 1.

[38] For example, the seventy-fifth (fiftieth) percentile incomes for married households were CHF 111,000 (CHF 64,000) in 2014. This amounts to US$122,000 (US$70,000), using the 2014 exchange rate of US$1.10 per CHF 1.

and without dependent children. Among households without dependent children, we moreover distinguish between pensioner and nonpensioner households as a proxy for age. This last distinction is prone to some reporting errors (see Section VA) and available only for a subset of years. We will therefore not use it for our baseline estimates.

For each of the nine household types (by family status and income class), we compute a representative average *tax rate* using the consolidated cantonal, municipal, and church tax liability as a percentage of gross wage income for representative households.[39]

We focus on the following three main representative tax rates:

- *households with children* (*nonpensioners*): consolidated tax rates on income of married couples with an average of 1.7 dependent children and a taxable income at, respectively, the median and the midpoints of third and fourth quartiles of the nationwide distribution;[40]
- *households without children* (*nonpensioners*): corresponding tax rates for unmarried taxpayers without dependent children;
- *pensioner households*: corresponding tax rates for married pensioners without dependent children

In our baseline estimates, where we do not distinguish between pensioner and nonpensioner households, we use (for childless households) a weighted average of tax rates for unmarried taxpayers without children and tax rates for pensioner couples without children, where the weights are based on the nationwide tax base shares in 2004. Finally, as a measure of the overall representative tax rate in a municipality and year (needed, e.g., for estimating the elasticity of housing prices), we compute weighted averages of the ninetieth-percentile tax rates for married taxpayers with two children, unmarried taxpayers without children and pensioner couples without children.

Panel B of Table 1 shows that there exists considerable variation in local income tax rates within Switzerland, with the highest rate exceeding the lowest rate by a factor of around five for most of our representative tax rates. Figure 2 illustrates this variation in the cross section and over time, mapping the local tax rates for unmarried taxpayers without children at the midpoint of the upper income quartile (approximately CHF 139,500 in 2004). Figure 2, panel A shows that tax rates can vary within geographically small regions, thus allowing residents to change their tax bill by relocating within commuting zones. In our empirical analysis, we exploit time variation, illustrated in Figure 2, panel B. This variation is substantial

[39] Representative tax rates for the different household types are based on tax rates computed by the Swiss Federal Tax Administration for discrete taxable income levels that range from CHF 10,000 to CHF 1,000,000 (US$11,000 to US$1.1 million in 2014). These data are published for a sample of the largest municipalities. We draw on earlier work, where we have extended this dataset to all municipalities (Parchet 2019a). Tax rates for specific income values (quartile boundaries) are obtained through linear interpolation between the nearest income levels reported in the official statistics.

[40] The average number of children in households with children equals 1.7 in the federal income tax records. We therefore proxy the tax rate of those households though linear interpolation between the published tax rates for married couples without children and the tax rates for married couples with two children.

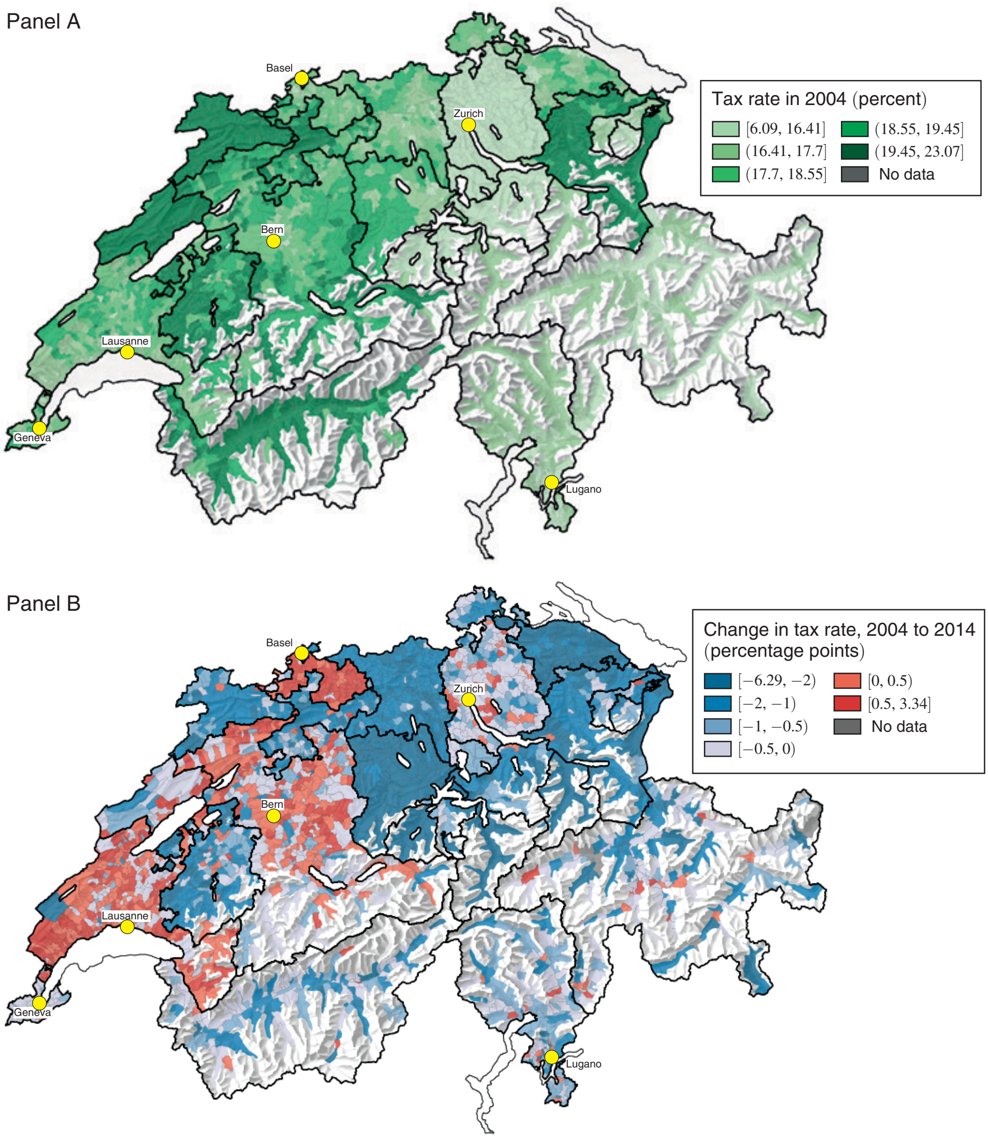


Figure 2. The Geography of Local Taxes in Switzerland

Notes: Panel A shows the consolidated cantonal, municipal, and church income tax rates (in percent) for unmarried taxpayers without children at the midpoint of the upper income quartile. Panel B shows the difference in the consolidated income tax rates between 2014 and 2004. Gray lines represent municipality borders. Thick black lines represent canton borders. White areas are lakes, and light-gray-shaded areas are uninhabited mountains.

as well: the scale attached to the map shows that tax rate changes ranged from −6.3 to +3.3 percentage points, for a sample average tax rate of 17.1 percent (Table 1, panel B).

Figure 3 further illustrates the identifying variation for our main sample of 812 border municipalities. The left-hand panel of Figure 3 shows that tax rates are changed frequently: the modal number of tax changes within our 11-year time window is 3.

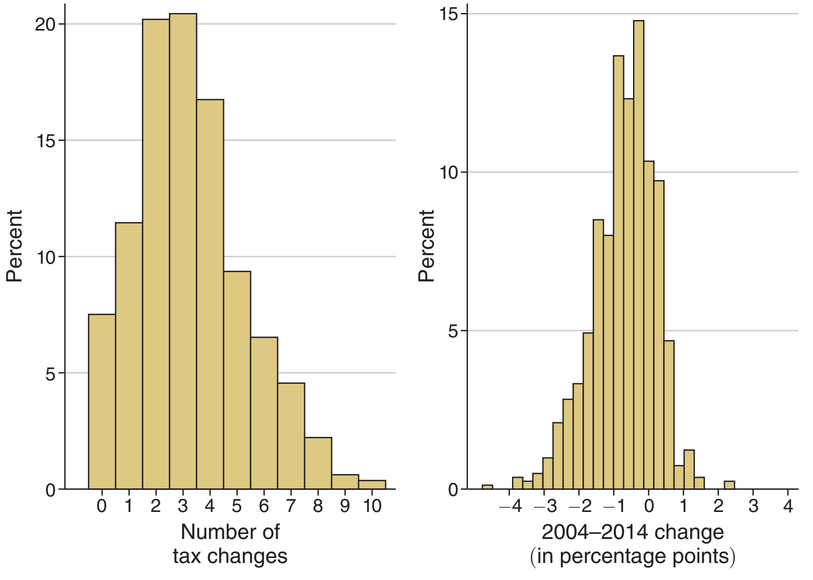


FIGURE 3. IDENTIFYING SAMPLE VARIATION IN LOCAL TAX RATES

Notes: Data for sample of border municipalities, 2004–2014. Number of municipalities: 812. Number of tax changes: 2,639. The left-hand panel reports the number of municipality-level tax changes implied by a change in the municipal tax multiplier. The right-hand panel shows the distribution of long differences (2014 value minus 2004 value) of the municipal tax income tax rate for unmarried taxpayers without children at the midpoint of the upper income quartile.

The right-hand panel of Figure 3 shows that most local tax rate changes in our sample are negative, but there is considerable variation.

Information on *housing prices* is taken from rental postings. The basic dataset available to us covers very close to the universe of Swiss online and print offers —some 1.6 million rental postings in total. The mean monthly rent for a 100 m^2 appartment is CHF 1,670 (US$1,837), but price variations are large (see the summary statistics in panel A of Table 1).[41] In addition to rental prices, postings report object-level characteristics, including floor space, the number of rooms (as dummy variables), and information on recent renovations. Rental prices provide an accurate measure of market prices because posted rents are very close to transaction rental prices in Switzerland, where negotiation over posted rents is rare.[42] In order to control for heterogeneous housing characteristics, we use residuals from an object-level regression of log rental prices on floor size (cubic polynomial), the

[41] Maps of average housing prices per municipality and of changes in these prices over time are presented in Supplemental Appendix Figure E2. These are raw prices per m^2, without conditioning on dwelling characteristics. Data on rental postings, building permit requests, and amenities are confidential and were kindly provided by Wüest Partner AG. This consultancy firm collects property advertisement information daily from all relevant websites and newspapers. Our dataset therefore covers essentially all arm's-length rental offers. Exceptions not covered by our data include some postings in case of simultaneous new rentals in multiunit buildings, and offers publicized only via informal local notice boards or word of mouth.

[42] Negotiation over purchase prices, however, is as common in Switzerland as it is elsewhere. Hence, posted prices are a more reliable measure in the rental market than in the owner market.

number of rooms, the interaction between size and number of rooms, a dummy for recent renovations, and municipality and year fixed effects.

We also collected time-invariant municipality-level amenity measures including indices for accessibility, exposure to natural risks (e.g., landslides), architectural heritage, and winter sunlight hours (panel E of Table 1).

For the estimation of the housing supply elasticity, reported in Supplemental Appendix B, we compute the municipal *housing stock* as habitable residential floor space net of demolitions (dwelling space) at annual intervals for 2004–2014.[43] We use municipal tax rates as demand shifters. This implies that we need to take account of the fact that cantons differ in the autonomy they grant to their municipalities with respect to property taxation. Where municipalities are allowed to set specific taxes on property values or transactions, these taxes will likely affect supply as well as demand, and local tax multipliers can no longer be interpreted as pure demand shifters (see Supplemental Appendix B.1). We capture the degree of local autonomy through three binary variables. First, the *no common multiplier* variable is set to one for cantons that allow municipalities to apply a different multiplier for the income tax and for real estate capital gains taxes, and to zero where municipalities do not have that option. Second, the *property tax* variable is set to one where municipalities are allowed to levy an annual tax on property values, and to zero otherwise. Third, the *transaction tax* variable is set to one where municipalities are allowed to levy a real estate transaction tax or such a tax exists at the cantonal level, and to zero otherwise. In the housing-supply regressions, we in addition control for local *administrative efficiency* and for *topographic constraints*.[44]

Finally, we collected data on municipal public expenditure. Except for some 170 large municipalities, municipal public accounts are reported only to the cantonal authorities, but not to the federal level. This forced us to gather these data from cantonal and, in some cases, municipal archives. We succeeded in obtaining broadly comparable expenditure data for 1,602 municipalities. The summary statistics in panel D of Table 1 confirm that schooling (which includes preschool facilities) is the largest municipal expenditure category, followed by social spending (which is largely nondiscretionary) and administration.[45]

Columns 7 and 8 of Table 1 show differences in means of our municipality-level variables between the border and nonborder subsamples. Municipalities in the border sample have lower housing prices than those in the nonborder sample. They have higher tax rates for households with children but lower ones for childless households, especially for pensioner couples. They are also less populous, which explains the lower share of developed land in the border sample. As a consequence, housing

[43] We thank the Federal Statistical Office for granting us access to confidential data from the Swiss Federal Registry for Buildings and Housing.

[44] See Supplemental Appendix B.1 for details on data construction.

[45] The lower share of expenditure for schooling in our main sample (20 percent) compared to the aggregated statistics reported by Swiss Federal Statistical Office (2017b) (27 percent) is largely explained by the existence in five cantons of single-purpose school districts, for which we do not have data. The average expenditure share for schooling in our border sample (27 percent), however, is consistent with aggregate statistics.

supply elasticities might differ between the two samples. We investigate the implications of different housing supply elasticities in Section IVE.[46]

III. Reduced-Form Responses to Tax Changes

Based on the data described in Section II, we can estimate the vector of reduced-form moments $\hat{\boldsymbol{\eta}}$ of equation (15): elasticities with respect to local income tax rates (i) of municipality-level counts of taxpayers for each our six household types (tax-base elasticities) and (ii) of municipality-level average housing prices.

Identifying causal effects of local tax rates is challenging for two reasons. First, local tax rates are decided by residents and could therefore respond directly to changes in the tax base. For example, an inflow of high-income taxpayers could strengthen the position of residents favoring lower tax rates, or municipalities could decide to lower their tax rate to mitigate the outflow of such taxpayers. Second, changes in local tax rates could be correlated with unobserved time-varying factors that also influence location decisions, giving rise to omitted variable bias. We therefore implement an instrumental variable strategy to address the potential endogeneity of local tax rates.

A. *Empirical Model*

Following the approach developed in Parchet (2019a), we take advantage of the fact that in Switzerland, three layers of government tax the same tax base. Cantonal borders create spatial discontinuities in fiscal policies across areas that are otherwise highly integrated. We implement a cross-border pairwise-comparison strategy and exploit changes in neighbor-canton tax rates as a source of exogenous variation. This variation is used to instrument differential changes in tax rates between neighboring municipalities located on opposite sides of canton borders. In Supplemental Appendix C, we develop this identification strategy step by step, starting from OLS panel estimation across all municipalities.

In our preferred specification, the long first-differences cross-border IV design, we restrict the sample to municipalities that are located close to a canton border. Specifically, we pair each municipality with its nearest neighbor-canton counterpart, provided their population centroids are located within no more than 10 kilometers' road distance from each other.[47] We then apply a cross-canton spatial difference estimation strategy, instrumenting the difference of the consolidated municipal tax rates with the corresponding difference in cantonal tax rates.

We jointly estimate long-first-difference models for the period 2004–2005 to 2013–2014. Specifically, we estimate the reduced-form moments $\boldsymbol{\eta} = \left[\eta^{N_1}, \ldots, \eta^{N_6}, \eta^{P}\right]'$ using the three-stage least squares (3SLS) estimator, and

[46] Border municipalities on average being somewhat smaller than nonborder municipalities also implies that our estimated tax base elasticities may be larger in absolute value than if we had estimated them using the universe of Swiss municipalities. Conditional on public good preferences, stronger mobility leads to a relatively larger incidence on landlords, and hence our estimates of renter incidence can be considered to be conservative.

[47] For a map of the border-municipality sample, see Supplemental Appendix Figure E3. Summary statistics are given in Table 1. Distances between municipalities are taken from Parchet (2019b).

instrumenting municipality-pair-level differences in consolidated tax rates with the corresponding difference in canton-level tax rates.

Specifically, the seven estimating equations are

$$\nabla\Delta\ln N_{jk}^{1} = \eta^{N_1}\nabla\Delta\ln\tau_{jk}^{1} + \boldsymbol{\mu}^{N_1}\nabla\mathbf{X}_{jk} + \phi_c^{N_1} + \varepsilon_{jk}^{N_1}, \tag{17a}$$

$$\vdots$$

$$\nabla\Delta\ln N_{jk}^{6} = \eta^{N_6}\nabla\Delta\ln\tau_{jk}^{6} + \boldsymbol{\mu}^{N_6}\nabla\mathbf{X}_{jk} + \phi_c^{N_6} + \varepsilon_{jk}^{N_6}, \tag{17f}$$

$$\nabla\Delta\ln P_{jk} = \boldsymbol{\eta}^{P}\nabla\Delta\ln\tau_{jk}^{P} + \beta_1\nabla SDL_{jk} + \beta_2\nabla TTP_{jk} + \boldsymbol{\mu}^{P}\nabla\mathbf{X}_{jk} + \phi_c^{P} + \varepsilon_{jk}^{P}, \tag{17g}$$

where ∇ denotes the difference within pairs of municipalities jk in two neighboring cantons, c and d, with $(j \in c) \neq (k \in d \neq c)$, and Δ represents the long difference between the averages for 2013–2014 and 2004–2005. N^{fm} and P, respectively, denote the count of taxpayers belonging to a specific household type fm and housing prices. τ^{fm} is the consolidated $(canton + municipal + church)$ tax rate as relevant to the associated regressand. We also control for the vector $\mathbf{X}$ of time-invariant municipal characteristics (accessibility, exposure to natural risks, architectural heritage, and winter sunlight hours). In the housing-price elasticity equation (17g), we in addition control for topographical constraints and local administrative efficiency.[48]

The long-first-difference strategy has the advantage of removing municipality-pair fixed effects for the joint estimation of the seven equations. Moreover, ϕ_c is an origin canton fixed effect such that our identification comes from municipalities in the same canton, but bordering different neighboring cantons. Changes in differentials of local tax rates, $\nabla\Delta\ln\tau_{jk}$, are instrumented with the corresponding changes of canton-level tax rates $\nabla\Delta\ln\tau_{cd}$. Since housing price data are more reliable in larger municipalities, regressions are weighted by the log of population in 2000 of the smaller municipality in the pair.

To be valid, this estimation strategy has to satisfy several conditions. First, tax base changes in border municipalities should not systematically affect canton-level fiscal policy (reverse causation). With spatial differencing, the identifying assumption requires the neighboring cantonal policy to be independent from the tax base in municipalities *j and k*, not only from municipality *j* as in Parchet (2019a). The assumption is that a set of border municipalities is small compared to the population and tax base of the entire canton. This could be of particular concern if the capital city or a major city is located at the cantonal border. We provide evidence in Supplemental Appendix C that our results are robust to the exclusion of capital towns from the border pairs and to the exclusion of small cantons in which a large share of the population is concentrated at a specific cantonal border. Second, canton-level

[48] See Supplemental Appendix B.1 for details.

tax changes should not be driven by unobserved factors that also change the attractiveness of border municipalities (omitted variables). In that respect, spatial differencing controls for regional shocks in, e.g., a local labor market, to the extent that the two areas are closely integrated. Our pairing of municipalities based on a maximum road distance of 10 km excludes municipalities divided by geographical features such as mountains or lakes. However, even if municipalities are spatially close, we cannot rule out that cantons create discontinuities in other policies than tax rates that would also influence households' location decisions. Our assumption is that changes in these other policies are not systematically correlated with cantonal tax changes. Spatial differencing also controls for policies that are common to two neighboring cantons (due to tax competition, for example). Canton fixed effects (in a first-difference setting) control for changes in canton-wide policies. Of potential concern are unobserved shocks that may affect border municipalities and canton-level tax policy but that are captured neither by our spatial differencing strategy nor by the canton fixed effects. To test for the absence of such shocks, we present an event-study design in Supplemental Appendix C, exploiting the full panel structure of our data to explore the dynamics of the effect of our instrument over time, both before and after changes in canton-level tax rates. Reassuringly, we find no evidence of changes in municipality-level tax bases that would anticipate canton-level tax changes.

Last, for the exclusion restriction to be valid, taxpayers should react to changes in cantonal tax differentials only because of the changed consolidated tax rates. A concern would arise if municipal and cantonal tax rates were used to provide different types of public goods that are valued unequally by taxpayers. We can assume here that taxpayers care only about their total tax bill (and a "consolidated" public good), irrespective of whether the public services they consume are financed at the municipal or the cantonal level. A less stringent version of this assumption is that taxpayers do not distinguish the levels of government involved in the financing of specific public services. This is a reasonable assumption given the complexity of the financing of subfederal public expenditure. With this identification strategy, we depart from our modeling assumption of a public good provided by one level of government. In our empirical setting, households consume locally (i.e., through their residence) a bundle of public services potentially provided by different levels of governments, and we structurally estimate their valuation of this bundle of public goods.

B. *Results*

Table 2 presents 3SLS estimates of equations (17a–17g). In panel A, we show the results with standard errors bootstrapped at the municipality-pair level. Bootstrapping comes at the cost of not being able to weight regressions by municipality size. Panel B presents the results for weighted regression with standard errors assumed to be homoskedastic. Both specifications lead to similar results. Our structural estimation in Section IV will be based on the weighted regression estimates of panel B.

We find that reduced-form tax base elasticities decrease strongly and monotonically with income for households without children. Estimated elasticities also

Table 2—Tax Base and Rental Price Elasticities: 3SLS Estimation

	Households without children			Households with children			Housing prices
	Bottom 50 (1)	Next 25 (2)	Top 25 (3)	Bottom 50 (4)	Next 25 (5)	Top 25 (6)	(7)
Panel A. Unweighted regression, bootstrapped standard errors							
Income tax rate	0.119	−0.247	−1.276	0.081	0.072	−0.071	−0.309
	(0.045)	(0.057)	(0.111)	(0.017)	(0.026)	(0.045)	(0.070)
Panel B. Weighted regression, homoskedastic disturbances							
Income tax rate	0.120	−0.227	−1.248	0.081	0.067	−0.072	−0.303
	(0.040)	(0.048)	(0.089)	(0.017)	(0.025)	(0.046)	(0.055)
Controls				YES			
Origin canton fixed effects				YES			
# of observations				3,530			
# of municipalities				812			
Instrument				Cantonal income tax rate differential			
Estimator				3SLS			

Notes: Standard errors reported in parentheses. Each column refers to an equation from (17a)–(17g). The equations are estimated jointly using 3SLS. The sample consists of cross-canton pairs of municipalities with a pairing road distance of 10 km. Panel A bootstraps the standard errors with 250 iterations of the unweighted 3SLS estimations. Panel B regressions are weighted by the log population in 2,000 of the smallest municipality in the pair. The consolidated personal income tax rate differentials are instrumented by the cantonal personal income tax rate differentials. Controls include (time-invariant) indices of accessibility, exposure to natural risks, architectural heritage, and hours of sunlight. In column 7, we in addition control for topographical constraints and local administrative efficiency.

decrease monotonically with income for households with children, but the magnitudes are much smaller. Moreover, we find estimated elasticities to be positive for all below-median income households and for households with children in the third income quartile. These results suggest (i) that households do not perceive taxes as net income losses but consider them jointly with the public goods supplied in return, (ii) that they hold heterogeneous preferences over those public goods, and (iii) that they have a nonzero propensity to move. Note also that our estimated tax base and housing price elasticities are close to the long-difference estimates presented in Supplemental Appendix Table C1.

IV. Estimation of Structural Parameters and Incidence: Baseline

With the reduced-form elasticities in hand, we can progress toward estimating the structural model given by equation (16).

A. *Calibration*

In order to implement our structural estimation, we need to calibrate a number of parameters. Panel A of Table 3 presents these calibrated values.

First, we draw on data from the Swiss Household Panel (SHP) to calibrate taste and expenditure parameters related to housing. The housing taste parameter α follows from households' Marshallian housing demand equation

Table 3—Structural Parameter and Elasticity Estimates

	Households without children			Households with children		
	Bottom 50 (1)	Next 25 (2)	Top 25 (3)	Bottom 50 (4)	Next 25 (5)	Top 25 (6)
Panel A. Calibration using:						
Swiss household panel						
Housing tastes (α)	0.16	0.16	0.16	0.16	0.16	0.16
Minimal housing expenditure (ν_h/h^*)	0.75	0.68	0.56	0.80	0.71	0.60
Expenditure share on housing (S)	0.38	0.23	0.16	0.37	0.25	0.18
Aggregate housing share (π)	0.13	0.14	0.17	0.16	0.18	0.21
Tax rate database						
Income tax rates (τ)	0.11	0.13	0.17	0.05	0.07	0.12
Simultaneous equation IV estimates (Supplemental Appendix Table B2)						
Housing supply price elasticity (η_s)			0.32			
Tax base database						
Taxpayer population share (s)	0.44	0.16	0.13	0.06	0.09	0.12
Share of tax base (γ)	0.18	0.18	0.30	0.02	0.07	0.25
Other parameter						
Congestion parameter (θ)			0.50			
Panel B. Structural parameters						
Preference for public goods ($\tilde{\delta}$)		0.054			0.114	
		(0.016)			(0.093)	
Idiosyncratic location preference dispersion parameter (λ)		8.106			0.528	
		(0.552)			(0.233)	
Panel C. Structural elasticities						
Tax base elasticities	0.182	−0.344	−0.967	0.091	0.050	0.002
	(0.038)	(0.040)	(0.062)	(0.017)	(0.017)	(0.034)
Marginal willingness to pay rent	−0.239	−0.410	−0.764	0.027	−0.021	−0.269
	(0.023)	(0.038)	(0.050)	(0.122)	(0.188)	(0.252)
Resident incidence	0.022	−0.042	−0.119	0.172	0.095	0.003
	(0.003)	(0.006)	(0.008)	(0.063)	(0.065)	(0.066)
Landlord incidence (η^{p,τ^*})			−0.281			
			(0.021)			

Notes: Standard errors reported in parentheses. Data source for information on housing expenditure (panel A): Swiss Centre of Expertise in the Social Sciences FORS (2016).

$h^*_{fmj} = \nu^f_h + \alpha\left[\left(1-\tau_j\right)w_m - p_j\nu^f_h\right]/p_j$, which can be rewritten as $S_{fmj} = S^{min}_{fmj} + \alpha\left(1 - S^{min}_{fmj}\right)$, where $S^{min}_{fmj} \equiv p_j\nu^f_h/\left(1-\tau_j\right)w_m$ is the expenditure share of essential housing consumption. We compute α as $\left(\bar{S} - \bar{S}^{min}\right)/\left(1 - \bar{S}^{min}\right)$, where $\bar{S}$ is the average expenditure share of housing (defined as annual rent over disposable income) calculated using SHP data for the years 2000 to 2004 ($\bar{S} = 0.24$). We proxy the expenditure share on essential housing needs, $\bar{S}^{min}$, using the average rent paid by bottom–5 percent income renter households in the SHP data, computed separately for different household types. Similarly, the type-specific expenditure share on essential housing needs (ν^f_h/h^*_m) is obtained by the average rent paid by bottom–5 percent income renters (differentiating by family status) over the average rent paid in each income class. Aggregate housing shares (π_{fm}) are likewise calculated directly from the SHP data.

We calibrate proportional income tax rates τ_j in matrix $\mathbf{B}_j$ (Section IC) by the group-averaged consolidated income tax rates for 2000–2004.[49] Table 3 shows that these representative tax rates range from 5 percent (bottom-50 households with children) to 17 percent (top-25 households without children). The progressivity of tax rates is determined by the canton-level tax schedules. We investigate the implications of progressivity for our welfare estimates in Section IVC.

The housing supply elasticity comes from estimates presented in Supplemental Appendix B.2. Our estimated value of 0.32 implies that to assume perfectly inelastic housing supply would not be appropriate in our setting.

Population shares s_{fm} and tax base shares γ_{fm} are computed from federal income tax statistics. Population shares take into account the marital status of households—that is, married households are counted as two people. Of our six baseline household types, 44 percent belong to the category "bottom-50 without children." The least frequent household type is bottom-50 taxpayers with children, accounting for only 6 percent of the total. This difference reflects the fact that households with children on average have higher incomes than households without children. Tax base shares reflect the unequal distribution of income: households in the top income quartile together account for 55 percent of overall income.

We calibrate the congestion parameter θ to the midpoint between the pure public good ($\theta = 0$) and full-rivalry ($\theta = 1$) cases. We explore the sensitivity of our structural estimation to this parameter in Section IVE.

B. *Estimates of Structural Parameters*

Armed with the reduced-form parameter estimates of Section III and the calibrated values of Section IVA, we can estimate the structural parameters for public good preferences and for the dispersion of idiosyncratic locational preferences through the minimization of equation (16). The minimum is selected after a random search of starting values to ensure a global minimum. Standard errors of the structural elasticities are calculated with the delta method.[50]

Panels B and C of Table 3 show point estimates and standard errors of our baseline structural estimation, and Figure 4 provides a corresponding illustration of our main incidence results. In panel B of Table 3, we present our estimates of the preference parameter for the public good, $\tilde{\delta}$, and of the idiosyncratic location preference parameter λ for households with and without children. We find preferences for locally provided public goods to be stronger for households with children than for childless households. Conversely, households with children are less mobile than childless households, their idiosyncratic location preference parameter λ being an

[49] Consolidation is across the federal, cantonal, municipal, and parish levels. In the calibrations, we include the federal income tax rate that in Section III and Supplemental Appendix B is absorbed by fixed effects.

[50] Standard errors of the structural parameters are given by $\mathbf{J}[\mathbf{m}(\boldsymbol{\vartheta})]'\,\hat{\mathbf{V}}^{-1}\,\mathbf{J}[\mathbf{m}(\boldsymbol{\vartheta})]$, where $\mathbf{J}[\mathbf{m}(\boldsymbol{\vartheta})]$ denotes the Jacobian of the moments $\mathbf{m}(\boldsymbol{\vartheta})$ with respect to the parameter vector $\boldsymbol{\vartheta}$. Because of the complexity of the moments, the Jacobian is very involved. Hence, we resort to symbolic computation in Mathematica. The delta method for the standard errors of the structural elasticities is implemented through the function "uncertainty propagation" in Mathematica.

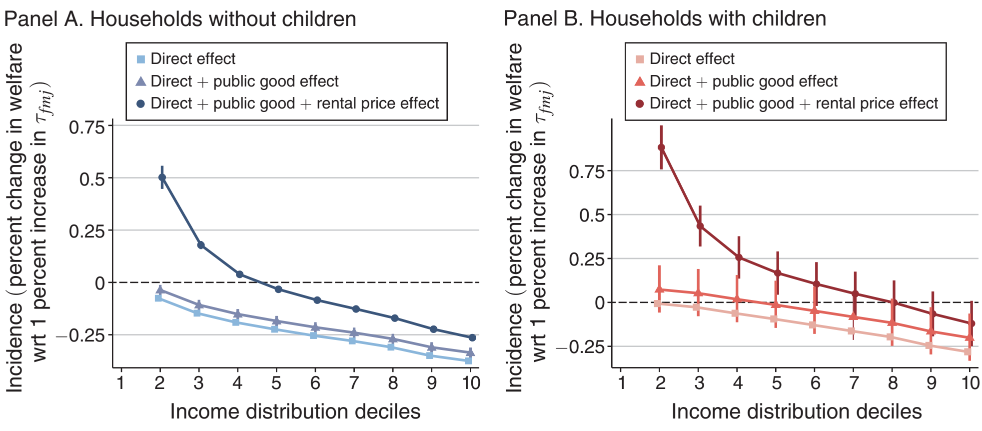


Figure 4. Welfare Effects of a Local Income Tax Increase

Notes: The figures show the tax incidence experienced by households without children (panel A) and with children (panel B). Households are grouped according to the deciles of the income distribution.

order of magnitude smaller than that of childless households. Both results are consistent with expectations.

Implied structural elasticities are shown in panel C of Table 3. The structural tax base elasticities are reassuringly close to the reduced-form elasticities presented in Table 2, with high-income households without children the most strongly deterred by higher local taxes and bottom-50 households responding positively to higher taxes.

Panel C of Table 3 also reports the estimated MWPR to compensate for higher taxes per group, as defined by equation (2). Our estimates are negative for four of the six household types, the exception being households with children in the first three quartiles of the income distribution, whose preferences for local public goods outweigh their disutility from higher tax burdens. Conversely, we obtain large negative estimates of the MWPR for top–25 percent households without children. Hence, at the margin, these households derive greater disutility from taxation and its effect on the cost of housing than the utility provided by local public goods. Within each family status, we observe—as expected—a negative relationship between income and the MWPR. For households with children, however, these differences are not statistically significant.

Equipped with the structural parameters of panel B in Table 3, we compute the household -type-specific welfare effects of an increase in local tax rates for households grouped by deciles of the income distribution.[51] These effects are illustrated in Figure 4 for households without children (panel A) and households with children

[51] These effects are computed using equation (12a), calibrating expenditure shares and tax rates for each decile of the income distribution instead of the three income groups used in our reduced-form regressions. Note that the elasticity of public good provision with respect to the local tax rate $\left(\sum_f \sum_m \left(\gamma_{fmj} - \theta s_{fmj}\right) \frac{dN_{fmj}}{N_{fmj}} \frac{\tau_j}{d\tau_j}\right)$ is computed with the structural tax base elasticities presented in panel C of Table 3. The first decile is not reported, because no data are available in the SHP for this group.

(panel B). The total welfare effect is decomposed into the direct welfare effect of the local tax increase, the effect of the related increase in public good provision and capitalization into lower housing prices. Among inframarginal (nonmoving) residents, the negative incidence of local taxes is borne entirely by above-median income households without children. All other nonmover household types either are indifferent or would gain from a marginal increase in local taxation and the associated local public goods.

These effects are all smaller than the structural estimate of the housing price elasticity of -0.28. In our model, this is entirely borne by absentee landlords. In reality, available data suggest that around a third of landlords are resident in the same municipality.[52] Private landlords likely belong to the top income classes. Considering the effect on locally resident landlords would therefore exacerbate the negative incidence we estimate for the top income classes, but it would not qualitatively affect the different welfare effects that we estimate across household types.

Figure 4, moreover, shows how the total welfare of a local tax increase can be divided into (i) a direct effect, which is nonpositive as tax rates are nonnegative; (ii) a public good effect, which is positive as we assume all households to derive utility from local public goods; and (iii) a rental price effect, which is positive, as higher tax rates lead to lower rental prices (see equation (12b)). It can be gleaned from Figure 4 that the public good effect and the rental price effect are stronger for households with children, while the direct effect is weaker (thanks to family deductions). Hence, all three forces contribute to childless household bearing more of the tax incidence than households with children.

C. *Tax Progressivity*

Figure 4 shows that a local tax increase is progressive: it benefits low-income households more than high-income households. This effect is, in part, mechanically driven by the underlying graduated tax schedule of Swiss cantons as well as by differential tax rates according to family status. In Figure 5, we switch off the effect of statutory tax progressivity and instead investigate the welfare effects of a counterfactual change in a hypothetical flat tax, the level of which we compute as the weighted mean of household-type average tax rates $\left(\tau = \sum_f \sum_m \gamma_{fm} \tau_{fm}\right)$. That is, we estimate equation (12b), where the change in the equilibrium housing price and tax base elasticities are obtained by solving the system of equations (10) for a hypothetical revenue-equivalent proportional tax rate and our estimated structural parameters.

These counterfactual results are shown in Figure 5. Removing statutory tax progressivity switches the direct effect from being progressive to being regressive: in utility terms, a proportional increase from a given tax rate hurts poor households more than rich households. Interestingly, our model suggests the rental price effect to be sufficiently progressive to offset the regressive direct effect. This confirms that

[52] See https://www.bfs.admin.ch/bfsstatic/dam/assets/4262589/master.

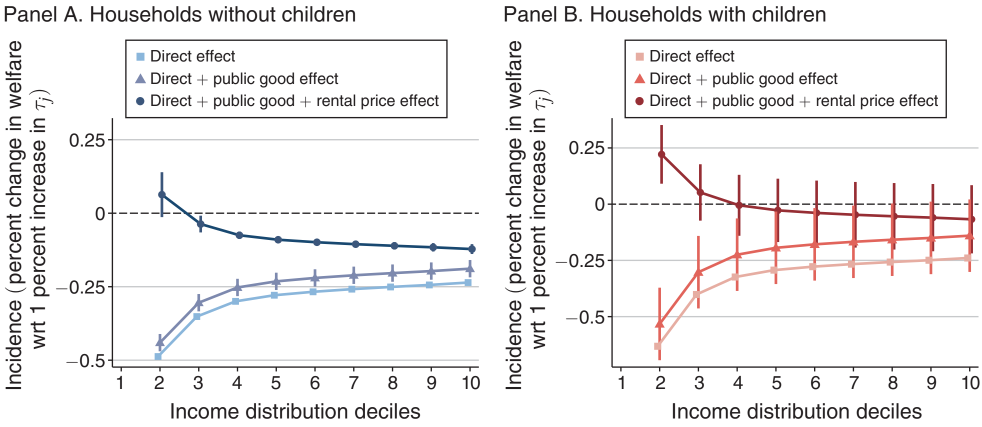


Figure 5. Welfare Effects of an Increase in a (Hypothetical) Proportional Local Income Tax

Notes: The figures show the tax incidence of a proportional tax experienced by households without children (panel A) and with children (panel B). Households are grouped according to the deciles of the income distribution. The proportional tax is computed as a weighted sum of household-type tax rates $\left(\tau = \sum_f \sum_m \gamma_{fm} \tau_{fm}\right)$.

capitalization into housing prices plays an important part in shaping the distributional effects of local taxes.[53]

D. *Property Taxes*

In some countries, including the United States and Canada, local governments mainly tax real estate rather than personal income. We therefore now use our framework to explore the welfare effects of a change in a hypothetical local property tax instead of a local income tax.

The welfare effect derived in equation (12b) is not specific to a local income tax and can easily be adapted to the case of a property tax. In that case, the indirect utility of household i with family status f and income w_m reads

$$V_{ifmj} = \kappa + \ln\left(w_m - [1+t_j]\, p_j \nu_h^f\right) - \alpha \ln\left([1+t_j]\, p_j\right) + \delta \ln\left(g_j - \nu_g^f\right) + \ln\left(A_{ifj}\right),$$

where t_j is a proportional property tax levied on rental prices (see Supplemental Appendix G for a detailed derivation). The effect of a small change in the property tax rate t_j of municipality j on the welfare of household type $\{f, m\}$ is then given by

$$\frac{d\mathcal{W}_{fm}^R}{d\ln t_j} = \alpha N_{fmj}\left(1 - \frac{\nu_h^f}{h_{fmj}}\right)^{-1}\left\{-\left[\frac{t_j}{1+t_j} - \frac{\delta}{\alpha}\left(\frac{g_j}{g_j - \nu_g^f}\right)\left(1 - \frac{\nu_h^f}{h_{fmj}}\right)\left(\frac{dg_j}{dt_j}\frac{t_j}{g_j}\right)\right] - \left(\frac{dp_j}{dt_j}\frac{t_j}{p_j}\right)\right\}.$$

[53] Note that the vertical position of the curves in Figure 5 cannot be readily compared to that of the corresponding curves in Figure 4, because the former depends on the the assumed level of the hypothetical proportional tax rate.

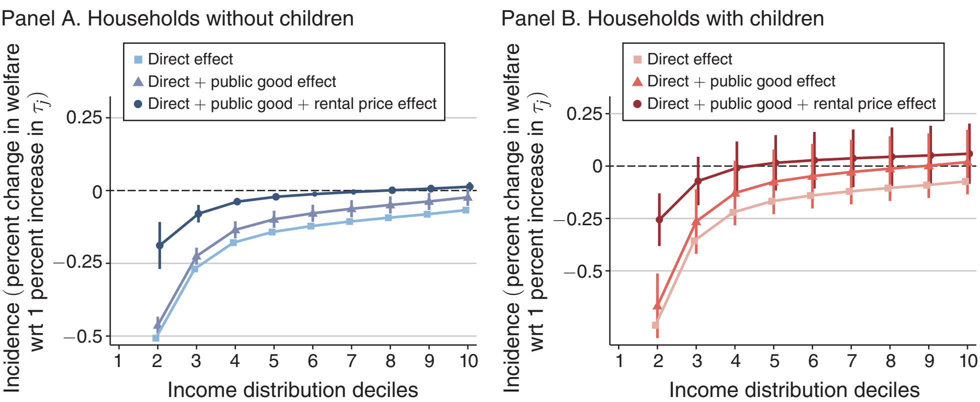


Figure 6. Welfare Effects of an Increase in a (Hypothetical) Local Property Tax

Notes: The figures show the tax incidence of an hypothetical property tax experienced by households without children (panel A) and with children (panel B). Households are grouped according to the deciles of the income distribution. The hypothetical property tax rate is calibrated to raise revenue equivalent to that raised by cantonal plus municipal income taxes absent behavioral effects.

Equipped with our estimated structural parameters λ_m and $\tilde{\delta}_m$, we can estimate the two key elasticities $\frac{dg_j}{dt_j}\frac{t_j}{g_j}$ and $\frac{dp_j^*}{dt_j}\frac{t_j}{p_j^*}$ by solving the system of equilibrium equations corresponding to the model with a property tax (see Supplemental Appendix equation (G7)). The hypothetical property tax is calibrated such as to substitute fully for cantonal plus municipal income tax revenue absent behavioral effects. This implies an assumed tax rate of 36 percent on rents, which corresponds to a rate of 1.4 percent of housing value. Figure 6 presents the results.

Not surprisingly, we find the direct effect of the property tax to be regressive due to low-income households spending a higher share of their income on housing. In contrast to the local income tax case, however, house price capitalization turns out to be insufficient to overturn the regressivity of a property tax. The main difference is that property tax revenue depends less on the tax-sensitive behavior of top-income taxpayers than on local income tax revenue. As a result, and given the balanced-budget constraint, public expenditure increases more strongly with a property tax increase (estimated elasticity $=$ 0.81, SE $=$ 0.04) than with an income tax increase (estimated elasticity $=$ 0.73, SE $=$ 0.02). Resident households are therefore "compensated" with public goods more strongly in the case of property tax increase than in the case of an income tax increase. This in turn implies that residential property demand and, thus, housing prices are affected less by a rise in a local property tax than by an equivalent rise in a local income tax. Local income taxes are therefore capitalized into housing prices more strongly than local property taxes. Indeed, our estimated elasticity of rental prices with respect to a local property tax equals -0.14 (SE $=$ 0.03), whereas the corresponding elasticity with respect to a local income tax equals -0.28 (SE $=$ 0.02; see Table 3).

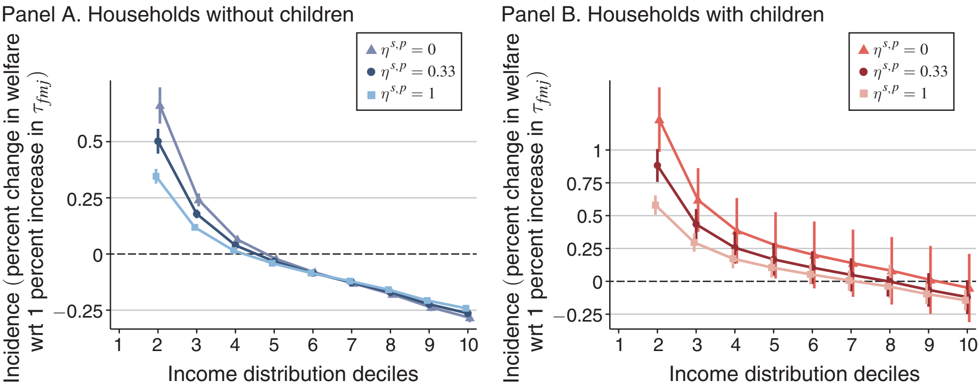


Figure 7. Welfare Effects for Different Housing Supply Elasticities

Notes: The figures show the tax incidence experienced by households without children (panel A) and with children (panel B) for different calibrated values for the housing supply elasticity. Households are grouped according to the deciles of the income distribution.

The weakness of the local income tax—its exposure to the behavioral response of high-income households—is therefore a boon to redistribution (in our framework, the incidence is largely shifted to absentee landlords). Conversely, a local property tax is more efficient for raising public revenue but more regressive due to lower capitalization into housing prices. Again, we find the capitalization channel to play an important role in determining the effective progressivity of local taxes.

E. *Robustness: Housing Supply and Rivalness of Public Goods*

In Figure 7, we investigate the sensitivity of our welfare estimates to different calibrated values of the housing supply elasticity $\eta^{s,p}$ (see Supplemental Appendix Table D1 for results on the full set of structural parameters and elasticities). The figure presents the welfare effect for two extreme scenarios: completely inelastic and a unit-elastic housing supply, with our baseline as the intermediate case. As expected, the incidence on resident renters is more progressive the less elastic the housing supply, as low-income households benefit the most from lower housing prices (housing prices decrease by −0.39 percent after a 1 percent increase in local taxes when housing supply is completely inelastic and by −0.17 percent when housing supply is unit-elastic; see Supplemental Appendix Table D1, panels A and B). The effects of changing housing supply are less precisely estimated for families with children (Figure 7, panel B), but in their case too, the progressivity-enhancing effect of stronger house price capitalization is evident.

In Supplemental Appendix Table D1, panels C and D, we also present results for different values of the congestion parameter while keeping the housing supply elasticity at its baseline value. It turns out that the congestion parameter affects only our estimation of the public goods preference parameter, but neither the idiosyncratic location preference dispersion parameter nor the structural elasticities. Hence, implied welfare effects do not hinge on the calibration of this parameter.

V. Extensions

A. *Decomposition by Age*

So far, we have posited that family status in terms of the presence of children is the key dimension driving the heterogeneity of households' valuation of local public goods and of the idiosyncratic location preference dispersion parameter. Another dimension likely to be important is the age category. In this subsection, we therefore divide childless households into pensioner and nonpensioner (i.e., working-age) categories, based on a variable in the federal income tax statistics indicating whether households receive a pension. This variable is recorded with some inconsistencies, forcing us to clean the dataset and to drop some sample years.[54]

Table 4 presents the 3SLS reduced-form estimates for the nine household types and housing prices.[55] Results for housing prices and for households with children are similar to our baseline reduced-form estimates reported Table 2. Elasticity estimates for childless working-age households are larger and those for pensioner households are smaller, in absolute value, than in the baseline, where the two categories are combined. These estimates also suggest that high-income households are more strongly deterred by higher taxes when they are of working age than when they are of pension age.

The welfare effects of a tax increase are shown in Figure 8.[56] It turns out that separating out pensioner households does not add much to our insights. Among households without children, and for any given income class, our estimated tax incidence is very similar for working-age and pensioner households (see panels A and B of Figure 8).

B. *The Local Budget Constraint*

Our identification of the distributional effects of local tax changes relies on a key simplification: the municipal budget is balanced, such that there exists a one-to-one relationship between increased tax revenue following a local income tax hike and increased availability of the local public good. In reality, changes in tax revenue might not always map one-for-one into changes in public good provision—e.g., in

[54] One source of measurement error is that the pension variable includes invalidity benefits. On average, 9 percent of "pensioner" households are below the pension age (64 for women and 65 for men). The median age of invalidity benefit recipients is around 53. Another source of imprecision is that cantonal tax authorities have different reporting practices (especially for married couples) that in some cases change over time. The calculated share of pensioner households at the canton level can therefore jump between years by several percentage points (up to 13 percentage points, for an average pensioner share of 23 percent). We dropped observations for cantons where such jumps occurred at the beginning (Thurgau and Ticino) or end (St. Gallen) of our sample period and where they affected a single year (Basel-Stadt). We also dropped observations for the canton of Vaud between 2005 and 2008 because of evident reporting errors. For the cantons in which discrete jumps happened in the middle of our observation period, we inferred for each municipality the number of pensioner households with the canton-level increase netted out (Geneva, Glarus, Fribourg, Solothurn, Valais). Note that we do not lose many observations in Table 4 compared to Table 2, as our first and last periods comprise two years.

[55] Analogous to Supplemental Appendix Table C1, Supplemental Appendix Table D2 shows the corresponding OLS and 2SLS specifications for nonpensioners and pensioner households without children.

[56] For details on the calibrated values and structural elasticities, see Supplemental Appendix Table D3. In Figure 8, the first two deciles are not reported, because no data are available in the SHP for some groups.

Table 4—Tax Base Elasticities for Pensioners and Nonpensioners: 3SLS Estimation

	Income class		
	Bottom 50 (1)	Next 25 (2)	Top 25 (3)
Panel A. Households without children: Nonpensioners			
Income tax rate	0.282	−0.276	−1.587
	(0.064)	(0.076)	(0.110)
Panel B. Households without children: Pensioners			
Income tax rate	0.252	−0.264	−0.278
	(0.026)	(0.055)	(0.088)
Panel C. Households with children			
Income tax rate	0.082	0.066	−0.058
	(0.017)	(0.025)	(0.046)
Panel D. Housing prices			
Income tax rate		−0.378	
		(0.054)	
Controls		YES	
Origin canton FE		YES	
# of observations		3,526	
# of municipalities		811	
Instrument		Cantonal income tax rate differential	
Estimator		3SLS	

Notes: Homoskedastic standard errors reported in parentheses. The equations are estimated jointly using three-stage least squares. The sample consists of cross-canton pairs of municipalities within a road distance of 10 km. Regressions are weighted by the log population in 2,000 of the smallest municipality in the pair. The consolidated personal income tax rate differentials are instrumented by the cantonal personal income tax rate differentials. Controls include (time-invariant) indices of accessibility, exposure to natural risks, architectural heritage, and hours of sunlight.

the presence of public-sector rent extraction or corruption (Diamond 2017), or in the case of net public (dis-)saving (Pettersson-Lidbom 2010). Here, we therefore employ our IV strategy to test for the appropriateness of the implied municipal balanced budget constraint.

Our identification strategy exploits upper-level tax changes in neighboring cantons as a source of exogenous variation for consolidated tax differentials. Hence, an exogenous increase in the consolidated tax differential between two municipalities located in adjacent cantons is driven by a decrease in the neighboring cantonal tax rate. Consistent with our negative tax base elasticities for top-income households, we expect that higher tax differentials lead to a worsening in municipal tax revenue (differentials). This is what we find in the first column of Table 5, which reports the results of our long first-difference model for total municipal revenue.[57]

[57] In all specifications of Table 5, we use as dependent variable the residuals from a regression on canton-year fixed effects in order to take into account canton-level changes in public accounting standards for municipality finances as well as changes of task allocations between different levels of governments.

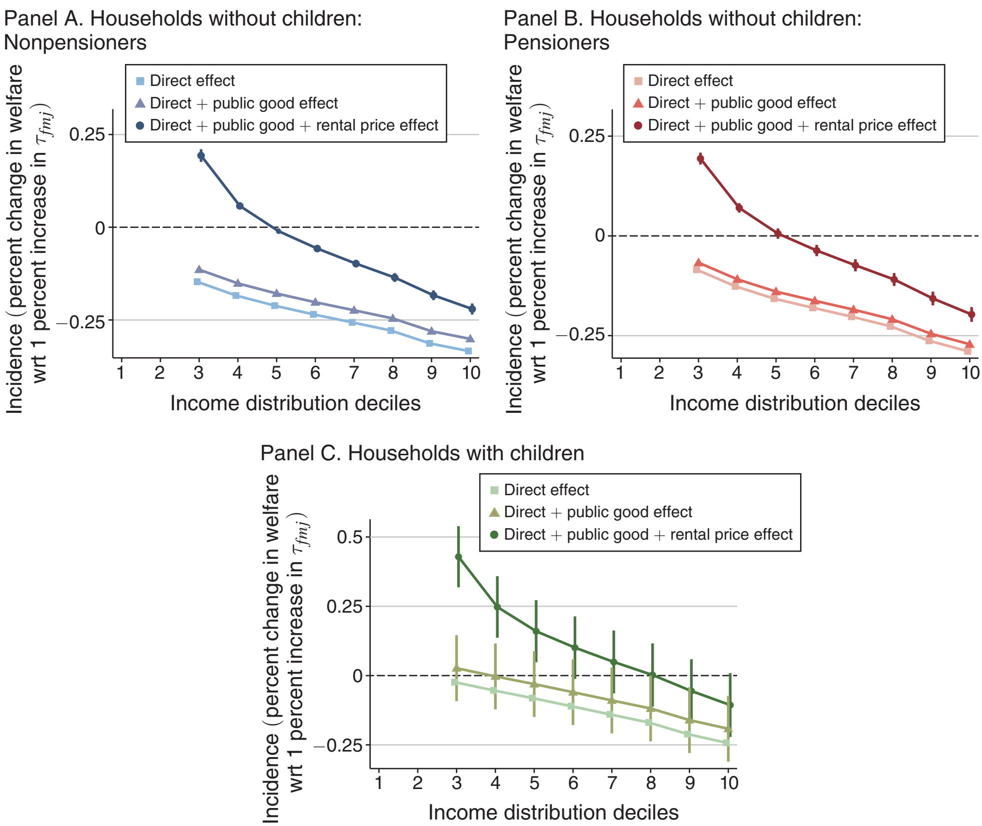


Figure 8. Welfare Effects: Pensioners and Nonpensioners

Notes: The figures show the tax incidence of a local tax change on nonpensioners households without children (panel A), pensioner households without children (panel B), and households with children (panel C). Households are grouped according to the deciles of the overall income distribution.

In column 2, we test the effect on total expenditure. Importantly, we find an effect that is similar to column 1, consistent with a binding local budget constraint.[58] In columns 3 to 8, we test for (endogenous) changes in the composition of expenditure. Unfortunately, results are not informative, as standard errors are large and often exceed the estimated coefficients. Taken at face value, the results suggest that lower tax revenue is associated with a decrease in educational spending, but to a lesser extent than other categories.

VI. Conclusions

We have studied the differential welfare effects of local-level taxation on heterogeneous households and absentee landlords. This issue is important for three reasons.

[58] Note that total expenditure is also directly affected by the change in the composition of the tax base. Hence, we cannot directly test the local budget constraint as expressed in equation (8c). Note also that we cannot use total expenditure directly in our structural model, as we do not know how much cantons spend in a given municipality.

Table 5—Public Good Elasticities

	Total		Expenditure per category					
	Revenue (1)	Expenditure (2)	Education (3)	Social (4)	Admin. (5)	Roads (6)	Police (7)	Health (8)
Income tax rate	−0.434	−0.360	−0.075	−0.572	−0.178	−0.197	0.202	0.648
	(0.193)	(0.178)	(0.249)	(0.526)	(0.248)	(0.343)	(0.381)	(1.062)
# of observations	3,627	3,627	3,324	3,324	3,324	2,752	3,324	2,742
# of municipalities	758	758	658	658	658	538	658	536
Kleibergen-Paap F-stat	139	139	267	267	267	226	267	229
Controls				YES				
Origin canton fixed effect				YES				
Instrument				Cantonal income tax rate differential				

Notes: This table reports the results of the IV pairwise long first-difference estimation model for border municipalities. Cluster robust standard errors at origin and destination municipality level are reported in parentheses. The sample consists of cross-canton pairs of municipalities within a road distance of 10 km. Regressions are weighted by log population in the year 2000 of the smaller municipality in the pair. The consolidated personal income tax rate differentials are instrumented by the cantonal personal income tax rate differentials. Controls include (time-invariant) indices of accessibility, exposure to natural risks, architectural heritage, and hours of sunlight.

First, according to the standard assumption of locally perfectly mobile residents, land—the immobile factor—bears the full incidence of local policies. However, residential mobility is costly, even at the local level, and hence welfare effects on resident nonowners need to be considered. Second, in this literature, preferences for local public goods have hitherto been studied without considering household heterogeneity. In this paper, we show that public good preferences differ substantially by family status. Third, taxpayer mobility has typically been estimated for top-income households. We consider taxpayers along the entire income distribution, and we link type-specific tax base elasticities to measures of households' willingness to trade off housing costs against local tax burdens.

We estimate the incidence of local tax changes in three main steps. First, we allow for heterogeneous households to have different valuations for locally tax-funded public goods. Second, we exploit cross-section and time variation in Swiss municipal tax rates at canton borders that we instrument with neighboring canton-level tax rates. This enables us to obtain more plausibly causal reduced-form elasticities of tax bases and housing prices with respect to local tax rates, and of housing supply with respect to housing prices. Third, we search for the preference parameters that best match our theoretical moments with those reduced-form elasticities.

We find large variation in the incidence of local taxes: below-median-income childless households—both of working age and of pension age—benefit from higher taxes, but above-median-income childless households are worse off when local taxes are raised. Households with children are found to benefit more from, or be hurt less by, higher taxes than childless households across all income classes. The structural estimates imply a stronger preference for local public goods—and much weaker mobility—among families with children. We show that households with children on the whole have more to gain from higher local taxes, for two main reasons: house-price capitalization benefits them more as they have greater housing needs, and local public goods are more valuable to families with children.

Our results show that local taxation—be it on income or on property—has distributional effects even in the absence of a progressive rate schedule. This has two reasons. First, to the extent that households exhibit nonhomothetic housing demand, the capitalization of tax rates into housing prices will affect them differently. Second, heterogeneous preferences for publicly provided goods imply that different households perceive local tax changes differently. This might help explain the absence of empirical evidence for perfect income sorting of households: households at different income levels will differ significantly in their valuation of local bundles of tax rates and public goods depending on their family status.

Our analysis is predicated on the implicit assumption that residents update their optimal location choice. In reality, residential moves are infrequent, consistent with our assumption that households are not perfectly mobile. The average tenancy of renter households in Switzerland is around six years.[59] This time span is somewhat smaller than the ten-year intervals we use to identify our elasticity estimates. Thus, our estimates ought to be interpreted as long-run welfare effects.

It is important to emphasize that we assume location-invariant household incomes throughout. We believe this to be a reasonable assumption for the analysis of local-level taxation within a commuting zone, where job choice is not tied to residence choice. If one wanted to analyze the incidence of taxation at the regional or national level, one would also need to account for the effect of taxpayer mobility on equilibrium wages. If, for example, high-skill workers are more mobile than low-skill workers, and if the two worker groups are complementary in production, then the out-migration of high-skill workers triggered by a tax increase will lead to lower demand and, hence, lower wages for remaining low-skill workers. This could attenuate and conceivably even overturn the progressive effect of taxation described in our fixed-wage setting.

We also abstract from strategic interactions among municipalities in their tax setting. Our thought experiment involves a shock to the tax rate of one municipality without taking account of possible second-round effects through strategic responses by neighboring municipalities. Our framework furthermore ignores purely "social" motives for residential sorting, whereby households might value neighbors with certain socioeconomic characteristics for reasons unrelated to housing prices or local public goods. Some location choices that our model attributes to public good preferences might therefore originate in such peer effects (see also Basten, Ehrlich, and Lassmann 2017).

More detailed data could also conceivably offer even deeper insights. For instance, it would be useful to allow for different housing market segments to have unequal relevance across household types. We leave such an extension for future work.

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