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Does tax competition tame the Leviathan?☆

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ABSTRACT

We study the impact of tax competition on equilibrium taxes and welfare, focusing on the jurisdictional fragmentation of federations. In a representative-agent model of fiscal federalism, fragmentation among jurisdictions with benevolent tax-setting authorities unambiguously reduces welfare. If, however, tax-setting authorities pursue revenue maximization, fragmentation, by pushing down equilibrium tax rates, may under certain conditions increase citizen welfare. We exploit the highly decentralized and heterogeneous Swiss fiscal system as a laboratory for the estimation of these effects. While for purely direct-democratic jurisdictions (which we associate with relatively benevolent tax setting) we find that tax rates increase in fragmentation, fragmentation has a moderating effect on the tax rates of jurisdictions with some degree of delegated government. Our results thereby support the view that tax competition can be second-best welfare improving by constraining the scope for public-sector revenue maximization.

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1. Introduction

Is tax competition good or bad for the wellbeing of society? This has been a question of concern to federal states for as long as taxpayers have been free to settle in whatever part of their country they pleased. And as some lucrative tax bases have become highly mobile across national borders, tax coordination has risen to the top of the international policy agenda as well. The main opposing arguments are straightforward. Advocates of tax harmonization think of governments as essentially benevolent maximizers of social welfare, whose ability to offer the optimum level of public goods is undermined by the erosion of their tax base. Conversely, those who view tax competition as a force for good consider governments as self-interested revenue maximizers, whose voracity may be constrained by tax competition. These are stock arguments in debates concerning tax coordination, such as on the taxation of e-commerce across US states, on harmonization of value added taxes and corporate taxes in the European Union, or on the definition of "harmful tax competition" by the OECD.

Research in this area abounds. Economic theory provides elegant statements of the conditions under which tax competition may be a force for good or a force for bad. Edwards and Keen (1996), for example, show that the net welfare effect of tax competition hinges on the relative magnitude of two parameters: the marginal excess burden of taxation and the government's marginal ability to divert tax revenue for its own uses. Such parameters, however, elude precise measurement. Empirical work has therefore focused on indirect approaches, based on observable variables. The most prominent strategy, initiated by Oates (1972, 1985), is

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to study the relationship between government size and "decentralization", where decentralization is understood alternatively as the share of sub-federal government in consolidated revenues or expenditure (centralism), or as the number of sub-federal governments (fragmentation).[1] This approach draws its working hypothesis from Brennan and Buchanan's (1980) description of governments as revenue-maximizing Leviathans, whose tax raising powers could be held in check by decentralization. Negative partial correlations between government size and decentralization were therefore interpreted as evidence in support of the Leviathan view, and, implicitly at least, of the conjecture that tax competition is a force for good. It has come to be recognized, however, that this approach faces a major identification problem, because negative correlations between government size and decentralization are also predicted by a model of horizontal tax competition among fully benevolent governments — in which case tax competition is welfare reducing.[2] Hence, regressing government size on decentralization does not allow conjectures on underlying government objectives or on the welfare consequences of tax competition. Recognizing the interpretational ambiguity besetting much of the existing empirical literature, Epple and Nechyba (2004, p. 2463) noted that "the work stimulated by Oates addresses the issue of whether spending falls with increased competition, but does not address the issue of whether resources are used more efficiently as competition increases". Similarly, Wilson and Wildasin (2004) concluded their survey with the observation that "more work is needed to incorporate reasonable political processes into tax competition models, leading to sharper empirical distinctions between good and bad tax competition".

In this paper, we seek to advance towards that aim through two main contributions. First, we address the difficulty of distinguishing good from bad tax competition in a way that is tied rigorously to the theory. We derive a reduced-form relationship which involves only observable variables and maps monotonically into welfare effects, drawing on a model of fiscal federalism in the vein of Keen and Kotsogiannis (2002). In this model too, the difference between welfare-improving and welfare-reducing tax competition hinges on largely unobservable structural parameters. However, we can establish the following prediction: if the relationship between states' "smallness" and the equilibrium state tax rate is positive for states that have relatively benevolent governments, and if, other things equal, this same relationship turns negative for states that have less benevolent governments, then the latter effect can be interpreted as evidence of welfare-increasing "Leviathan taming" in these states. The intuition is straightforward. The smaller a state j, the less it internalizes the externalities created by its choice of tax rate on the tax base of other jurisdictions, both horizontally (i.e. for the other states in the federation, whose tax base shrinks if state j lowers its tax rate) and vertically (i.e. for the federal government, whose tax base increases if state j lowers its tax rate). Smallness therefore exacerbates distortions created by externalities. Dominant horizontal externalities lead to state taxes that are too low, while vertical externalities push towards state taxes that are too high. If smallness is *positively* correlated with state tax rates set by relatively *benevolent* governments, this implies that the dominating externality pushes towards equilibrium state taxes that are too high. If smallness is at the same time *negatively* correlated with tax rates among *Leviathan* states, all else equal, this implies that smallness (i.e. tax competition) must be a good thing for the citizens of those states, as it countervails both their governments' intrinsic desire to overtax and the vertical externalities pushing towards excessively high taxes.[3]

An empirical evaluation of this prediction requires extraneous information on the benevolence of government. Our second main contribution is to exploit an empirical setting that allows us to distinguish *a priori* between government objectives across jurisdictions. We compile a detailed new data set of local taxation in Switzerland, which offers a propitious laboratory for research on tax competition thanks to the exceptional institutional diversity and fiscal autonomy of Swiss sub-federal jurisdictions. With its three hierarchically nested layers of government (central, cantonal and municipal), Switzerland can be considered a federation of federations, thus allowing identification from variation between as well as within federations (cantons). Another feature of the Swiss data is that they allow us to classify jurisdictions by the benevolence of their governments, where we take the intensity of direct-democratic control in matters of local taxation as a proxy measure for benevolence. We thereby have empirical counterparts for all the variables that appear in the theoretical prediction we wish to test.

We estimate the impact of government benevolence on the relationship between local tax rates and the relative smallness of jurisdictions, controlling for differences in revenue needs, locational attractiveness and systemic idiosyncrasies either through jurisdiction-level controls or, in the most demanding specifications, through jurisdiction-level fixed effects. Our central empirical finding is that, among jurisdictions with relatively benevolent governments, smaller ones set higher equilibrium tax rates, but that this relationship disappears in jurisdictions with greater scope for governmental revenue maximization. Hence, our estimation results coincide with the theoretical prediction. Our empirical specification allows us to interpret this finding as evidence that tax competition has a moderating impact on equilibrium taxes *because* governments are Leviathans, and the underlying theory identifies this as evidence of beneficial tax competition. We thereby overcome the interpretational ambiguity of prior empirical work.

Our paper contributes to some additional issues raised in the literature. One recurrent theme in empirical research following Oates (1985) concerns the definition of "decentralization", the metric for the intensity of tax competition. We argue that fragmentation is the appropriate measure: while, to the extent that governments are benevolent, relative sizes of federal and sub-federal government budgets are endogenous, the number of jurisdictions, and thus the relative size of a representative jurisdiction, can more plausibly be treated as exogenous with respect to citizens' *fiscal* preferences.[4] We therefore model the intensity of tax competition via differences in states' smallness, in terms of their population share.

By allowing for fiscal interdependencies not only among same-level governments but also among different hierarchically nested government layers, our analysis furthermore takes account of the fact that the standard model of purely horizontal tax competition is increasingly inappropriate as a framework for analyzing non-coordinated tax setting in many real-world contexts. Both fiscal decentralization from national to sub-national governments and (to an as yet lesser extent) delegation of fiscal competencies from national governments to supranational institutions are evident global trends.[5]

The configuration studied in this paper is therefore not specific to the Swiss case. In general, vertical externalities are more likely

[1] Important later contributions to this literature include Nelson (1987), Wallis and Oates (1988), Zax (1989) and Forbes and Zampelli (1989). For a survey, see Feld et al. (2010).

[2] This has in fact first been pointed out by Oates (1985, footnote 2) himself, as he stated that "other sorts of models besides Leviathan could produce such an outcome". See also Hoyt (1991).

[3] For a graphical representation of the different predicted relationships between smallness and equilibrium tax rates, see Fig. 1 in Section 2.3.

[4] Fragmentation represents the standard approach for modeling the intensity of tax competition in theories of fiscal federalism and Leviathan governments (see, e.g., Epple and Zelenitz, 1981; Keen and Kotsogiannis, 2003; Eggert and Sørensen, 2008).

[5] See Epple and Nechyba (2004) for a survey of the theoretical and empirical literature on fiscal decentralization.

to dominate the smaller is the sub-federal fiscal share. Average revenues of our sub-federal jurisdictions (municipalities) amounted to 69% of corresponding federal (canton) revenues in our sample period 1990–2009, which is a relatively high sub-federal fiscal share in international comparison.[6] The scope for vertical externalities should therefore be rather greater in many other federations. In addition, even the "Leviathan" governments in our Swiss data are subject to direct-democratic controls via voluntary referenda, which means that elected officials still enjoy comparatively little leeway to pursue their self-serving aims. Other nations' sub-federal jurisdictions likely exhibit greater scope for both vertical externalities and revenue maximization than Swiss municipalities, and hence our results imply that there is even greater scope for Leviathan-taming tax competition in many other federations.

Finally, our study is related to a literature that seeks to establish how different democratic institutions shape policy outcomes. The impact of direct democracy represents one of the key themes in this research area. In a comprehensive literature survey, Besley and Case (2003, p. 45) put the central insight as follows: "the possibility of initiatives forces greater agreement between voter preferences and policy outcomes, assuming that representatives elected to the legislature have views that are out of step with the citizens at large". In the same vein, Matsusaka (2005) concludes that "direct democracy works", precisely because it mitigates agency problems between voters and potentially Leviathan governments. Our contribution is to explore the effect of direct democracy on local taxation via its interaction with fiscal externalities. This causal link has not, to our knowledge, been studied before.

The paper is organized as follows. Section 2 presents the theoretical model underlying our analysis and derives testable predictions. In Section 3, we discuss our estimation strategy and describe the empirical setting. Regression results are reported in Section 4, and Section 5 offers a concluding summary and discussion.

2. The model

The theoretical framework informing our estimation strategy is a "small open federation" variant of the model developed by Keen and Kotsogiannis (2002). We extend their model by allowing for heterogeneous government objectives and state sizes while retaining the assumptions that private agents hold identical preferences and that there is a single mobile tax base.[7]

After setting up the model we characterize its equilibrium. For the subsequent development, we can use the theoretical results of monotonic comparative statics in supermodular games, which requires only a minimum of structure. Our analysis proceeds in three steps: i) we show that if (equilibrium) tax rates *increase* with intensified tax competition (smaller size of jurisdictions), then this situation is unambiguously welfare reducing for any type of government objective; ii) if we observe raising tax rates with more competition for relatively *benevolent* governments, it must also be that tax rates are falling for some less benevolent governments; iii) finally, if points i) and ii) apply, we can then translate the tax effect of size into a welfare effect of size.

2.1. A small open federation

We consider a federation with a central government and $N \geq 1$ fiscally autonomous sub-federal states j. These states are alike in all respects bar their size and their governments' preferences. Each state is populated by M_j investor-firms.[8] Hence, the federation's total population is given by $\sum_{j=1}^{N} M_j = M$. The tax base is represented by a production factor K that is perfectly mobile among states as well as between the federation and the outside world. K can represent any mobile factor, including labor, but for simplicity we refer to it as "capital".

Investor-firms determine the within-federation, per-firm supply (S) and demand (K) of capital. Firms use an identical concave production technology $F(K_j)$, with $F' > 0$ and $F'' = c < 0$ in the relevant range of K_j, implying that the slope of the demand for capital does not depend on the tax rate. The net-of-tax rate of return ρ is determined in a federation-wide capital market. Capital is taxed by federal and state governments at rates T and t_j respectively, with $\tau_j = T + t_j$. We denote the vector of state tax rates by t, with elements t_j. The vector of equilibrium state tax rates is denoted by t^*.

Profit maximization determines per-firm capital demand $K_j = K(\rho + \tau_j)$, with $K_j' = 1/c$. State j's aggregate capital demand is simply $M_j K_j$. Rent $\pi_j = \pi(K_j)$, defined as the difference between the value of production and the rental cost of capital, is distributed to residents.

Each investor is endowed with e units of capital, of which S_j is invested within the federation and the remainder is invested in the rest of the world (ROW).[9] Without loss of generality, returns in the ROW are normalized to zero, which implies that ρ can take negative values if the rate of return is lower in the federation than in the ROW.

Preferences over private goods are given by

$$W_j^{private} = u\left((1+\rho) S_j\right) + (e - S_j) + \pi_j, \tag{1}$$

where $u(\cdot)$ is an increasing and concave function, implying a home bias in investment. Domestic and foreign incomes being perceived as imperfect substitutes, differences in the rate of return between the federation and the ROW can exist even with perfect capital mobility.

The investment decision implies per-investor capital supply $S_j = S(\rho)$, which turns out to be identical across states. Capital supply from state j is thus given by $M_j S(\rho)$. For analytical convenience, we assume that inward investment from outside the federation is zero.[10] Market clearing implies that $\sum_j M_j S(ho) = \sum_j M_j K(\rho + \tau_j)$ and determines the equilibrium rate of return in the federation. The effect on the rate of return of a change in state j's tax rate (using $K_j' = 1/c$) is

$$\frac{\partial \rho}{\partial t_j} = \frac{M_j K'}{\sum_k M_k (S' - K')} = p_j \frac{K'}{(S' - K')} < 0, \tag{2}$$

[6] Data from the OECD's Fiscal Decentralization Database (own-source tax revenue). For comparison, in 2016 US state and local revenue corresponded to 49% of federal tax revenue, while the relative size of local tax revenue to state tax revenue amounted to 70%. The corresponding shares in Germany were 47% and 36% respectively.

[7] The model follows a tradition of modeling tax competition as a simultaneous-move game among N symmetric states with constant returns, an immobile and a perfectly mobile factor, and one-for-one technology for transforming private into publicly provided goods (Zodrow and Mieszkowski, 1986). Heterogenous government objectives and state sizes have been considered independently by, among others, Keen (1998) and Bucovetsky (1991). Important theoretical precursors to the work of Keen and Kotsogiannis (2002, 2003, 2004) include Wrede (1996, 1999), Dahlby (1996) and Fuest (2000).

[8] We will use the terms "investor", "firm" and "agent" interchangeably.

[9] In the interpretation of K as labor, e represents endowments of time which can be "invested" in the labor market. Note that one might equivalently interpret the model in terms of an intertemporal savings decision, as in Keen and Kotsogiannis (2002), by relabeling "investment in ROW" as first-period consumption and "domestic investment" as investment for second-period consumption.

[10] Allowing for two-way international investment flows would complicate the model without changing any of our qualitative results.

where $p_j = \frac{M_j}{M}$ is the population share of state j. Similarly, the effect on ρ of a change in the tax rates of *all* states is

$$\rho' \equiv \frac{\partial \rho}{\partial \mathfrak{t}} = \frac{\sum_j M_j K'}{\sum_j M_j (S' - K')} = \frac{K'}{(S' - K')} \in [-1, 0).$$

Hence, $\frac{\partial \rho}{\partial t_j} = p_j \rho'$. This implies that the change in the net-of-tax rate of return with respect to a change in one state's tax rate is independent of the distribution of the federal population among the other states (as the distribution of $p_{i \neq j}$, does not feature in $\frac{\partial \rho}{\partial t_j}$).

Publicly provided goods are produced with constant returns and distributed equally to all investor-firms, and no tax revenue is wasted. This implies per-capita budget constraints $g_j = t_j K (\rho + \tau_j)$ for the state governments, and $G = \frac{1}{M} \sum_j T M_j K (\rho + \tau_j)$ for the federal government.[11]

Publicly provided goods enter agents' utility function. Total indirect utility for an investor in state j can be written as

$$W_j = u\left((1 + \rho) S(\rho)\right) + (e - S(\rho)) + \pi (\rho + \tau_j) + \Gamma (g_j; G), \qquad (3)$$

where $\Gamma (g_j; G)$ is increasing and concave in both arguments.

2.2. Government preferences and citizen welfare

The existing literature identifies two polar cases: benevolent governments and purely revenue-maximizing (Leviathan) governments. We allow also for intermediate cases. This is captured by the following per-capita objective function of state governments:

$$\Omega_j = (1 - \mu_j) W_j + \mu_j t_j K (\rho + \tau_j), \qquad (4)$$

with $\mu_j \in [0, 1]$.

For $\mu_j = 0$, the government's objective function coincides with the utility of the state's residents, whereas $\mu_j = 1$ represents a pure Leviathan. Hence, larger values of μ characterize governments with a stronger taste for revenue maximization.[12]

State governments maximize Ω_j taking into account agents' choices, factor-market clearing and the budget constraints. They hold Nash conjectures over other states' tax rates and the federal tax rate. We do not model the tax setting of the federal government explicitly, neither in terms of objective function nor timing, but assume that the federal tax rate is independent of the distribution of investor-firms across states, which is sufficient for isolating the welfare effects of state taxes separately from the determination of T.[13] In other words, our results hold conditional on T. The overall welfare effect of taxation, however, also depends on the determination of federal taxes. We address this issue in the empirical analysis by controlling for T.

Using Eq. (2), and the fact that $\pi' = \frac{\partial \pi}{\partial \tau_j} = -K$, we can write the first-order condition, evaluated at equilibrium and implicitly determining state tax rates, as

$$H_j \equiv \left.\frac{\partial \Omega_j}{\partial t_j}\right|_{\mathfrak{t}=\mathfrak{t}^*} = (1 - \mu_j) \left\{ \frac{1}{(1 + \rho)} S p_j \rho' - K_j (p_j \rho' + 1) + \Gamma_g \left[K_j + t_j K' (p_j \rho' + 1)\right] + \Gamma_G \left[T K' p_j (\rho' + 1)\right] \right\} + \mu_j \left[K_j + t_j K' (p_j \rho' + 1)\right] = 0, \qquad (5)$$

where $\frac{1}{1+\rho} = u'$ (see Eq. (3)).

This first-order condition implies

$$\left.\frac{\partial (t_j K_j)}{\partial \mathfrak{t}}\right|_{\mathfrak{t}=\mathfrak{t}^*} = \left.\frac{\partial (g_j)}{\partial \mathfrak{t}}\right|_{\mathfrak{t}=\mathfrak{t}^*} = K_j + t_j K' (\rho' + 1) \geq 0. \qquad (6)$$

At equilibrium, tax revenues increase with a symmetric rise in states' tax rates, and overall changes in equilibrium state tax rates have a weaker effect on capital supply than a tax increase by a single state. Hence, state governments find themselves on the upward sloping part of their Laffer curve, and state tax rates are monotonically related to changes in tax revenues and public spending. This implies that our empirical approach based on tax rates is consistent with Oates-type specifications, which use tax revenues or public spending as the dependent variable.

Given the homogeneity of agents, social welfare is characterized by W_j. Analysis of the symmetric version of this model (e.g. by Keen and Kotsogiannis, 2002, 2003) has shown that, except for knife-edge configurations, independent state-level tax setting leads to socially suboptimal equilibrium state tax rates: a symmetric change in *all* tax rates can be welfare improving. The equivalent in our setup is a marginal change in $\mathfrak{t}$. Using the fact that, for state j, the other states' tax rates enter the welfare function only indirectly via their effect on ρ, we can express the effect of such a change as

$$\frac{\partial W_j}{\partial \mathfrak{t}} = \frac{1}{(1 + \rho)} S \rho' - K_j (\rho' + 1) + \Gamma_g \left[K_j + t_j K' (\rho' + 1)\right] + \Gamma_G T K' (\rho' + 1). \qquad (7)$$

For less than pure Leviathans ($\mu < 1$), subtracting Eq. (5) from Eq. (7) yields an expression that lends itself to economic interpretation:

$$\left.\frac{\partial W_j}{\partial \mathfrak{t}}\right|_{\mu_j < 1} = (1 - p_j) \left[\overbrace{\left(\frac{S}{(1 + \rho)} - K_j \right) \rho'}^{\lesseqgtr 0} + \overbrace{\Gamma_g t_j K' \rho'}^{>0} + \overbrace{\Gamma_G T K' (\rho' + 1)}^{<0} \right] - \frac{\mu_j}{1 - \mu_j} \underbrace{\left[K_j + t_j K' (p_j \rho' + 1)\right]}_{>0} \gtrless 0.^{14} \qquad (8)$$

[11] This model abstracts from vertical transfers. In the empirical part, we shall take account of this by controlling for vertical fiscal equalization.

[12] Keen and Kotsogiannis (2003) model the Leviathan by assuming that some exogenously given fraction of tax revenues is used for expenditure that benefits only the government itself. Adopting this modeling approach would not change our relevant results. Eggert and Sørensen (2008) represent Leviathans as pursuing vote maximization through rents offered to public-sector employees, who have a positive weight in the social welfare function. It turns out that this leads to qualitatively equivalent conclusions regarding the desirability of horizontal tax competition to those identified by Edwards and Keen (1996) and therefore to those implied in our model as well. Keen (1998) combines benevolent and Leviathan motives by positing the objective function $(1 - \mu)\, v (\rho + \tau) + \Gamma(tK, G)$, where $v()$ represents citizens' utility from a private good, and $\Gamma()$ represents utility from the public good. This setup could only be applied to our analysis if federal spending G were taken as fully exogenous, which would assume away vertical externalities.

[13] See Keen and Kotsogiannis (2002, p. 368f) for a discussion in the symmetric case. Importantly, they show that with only one tax instrument at hand, even a benevolent federal government will not be able to correct state-level externalities fully to achieve the first-best outcome.

If $\frac{\partial W_j}{\partial \mathfrak{t}} < 0$, state j's tax rate is too high from a social point of view, i.e. a coordinated tax cut would raise social welfare. Similarly, $\frac{\partial W_j}{\partial \mathfrak{t}} > 0$ implies that tax rates are below the social optimum.

The first set of brackets contains three terms. The first of these terms may be called a *tax exporting effect*, due to the fact that in this setting, unlike in the symmetric model, capital supply and demand in state j are not necessarily equal. This effect pushes equilibrium tax rates above or below the social optimum, depending on whether $K_j > \frac{S}{(1+\rho)}$ or $K_j < \frac{S}{(1+\rho)}$. The second term represents the *horizontal tax externality*, arising from the interaction among state governments, and driving equilibrium tax rates below the social optimum. The third term represents the *vertical tax externality*, which results from the use of the same tax base by the federal and the state governments. This effect pushes equilibrium tax rates above the social optimum. Finally, the second brackets contain what we call the *Leviathan effect*, representing the deviation from optimal revenue collection induced by Leviathan government preferences. The Leviathan effect implies that the higher is μ_j the greater is the scope for excessively high state tax rates.

2.3. State size

While we cannot obtain closed form expressions for the equilibrium tax rates, we are nevertheless in a position to study the effect of a change in state size on the equilibrium state tax rate through a simple exercise in comparative statics. State size is our (inverse) measure of fragmentation.[15] We abstract from the impact of a small change in the size of one state dp_j on the relative size of the other states ($dp_{i\neq j} \cong 0$).[16]

Let $\mathcal{H}$ denote the system of first-order conditions characterized by Eq. (5), $\mathcal{H}_t$ the Jacobian matrix with element i,j equal to $\frac{\partial H_i}{\partial t_j}$ and $\mathcal{H}_{p_j}$ the vector with i-th element $\frac{\partial H_i}{\partial p_j}$. The expression for the vector $\nabla \mathfrak{t}_{p_j}$ with elements $\frac{\partial t_i}{\partial p_j}$ is then given by $\nabla \mathfrak{t}_{p_j} = -\mathcal{H}_t^{-1} * \mathcal{H}_{p_j}$.

For our welfare analysis we need to impose some additional structure. We assume, as in Devereux et al. (2008), that the marginal rate of substitution (MRS) between S and g is constant in the neighborhood of equilibrium, which implies that tax rates are strategic complements.[17] Strategic complementary, and hence supermodularity, allows us to use the monotonicity results of comparative statics in supermodular games, i.e. Theorem 4 (Monotonicity Theorem) of Milgrom and Shannon (1994) and Theorem 2.3 of Vives (2000). In the context of our model, these results imply that $sign(\nabla \mathfrak{t}_{p_j}) = sign(\mathcal{H}_{p_j})$, or in other words, all elements of $\mathcal{H}_t^{-1}$ are negative. Recall also that our results hold conditional on T.

Concerning the sign of $\frac{\partial t_j}{\partial p_j}$ (and $\frac{\partial t_i}{\partial p_j}$), we can therefore concentrate on

$$\frac{\partial H_j}{\partial p_j} = (1-\mu_j)\left[\left(\frac{S}{(1+\rho)} - K_j\right)\rho' + \Gamma_g t_j K'\rho' + \Gamma_G TK'(\rho'+1)\right] + \mu_j t_j K'\rho'. \tag{9}$$

This implies that the state tax rate may increase or decrease with state size. The net effect depends on

1. the balance between horizontal and vertical tax externalities (with dominant horizontal externalities strengthening the tendency for tax rates to rise with state size, and vice-versa for dominant vertical externalities), which can be gleaned from the correspondence of bracketed terms in Eqs. (8) and (9), and
2. the intensity of Leviathan preferences (with stronger Leviathan preferences weakening the relative importance of vertical externalities).

Another useful comparative static result is the effect of the Leviathan parameter μ on equilibrium tax rates. This is given by $\nabla t^*_{\mu_j} = -H_t^{-1} * H_{\mu_j}$. Again focusing on $\frac{\partial H_j}{\partial \mu_j}$, we obtain

$$\frac{\partial H_j}{\partial \mu_j} = -\left\{\frac{1}{(1+\rho)} Sp_j\rho' - K_j(p_j\rho'+1) + \Gamma_g\left[K_j + t_jK'(p_j\rho'+1)\right] + \Gamma_G\left[TK'p_j(\rho'+1)\right]\right\} + \left[K_j + t_jK'(p_j\rho'+1)\right] > 0. \tag{10}$$

Given that the second square bracketed term is positive, inspection of Eq. (5) shows that the term in curly brackets must be negative at equilibrium, which establishes the sign of $\frac{\partial H_j}{\partial \mu_j}$. Hence, an increase in the Leviathan parameter, all else equal, always increases the equilibrium tax rate.

The relationship between state size and equilibrium tax rates is interesting in itself and can be measured empirically. However, we ultimately strive for statements about welfare effects of tax competition. This requires that we establish a link between, on the one hand, the observable relationship between state size and the equilibrium tax rate (the "tax rate effect of size"), and, on the other hand, the unobservable relationship between state size, the tax rate and welfare (the "welfare effect of size"). Since relative state size serves as an inverse measure for the intensity of tax competition, the welfare effect of size can be interpreted as an inverse measure of the desirability of tax competition.[18]

The utility function Eq. (3) implies that welfare is not affected by p_j directly but indirectly via the effect of p_j on t_j. The welfare effect of a change in state j's size, conditional on T, can then be written as

$$\frac{\partial W_j}{\partial p_j} = \frac{\partial W_j}{\partial \mathfrak{t}}\left(\sum_i \frac{\partial t_i}{\partial p_j}\right). \tag{11}$$

Thus, the welfare effect of size is the product of (a) the derivative of state welfare relative to the vector of state tax rates and (b) the tax rate effect of size, summed across all states of the federation.

It can be shown that, with purely benevolent governments, intensified tax competition via smaller state size will reduce welfare, irrespective of the dominant tax externality.[19] However, even the parsimonious model studied here does not allow for *general* results on the welfare implications of state size for positive values of the Leviathan parameter.[20] We can, however, identify a mapping from

[14] The corresponding expression for pure Leviathansis: $\left.\frac{\partial W_j}{\partial \mathfrak{t}}\right|_{\mu_j=1} = \underbrace{\left(\frac{S}{(1+\rho)} - K_j\right)\rho' - K_j}_{<0} + \underbrace{(1-p_j)\Gamma_g K' t_j \rho'}_{>0} + \underbrace{\Gamma_G TK'(\rho'+1)}_{<0} \gtrless 0.$

[15] The relationship between state size and fragmentation is discussed in Section 2.4.

[16] Strictly speaking, per the definition of p_j, any change in size of jurisdiction j needs to be compensated by corresponding changes in jurisdictions $i \neq j$. For a sufficiently large number of sub-federal jurisdictions, however, this becomes a second-order effect. Note that the average number of jurisdictions in our data set is 178.

[17] See Proposition 1 of Vrijburg and de Mooij (2016).

[18] As we are focusing on the change in welfare induced by a change in state size, our results are consistent with the finding that, with horizontal tax competition and a given distribution of state sizes, smaller states obtain a higher level of welfare in equilibrium than larger states (see e.g. Bucovetsky, 1991).

[19] This mirrors the result of Keen and Kotsogiannis (2004). The formal proof of this result in our specific setting can be provided on request.

[20] One exception should be noted. Keen and Kotsogiannis (2003) show that tax competition between *purely Leviathan* governments is unambiguously welfare improving in the special case where federal and state-level public goods are perfect substitutes.

tax effects of state size to welfare in one particular configuration. This mapping is established through three propositions.

The first stepping stone is offered by the following specific but ultimately very helpful result:

Proposition 1. *Suppose* $\frac{\partial t_j}{\partial p_j} < 0$. *Then* $\frac{\partial W_j}{\partial t} < 0$ *and* $\frac{\partial W_j}{\partial p_j} > 0$.

Proof. If $\frac{\partial t_j}{\partial p_j} < 0$, then strategic complementarity implies $\sum_i \frac{\partial t_i}{\partial p_j} < 0$. Further, Eqs. (8) and (9) imply that $\left[\left(\frac{S}{(1+\rho)} - K_j\right)\rho' + \Gamma_g t_j K'\rho' + \Gamma_G TK'(\rho'+1)\right] < 0$, and the proposition follows. ■

To put this simply: if intensified tax competition implied by smaller state size leads to *higher* equilibrium tax rates, then tax competition is unambiguously welfare reducing. The logic of this result is as follows. If equilibrium tax rates rise as states get smaller, this must mean that vertical tax externalities dominate the horizontal tax externalities, as they are the only force pushing towards higher taxes as states get smaller. Combined with the tendency of Leviathans to overtax irrespective of state size, this implies suboptimally high state tax rates.

Proposition 1 is the starting point for a unique mapping from the tax rate effect of size to the welfare effect of size for the specific case where we compare jurisdictions of which some have higher μ_j's than others, and where the tax rate effect of size for the lower-μ_j jurisdictions is negative (i.e. Proposition 1 holds for the more benevolent states).

The second step is offered by Proposition 2:

Proposition 2. *Suppose* Proposition 1 *holds for an interior value of* μ_j. *Then there exists a pivotal value* $\tilde{\mu}_j$ *above which* $\frac{\partial t_j}{\partial p_j} > 0$.μ_j *is characterized by:*

$$\tilde{\mu}_j = \frac{\left(\frac{S}{(1+\rho)} - K_j\right)\rho' + \Gamma_g t_j K'\rho' + \Gamma_G TK'(\rho'+1)}{\left(\frac{S}{(1+\rho)} - K_j\right)\rho' + \Gamma_g t_j K'\rho' + \Gamma_G TK'(\rho'+1) - t_j K'\rho'},$$

evaluated at equilibrium.

Proof. Inspection of Eq. (9) shows that $\lim_{\mu_j \to 1} \frac{\partial H_j}{\partial p_j} > 0$. The monotonicity following from Eq. (10) implies that $\tilde{\mu}_j$ exists, i.e. at $\tilde{\mu}_j$ the sign of $\frac{\partial t_j}{\partial p_j}$ switches. ■

According to this Proposition, the relationship between state size and the tax rate switches sign as μ_j increases. How is this possible? The intuition is as follows. The more Leviathan a state government, the less it cares about federally financed public goods, since federal funds are assumed to be distributed equally to all citizens without transiting through state budgets. As a result, the vertical externality loses force as μ_j increases. In the limit, for a pure Leviathan state, the existence of the upper-level government is irrelevant to the relationship between smallness and chosen state tax rates. Hence, if the vertical externality is strong for a relatively benevolent state government, leading taxes to fall in state size p_j, the relative force of this externality will be reduced if that state government becomes more Leviathan, leading equilibrium state taxes to rise in p_j.

Finally, we can derive Proposition 3, which maps Proposition 2 into welfare. This will be the main result informing our empirics, as it allows us to make welfare statements based on observed relationships between tax rates, state sizes and government types.

Proposition 3. *Suppose* Proposition 1 *holds for* $\mu_j = \overline{\mu}_j < 1$. *Then,* $\left.\frac{\partial t_j}{\partial p_j}\right|_{\mu_j = \overline{\overline{\mu}}_j > \overline{\mu}_j} > 0$ *implies that* $\left.\frac{\partial W_j}{\partial p_j}\right|_{\mu_j = \overline{\overline{\mu}}_j} < 0$.

Proof. A sufficient condition for this Proposition to hold is that $\left. t_j^* \right|_{\mu_j = \overline{\overline{\mu}}_j} > \left. t_j^* \right|_{\mu_j = \overline{\mu}_j} \forall \mu_j, j$, which holds from Eq. (10). ■

Equilibrium tax rates are always higher for less benevolent governments, *ceteris paribus*. This implies that equilibrium tax rates are the lowest, for any p_j, when $\mu_j = 0$, i.e. the purely benevolent case marks the lower bound.

Hence, if the vertical tax externality dominates in a state under relatively benevolent government, then if a decrease in this state's size under a less benevolent government will lower equilibrium tax rates this decrease in state size increases welfare: tax competition will be welfare improving.

This is illustrated in Fig. 1, which plots the deviation of equilibrium state tax rates from their optimum $\left(t_j^* - t_j^{opt}\right)$ against

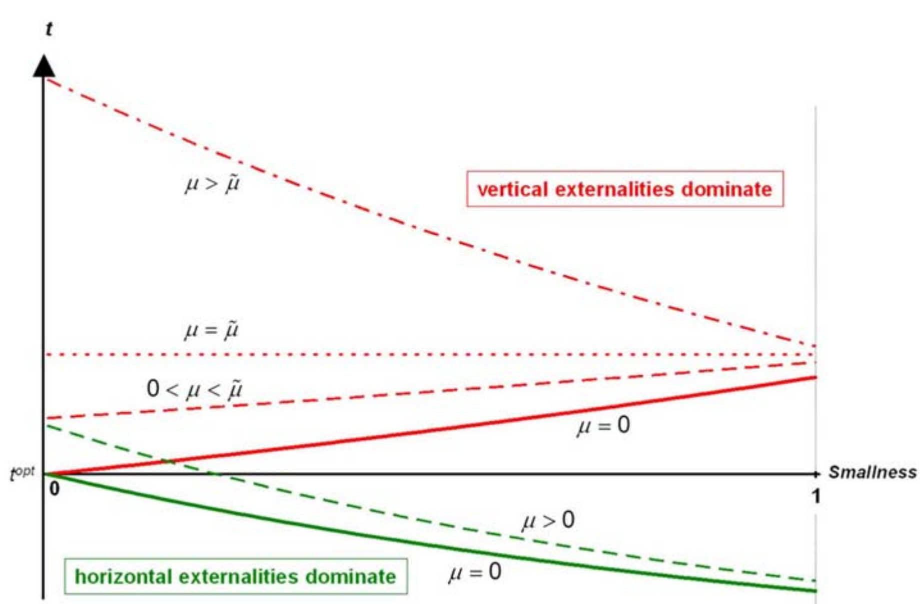

Fig. 1. Smallness, Leviathan and equilibrium tax rates.

different levels of smallness. When governments are purely benevolent ($\mu_j = 0$) and there is only one sub-federal state, the state tax rate is optimal $\left(t_j^* = t_j^{opt}\right)$. Negative correlations between tax rates and smallness have sometimes collectively been interpreted as evidence of Leviathan taming. It turns out that taxes fall in smallness irrespective of government preferences in all cases where horizontal externalities dominate. In those configurations, increasing smallness (i.e. tax competition) can be a good or a bad thing, depending on whether t_j^* is above or below t_j^{opt}. Traditionally, regressions of government size on decentralization were (at least implicitly) predicated on the assumption that t_j^* is above t_j^{opt}, but this is not something that can be ascertained empirically. Hence, the usefulness of the case where equilibrium tax rates rise in smallness for μ_j up to a pivotal level $\tilde{\mu}_j$, but fall in smallness for μ_j above $\tilde{\mu}_j$. In that case, Proposition 3 states that smallness (i.e. tax competition) is an unambiguous force for good for all $\mu_j > \tilde{\mu}_j$, as t_j^* is monotonically lowered by increasing smallness towards t_j^{opt}, but t_j never falls below t_j^{opt}, i.e. the equilibrium tax rate under dominant vertical externalities is never lower than the first-best tax rate t_j.

In terms of Fig. 1, Proposition 3 is equivalent to stating that, given either dominant externality, the lines representing equilibrium tax rates over the support of smallness never cross. This is what we show to hold in the proof to the Proposition, based on expression (10).

2.4. Fragmentation

The key variable driving the intensity of tax externalities in our model is the relative smallness of states, whereas the related empirical literature uses two different exogenous variables, fragmentation and centralism.

Our definition of smallness can be taken as a measure of fragmentation, because, from the point of view of a representative state, a fragmented federation implies relatively small states.[21] The model clearly shows that observed inverse relationships between tax rates and fragmentation are not sufficient to infer Leviathan governments. However, it also offers an analytically rigorous version of the popular view that intensified competition from increased fragmentation can "tame the Leviathan" (without constraining it excessively), provided that vertical externalities dominate when state governments are relatively benevolent.

What about the exogeneity of smallness? Jurisdictional definitions may be endogenous with respect to taxation in certain settings (Perroni and Scharf, 2001), especially in the context of single-purpose districts (Hoxby, 2000). Our analysis is based on a sample of general-purpose jurisdictions with historically predetermined boundaries, such that jurisdictions' size in geographic terms can reasonably be taken as exogenous. Smallness in population terms, however, may in reality be to some extent influenced by tax rates. We address this issue in the empirics by considering smallness in terms of both population and area.

3. Empirical setting

3.1. The regression model

Eqs. (5) and (9) imply:

$$t_{jk} = f\left(n_{jk}, \mu_{jk}, T_k, \sqcup_{-j,k}\right) | \mathbf{X}_{jk}, \qquad (12)$$

where j again indexes states, k denotes different federations, n_{jk} represents smallness, and $\mathbf{X}_{jk}$ represents idiosyncrasies in revenue needs and tax-base elasticities.

A negative relationship between state tax rates and smallness could reflect (a) the dominance of horizontal externalities and relatively benevolent governments, or (b) the presence of Leviathan state governments. According to the theory, a positive relationship would in turn point unambiguously to dominant vertical externalities.

If underlying state government objectives (μ_{jk}) are measurable, the natural cross-section empirical specification becomes:

$$t_{jk} = \beta_0 + \beta_1 n_{jk} + \beta_2 \mu_{jk} + \beta_3 \left(n_{jk} * \mu_{jk}\right) + \beta_4 T_k + \gamma \bar{t}_{-j,k} + \mathcal{X}_{jk}\delta + e_k + u_{jk}, \qquad (13)$$

where $\bar{t}_{-j,k}$ is a weighted average of neighboring state tax rates, e_k is a fixed effect that absorbs all unobservable time-invariant variation at the level of federations, and u_{jk} is a stochastic disturbance.

The estimated coefficient $\widehat{\beta}_1$ represents the (inverse of the) tax effect of size for relatively benevolent governments ($\mu_j = \overline{\mu}$). For our empirical purposes, we shall treat μ as a dummy variable, setting the lower-bound value $\overline{\mu}$ equal to zero. If $\widehat{\beta}_1 > 0$, vertical externalities dominate at $\overline{\mu}$, and Proposition 1 applies. The coefficient $\widehat{\beta}_3$ then quantifies the differential effect of smallness on state tax rates for "relatively Leviathan" governments ($\mu_j = \bar{\bar{\mu}} > \overline{\mu}$). This will be our main coefficient of interest.

According to Proposition 3, if $\widehat{\beta}_1 > 0$, $\widehat{\beta}_3 < 0$, and $\widehat{\beta}_1 + \widehat{\beta}_3 < 0$, we can infer that tax competition tames the Leviathan and increases social welfare. We call this "*strong Leviathan taming*": stiffer tax competition from increased smallness improves welfare in Leviathan states. Another possible parameter configuration is $\widehat{\beta}_1 > 0$, $\widehat{\beta}_3 < 0$, but $\widehat{\beta}_1 + \widehat{\beta}_3 \geq 0$. We refer to this as "*weak Leviathan taming*". In this case, stiffer tax competition from increased smallness is less harmful in Leviathan states than in relatively benevolent states.

Some additional issues need to be considered in taking the theory to data. First, estimation of Eq. (13) requires variation in μ_{jk} and in n_{jk}. This is most likely to be found in a comparison of multiple federations, which ideally should be similar to each other in all other relevant respects. Note that for the identification of strong Leviathan taming, we do not need to observe the full range of μ_{jk}, but only some instances of $\mu_{jk} > \tilde{\mu}_{jk}$ and some instances of $\mu_{jk} < \tilde{\mu}_{jk}$. Second, the theoretical model assumes states to be identical except for their size. Empirical estimation needs to control for relevant asymmetries across states and federations, such as revenue needs, preferences for public goods, locational advantages and federation-level tax rates. Hence, federation-level fixed effects as well as time-varying state-level control variables $\mathbf{X}_{jk}$ are included in Eq. (13). Third, we express all non-dichotomous variables in natural logs, so that the estimated coefficients can be interpreted as elasticities.

Finally, our data are in panel format and therefore allow us to exploit time variation in the data. Indexing years by t, we can estimate the following state-level fixed-effects (FE) model:

$$t_{jkt} = \beta_0^{FE} + \beta_1^{FE} n_{jkt} + \beta_2^{FE} \mu_{jkt} + \beta_3^{FE}\left(n_{jkt} * \mu_{jkt}\right) + \beta_4^{FE} T_{kt} + \gamma^{FE} \bar{t}_{-j,kt} + f_{jk} + u_{jkt}^{FE}, \qquad (14)$$

where the state-level fixed effects are written as f_{jk}. Identification of the parameters of interest is therefore driven solely by the timing of changes in smallness n_{jkt} and government preferences μ_{jkt}.

3.2. Switzerland: a laboratory for research on tax competition

Although the reduced-form predictions we seek to put to the test could conceivably also be estimated on data for other federal

[21] The empirical Leviathan literature has paid considerable attention to centralism, i.e. the allocation of fiscal powers between the federal and state government levels. Unlike fragmentation, however, the degree of centralism cannot be considered as an exogenous determinant of the intensity of tax competition. See e.g. Wilson and Janeba (2005) who study how the choice of t/T may be used strategically by the central government to minimize the distortions arising from the interplay of horizontal and vertical tax externalities.

systems, Switzerland presents a particularly propitious empirical setting. The Swiss fiscal constitution distinguishes three largely autonomous jurisdictional layers (national, cantonal and municipal). Each jurisdictional layer collects a roughly equal share of total tax revenues.[22] We will concentrate on the cantonal and municipal levels. Direct taxation at both these levels of government encompasses four conventional tax bases: personal income and wealth, and corporate income and capital. Personal income is by far the most important tax base, accounting for over 70% of municipal and over 60% of cantonal tax revenues. In contrast to many other countries, property taxation is small even at the local level.[23] Hence, local tax bases are for the most part highly mobile. Summary statistics are given in Table 1.

Two institutional features make Switzerland particularly well suited to our study. The three-tier fiscal constitution implies that Switzerland can be considered as a *federation of federations*. We will take cantons to represent the federations (k) of our empirical model, while municipalities represent the states (i, j). Switzerland is divided into 26 cantons, which in turn contain between 3 (Basel Stadt) and 404 (Bern) municipalities.[24]

The second institutional feature we exploit is variation across municipalities and cantons in the intensity of direct-democratic involvement in the tax setting process. Measures of this intensity serve as our proxy for μ_j. We distinguish three categories: "*assembly*" municipalities that set tax rates and budgets via show of hands at town hall meetings of the entire citizenry and are thus associated with the lowest values of μ_j; "*referendum*" municipalities, whose constitutions feature compulsory referenda on fiscal decisions above certain thresholds and are associated with intermediate values of μ_j; and a residual "*Leviathan*" category of municipalities where fiscal matters are largely under the control of elected executives.

Our strategy is built on the assumption that decisions in municipalities with greater scope for direct-democratic participation in the tax setting process are more likely to correspond to the policy preferred by the median voter, whereas less direct-democratic control offers greater leeway to Leviathan governments. This assumption has considerable theoretical and empirical support. Gerber (1996) and Besley and Coate (2008) model how the availability of direct-democratic instruments will push policy outcomes towards the preferences of the median voter. Empirical work by Gerber (1999), Lutz (2010), Matsusaka (1995, 2004) and Matsusaka and McCarty (2001), based on extensive analyses of US data, confirms that proposition.[25]

[22] Over our sample period 1990–2009, revenue shares have remained fairly constant at some 30%, 40% and 30% for the national, cantonal and municipal government levels, respectively (Feld et al., 2010).

[23] See Brülhart et al. (2015).

[24] These numbers refer to 1995. The total number of municipalities is in slow decline, as micro-municipalities (some with populations below 100) are encouraged to merge. Since our sample includes 362 relatively large municipalities, such changes do not affect our data.

[25] Cases have been documented, however, where local-level direct democracy did not work as modeled in our paper. Asatryan (2016), for example, finds that the introduction of voter initiatives in German municipalities was associated with an expansion of local government size. This might be due to the fact that – unlike in the Swiss case – these initiatives were allowed only on non-budgetary issues, such that the fiscal implications often were not salient at the time of voting or not even borne by the municipalities themselves. Asatryan's (2016) result also points to the distinction between initiatives, which can aim at both higher or lower public expenditure, and referenda, which generally serve only to block tax and spending proposals (see e.g. Matsusaka, 2004). Another diverging case has been documented by Hinnerich and Petterson-Lidbom (2014), who show that the introduction of town-hall decision making in Swedish municipalities after 1919 often led to capture by local elites and lower spending on public welfare than in municipalities with representative governments. The authors mainly attribute this outcome to the hierarchical nature of largely agrarian communities in early 20th-century Sweden, allowing for "de facto" political power of elites to have greater weight in town hall meetings than in (anonymous) elections. This mechanism is much less likely to be relevant in late 20th-century Switzerland.

Substantial evidence exists also of the heterogeneity in direct-democratic institutions within Switzerland. Ladner and Fiechter (2012) provide a descriptive account of municipality-level institutional variety, documenting how some municipalities "dispose of a long tradition of direct-democratic involvement of citizens (…), whereas others rely on more representative forms of local democracy" (p. 438). This institutional diversity has been shown to affect policy outcomes significantly. Based on canton-level data, Feld and Matsusaka (2003) and Funk and Gathmann (2011, 2013) find that direct democracy acts as a brake on public expenditure. The effects they find are economically substantial: Funk and Gathmann (2011), for instance, estimate that the existence of a mandatory budget referendum reduces canton-level expenditure by 12%. Frey and Stutzer (2000) report that, *ceteris paribus*, residents of more direct-democratic cantons are happier than those of cantons with more strongly delegated government.

In our model, the choice of the median voter represents the socially optimal state-level response. If one were to allow for heterogeneous voter preferences or incomplete information, however, the welfare implications of direct democracy would no longer be so clear cut. When voter preferences differ in nature and intensity, referenda can be inferior to cost-benefit analysis (Osborne and Turner, 2010) or to logrolling in an elected legislature (Matsusaka, 1995). Informational advantages on the part of the government could offer another rationale for delegated decision making (Maskin and Tirole, 2004), as could the presence of a large share of noise voters (Besley and Coate, 2008). Hence, a perfectly informed and benevolent state government might opt for a different tax rate from that chosen through direct-democratic voting. In such a setting, t_j^{opt} could still be interpreted as the median-voter choice in the absence of tax externalities, but not as the social optimum. Furthermore, β_2 could conceivably be positive for reasons other than Leviathan government preferences (although we do not find that particularly plausible). These factors will have no bearing on our parameter of central interest, β_3. A perfectly benevolent and well informed state government might choose a different tax level from that preferred by its median voter, but there is no reason to expect it to react differently from its median voter to changes in the intensity of tax competition.[26]

Several additional aspects of fiscal policy making in Switzerland correspond closely to the features of our theoretical model. The theory assumes perfectly overlapping tax bases. This is precisely true within cantons, where tax bases are determined by the cantonal tax law and thus identical. Even across cantons, tax bases are very similar, as the information to determine the national tax base is drawn from tax forms used to report to the cantonal authorities.

The theory furthermore implies full fiscal autonomy of sub-federal states. This largely applies to Swiss cantons and municipalities. In spite of considerable harmonization of tax *bases* across cantons, cantonal authorities enjoy full autonomy in choosing tax *rates*. Most cantons use the following procedure to set taxes. The cantonal tax law determines a tax schedule on the main tax bases. This schedule determines the level and progressivity of each tax instrument. The cantonal authorities annually decide on a multiplier that shifts the base tax schedule, determining the effectively applied cantonal tax. Most cantons fix a single multiplier across the major tax bases. Similarly, most municipalities annually set a single multiplier, which, applied to the cantonal tax schedule, determines the effectively applied municipal tax. This particular procedure implies that municipalities are heavily constrained in their choice of the "tax mix", and that tax setting authorities concentrate their decisions on tax bases with the highest impact on tax revenue (i.e. personal income taxes). Reflecting the

[26] This might not be true if governments understood the implications of tax externalities for their decision while voters did not. Given the intensity of the public debate about tax competition within Switzerland, such a scenario does not appear realistic.

Table 1
Descriptive statistics.

	Obs.	Mean	Std. dev.	Min	Mun or cant. with min.	Max	Mun or cant. with max.
Municipal personal income tax rate (%)							
Married, median inc.	6519	3.74	1.26	0.37	Baar (ZG)	8.66	Menznau (LU)
Married, median inc. ($\mu = 0$)	5549	3.79	1.28	0.37	Baar (ZG)	8.66	Menznau (LU)
Married, median inc. ($\mu = 1$)	970	3.45	1.12	0.37	Zug (ZG)	6.83	Sierre (VS)
Single, median inc.	6519	5.10	1.34	1.27	Freienbach (SZ)	8.84	Menznau (LU)
Married, high inc.	6519	10.72	2.25	2.37	Freienbach (SZ)	16.01	Balsthal, Solothurn (SO)
Smallness (%)	6519	97.07	4.65	62.82	Appenzell (AI)	99.96	Kilchberg (BL)
Area based smallness (%)	6380	98.58	2.09	80.11	Urnaesch (AR)	99.97	Nidau (BE)
Government objective (μ)	6519	0.15	0.36	0	*(Several)*	1	*(Several)*
Municipal controls							
Population (in thsd)	6519	9.85	23.43	0.10	Kilchberg (BL)	386.60	Zürich (ZH)
Dependency ratio	6519	32.07	3.51	20.51	St. Moritz (GR)	45.77	Sumvitg (GR)
Share of protestants	6519	40.71	21.08	2.14	Sumvitg (GR)	85.05	Kilchberg (BL)
Share of foreigners	6519	16.20	8.49	1.37	Sumvitg (GR)	51.85	Renens (VD)
Area (km^2)	6519	19.56	28.87	1.30	Schönenbuch (BL)	203.90	Zernez (GR)
Urban center dummy	6519	0.15	0.35	0	*(Several)*	1	*(Several)*
Aggregate municipal fiscal equalization flows (in thsd CHF per canton)	6378	94,509	104,081	0	*(Several)*	413,348	ZH
Cantonal personal income tax rate							
Married, median inc.	6519	3.43	1.15	0.46	Zug	8.51	Basel-Land
Single, median inc.	6519	4.70	1.18	1.79	Schwyz	9.51	Basel-Land
Married, high inc.	6519	10.34	2.36	3.35	Schwyz	16.39	Basel-Land

Notes: Government objective (μ) according to referendum definition.

high degree of cantonal and municipal tax setting autonomy, tax rates and schedules vary substantially across cantons and municipalities. For example, the highest municipal income tax rate on a median-income single household exceeds the lowest one by a factor of almost seven (see Table 1).

The theory abstracts from interjurisdictional fiscal transfers. Although vertical and horizontal fiscal transfers exist within cantons, they on average represent <15% of total municipal revenue.[27] Nevertheless, we empirically control for canton-level net equalization flows.

3.3. Data

We have collected a panel data set of municipal and cantonal tax rates and control variables for the period 1990 to 2009. The data set covers up to 365 municipalities, spread across 22 cantons and containing some 48 percent of the national population.[28] The panel is not fully balanced, but for 228 municipalities we have data for all 20 sample years, and the remaining municipalities are all observed for at least 3 sample years. The sample is constructed as follows. We started with an official data set from the Swiss Federal Finance Administration (FFA) containing fiscal information on 406 municipalities across all cantons for 1990 to 2009. The FFA selects these municipalities in order to cover all 26 cantons. In some small cantons, all municipalities are covered, but in most cantons the FFA conducts random sampling. The municipality hosting the cantonal capital as well as municipalities defined as urban centers are always included. We surveyed the municipal clerks of all these municipalities to obtain information on fiscal decision making systems in force over our sample period. Thanks to a high response rate we ended up with our sample of 365 municipalities.[29] In 256 of those municipalities, taxes are set by citizen assemblies, in 93 municipalities taxes are set by the municipal executive, and 16 municipalities have changed system within our sample period. Of the 93 municipalities with tax setting by the executive, 43 have a compulsory referendum, 25 a voluntary referendum and 25 have neither.

We construct two alternative dummy variables, denoted by $\widehat{\mu}$, and their associated data samples. In the "referendum sample", the dummy variable is set to 0 for all assembly or compulsory referendum municipalities, and to 1 for the remaining (Leviathan) municipalities. Hence, according to the referendum definition, we have 305 non-Leviathan and 50 Leviathan municipalities, plus 10 switchers.[30] In the "assembly sample", the dummy variable is set to 0 only for the assembly municipalities, while municipalities with compulsory or voluntary referenda are dropped. Hence, the assembly sample has a smaller number of observations but a larger implied distance between $\widehat{\mu} = 0$ and $\widehat{\mu} = 1$. $\widehat{\mu}$ exhibits useful variance, as it differs among many same-canton municipalities as well as between cantons: while the total sample standard deviation of $\widehat{\mu}$ is 0.35 (referendum sample, see Table 1), the within-canton standard deviation still amounts to 0.26.

Since $\widehat{\mu}$ features as a regressor in our empirical model, it is implicitly assumed to be an exogenous feature. As pointed out e.g. by Besley and Case (2003), institutions are ultimately endogenous too. $\widehat{\mu}$ could depend on, or be simultaneously determined with, t in two evident ways. On the one hand, local communities might push for more direct democracy if delegated governments chronically overspend, in which case high (lagged) t is associated with low $\widehat{\mu}$. On

[27] See www.efv.admin.ch/e/dokumentation/finanzstatistik/index.php.

[28] This is a significantly expanded data set compared to that used in our original working paper with the same title (Brülhart and Jametti, 2007). In that version of the paper, we could draw on data only for five sample years and 131 municipalities. Importantly, this made it impossible to control for municipality-level fixed effects in our estimations.

[29] For 103 of those municipalities, we could cross-validate the information obtained through our own survey with corresponding data collected in the mid-1990s for the study by Feld and Kirchgässner (2001). We are grateful to Lars Feld for sharing this data set with us.

[30] The difference in the number of switchers is explained by the grouping of direct-democratic instruments in the referendum definition, e.g. a municipality changing the tax setting procedure from an assembly to a compulsory referendum does not change the value of μ in the sample.

the other hand, the predominantly conservative mentality of certain local electorates could simultaneously induce lower t and a lower $\widehat{\mu}$.

Democratic institutions have a habit of being highly persistent, especially in Switzerland. Indeed, in our sample only 16 municipalities have changed institutions in the tax setting process during our sample period.[31] Additional evidence on the stability over time of direct-democratic institutions in Swiss cantons is provided by Feld and Matsusaka (2003). This durability of the institutional structure to some extent mitigates concerns about endogeneity. Moreover, we systematically include canton-level fixed effects and thereby capture the main fault lines in Swiss political culture (language regions, rural versus urban cantons, low-lying versus mountainous cantons).[32] Finally, given that some municipalities did change their tax setting institutions, our data allow us to estimate models featuring municipality specific fixed effects, thus identifying our coefficient of interest off changes in $\widehat{\mu}$.

Additionally, we performed two statistical exercises to evaluate our assumption of exogeneity of institutions: a balancing test on the municipalities that have changed institutions (Becker and Ichino, 2002), and an overall identification of potential omitted variable bias (Oster, 2019). First, we estimated the propensity score of the fact that a municipality switches institutions conditional on all municipal controls (expressed in levels). The balancing test confirms that, conditional on controls, treatment assignment, i.e. institutional switch, is random in our sample.[33] Second, we use the specification including municipality fixed effects to test the degree of selection on unobservables necessary to render the Leviathan main effect insignificant. According to this test, time-varying unobservables would need to be more than four times as important as time-varying municipal observables.[34]

Municipal and cantonal tax rates were obtained from an exhaustive data set of yearly tax rates for personal income for all municipalities (and cantons) in Switzerland.[35] We focus on effective consolidated municipal and cantonal personal income tax rates for three representative taxpayers:

1. median-income single households (annual income of CHF 50,000),
2. median-income married households with two children (CHF 80,000), and
3. high-income married households with two children (CHF 500,000).[36]

Data limitations preclude us from including other tax bases to which municipalities have access, e.g. personal wealth and corporate income and capital. However, as mentioned before, most municipalities set a single multiplier across all tax bases. Moreover, personal income taxes are by far the largest source of cantonal and municipal income, accounting for some two-thirds of sub-federal revenue.

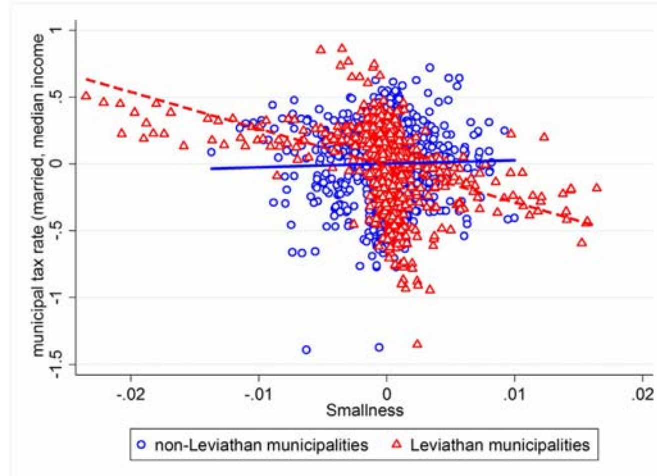

Fig. 2. Municipal tax rates and smallness: unconditional distributions.

The *smallness* of a municipality is defined as percentage points relative to its canton as $n_{jk} = 100 * (1 - \frac{P_{jk}}{P_k})$, where P_{jk} is the population of municipality j in canton k, and P_k is the respective cantonal population.

A range of control variables are included in all estimated equations (see Table 1 for summary statistics). Theory suggests that we should control for the respective *cantonal tax rates*, the equivalent of T. In addition, we control for the spatially weighted *neighbors' tax rates of other municipalities*, $\bar{t}_{-j}$, so as to capture direct strategic interactions among municipalities. $\bar{t}_{-j}$ is constructed as the average tax rate of all municipalities excluding j, inversely weighted by their euclidean distance from j.[37] *Neighbors' tax rates* are instrumented, in some specifications, with spatially weighted averages of all municipality-level controls. Controls are also warranted to allow for differences in municipalities' public revenue needs. We include regressors measuring municipal *population*, the *dependency ratio*, measured as the sum of the share of population under 20 and above 65, the *share of foreigners*, municipal *area*, and a dummy for municipalities that represent *urban centers*. Municipal area captures two effects: it implies revenue needs for transport and communication services, and it is strongly positively correlated with the mountainousness of municipalities. The *share of Protestants* in municipal population is added to control for attitudinal differences. Finally, to control for fiscal equalization, we include annual net municipal equalization flows aggregated by canton, obtained from the Federal Finance Administration.

4. Results

4.1. A first look at the data

As an illustrative preliminary step, we look at an unconditional version of our key relationship. Fig. 2 plots municipal tax rates over smallness separately for non-Leviathan and Leviathan municipalities, using the referendum definition and centering the variables within municipalities (i.e exploiting only the time variation within municipalities). Our central result already emerges at least in part: while municipal tax rates slightly increase in smallness for the non-Leviathan municipalities (consistent with dominant vertical

[31] 15 municipalities switched to a more Leviathan government, generally abolishing the municipal assembly for a council, while one municipality (Rorschach) reintroduced the assembly.

[32] See Eugster and Parchet (2019) on cultural differences in local fiscal policy preferences across linguistic regions in Switzerland.

[33] The individual critical significance level we impose on the balancing test is 0.0004, implying an overall significance level of 0.05.

[34] Our estimated value of the test statistic ("delta", for a maximum R^2 of 1.0) is 4.7, which implies that proportional selection on unobservables would need to be 4.7 times as large as selection on observables (see Oster, 2019). Time invariant unobservables are absorbed by the municipal fixed effects.

[35] We thank Raphaël Parchet for the generous provision and assembly of these data. A more detailed description of the data can be found in Parchet (2019).

[36] See Brülhart and Jametti (2006) for further details on the selection of specific tax rates.

[37] Application of linear spatial weights changes none of our qualitative findings. We exponentiate distances by 2.5 based on previous findings on spatial decay functions based on intra-national migration (e.g. Schwartz, 1973) and commuting (e.g. Harsman and Quigley, 1998). Note that these control variables may also capture horizontal tax-competition effects that cross canton borders.

externalities), they clearly decrease in smallness for the Leviathan municipalities.

4.2. Baseline regressions

Our baseline estimation results of the empirical model (13) are shown in Table 2, separately for the referendum and assembly definitions of $\widehat{\mu}$.

We first concentrate on the results based on the referendum definition (first four columns of Table 2), as this classification encompasses our full data set. The model performs well. All statistically significant coefficients on the control variables conform with expectations: urban centers and municipalities covering large areas have relatively high taxes; while municipalities with large populations have relatively low taxes (consistent with scale economies in local public service provision).[38] The predominantly positive coefficients on spatially weighted tax rates of surrounding municipalities suggests that tax rates are strategic complements, consistent with our theoretical assumption as well as with earlier results of Feld and Reulier (2009).

Our main parameters of interest are those shown in the first three rows of the table. We find the main effect of smallness to be positive and statistically significant throughout. This is consistent with the scenario underlying Propositions 1 and 2: for relatively benevolent municipalities ($\widehat{\mu} = 0$), vertical externalities dominate $\left(\frac{\partial t_i}{\partial p_j} < 0\right)$.

Our estimation also confirms that direct-democratic fiscal powers represent a valid proxy variable for revenue maximization: the coefficient on the Leviathan dummy ($\widehat{\mu}$) is statistically significantly positive. This means that at the point where smallness is zero, i.e. where intra-cantonal tax competition cannot exist, less direct-democratic municipalities have significantly higher average tax rates than more direct-democratic ones. The size of this coefficient is considerable. In our 2SLS specification, for example, we obtain a coefficient estimate of 2.00 (Table 2, column 4). This implies that, without intra-cantonal tax competition, Leviathan municipalities' average tax rate is more than seven times ($= e^{2.00}$) as high as in otherwise identical benevolent municipalities. This is not plausible, but it is a prediction for a scenario with a smallness of zero, which is far outside the observed range. The mean value of smallness in our data is 97.1 (Table 1). For such a municipality, the implied increase in the tax rate when switching from non-Leviathan to Leviathan status is 3 percent ($= e^{2.00-0.43*\ln(97)} - 1$). For the sample municipality with the lowest observed value of smallness (62.8), the implied Leviathan tax differential is 25 %. These strike us as plausible magnitudes.[39]

These computations point to our third and most important empirical result. We find a negative coefficient on the interaction variable between $\widehat{\mu}$ and smallness. Hence, greater scope for Leviathan government reduces the tax-raising effect of smallness. Stated in reverse: fragmentation, while yielding inefficiently high equilibrium tax rates for benevolent municipalities, acts as a counterweight to the desire for high taxes on the part of Leviathan municipalities. The coefficient on the interaction between $\widehat{\mu}$ and smallness being somewhat larger in absolute value than the coefficient on smallness suggests the presence of what we have termed "strong Leviathan taming", which in turn implies that fragmentation is (second-best) welfare improving in so far as the Leviathan municipalities are concerned. However, strong Leviathan taming is not statistically significant in the sense of a Wald test on the hypothesis $\widehat{\beta}_1 + \widehat{\beta}_3 = 0$ (bottom row of Table 2).

In columns 5 to 8 of Table 2, we show estimates of models based on the narrower definition of "benevolence", where $\widehat{\mu}$ is set to zero only for municipalities that make fiscal decisions via a vote by an assembly of the entire citizenry, and municipalities with intermediate (i.e. referendum based) systems are left out. We observe that this changes our main results in the expected way. The coefficients on smallness almost double in size. The main effect of the Leviathan dummy is again statistically significantly positive, and its magnitude is larger, which is in line with the starker difference between $\widehat{\mu} = 0$ and $\widehat{\mu} = 1$ under the assembly definition. The estimated coefficient implies that a municipality with mean smallness will raise its tax rate by 9 percent ($= e^{2.56-0.54*\ln(97)} - 1$) if it switches from tax setting by citizen assemblies to tax setting by the municipal executive.

Our main interest again concerns the slope-shifting effect of $\widehat{\mu}$. This coefficient increases in size, but it remains statistically significant only when we omit the municipal controls. The interaction effect also remains larger in absolute terms than the main effect of smallness, which is consistent with strong Leviathan taming, although this difference is not statistically significant either. In sum, the results obtained for the assembly definition confirm those found in the larger data set underlying the referendum definition, but our estimates lose precision.

The relationship between tax rates and smallness implied by our baseline coefficient estimates of Table 2 are illustrated in Fig. 3.[40] The blue lines refer to the sample of municipalities based on the referendum definition, while the red lines refer to the narrower sample of municipalities based on the assembly definition. In both cases the graph shows how the relation between predicted tax rates and smallness turns from positive to negative as one switches from municipalities with strongly developed direct democracy to municipalities with greater scope for governmental discretion.

4.3. Extensions

To explore the robustness of our results, we consider a number of extensions to the benchmark estimations of Table 2.

First, we re-estimate our baseline models including municipality-level fixed effects, based on Eq. (14). We can thereby soak up any time-invariant unobserved differences between municipalities that might conceivably determine both observed tax rates and political institutions. This specification is statistically more demanding, as identification of the coefficients on $\widehat{\mu}$ now rely on the 16 municipalities which have switched tax setting arrangements within our sample period. Table 3 shows the results. While most coefficients and their associated standard errors are larger in absolute value than are our baseline estimates, our qualitative findings turn out to be robust to this estimation method. The main effect of the Leviathan dummy, $\widehat{\beta}_2$, remains statistically significantly positive throughout, while its interaction effect with smallness, $\widehat{\beta}_3$, is always negative and significant. Again, we cannot reject the hypothesis that the two coefficients sum to zero, i.e. that Leviathan taming is of the weak kind.

Our estimated main effects of smallness, though consistently positive and thus consistent with Proposition 1, are considerably larger in the municipal fixed-effects estimations of Table 3 than in our baseline models shown in Table 2. This might point to an endogeneity problem: municipal population growth and municipal tax rates might be negatively correlated for reasons other than the causal effects of municipal taxes. We therefore replace population-based smallness, our baseline size measure, with area-based smallness. This measure does not vary over time, which does not allow us to identify the main

[38] While consolidated (municipal plus cantonal) tax rates are generally higher in the Latin cantons, municipal taxes tend to be lower, reflecting a higher degree of centralism in those cantons.

[39] Using canton-level data, Funk and Gathmann (2011) find that the introduction of a mandatory budget referendum has on average reduced public spending by 12 %.

[40] We take the coefficient estimates for the 2SLS models (Table 2, columns 4 and 8).

Table 2
Estimation results with canton-level fixed effects.

Dep. var. = log municipal personal income tax (married, median income)	**Referendum definition**				**Assembly definition**			
OLS			*2SLS*	*OLS*			*2SLS*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Smallness (main effect)	0.759***	0.736***	0.402*	0.403**	1.397***	1.384***	0.789	0.745
	(0.144)	(0.137)	(0.205)	(0.202)	(0.362)	(0.363)	(0.546)	(0.535)
Government objective (μ)	4.121***	4.013***	1.960*	1.997*	6.604**	6.416**	2.687	2.559
	(1.090)	(1.089)	(1.112)	(1.090)	(2.374)	(2.443)	(2.696)	(2.563)
μ* Smallness (interaction effect)	−0.897***	−0.874***	−0.418*	−0.426*	−1.432**	−1.391**	−0.568	−0.541
	(0.237)	(0.237)	(0.242)	(0.238)	(0.516)	(0.531)	(0.587)	(0.558)
Neighbors' avg tax rate		0.001	0.016**	0.005		−0.002	0.011	−0.004
		(0.009)	(0.007)	(0.010)		(0.011)	(0.009)	(0.015)
Cantonal tax rate		0.302*	0.313*	0.316**		0.359**	0.356**	0.359***
		(0.150)	(0.155)	(0.152)		(0.138)	(0.129)	(0.126)
Municipal controls								
Population			−0.056**	−0.056***			−0.059**	−0.060**
			(0.022)	(0.021)			(0.026)	(0.026)
Dependency ratio			0.106	0.109			0.125	0.131
			(0.095)	(0.092)			(0.112)	(0.107)
Share of protestants			−0.027	−0.026			−0.025	−0.023
			(0.018)	(0.017)			(0.023)	(0.022)
Share of foreigners			0.020	0.021			0.021	0.022
			(0.022)	(0.021)			(0.023)	(0.023)
Area			0.056**	0.053**			0.059*	0.057**
			(0.027)	(0.026)			(0.030)	(0.029)
Urban center dummy			0.080***	0.079***			0.119***	0.118***
			(0.027)	(0.026)			(0.041)	(0.040)
Aggr. mun. equalization flows			−0.016	−0.016			−0.033	−0.033
			(0.013)	(0.013)			(0.022)	(0.021)
Level of fixed effects	Canton	Canton	Canton	Canton	Canton	Canton	Canton	Canton
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	6519	6519	6378	6378	5186	5186	5180	5180
Number of groups (cantons)	22	22	22	22	19	19	19	19
R^2	0.63	0.66	0.70	0.70	0.62	0.67	0.71	0.71
Kleibergen-Paap rank stats				94.32				214.62
Wald test statistic on smallness:								
main + interaction effect = 0	0.65	0.65	0.01	0.01	0.02	0.00	0.26	0.23
p-Value	0.43	0.43	0.94	0.92	0.90	0.98	0.62	0.63

Notes: standard errors in parentheses, clustered at the cantonal level. Non-dichotomous variables in natural logs. 2SLS: neighbors' tax rate instrumented by distance-weighted averages of municipal controls.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

effect; but our data offer sufficient variation for us to estimate the interaction effect in the sample based on the referendum definition. The resulting estimates are shown in column 3 of Table 3. We find that the coefficient on the interaction term remains negative and statistically highly significant.[41]

Finally, we estimate the baseline model separately for two alternative income tax rates: the tax rate on single median-income households, and the tax rate on married high-income households, where high income is defined as the tenth percentile in the nationwide distribution of taxable incomes in a given year. Table 4 reports our estimates. The estimated coefficients for those two alternative personal income tax rates are very similar, suggesting that the baseline results are not driven by the selection of the tax rate on one particular type of taxpayer. This is not surprising, as most municipalities decide on a single multiplier that shifts tax schedules symmetrically for all tax bases.[42]

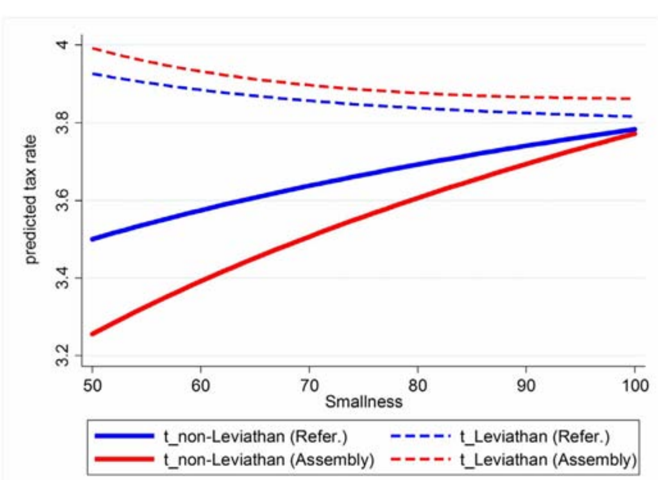

Fig. 3. Estimated Leviathan taming.

[41] In Table 3, our coefficients of main interest are considerably bigger in a absolute value when estimated for assembly municipalities than when estimated for referendum municipalities. Taken together, however, they imply predicted tax functions similar to those illustrated in Fig. 3.

[42] The remaining differences are due to a small number of municipalities that retain some autonomy over schedules and, for the estimations with municipal fixed effects, non-zero correlations between canton-level tax progressivity and the incidence of municipalities that switched fiscal decision-making systems.

Table 3
Estimation results with municipality-level fixed effects.

Dep. var. = log municipal personal income tax (married, median income)	**Referendum definition**				**Assembly definition**		
	OLS			*2SLS*	*OLS*		*2SLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Smallness (main effect)	−0.004	2.382		2.435	7.882*	1.384***	0.789
	(2.209)	(2.303)		(2.306)	(4.224)	(3.922)	(3.843)
Government objective (μ)	6.659***	6.050**	46.664***	6.123**	42.230*	44.319*	44.514*
	(2.486)	(2.438)	(17.216)	(2.467)	(24.077)	(23.955)	(23.765)
μ* Smallness (interaction effect)	−1.483***	−1.349**		−1.365**	−9.260*	−9.717*	−9.761*
	(0.554)	(0.544)		(0.550)	(5.278)	(5.251)	(5.209)
μ* Area-based smallness (interaction effect)			−10.173***				
			(3.752)				
Neighbors' avg tax rate	0.162***	0.163***	0.163***	0.118***	0.182***	0.180***	0.140***
	(0.046)	(0.048)	(0.048)	(0.046)	(0.037)	(0.036)	(0.036)
Cantonal tax rate	0.274***	0.296***	0.295***	0.306***	0.328***	0.329***	0.337***
	(0.048)	(0.047)	(0.047)	(0.045)	(0.053)	(0.051)	(0.047)
Level of fixed effects	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality	Municipality
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-varying municipal controls	No	Yes	Yes	Yes	No	Yes	Yes
Number of observations	6519	6378	6378	6378	5186	5186	5180
Number of groups (cantons)	365	365	365	365	295	295	295
R^2	0.80	0.81	0.81	0.81	0.82	0.82	0.82
Kleibergen-Paap rank stats				249.15			193.94
Wald test statistic on smallness: main + interaction effect = 0	0.46	0.20		0.21	0.17	0.03	0.02
p-Value	0.50	0.65		0.64	0.68	0.87	0.89

Notes: standard errors in parentheses, clustered at the municipality level. Non-dichotomous variables in natural logs. Time-varying municipal controls included: population, dependency ratio, share of protestants, share of foreigners. 2SLS: neighbors' tax rate instrumented by distance weighted averages of municipal controls. (7) estimated with municipality-level dummies, coefficient on smallness not presented since identified by missing observations.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

5. Conclusions

In "Oates regressions", jurisdictional fragmentation is often found to be associated with lower tax rates. Traditionally, it has been difficult to read a clear interpretation into such results, because a negative partial correlation between fragmentation and tax rates could represent either (second-best efficient) Leviathan taming via horizontal tax competition, or a race to the bottom away from the socially optimal tax rates. This paper offers a theory-driven empirical reassessment of Oates's approach.

We show that the interpretational ambiguity can be overcome when one considers a model of fiscal federalism featuring vertical as well as horizontal tax externalities, and when one can draw on extraneous information on the democratic constraints on tax setting authorities at the sub-federal level. According to the theory, tax-rate reducing competition among jurisdictions with some degree of Leviathan government behavior is welfare improving if, all else equal, competition among more benevolent jurisdictions would have raised equilibrium tax rates.

We employ data on tax setting in Swiss municipalities and cantons for an assessment of this prediction. A sizeable subsample of Swiss municipalities set tax rates by direct-democratic participation of the citizenry, which constrains local executives to behave "benevolently". We find that, for these direct-democratic municipalities, the basic relationship between relative "smallness" and average tax rates is positive: the smaller they are, the higher their tax rates. This is consistent with dominant vertical externalities in a model of tax competition among benevolent jurisdictions in federal systems.

Our central finding is that, other things equal, the relationship between fragmentation and tax rates turns negative (or at least not significantly different from zero) for the municipalities with less direct democracy and more delegated fiscal authority. Hence, we infer in this case that tax rates fall (or at least do not rise) in fragmentation *because* these municipalities offer some scope for Leviathan government behavior. Set against the theory, we can interpret this finding not only as evidence of Leviathan taming via jurisdictional fragmentation but also as a manifestation of welfare-enhancing tax competition.

The flip side of our central finding, of course, is that the significant impact of fragmentation on the taxes of direct-democratic municipalities implies welfare-reducing distortions from (vertical) tax externalities. Coordinated tax setting by benevolent governments remains the first-best policy. However, to the extent that there are constitutional or other limits on the feasibility of direct-democratic participation in sub-federal fiscal policy making, our analysis suggests that the competitive pressures arising from sub-federal jurisdictional fragmentation are likely to be welfare enhancing.

How general is this result? As discussed above, the conditions for beneficial tax competition seem if anything more likely to hold in many other contexts than our Swiss setting. First, most real-world federations (e.g. US states or EU member countries) have considerably smaller sub-federal fiscal shares than Swiss cantons, and thus even greater scope for dominant vertical tax externalities.[43] Second, given the pervasiveness of direct-democratic institutions in Switzerland, most sub-federal governments enjoy considerably greater leeway for revenue maximization than Swiss municipal authorities. Hence,

[43] See also the calculations based on parameters for the US economy by Keen and Kotsogiannis (2002, 367f.), indicating that dominance of vertical externalities among US states is a real possibility.

Table 4
Estimation results for different representative municipal tax rates.

	Dep. var. = log municipal personal income tax (single, median income)					**Dep. var. = log municipal personal income tax (married, high income)**				
	Canton fixed effects			Municipality fixed effects		Canton fixed effects			Municipality fixed effects	
	OLS		*2SLS*	*OLS*	*2SLS*	*OLS*		*2SLS*	*OLS*	*2SLS*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Smallness (main effect)	0.731***	0.388*	0.389*	1.861	1.757	0.730***	0.360	0.360*	1.304	1.249
	(0.135)	(0.216)	(0.212)	(2.456)	(2.467)	(0.130)	(0.215)	(0.211)	(1.913)	(1.915)
Government objective (μ)	3.867***	1.890	1.911*	4.731*	4.762*	3.703***	1.818	1.827	2.064*	2.065*
	(1.088)	(1.126)	(1.102)	(2.495)	(2.506)	(1.073)	(1.144)	(1.118)	(1.138)	(1.133)
μ* Smallness (interaction effect)	−0.842***	−0.402	−0.407*	−1.059*	−1.066*	−0.805***	−0.385	−0.387	−0.461*	−0.462*
	(0.236)	(0.245)	(0.240)	(0.557)	(0.559)	(0.233)	(0.249)	(0.243)	(0.255)	(0.254)
Neighbors' avg tax rate	−0.004	0.008	0.003	0.118***	0.074***	−0.006	0.003	0.001	0.072***	0.057***
	(0.008)	(0.007)	(0.009)	(0.041)	(0.023)	(0.007)	(0.006)	(0.007)	(0.018)	(0.014)
Cantonal tax rate	−0.212	−0.163	−0.164	−0.130*	−0.134*	−0.550**	−0.536**	−0.536**	−0.528***	−0.531***
	(0.283)	(0.301)	(0.294)	(0.069)	(0.069)	(0.230)	(0.249)	(0.243)	(0.064)	(0.064)
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-varying municipal controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Number of observations	6519	6378	6378	6378	6378	6519	6378	6378	6378	6378
Number of groups	22	22	22	365	365	22	22	22	365	365
R^2	0.31	0.39	0.38	0.52	0.52	0.34	0.43	0.43	0.59	0.59
Kleibergen-Paap rank stats			129.37		296.56			486.57		1699.38
Wald test statistic on smallness: main + interaction effect = 0	0.41	0.00	0.01	0.11	0.08	0.18	0.01	0.01	0.19	0.17
p-Value	0.53	0.95	0.94	0.74	0.78	0.67	0.92	0.91	0.66	0.68

Notes: government objective according to referendum definition. Standard errors in parentheses, clustered at the level of the fixed effects. Non-dichotomous variables in natural logs. Time-varying municipal controls included: population, dependency ratio, share of protestants, share of foreigners. 2SLS: neighbors' tax rate instrumented by distance-weighted averages of municipal controls.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

there is reason to expect even greater scope for Leviathan-taming tax competition in other federations.

Could this extrapolation from our data set be tested empirically? The critical component is observable differences in institutional constraints at the sub-federal level. Although the extent of sub-national institutional diversity observed in Switzerland may well be unique in the world, empirically exploitable variation exists in other federations as well. Romer and Rosenthal (1982), and Farnham (1990), for example, have exploited differences in the availability of citizens' initiatives at the level of US communities in a studies of local expenditure levels. As an alternative, one might use the closeness of local election results as an inverse proxy for the latitude local politicians enjoy to make decisions that diverge from the median voter's preferences. Such an approach finds support in the results found by Besley and Case (2003) and Besley et al. (2010), whereby stronger party competition in US state legislatures yield lower tax burdens; and in those obtained by List and Sturm (2006), according to which more narrowly elected state governors try harder to satisfy the preferences (in terms of environmental spending) of their electorate.

There are some evident limits to the generality of our study. By adopting a representative-agent framework with a single tax base, our analysis has abstracted from welfare effects arising through Tiebout sorting, through policy interactions concerning multiple tax bases, through expenditure-side inefficiencies such as waste induced by red tape in large centralized bureaucracies, through differential policy responses among jurisdictions of unequal intrinsic attractiveness to the mobile tax base, or through different forms of indirect democracy.[44] Moreover, explicit consideration of horizontal and vertical fiscal transfers might be warranted in alternative empirical settings.

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[44] On the last three effects, see, respectively, Bandiera et al. (2009), Cai and Treisman (2005) and Janeba and Schjelderup (2009).

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