Are incentive effects from fiscal equalization underestimated? Evidence from a Swiss reform

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Abstract

This paper investigates incentive effects of fiscal equalization on local tax rates. I propose three refinements to current empirical estimations of these incentive effects. I show that local policy-makers may conceive changes in equalization transfers as stemming from discrete rather than marginal changes in the tax base, thus considering "supramarginal" equalization rates. Second, I study "effective" equalization rates which condition on the current tax rate. Third, I control for redistribution effects. I investigate the reform of an inter-municipal equalization scheme in Switzerland. My baseline estimate from supramarginal equalization rates is 2-3 times larger than found in previous studies.

JEL-Classification: H71, H77, R51

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1 Introduction

How does fiscal equalization affect the policy incentives facing state and local governments? Delegation of taxing powers to sub-national governments within federations usually comes together with redistribution of fiscal resources. Equalization schemes ensure a sufficient funding for a certain level of public good provision across jurisdictions.

It has been shown that higher equalization rates lead to lower "fiscal effort" and thus higher sub-federal equilibrium tax rates (Baretti, Huber, and Lichtblau 2002; Smart 2007; Buettner 2006; Egger, Köthenbürger, and Smart 2010; among others). The logic behind this result is that, given mobile tax bases, transfers compensating for changes in the local tax base work as subsidies for tax increases. Fiscal equalization has thus been thought of as a corrective device for "race-to-the-bottom" tax competition (Köthenbürger 2002; Bucovetsky and Smart 2006). However, to the extent that sub-federal governments may have Leviathan preferences, resulting equilibrium tax rates could be sub-optimally high (Brülhart and Jametti 2019). In that case, fiscal equalization implies a standard equity-efficiency trade-off as known in many other policy contexts.

In this paper, I propose three refinements to the empirical estimation of incentive effects of fiscal equalization. These refinements suggest that the incentive effects have been underestimated in related analyses. Past estimates of the effect of a 1 percentage-point increase in the equalization rate on local tax rates range from 0.01 to 0.23 percentage-point increases (Egger, Köthenbürger, and Smart 2010; Miyazaki 2020; Buettner and Krause 2020; Buettner 2006). My results show that the relevant incentive effect may be 2-3 times bigger.[1]

The main innovations of this research are the following. First, I show that for measuring the extent of equalization it can be important to consider the implications of discrete changes in jurisdictions' tax bases instead of focusing on marginal changes as done in the literature to date. Indeed, it is natural to conceive of local decision-makers as reasoning in terms of the foregone equalization transfers resulting from a discrete change in their tax base – say by attracting a wealthy family or a profitable firm. Most of the existing literature, however, considers the implications of marginal changes in tax bases. Given that equalization schedules typically feature non-linearities, focusing on equalization rates with respect to marginal changes can conceal the effect of thresholds in equalization schedules that only enter the analysis when discrete changes are considered.[2] I refer to equalization rates for discrete changes in tax bases as "supramarginal" equalization rates.

Second, a policy-relevant measure of equalization rates should not only consider statutory equalization schedules but should also condition on jurisdictions' own tax rates. I refer to this as an "effective" equalization rate: from the point of view of the local policy-maker, the amount of payment or subsidy implied in the equalization scheme should be compared to the change in own tax revenue of the jurisdiction. Take a high-tax and a low-tax locality that both consider lowering their tax rate to attract additional taxpayers. If the statutory equalization rate lies somewhere between the tax rates of those two jurisdictions, only the high-tax locality will have any incentive to lower their

1. I summarise in Appendix A.1 all relevant past estimates of the incentive effect, the empirical settings and variables used.

2. Non-linear equalization schedules can for instance be found in Germany (Egger, Köthenbürger, and Smart 2010), Japan (Miyazaki 2020) or Canada (Smart 2007).

tax rate – the low-tax locality would actually benefit, in fiscal terms, from increasing theirs. Hence, the effective incentive effect of a given statutory equalization rate will depend on jurisdictions' own tax rates. Ignoring this in empirical estimations will unnecessarily mask potentially sizable heterogeneity and thus introduce measurement error.

Third, reforms of equalization schemes that serve to identify incentive effects empirically also have redistribution (i.e. income) effects that need to be accounted for: some changes in transfer volumes tend to be conditional on jurisdictions' characteristics but unconditional on tax bases. In order to isolate incentive effects from shifts in the local budget constraint, changes in the volume of equalization transfers need to be quantified and controlled for. I refer to the variation in equalization amounts as "net equalization transfers". My estimates show that redistribution effects do not impact local tax rates, consistent with Leviathan preferences of local governments.

In order to examine these refinements, I use a quasi-experimental setting allowing me to exploit an exogenous change in equalization rates and transfers and thus estimate plausibly causal effects. My identification strategy relies on the reform of a kinked inter-municipal equalization schedule that naturally creates treated and control municipalities affected or not by a change in the statutory equalization rate. In a second step, I instrument the change in marginal/supramarginal, nominal/effective equalization rates faced by all municipalities and estimate elasticities of municipal tax rates. Compared to past findings, I observe large increases in tax rates for marginal equalization rates (0.08 percentage-points for a 1 percentage-point increase in the equalization rate) and even larger for supramarginal equalization rates (0.25 percentage-points for a 1 percentage-point increase in the equalization rate).[3]

Finally, this is the first academic study of fiscal equalization among municipalities within a Swiss canton. This setting has two main attractive features. One advantage is that municipalities have a single decision variable to set the tax level: a multiplier that is applied to the canton-level tax schedule, with perfect overlap of tax bases. This makes jurisdictions' full tax policy stances quantifiable through a single number. Given that municipal taxes are raised on personal income and wealth as well as on corporate income and capital, changes in the municipal multiplier affect a very broad local tax base. Another advantage of this empirical setting is that Swiss municipalities are small jurisdictions (with a median population of around 1,000 inhabitants). They are thus set in a homogeneous institutional and economic environment, which makes them highly comparable. Figure 1 illustrates the special nature of my empirical setting. Municipal multipliers in Switzerland govern around 50% of their total revenue and approximately 70-80% of their total tax revenue, which is comparable to taxing powers of Canadian provinces (Smart 2007) but much larger than the scope of German municipal business tax rates (Buettner 2006; Egger, Köthenbürger, and Smart 2010), Japanese municipal capital tax rates (Miyazaki 2020) and German state-level tax rates (Baretti, Huber, and Lichtblau 2002; Buettner and Krause 2020).

The impact of equalization rates on tax rates has previously been explored empirically by a number of authors using different specifications of the the equalization rate. One common approach has been to exploit simulations to compute equalization transfers and therefore equalization rates. Baretti, Huber, and Lichtblau (2002) construct marginal equalization rates by taking into

3. These magnitudes are equivalent to elasticities of 0.026 for marginal equalization rates and 0.068 for supramarginal equalization rates.

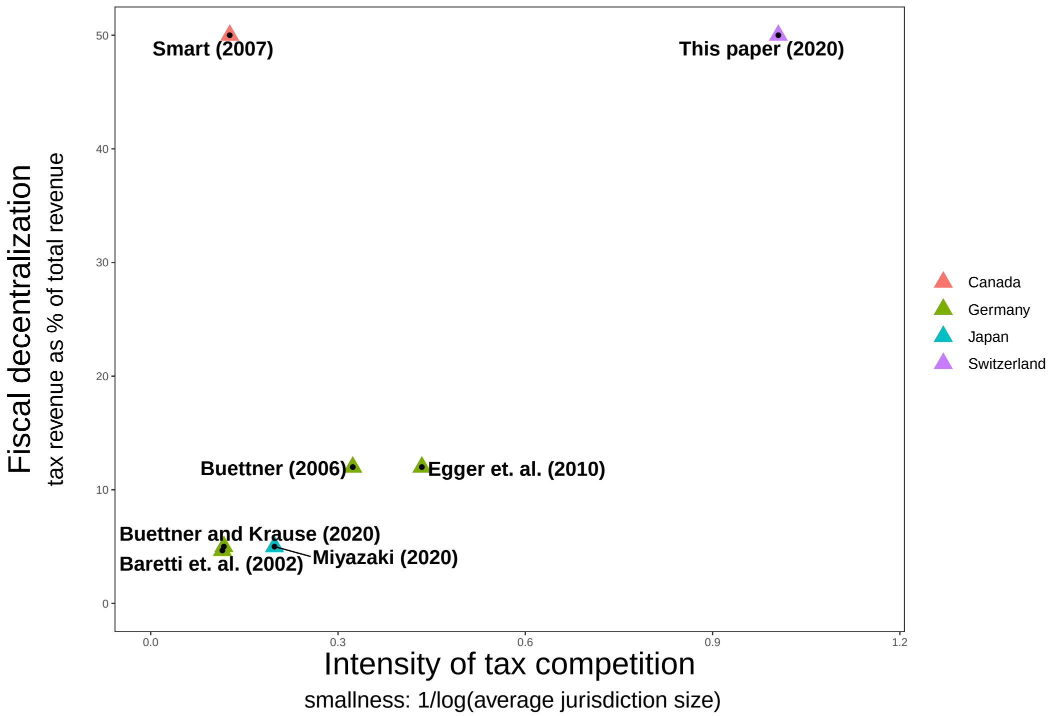

Figure 1: Recently studied empirical settings according to the degree of fiscal decentralization and smallness of jurisdictions. Jurisdiction size is measured using the average population. The relevant tax revenue refers to the tax revenue generated by the tax rate investigated in the paper. Decentralization is constructed as the ratio of the relevant tax revenue to the jurisdictions total revenue (including federal transfers). Jurisdiction sizes, tax and total revenues have been taken either from the papers themselves or from the respective statistical office: for German state level data (Baretti, Huber, and Lichtblau 2002, Buettner and Krause 2020): https://www.destatis.de/DE/Themen/Staat/Oeffentliche-Finanzen/_inhalt.html, for German municipal level data concerning Baden-Württemberg (Buettner 2006): https://www.statistik-bw.de and for Lower-Saxony (Egger, Köthenbürger, and Smart 2010): https://www.statistik.niedersachsen.de/startseite/ , Canadian province level data (Smart 2007): https://www150.statcan.gc.ca and Japanese municipal level information (Miyazaki 2020): https://www.e-stat.go.jp/en.

account vertical and horizontal transfers of the German state-level equalization scheme. The authors show that high marginal equalization rates are correlated with low tax enforcement activity and therefore tax revenue. At the German municipal level, Buettner (2006) proceeds similarly by computing marginal equalization rates based on all types of transfers from and to municipality, state and federal governments. The author finds increases between 0.13 to 0.23 percentage-points in the tax rates as a response to a 1 percentage-point increase in the marginal equalization rate. More recently, Buettner and Krause (2020) use the delegation of taxing powers to German states in order to study the impact of horizontal equalization transfers on tax policy. They simulate a small shock to the tax base in order to compute marginal equalization rates. Their findings suggest that when being able to set their own tax rate, German states react strategically to the marginal equalization rate and increase their real-estate transfer tax by 0.013 percentage-points for a 1 percentage-point increase in the marginal equalization rate.

Another common approach to measure incentive effects has been to use the statutory equalization rate, set by law. Smart (2007) uses a reform in the Canadian States equalization scheme to show that recipient jurisdictions decreased their effective tax rates as a response to a cut in the marginal equalization rate. Canadian provinces are predicted to increase their effective tax rates by 0.14 percentage-points as a response to a 1 percentage-point increase in the marginal equalization rate. Miyazaki (2020) examines the kinked equalization schedule faced by Japanese municipalities to show that higher statutory equalization rates led to implementing additional corporate taxes. Egger, Köthenbürger, and Smart (2010) is the study most closely related to this research. The authors use a reform in the equalization scheme of Lower Saxony (Germany) to measure its impact on municipal business taxes. The authors use a change in statutory equalization rates faced by municipalities below and above a target tax base level. They show a positive causal impact of changes in statutory the equalization rate on local business tax rates. The authors measure increases of 0.04 percentage-points to an increase of 1 percentage-point in the marginal equalization rate. Available pre-reform periods are however not exploited to statistically exclude possible pre-trends that may undermine the results. By working with marginal equalization rates, Egger, Köthenbürger, and Smart (2010) also exclude the possibility that local decision makers optimise assuming discrete changes in the tax base. Given the kinked equalization schedule investigated, this distinction is likely to matter as the true incentive effect may be underestimated.[4]

The remainder of the paper is organized as follows. Section 2 introduces the model. Section 3 details the reform, data and issues concerning endogeneity and identification. Section 4 shows the empirical results and offers a discussion. Section 5 concludes.

2 Fiscal equalization and tax competition

The policy incentives created by fiscal equalization are first analysed using a model of tax competition with jurisdictions varying in population size as in Bucovetsky (1991). Local governments face a tax base equalization scheme with marginal equalization rate α.[5] Using this set-up, I show that the net effect of a small change in the equalization rate on equilibrium tax rates can

4. This issue also applies to Smart (2007) or Miyazaki (2020) who explicitly examine kinked equalization schemes.

5. See Köthenbürger (2002) for a theoretical investigation on tax base versus tax revenue equalization schemes.

be decomposed into the incentive and the redistribution effect.

2.1 Households, capital and local governments

Suppose a federation that is composed of n jurisdictions i, which are in turn composed of many (identical) households. The share of population s_i differs according to jurisdiction i, thus $s_1 > s_2$ for the $n = 2$ case. Identical firms produce output with a strictly concave production function using labour and capital and that exhibits CRS. Each household inelastically supplies one unit of labour L_i, which is the immobile factor. Capital K_i is fully mobile across jurisdictions and fixed at the national level. The production function $F(K_i, L_i)$ can be written in its intensive form $f(k_i)$, where k_i describes the capital-labour ratio for jurisdiction i. The average capital-labour ratio can be described as $\sum_i s_i k_i = k^*$. Capital and labour markets are perfectly competitive. Capital is therefore allocated according to the net-of-tax return.[6] Households in each jurisdiction derive utility from a private good c_i and a public good g_i. Following the literature on tax-competition, I assume a quasilinear-utility form such that the consumer problem is given by

$$\max_{c,g} U_i = c_i + \Gamma(g_i) \tag{1}$$

$$s.t.\ \ c_i = f(k_i) - f'(k_i)k_i + rk^* \tag{2}$$

$$g_i = \tau_i k_i + \alpha \bar{t}(k^* - k_i). \tag{3}$$

Private consumption is paid through wage income $w_i = f(k_i) - f'(k_i)k_i$ and capital income rk^*. Financing of the public good stems from tax revenue $\tau_i k_i$

6. In Appendix A.2, I use the arbitrage condition on capital to show that jurisdictions with larger populations set higher equilibrium taxes in the absence of fiscal equalization.

and equalization transfers from a tax base equalization scheme $\alpha\bar{t}(k^* - k_i)$.[7] Jurisdictions can either be "contributors" or "recipients" of the equalization system according to their relative tax base level. The equalization scheme is moreover characterised by the harmonizing rate $\bar{t}$ and equalization rate α. The harmonizing rate $\bar{t}$ is a unique tax rate applied to tax bases in order to make them comparable. Equalization rate α defines how much of the difference between actual and target harmonized tax base level is received/payed in equalization transfers. Both parameters are set at the federal level.

In this model it is assumed that the local government chooses its tax rate as to maximize the utility of a representative citizen. The optimization problem of jurisdiction i becomes:

$$\max_{\tau_i} W_i = f(k_i) - f'(k_i)k_i + rk^* + \Gamma(\tau_i k_i + \alpha\bar{t}(k^* - k_i)). \tag{4}$$

From this unconstrained maximization problem I get the necessary and sufficient first-order condition:

$$\underbrace{-f''(k)\frac{\partial k_i}{\partial \tau_i}k_i}_{\frac{\partial c_i}{\partial \tau_i}} + \underbrace{\Gamma_g}_{MRS_i} \underbrace{[k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}]}_{\frac{\partial g_i}{\partial \tau_i}} = 0. \tag{5}$$

Re-arranging equation (5), I get the the "Samuelson Condition" which states that $MRS_i \equiv \Gamma_g = -\frac{\partial c_i}{\partial \tau_i}/\frac{\partial g_i}{\partial \tau_i} \equiv MCPF_i$, where $MCPF_i$ stands for the marginal cost of public funds. Benevolent governments therefore conduct fiscal policy by equating the cost of raising one more unit of public funds to the households' marginal rate of substitution.

7. Note that $\frac{\partial k^*}{\partial \tau_i} = 0$. Since capital is fixed on the national level, the capital outflow for a region increasing taxes and the capital inflow for the other region mitigate and fully compensate each other.

2.2 Changes in the marginal equalization rate

I am interested in how equilibrium tax rates react to an exogenous change of the marginal equalization rate. For that, I use equation (5) in order to derive an explicit expression. This gives the following:

$$\frac{\partial \tau_i}{\partial \alpha} = \Omega^{-1}\Big[\underbrace{-\Gamma_{gg}\bar{t}(k^* - k_i)(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})}_{\text{redistribution effect}} + \underbrace{\Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i}}_{\text{incentive effect}}\Big], \tag{6}$$

where

$$\Omega = -f''(k_i)\Big[\frac{\partial k_i}{\partial \tau_i}\Big]^2 + \Gamma_{gg}(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})^2 + 2\Gamma_g \frac{\partial k_i}{\partial \tau_i} < 0 \tag{7}$$

is the second order condition for the local governments optimization problem. The change in the equalization rate yields two possibly competing effects. On the one hand, the slope of the budget constraint of local governments is affected by the change in α. On the other hand, the level of the budget constraint is affected through an increased volume of equalization transfers due to greater redistribution.[8] The incentive effect is strictly positive, meaning that contributors as well as recipients see their marginal cost of public funds decrease as the marginal equalization rate increases. However, the redistribution effect created by the transfers' volume shift reinforces (mitigates) the incentive effect for equalization contributors (recipients). This is due to the consequent larger redistribution of equalization transfers that impacts negatively the marginal rate of substitution for recipients and positively for contributors. If jurisdiction sizes strongly differ, thereby leading to large equilibrium tax rate discrepancies, the net effect for local governments with very high tax rates can

8. This second effect is first mentioned as the "redistribution effect" in Köthenbürger (2002) and can be interpreted as an income effect shifting up or down the jurisdictions' budget constraint.

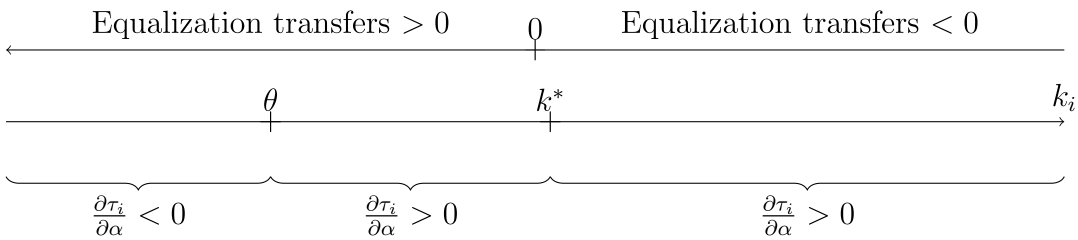

Figure 2: Net effect of a small change in α. θ represents the tax base value at which the income and incentive effect fully offset each-other.

be negative. This is illustrated in Figure 2.[9] The existence of the redistribution effect depends critically on the benevolence assumption. When looking at revenue-maximizing Leviathans, an increase in the marginal equalization rate leads unambiguously to an increase in equilibrium tax rates because the local government does not take into account the agents utility.[10] In the literature, Egger, Köthenbürger, and Smart (2010) or Smart (2007) drop the benevolent assumption in order to focus on the incentive effect of fiscal equalization. Buettner (2006) looks at a similar income effect by investigating grants that are unconditional on the jurisdictions' tax base. In the empirical analysis of this research I test the existence of the redistribution effect by including a variable capturing the variation in equalization transfers.

9. Value θ represents the specific value of k_i where the net effect of a change in the equalization rate equals 0. This threshold moves to the right as α increases because the redistribution effect is strictly increasing in the equalization rate. See a more detailed analysis of the θ threshold in Appendix A.5.

10. I relax the benevolence assumption in Appendix A.4 by allowing a "degree of benevolence" to vary. I show that greater benevolence leads to lower tax-raising incentive effects because the local decision maker takes into account the optimal mix of public and private goods of the representative citizen.

2.3 The effective equalization rate

Recent reports on the German and Swiss equalization systems shed light on the possibility that local governments consider an "effective" equalization rate when making fiscal policy decisions (Burret, Bury, and Feld 2018; Leisibach and Schaltegger 2019). The effective equalization rate is defined as the share of equalization transfers compensating a gain or loss in tax revenue (conditional on the current tax rate). This contrasts with the "nominal" equalization rate understood as the share of transfers compensating changes in the tax base. Formally one can then show that

$$\widetilde{\alpha} = \frac{\bar{t}}{\tau_i}\alpha, \tag{8}$$

where $\widetilde{\alpha}$ is the effective equalization rate. Equation (8) suggests that the effective equalization rate is endogenous given that it is a function of the jurisdiction's tax rate. In the case where the local jurisdictions' tax rate $\tau_i > \bar{t}\alpha$, the incentive would be to lower equilibrium taxes such as to increase the effective equalization rate. In contrast, low-tax jurisdictions, for which $\tau_i < \bar{t}\alpha$ will want to increase theirs.[11] This can be shown formally by replacing the nominal equalization rate by the effective equalization rate of (8) in the local governments budget constraint (equation (3)). Again, I am interested in a small change in the nominal equalization rate α:

$$\begin{aligned} \frac{\partial \tau_i}{\partial \alpha} = \widetilde{\Omega}^{-1}\Big[& \underbrace{-\Gamma_{gg}\frac{\bar{t}^2}{\tau_i}(k^* - k_i)(k_i + (\tau_i - \widetilde{\alpha}\bar{t})\frac{\partial k_i}{\partial \tau_i} - \alpha\frac{\bar{t}^2}{\tau_i^2}(k^* - k_i))}_{\text{redistribution effect}} \\ & + \underbrace{\Gamma_g \frac{\bar{t}^2}{\tau_i^2}(k^* - k_i)}_{\text{effective rate effect}} + \underbrace{\Gamma_g \frac{\bar{t}^2}{\tau_i}\frac{\partial k_i}{\partial \tau_i}}_{\text{incentive effect}} \Big], \end{aligned} \tag{9}$$

11. Recall that in the framework of asymmetric jurisdiction sizes and fiscal equalization, low-tax (high-tax) jurisdictions are contributors (recipients) of the equalization system.

where

$$
\begin{aligned}
\widetilde{\Omega} = & -f''(k_i)\Big[\frac{\partial k_i}{\partial \tau_i}\Big]^2 + \Gamma_{gg}(k_i + (\tau_i - \widetilde{\alpha}\bar{t})\frac{\partial k_i}{\partial \tau_i} - \alpha\frac{\bar{t}^2}{\tau_i^2}(k^* - k_i))^2 + \Gamma_g\frac{\partial k_i}{\partial \tau_i} \\
& + 2\frac{\alpha\bar{t}^2}{\tau^3}(k^* - k_i) + 2\frac{\alpha\bar{t}^2}{\tau^2} < 0
\end{aligned} \tag{10}
$$

is the second order condition of the optimization problem. If jurisdictions optimize over the effective equalization rate, the income and incentive effects are scaled according to the the ratio of actual tax rate and the harmonizing rate. The incentive effect is either mitigated or reinforces by what I call the "effective rate effect", which depends on the harmonized tax base and tax rate of the jurisdiction. Incentive effects are hence exacerbated (diminished) for contributors (recipients) if they consider $\widetilde{\alpha}$ instead of the nominal rate α.

3 Empirical strategy

3.1 Municipal fiscal policy and equalization in the canton Bern

Switzerland is a highly fiscally decentralized country that delegates much of the taxing powers to local governments such as states or municipalities. This federal fiscal architecture comprehends an equalization system between cantons (states), and they in turn implement equalization schemes among their municipalities.[12] In my empirical investigation I look at the canton of Bern, which is the second most populous canton in the country and has the largest number of municipalities. Local governments in Bern enjoy a high level of autonomy in their budget decisions. The cantonal government sets the schedule of income, wealth and corporate tax rates, which is then subject to cantonal,

12. For a detailed description of different municipal equalization systems, see Rühli (2013).

municipal and church multipliers. The relevant tax base of a municipality is thus the personal income, wealth and capital from all households and firms residing in the municipality. Municipal fiscal policy decisions are therefore based on the tax multiplier that is applied to the comprehensive tax base as defined by cantonal law.[13]

Bern's municipal fiscal equalization scheme consists of vertical and horizontal transfers. The former contain canton-municipality cost-sharing payments and transfers unconditional on the municipal tax base. The latter stem from a tax base equalization system designed to reduce the fiscal impact of differential per-capita tax bases across municipalities. The focus of this paper is on incentives created by the horizontal transfers.[14] Equalization transfers function are governed by the following function:

$$T_{i,t}^{FE} = \alpha_{i,t}(\bar{t}k_t^* - \bar{t}k_{i,t}) + \Lambda_{i,t}, \tag{11}$$

where the statutory equalization rate is defined as

$$\alpha_{i,t} = \begin{cases} \alpha, & \text{if } \bar{t}k_{i,t} \geq \bar{t}\hat{k}_t \\ 1, & \text{if } \bar{t}k_{i,t} < \bar{t}\hat{k}_t, \end{cases} \tag{12}$$

and $\Lambda_{i,t}$ represents vertical transfers. The cantonal average tax base k_t^* and municipalities' actual tax base $k_{i,t}$ are computed based on the 3 previous years and multiplied by a unique harmonizing rate $\bar{t}$.[15] Municipalities face a discontinuity in the equalization schedule at $\hat{k}_t$ which is set as a target threshold (called

13. By law, changes in the local tax multiplier must face a compulsory vote by the electorate of the municipality, either through an assembly meeting or a ballot vote.

14. In Appendix A.3, I explore the impact of an exogenous change in the vertical transfers on equilibrium tax rates. This analysis is analogous to the effect of virtual grants on equilibrium tax rates studied by Buettner (2006).

15. This harmonizing rate is chosen by the cantonal government and is exogenous to municipalities' actual multipliers.

the *Mindestausstattung*) chosen by the upper-level government. For municipalities with tax base levels below the threshold, any small increase (decrease) in the harmonized tax base is fully compensated by a change in equalization transfers. Municipalities above the target face a statutory equalization rate $\alpha \in (0, 1)$ which is decided at the cantonal level by decree. Vertical transfers consist of subsidies to municipalities determined by geographic, social or demographic characteristics and above-average tax-rates. Moreover, municipalities financially co-fund some public-transport, social security and other expenditures decided at the cantonal level through a cost-sharing scheme also contained in $\Lambda_{i,t}$.

3.2 Identification: the reform

To measure the incentive and redistribution effects of fiscal equalization I exploit a reform in the municipal equalization schedule of the canton Bern. In 2012, cantonal authorities decided to increase of the statutory equalization rate α, the target harmonized tax base threshold $\hat{k}_t$ and to decrease the harmonizing rate $\bar{t}$. The reform of the equalization schedule is illustrated in figure 3. The statutory equalization rate was raised from 0.25 to 0.37 and the target threshold $\bar{t}\hat{k}_t$ from 80% to 86%.[16] The unique harmonizing rate $\bar{t}$ was lowered

16. From 2008 on, the cantonal executive branch (with a left-wing majority) expressed concerns that horizontal transfers were not redistributive enough and that vertical transfers set wrong incentives for municipalities, especially with respect to grants conditional on the current municipal multiplier. The cantonal government hence put forward a comprehensive reform of the system that would correct for tax-setting incentives and increase fairness of the system. The cantonal parliament (approx. 51% of right-wing parliamentarians) as well as municipality associations were consulted and largely approved the project. See more details (in German) here.

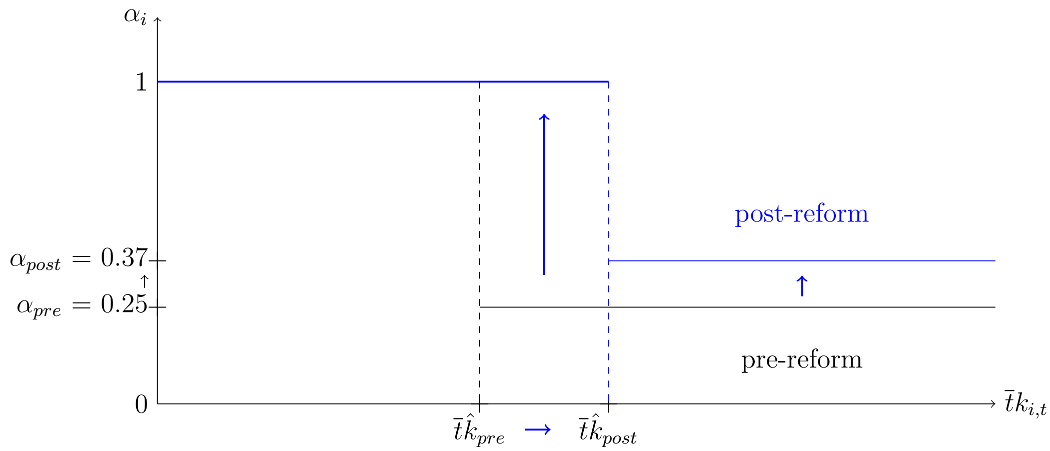

Figure 3: The equalization schedule and its reform. The horizontal axis represents the harmonized tax base and the vertical axis the statutory equalization rate. Cantonal authorities implemented a reform in 2012 by increasing of the statutory equalization rate and the minimum endowment threshold (illustrated in blue).

from 2.4 to 1.65.[17] The reform thus had a differential impact on municipalities according to their per-capita tax base in 2012. Those slightly above the pre-reform target threshold saw their statutory equalization rate increase by 75 percentage points whereas those already above the post-reform target threshold in 2012 observed an increase of only 12 percentage points. The discontinuous structure of the schedule and the nature of the reform naturally delimit groups of municipalities that are differentially affected by changes in their statutory equalization rates. This allows me to define treated and control municipalities respectively as those seeing an increase in their statutory equalization rate and those that did not.[18] I do not take into account municipalities

17. This change impacted the effective rate of municipalities, which depends on the harmonizing rate $\bar{t}$, the current tax multiplier τ_i and the statutory equalization rate α (see equation (8)).

18. As Figure 3 suggests, different treatment intensities could also be incorporated in the analysis. However, municipalities facing the large increase of 75 percentage account for

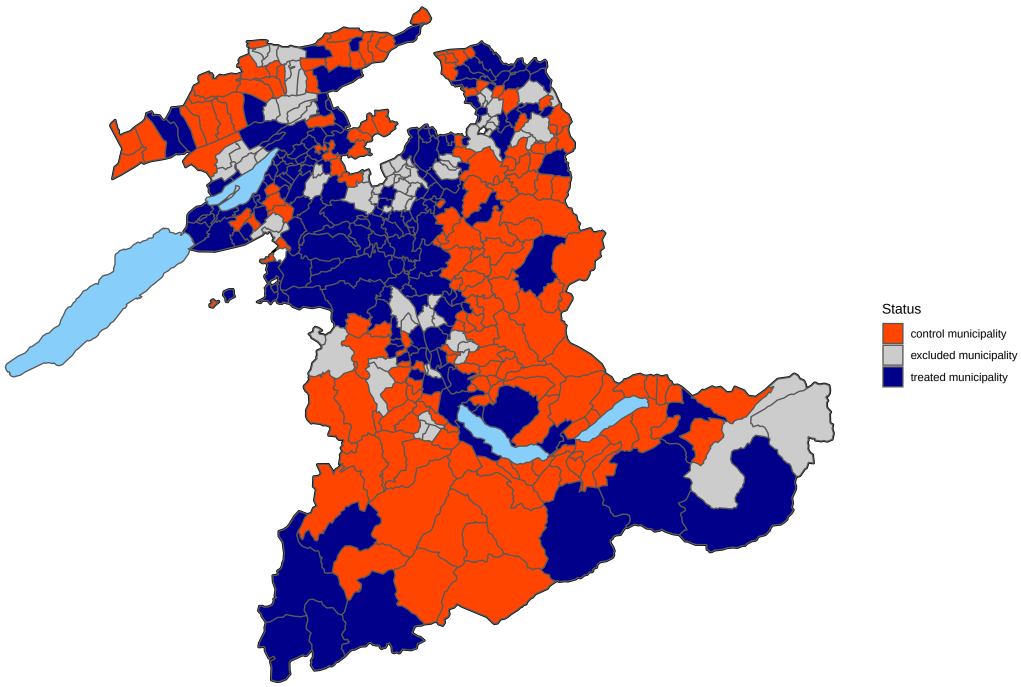

Figure 4: Treatment status of municipalities according to their change in statutory equalization rate in 2012. Grey areas represent municipalities that amalgamated between 2007-2017. Lakes are represented in light blue.

that merged during the 2007-2017 period. A map of the treatment status by municipality is shown in Figure 4.

The reform generated changes in the total volume of horizontal and vertical equalization payments to and from municipalities. In order to replace vertical transfers linked with tax rates, the reform substituted these by transfers that are conditional only on measurable geographic and socio-demographic characteristics. Furthermore, the reform contained a restructuring of the cost-sharing

around 10% of my sample which means a highly imprecise estimation. I therefore consider all municipalities observing an increase in their marginal equalization rate in 2012 as treated.

transfers between municipalities and the canton.[19] The net variation of the horizontal and vertical equalization transfers allows me to measure the budget shift created by the reform and therefore distinguish between incentive and redistribution effects.

The concurrent change in the statutory equalization rate α_i and the harmonizing rate $\bar{t}$ moreover implied a mechanical change in the effective equalization rate $\widetilde{\alpha}_i$ for some municipalities. Keeping tax-multipliers constant, equation (8) tells us that municipalities with no change in their statutory equalization rates (i.e. control municipalities) saw a decrease in their effective equalization rates by -75 percentage-points. The treated municipalities on the other hand saw a limited increase in the effective equalization rate of 1.05 percentage points.

3.3 Econometric approach

In order to measure the incentive and redistribution effects induced by the fiscal equalization reform, my strategy is twofold. I first analyse the gradual difference over time in tax multipliers of treated and control municipalities by implementing a difference-in-difference approach with multiple pre- and post-treatment periods. Second, I quantify the incentive and redistribution effects by using an instrumental variable approach and specifying alternative measures for the equalization rate.

The average treatment effect of the reform is estimated by

$$log(m_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\lambda} + \epsilon_{i,t}, \tag{13}$$

where $m_{i,t}$ is the tax multiplier of municipality i at time t, $D_{i,t}$ is the indicator function taking the value 1 for the treatment group in the post-reform

19. In particular grants for schooling and social security have been reorganized through the reform.

period. The regression contains municipality-level time varying controls $\mathbf{X}_{i,t}$ (net equalization transfers, share of population, net debt, government spending, share of foreigners, relative harmonized revenue, share of right wing votes at the last national election), and a set of fixed effects μ_t, ϕ_i. For robustness I alternatively also include linear municipality and district specific time trends such as to capture differential idiosyncratic trends and momentary shocks at different geographic levels.[20] β_1 measures the average treatment effect.[21] Given the availability of multiple pre- and post- reform years, I also look at the dynamics of the treatment effect on tax multipliers by estimating the following event-study regression in the spirit of Autor (2003):

$$log(m_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t E_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}, \tag{14}$$

where $E_{i,t}$ is an indicator function taking the value 1 for year t and if municipality i is part of the treatment group.[22] I include, as in the difference-in-difference specification, time and municipality level fixed-effects δ_i, ψ_t as well as time varying controls $\mathbf{X}_{i,t}$. This specification allows me to perform pre-trends checks to insure that the two group of municipalities did not have diverging levels in local taxation prior to the reform, and on the other hand to examine

20. Given the heterogeneity of local conditions (topographic notably) and the size of the territory of canton Bern, including district and municipality specific linear time trends capture shifts in local conditions that could explain changes in taxation decisions.

21. Falsification tests are performed in order to test the validity of the identification strategy for this difference-in-difference. I first artificially assign different treatment timings based on pre-reform years. I then address potential concerns that the results would only be driven by contributor municipalities that would increase their tax multipliers following a larger amount of horizontal equalization transfers to pay by assigning the treatment status according to the recipient or contributor status at the time of the reform.

22. Note that I take the last pre-reform period as the reference year.

the progressive response of treated municipalities' multipliers after the reform. In order to settle concerns of selection into treatment for municipalities close to the threshold after the reform, I discard 40 "unstable" municipalities which changed groups in the post-reform period for this approach.

To quantify precisely the incentive and redistribution effects of fiscal equalization, I use variation in the statutory equalization rate $\alpha_{i,t}$ and net equalization transfers $T_{i,t}^{FE}$. Using simulation, I compute alternative measures of the equalization rate along two dimensions according to the following formulas:

$$\alpha_{i,t}^{\text{nominal}} = \frac{\Delta T_{i,t+1}^{H}}{\bar{t}(\Delta k_{i,t})}, \tag{15}$$

$$\alpha_{i,t}^{\text{effective}} = \frac{\Delta T_{i,t+1}^{H}}{\tau_{i,t}(\Delta k_{i,t})}. \tag{16}$$

$T_{i,t+1}^{H}$ are the horizontal equalization transfers after the tax base shock Δ, $\tau_{i,t}$ is the current tax multiplier, $k_{i,t}$ the tax base and $\bar{t}$ the harmonizing rate. On the one hand I vary the magnitude of the shock to the tax base with positive nominal or proportional shocks Δ to the tax base. Small shock magnitudes measure marginal equalization rates, while larger shocks allow to compute "supramarginal" equalization rates.[23] Since the equalization schedule is discontinuous, a large enough shock to the tax base of a municipality located to the left of the target threshold $\bar{t}\hat{k}_t$ in Figure 3 means that it can possibly end up in the right segment of the equalization schedule, hence facing a lower equalization rate after the tax base shock. On the other hand I distinguish nominal and effective equalization rates according to whether the shock is apprehended on the harmonized tax base (nominal equalization rate, equation (15)), or on the tax revenue conditional on the current tax rate (effective equalization rate,

23. The nominal magnitudes correspond to 1CHF (marginal), 1K, 10K, 100K, 500K, 1mio (supramarginal) and the proportional shocks to 0.01ppt (marginal), 0.1ppt, 1ppt, 10ppt, 50ppt, 100ppt (supramarginal).

equation (16)).[24] To estimate the elasticity of tax multipliers to the various equalization rate measures, I borrow an instrumental variable approach from the literature on personal income taxes (Gruber and Saez 2002; Blundell, Duncan, and Meghir 1998 or Buettner and Krause 2020).[25] The procedure consists in constructing counterfactual equalization rates keeping the economic environment constant before and after the reform. For this, I aggregate the data in one pre-reform and one post-reform period.[26] I then construct counterfactual post-reform equalization rates and transfers by keeping constant pre-reform tax bases and tax rates. The panel variation of the counterfactual is then solely due to the rule change and not to changes in variables that may be endogenous to the reform itself. I apply this procedure for all specifications of the equalization rate. The counterfactual equalization rates and transfers are then used as instruments. I estimate the effect of the change in the particular equalization rate and transfers on tax multipliers and government spending

24. These specifications of the equalization rate question the "salience" of the parameter to local policy-makers. Analogously as the "average tax rate" in Chetty, Looney, and Kroft (2009), municipalities may find the supramarginal and/or effective equalization rate more salient than the nominal marginal equalization rate for instance.

25. In this second empirical approach, I do not eliminate the "unstable" municipalities. Instrumenting the variation in the net equalization transfers and equalization rates is hence needed to avoid changes in local taxation that would be due to underlying economic conditions that affect municipalities' tax bases and simultaneously change their position on the equalization schedule.

26. I chose to average over 2007-2011 for the pre-reform period and 2013-2017 for the post-reform period. In Appendix A.12 and A.13 I disaggregate and use separately each post-reform year to estimate gradually the incentive effects.

using

$$\begin{cases} log(m_{i,t}) = \beta_0^1 log(g_{i,t}) + \beta_1^1 \widehat{log(\alpha_{i,t}^{j,\Delta}}) + \beta_2^1 \widehat{T_{i,t}^{FE}} + \mathbf{C}_{i,t}\boldsymbol{\eta^1} + \rho_t + \xi_i + \varepsilon_{i,t}^1 \\ log(g_{i,t}) = \beta_0^2 log(m_{i,t}) + \beta_1^2 \widehat{log(\alpha_{i,t}^{j,\Delta}}) + \beta_2^2 \widehat{T_{i,t}^{FE}} + \mathbf{C}_{i,t}\boldsymbol{\eta^2} + \rho_t + \xi_i + \varepsilon_{i,t}^2, \end{cases} \tag{17}$$

where $m_{i,t}$ is the tax multiplier, $g_{i,t}$ is the per-capita total expenditure, $\widehat{log(\alpha_{i,t}^{j,\Delta}})$ is the instrumented equalization rate with $j \in \{\text{nominal}, \text{effective}\}$ and computed with a shock of magnitude $\Delta \in$ {1CHF, 1K, 10K, 100K, 500K, 1mio, 0.01ppt, 0.1ppt, 1ppt, 10ppt, 50ppt, 100ppt}. $\widehat{T_{i,t}^{FE}}$ are the instrumented net equalization transfers. Time varying controls $\mathbf{C}_{i,t}$ (share of population, net debt, share of foreigners, relative harmonized revenue, share of right wing votes at the last national election) as well as time ρ_t and municipality ξ_i level fixed effects in both equations are included. This estimation method jointly estimates 3SLS regressions by using the fact that their error term is correlated.[27] The coefficient of interest, β_1^1, is the elasticity of the tax multiplier with respect to the equalization rate.

3.4 Data and descriptive statistics

I collect data from the statistical office of the canton Bern which has detailed information on fiscal equalization transfers, tax multipliers and municipal finances. Socio-economic measures at the municipality level are available at the national statistical office. I can draw on a balanced panel data set of 325 municipalities for the years 2007-2017. Within this time period, 44 municipalities of the 395 in 2007 have merged. I exclude such observations completely

27. Since budget decisions imply the simultaneity between spending and taxing decisions, $cor(\varepsilon_{i,t}^1, \varepsilon_{i,t}^2) \neq 0.$ is likely to be verified.

from my sample.[28] The symmetric window around the 2012 revision of the equalization mechanism has been chosen as to minimize measuring potential effects that would relate to the first introduction of the equalization system in 2002.

Table 4 in Appendix A.6 shows summary statistics for my main variables of interest and controls. The upper panel lists the dependent and control variables that are used in my estimations. The bottom panel on shows the nominal and effective equalization rates computed with varying magnitudes. As simulated shocks grow in magnitude, the average equalization rate tends to decrease, which highlights the discontinuous structure of the equalization schedule. Effective equalization rates tend to be, at every shock magnitude, higher than their nominal counterparts. This is explained by average municipal tax multipliers that are lower than the harmonizing rate.[29] Recall that net equalization transfers consists of the sum of vertical and horizontal transfers. As Table 4 shows, the net equalization bill is on average negative, meaning that the average municipality pays more than receives it from the equalization system. This is driven by the vertical transfers $\Lambda_{i,t}$, where municipalities are net debtors to the canton.

28. In the event-study approach, I further restrict the sample by taking out the unstable municipalities that changed treatment status after the reform.

29. Appendices A.7 and A.8 present correlations between marginal and supramarginal equalization rates respectively for nominal and effective rates. These correlation coefficients show how increases in the shock magnitude lead to lower correlation between statutory and the other equalization rates.

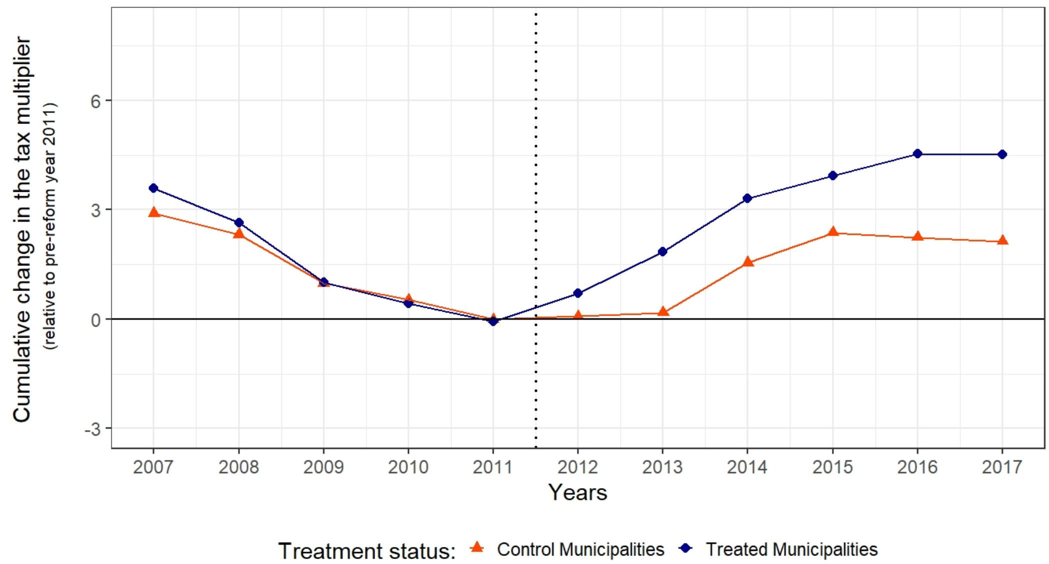

Figure 5: Cumulative change of the municipal tax multiplier. The vertical axis represents the average difference in municipal tax multipliers with respect to 2011. The horizontal axis represent years. A municipality is considered treated if it observed an increase in its statutory equalization rate in 2012. Municipalities which changed treatment status after the reform and those who amalgamated are excluded from the sample.

4 Results

4.1 Event-study analysis

Figure 5 shows the cumulative change in unconditional average tax multipliers with respect to the 2011 level for treated and control municipalities. The treated municipalities gradually adjusted their multipliers following the change in the statutory equalization rate in 2012. There is no evidence of potential pre-trends explaining the post-reform divergence in tax multipliers. Results from the difference-in-difference estimation support this graphical evidence, as coefficients in Table 1, columns (1) and (2) confirm a positive impact of the reform on local tax multipliers for the treated. In columns (3) and (4), I

	Dependent variable			
	$\log(m_{i,t})$			
	(1)	(2)	(3)	(4)
$D_{i,t}$	0.0149	0.0156	0.0126	0.0080
(treated × period)	(0.0080)	(0.0079)	(0.0032)	(0.0043)
Controls	∅	✓	✓	✓
Year FE	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓
District-specific linear time trends	∅	∅	✓	∅
Municipality-specific linear time trends	∅	∅	∅	✓
# of observations	3135	3135	3135	3135

Table 1: Difference-in-Difference results. $D_{i,t}$ is an indicator function taking 1 for treated municipalities in the post-reform period. Controls are time-varying and include net equalization transfers, share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Standard errors are robust and clustered at the municipality level.

add respectively municipality specific and district specific linear time trends as to control for potential differential trends that would be captured by the difference-in-difference estimator. Municipality-level linear time trends considerably reduces the coefficient and slightly diminishes its significance level. This is unsurprising given that municipalities tend to change their taxes slowly over time. The linear municipality level trend may therefore partly capture some of the causal impact of the reform on tax multipliers. Overall, my results suggest that the treated municipalities have increased their tax multipliers on average 1.3% more than the control municipalities as a result of the equalization reform.

Figure 6 shows that in periods prior to the reform, treatment and control municipalities cannot be statistically distinguished. From 2012 on, treated

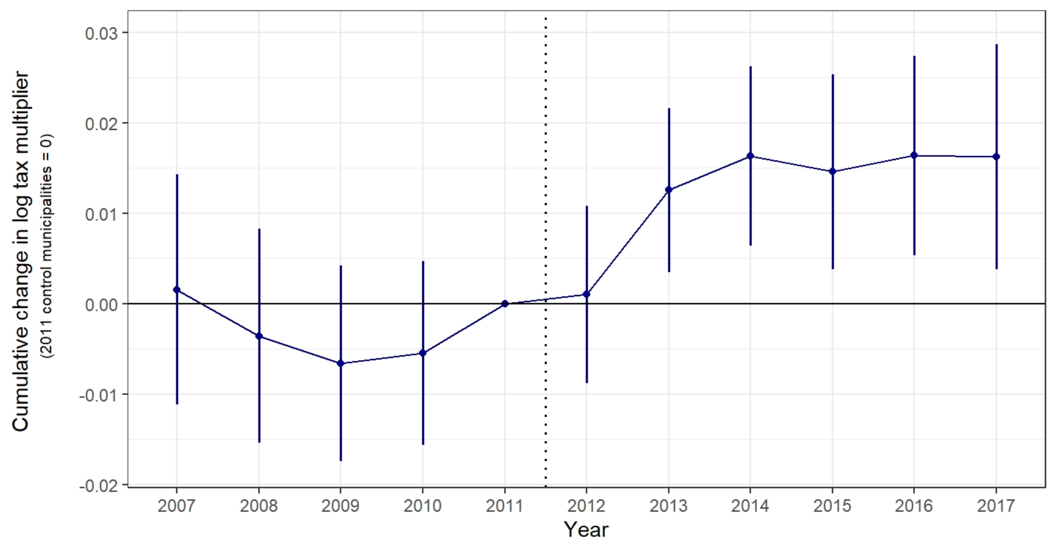

Figure 6: Treatment effect dynamics. This figure displays the coefficients and 90% confidence intervals of treatment-year dummies found in equation (14). The regression includes municipality and year fixed effects and a set of time-varying controls (net equalization transfers, share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right-wing votes at the last national election). 2011 is used as a reference year. Standard errors are clustered at the municipality level. Numerical values and can be found in Appendix A.9.

municipalities have slowly responded to the change in the statutory equalization rate by increasing their tax multipliers. The effect steadies around two years after the reform. The cumulative impact of the reform corresponds to an increase of around 1.6% of treated municipalities' multipliers compared to untreated which is not far from the average treatment effect measured previously.

Robustness of these findings is tested by performing two standard falsification tests: once addressing the timing concern, then the treatment assignment. I first carry out estimation of equation (13) with artificial treatment years 2010, 2009 and 2008 on a sub-sample including only pre-reform years. Results shown in Appendix A.10 do not suggest any divergence between control and treated when changing the reform year. Treatment status is then artificially assigned based on the relative harmonized revenue in 2011 according to the contributor versus recipient dichotomy. Coefficients on the placebo treatment group in Appendix A.11 are close to zero and not statistically significant, which is consistent with the interpretation that results from the event-study approach identify correctly the impact of the change in statutory equalization rate on tax multipliers.

4.2 The elasticity of tax multipliers with respect to equalization rates

With the help of the different specifications of the equalization rate defined in equations (15) and (16), I now look at estimations of the tax elasticities. Table 2 shows the estimates of the impact of statutory, nominal marginal and nominal supramarginal equalization rates on tax multipliers from regression equation (17). Unsurprisingly, equalization rates based on shocks from 1CHF to 1K CHF and 0.01ppt to 1ppt yield similar coefficients as the statutory measure. The coefficient tends to decrease slightly when looking at the 100K or the 10ppt shock which suggests that these measures still capture the change in the marginal equalization rate but with more imprecision. This is confirmed when looking at correlations between statutory and simulation-based equalization rates shown in Appendix A.7, tables 5 and 6 : equalization rates constructed based on 1K-100K and 0.01ppt-10ppt shocks are strongly correlated with the statutory measure. This correlation however decreases with shock magnitude. Supramarginal rates based on larger shocks yield considerably higher and sta-

Dependent variable:	log($m_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Nominal shocks							
log nominal equalization rate	0.026	0.026	0.025	0.021	0.021	0.054	0.068
	(0.011)	(0.011)	(0.011)	(0.012)	(0.015)	(0.020)	(0.024)
Net equalization transfers	−0.026	−0.026	−0.026	−0.025	−0.022	−0.019	−0.016
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)
Shock magnitude	Statutory	+1CHF	+1K	+10K	+100K	+500K	+1mio
Panel B: Proportional shocks							
Log nominal equalization rate	0.026	0.026	0.026	0.025	0.024	0.057	0.070
	(0.011)	(0.011)	(0.011)	(0.012)	(0.014)	(0.021)	(0.024)
Net equalization transfers	−0.026	−0.026	−0.026	−0.025	−0.020	−0.020	−0.017
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Shock magnitude	Statutory	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Controls	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓	✓	✓	✓
# of observations	650	650	650	650	650	650	650

Table 2: Nominal equalization rates 3SLS regressions. Coefficients on log nominal equalization rates can be interpreted as elasticities. Each column in each panel is characterised by a different shock magnitude used in order to compute the equalization rate. Variables are averaged over years 2013-2017 for the post-reform period and over years 2007-2011 for the pre-reform period. Controls include net equalization transfers, share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Every regression is estimated using robust and clustered errors at the municipal level.

tistically significant elasticities reaching the value of 0.07 for 100 percentage-point shocks. Correlation tables in appendix A.7 this time tell another story. Equalization rates based on 500k-1m CHF and 50ppt-100ppt are much less correlated with the statutory measure. Larger coefficients in Table 2 hence highlight the fact that municipalities that did not see any change in their statutory equalization rate may have reacted to changes in their supramarginal

Dependent variable:	$\log(m_{i,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Nominal shocks						
Log effective equalization rate	0.009	0.008	0.001	−0.016	−0.048	−0.135
	(0.012)	(0.012)	(0.013)	(0.017)	(0.029)	(0.043)
Net equalization transfers	−0.026	−0.026	−0.024	−0.022	−0.018	−0.013
	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.020)
Shock magnitude	+1CHF	+1K	+10K	+100K	+500K	+1mio
Panel B: Proportional shocks						
Log effective equalization rate	0.009	0.009	0.006	−0.009	−0.035	−0.077
	(0.012)	(0.012)	(0.013)	(0.015)	(0.028)	(0.037)
Net equalization transfers	−0.026	−0.026	−0.026	−0.022	−0.019	−0.016
	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.021)
Shock magnitude	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Controls	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓	✓	✓
# of observations	650	650	650	650	650	650

Table 3: Effective equalization rates 3SLS regressions. Coefficients on log effective equalization rates can be interpreted as elasticities. Each column in each panel is characterised by a different shock magnitude used in order to compute the equalization rate. Variables are averaged over years 2013-2017 for the post-reform period and over years 2007-2011 for the pre-reform period. Controls include net equalization transfers, share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Every regression is estimated using robust and clustered errors at the municipal level.

equalization rates because they conceive foregone equalization transfers in discrete terms. This suggests that past studies analyzing kinked or discontinuous equalization schedules have underestimated the incentive effects of fiscal equalization by focusing solely on variation in marginal equalization rates.

Looking at the responses of municipal tax multipliers to effective equalization rates in Table 3, I find small positive and even negative coefficients. Recall that the reform induced a large negative impact on effective marginal equalization rate for municipalities whose statutory equalization rate did not change and a limited increase for municipalities who did see an increase. Variation in the effective equalization rate is therefore mainly driven by control municipalities. As my theoretical findings in Section 2.3 highlight, recipients and high-tax jurisdictions have less incentive to increase tax rates and may even respond by decreasing taxes as to keep the effective equalization rate high. Empirical results from Table 3 confirm this. When using larger shocks on tax bases, the effect becomes even significantly negative which is consistent with the offsetting force of the "effective rate effect" in equation (9). If decision-makers consider the effective equalization rate, increasing the tax rate makes equalization transfers smaller in proportion to tax revenue. Worse-off recipient municipalities may have the incentive to decrease the tax rate as to rely more heavily on equalization transfers compared to their own tax revenues. Given that the reform entailed variation mostly for the recipient municipalities, the small positive or even negative coefficients in Table 3 are consistent with the theoretical prediction. This indicates that acknowledging the effective equalization rate may not merely be a theoretical curiosity, but a reality in how local decision-makers conceive fiscal equalization.

Given that the main results shown in Tables 2 and 3 are based on period aggregated data, I perform sensitivity tests regarding the post-reform year selection in Appendix A.12 for nominal equalization rates and Appendix A.13 for effective equalization rates. Similarly to Egger, Köthenbürger, and Smart (2010), I estimate changes in marginal/supramarginal and nominal/effective equalization rates using every post-reform year available. These figures again show the gradual reaction of local governments to the equalization reform. When looking at supramarginal rates, the effect is stronger and suggests a quicker reaction from municipalities.

The theoretical predictions concerning the incentive effect of fiscal equalization are confirmed by the various estimates on equalization rates. Nonetheless, I find no evidence of a redistribution effect. In Tables 2 and 3, the instrumented change in net equalization transfers shows a negative sign but no significance. One conclusion from this observation is that municipalities are revenue maximizers, meaning that the objective function of local governments does not take into account the relative marginal utilities of residents. Appendix A.4 demonstrates that a higher weight put on revenue maximization by jurisdictions is linked to lower redistribution effects. In this case, fiscal equalization might not be efficiency enhancing but rather lead to sub-optimally high taxes.[30]

5 Summary and conclusion

A number of studies to date have shown the existence of the tax raising incentives created by equalization transfers. This study adds to these by investigating three new empirical issues. I firstly distinguish marginal equalization rates (how much does a jurisdiction have to pay in equalization transfers for a small increase in the tax base?) from "supramarginal" equalization rates (how much does a jurisdiction have to pay in equalization transfers for a larger, discrete

30. An alternative explanation for the non-existence of any redistribution effect would be related to the so-called "flypaper effect" (Bailey and Connolly 1998; Dahlberg et al. 2008; Leduc and Wilson 2017). This literature documents empirically and theoretically that change in inter-governmental grants tend to translate into government expenditure but not into tax rates because of the nature of grants is separated by decision makers from other revenue sources (Inman 2008).

increase in the tax base?). This new measure allows me to take into account discontinuities in equalization schedules. The second refinement included in this paper is a measure of the equalization rate which conditions on current tax rates. Local decision-makers may in fact assess equalization transfers with respect to their impact on tax revenues rather than their impact on the tax base. This "effective" equalization rate takes account of the fact that jurisdictions face different incentive effects depending on their current tax rates. Not recognizing this may disregard important heterogeneity in incentives from fiscal equalization. Finally, I document and test the existence of "redistribution effects" linked to changes in total amounts of transfers conditional and unconditional on the tax base.

I use a reform in a Swiss canton's inter-municipal equalization system to estimate incentive and redistribution effects. The reform entailed an increase of the statutory equalization rate for municipalities above a minimum threshold tax base size. I first exploit this by implementing an event-study approach allowing me to look at the dynamics of the response of treated municipalities and verify that any observed effects are not driven by pre-existing trends. Second, I estimate the elasticity of tax multipliers with respect to marginal/supramarginal nominal/effective equalization rates. I instrument equalization rates by constructing counterfactual equalization rates keeping pre-reform tax bases and tax rates constant over time and allowing variation only from the reform itself (in the spirit of Gruber and Saez 2002).

Results show an elasticity of local tax rates with respect to supramarginal equalization rates of 0.070. My baseline estimate of the elasticity of local tax rates with respect to marginal equalization rates is of 0.025. This implies that local policy-makers consider discrete changes in their tax base by attracting businesses for instance and not only marginal increases or decreases. My findings suggest that past studies have underestimated the incentive effects of fiscal equalization on local taxation. My results also demonstrate that the response of tax rates to effective equalization rates ranges from small to negative according to the tax base shock magnitude used to compute the effective equalization rate. Finally, changes in volume of equalization transfers have no discerning effect on local tax rates, which suggests that local governments may take their policy decisions mostly as "revenue maximizers" rather than "utility maximizers".

Whether the observed responses are efficiency and/or equity enhancing depends on the the level of tax competition and the efficient tax rates. Findings in this strand of literature still lack a measure of efficient tax level which could help assess the actual extent to which an equalization system needs reform or not. It is clear that future research must investigate a way to measure efficiency of tax levels. However, results from this study show that incentive effects may be larger than previously estimated and that jurisdictions tend to pursue revenue rather than utility maximization. This suggests that fiscal equalization schemes cannot avoid trading off more equitable distribution of tax revenues across jurisdictions against inefficiently high local tax rates.

References

Autor, David H. 2003. "Outsourcing at will: The contribution of unjust dismissal doctrine to the growth of employment outsourcing." *Journal of labor economics* 21 (1): 1–42.

Bailey, Stephen J, and Stephen Connolly. 1998. "The flypaper effect: Identifying areas for further research." *Public choice* 95 (3-4): 335–361.

Baretti, Christian, Bernd Huber, and Karl Lichtblau. 2002. "A tax on tax revenue: The incentive effects of equalizing transfers: Evidence from Germany." *International Tax and Public Finance* 9 (6): 631–649.

Blundell, Richard, Alan Duncan, and Costas Meghir. 1998. "Estimating labor supply responses using tax reforms." *Econometrica,* 827–861.

Brülhart, Marius, and Mario Jametti. 2019. "Does tax competition tame the Leviathan?" *Journal of Public Economics* 177:104037.

Bucovetsky, Sam. 1991. "Asymmetric tax competition." *Journal of Urban Economics* 30 (2): 167–181.

Bucovetsky, Sam, and Michael Smart. 2006. "The efficiency consequences of local revenue equalization: Tax competition and tax distortions." *Journal of Public Economic Theory* 8 (1): 119–144.

Buettner, Thiess. 2006. "The incentive effect of fiscal equalization transfers on tax policy." *Journal of Public Economics* 90 (3): 477–497.

Buettner, Thiess, and Manuela Krause. 2020. "Fiscal equalization as a driver of tax increases: Empirical evidence from Germany." *International Tax and Public Finance,* 1–23.

Burret, Heiko T, Yannick Bury, and Lars P Feld. 2018. "Grenzabschöpfungsraten im deutschen Finanzausgleich." In *List Forum für Wirtschafts-und Finanzpolitik,* 44:1–22. 1. Springer.

Chetty, Raj, Adam Looney, and Kory Kroft. 2009. "Salience and taxation: Theory and evidence." *American economic review* 99 (4): 1145–77.

Dahlberg, Matz, Eva Mörk, Jørn Rattsø, and Hanna Ågren. 2008. "Using a discontinuous grant rule to identify the effect of grants on local taxes and spending." *Journal of Public Economics* 92 (12): 2320–2335.

Egger, Peter, Marko Köthenbürger, and Michael Smart. 2010. "Do fiscal transfers alleviate business tax competition? Evidence from Germany." *Journal of Public Economics* 94 (3-4): 235–246.

Gruber, Jon, and Emmanuel Saez. 2002. "The elasticity of taxable income: evidence and implications." *Journal of Public Economics* 84 (1): 1–32.

Inman, Robert P. 2008. *The flypaper effect.* Technical report. National Bureau of Economic Research.

Köthenbürger, Marko. 2002. "Tax competition and fiscal equalization." *International Tax and Public Finance* 9 (4): 391–408.

Leduc, Sylvain, and Daniel Wilson. 2017. "Are state governments roadblocks to federal stimulus? Evidence on the flypaper effect of highway grants in the 2009 Recovery Act." *American Economic Journal: Economic Policy* 9 (2): 253–92.

Leisibach, Patrick, and Christoph A Schaltegger. 2019. "Zielkonflikte und Fehlanreize: Eine Analyse der Anreizwirkungen im Schweizer Finanzausgleich." *Perspektiven der Wirtschaftspolitik* 20 (3): 254–280.

Lundqvist, Heléne. 2015. "Granting public or private consumption? Effects of grants on local public spending and income taxes." *International Tax and Public Finance* 22 (1): 41–72.

Miyazaki, Takeshi. 2020. "Intergovernmental fiscal transfers and tax efforts: Regression-discontinuity analysis for Japanese local governments." *Regional Science and Urban Economics,* 103554.

Rühli, Lukas. 2013. *Irrgarten Finanzausgleich: Wege zu mehr Effizienz bei der interkommunalen Solidarität; Kantonsmonitoring 5.* Avenir Suisse.

Smart, Michael. 2007. "Raising taxes through equalization." *Canadian Journal of Economics/Revue canadienne d'économique* 40 (4): 1188–1212.

A Appendix

A.1 Literature: Empirical set-up and estimates

(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Baretti et. al. 2002	DE	Panel	state	tax revenue	1970-1988	nominal marginal	NA (tax-revenue sharing)
Buettner 2006	DE	RDD; FD	mun. (cities)	business tax	1980-2000	nominal marginal	+0.23ppt (RDD) & +0.13ppt (FD)
Smart 2007	CA	IV	state	effective tax rate	1972-2002	nominal marginal	+0.14ppt
Egger et. al. 2010	DE	DiD	mun.	business tax	1994-2004	nominal marginal	+0.04ppt
Buettner and Krause 2020	DE	DiD	state	real estate transfer tax	2006-2017	nominal marginal	+0.013ppt
Miyazaki 2020	JAP	RDD	mun.	effective additional corporate tax	1990-2000	nominal marginal	+ 0.01%
This paper 2021	CH	DiD, 3SLS	mun.	tax multiplier	2007-2017	marginal, vs. supra marginal, nominal vs. effective	nominal marginal: +0.08ppt; nominal supra: +0.25ppt; (effective marginal: +0.012ppt; effective supra: -0.28ppt)

(I): Paper; **(II)**: Country of study; **(III)**: Identification; **(IV)**: Government level ; **(V)**: Dependent variable (tax instrument) ; **(VI)**: Timing ; **(VII)**: Variable of interest (equalization rate measure); **(VIII)**: Incentive effect on tax instrument (for a 1ppt increase in the equalization rate)

A.2 Jurisdiction size and tax base elasticity

Assume full mobility of capital and perfect competitive capital market. The arbitrage condition on the capital market in the 2 jurisdiction case therefore writes:

$$f'(k_1) - \tau_1 = r = f'(k_2) - \tau_2. \tag{18}$$

Assuming that jurisdiction 1 has a larger share of population, $\left|\frac{\partial k_1}{\partial \tau_1}\right| < \left|\frac{\partial k_2}{\partial \tau_2}\right|$. Larger regions will therefore be less sensitive to a small change in the tax rate. With no equalization between jurisdictions, populous jurisdictions therefore set higher equilibrium tax rates.

A.3 Transfers windfall: the effects of a shock on unconditional grants

This paper has mainly focused on the horizontal redistribution component of fiscal equalization. In this brief subsection, I show that adding further transfers (i.e. a "transfer windfall") that are unconditional on the local tax rate leads to local jurisdictions decreasing the equilibrium tax rate. This effect is analogous to the redistribution effect that shown in equations (6) or (9). In order to investigate this "pure" redistribution effect, I add the unconditional transfers parameter Λ_i to the local governments budget constraint. This gives

$$g_i = \tau_i k_i + \alpha \bar{t}(k^* - k_i) + \Lambda_i \tag{19}$$

A increase (decrease) in unconditional transfers Λ_i affects the MRS between the public good and private consumption for the representative citizen. In turn, a local government may respond by decreasing (increasing) the tax rate as to bring back the MRS equal to the marginal cost of public funds such that the Samuelson condition holds. Given that Λ_i is orthogonal from the tax rate or the tax base level , I know that Λ_i is not explicitly included in the first order condition of the government's optimization problem. However, it enters the public good valuation function $\Gamma(.)$ through the financing of g_i. I can thus already guess that any behavioural changes due to an exogenous change in unconditional grants will be channeled through relative marginal utilities between public and private consumption. Therefore, I once again apply the implicit function theorem in order to investigate the effect of a small change in Λ_i. This gives the following for jurisdiction i:

$$\frac{\partial \tau_i}{\partial \Lambda_i} = \frac{-\overbrace{\Big[k_i + \tau_i \frac{\partial k_i}{\partial \tau_i} - \alpha \bar{t} \frac{\partial k_i}{\partial \tau_i}\Big]}^{g_\tau} \overbrace{\frac{\partial \Gamma_g(.)}{\partial \Lambda_i}}^{\frac{\partial MRS_i}{\partial \Lambda_i}}}{\underbrace{-f''(k_i)\Big[\frac{\partial k_i}{\partial \tau_i}\Big]^2 + \Gamma_{gg}(k_i + (\tau_i - \alpha \bar{t})\frac{\partial k_i}{\partial \tau_i})^2 + 2\Gamma_g \frac{\partial k_i}{\partial \tau_i}}_{S.O.C.}}. \tag{20}$$

Simple optimization theory allows me to be sure that the denominator, which is also the second order condition of the maximization problem, is negative. This thus allows me to focus on the sign of the numerator. I firstly assume that g_τ is positive such that a small increase in the local tax rate increases the governments revenue.[31]Turning to the $\frac{\partial \Gamma_g(.)}{\partial \Lambda_i}$ expression, this can be seen as the change in relative marginal utilities when a transfer windfall hits jurisdiction i. Put simply, an increase (decrease) in unconditional grants will unambiguously decrease (increase) the marginal rate of substitution between public and private consumption because of the balanced budget condition. Under these conditions, it is pretty straight forward to show that $\frac{\partial \tau_i}{\partial \Lambda_i} < 0$. The logic behind this is that a positive (negative) change in Λ_i yields a decrease (increase) in the MRS for local jurisdiction i. In turn, the local government will decrease (increase) tax-rates such that the marginal cost of public funds equates the marginal rate of substitution. Overall an increase (decrease) in unconditional grants should thus be translated into higher (lower) public consumption and lower (higher) tax rate in similar magnitude.[32] My empirical results do not show sign of the existence of such redistribution effects on tax rates.

A.4 Varying the "degree of benevolence"

One of the main assumptions of the model described in this study is the benevolence of local governments, meaning that they seek to maximize the representative citizens util-

31. This common assumption insures that local governments do not locate on the downward sloping side of the Laffer-curve.

32. This theoretical finding is often disproven by empirical findings which fail to observe changes in the tax rates and mostly identify 1-to-1 changes in government spending. This observation is commonly named as the "flypaper effect" (see Lundqvist 2015; Leduc and Wilson 2017 or Dahlberg et al. 2008 for causal analysis)

ity. This leads to possible redistribution effects when the volume of equalization transfer changes. I look here at an “in-between” case where local jurisdictions may partly act as revenue-maximizing Leviathans. Let $\gamma \in (0,1)$ represent the degree of benevolence of a given jurisdiction. The maximization problem of the local jurisdiction is then modified as to analyze a case where the local government has a certain degree of benevolence in the sense that it values utility of its citizens and not solely government revenue. This gives the following

$$\max_{\tau_i} \Omega_i = \gamma(f(k_i) - f'(k_i)k_i + rk^* + \Gamma(\tau_i k_i + \alpha\bar{t}(k^* - k_i))) + (1-\gamma)(\tau_i k_i + \alpha\bar{t}(k^* - k_i));$$

The first order condition then writes as

$$\gamma\{-f''(k)\frac{\partial k_i}{\partial \tau_i}k_i + \Gamma_g[k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}]\} + (1-\gamma)\{k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}\} = 0.$$

As before I get the effect of the equalization rate on the local tax rate for region i by applying the implicit function theorem to the first order condition stated above.

$$\frac{\partial \tau_i}{\partial \alpha} = \frac{\gamma(-\Gamma_{gg}\bar{t}(k^* - k_i)(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}) + \Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i}) + (1-\gamma)(\bar{t}\frac{\partial k_i}{\partial \tau_i})}{\gamma(-f''(k_i)\left[\frac{\partial k_i}{\partial \tau_i}\right]^2 + \Gamma_{gg}(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})^2 + 2\Gamma_g\frac{\partial k_i}{\partial \tau_i}) + (1-\gamma)2\frac{\partial k_i}{\partial \tau_i}}$$

It it is therefore straightforward to see that as the benevolence degree tends to 1, we have the classical Welfare maximizing case and when $\gamma \to 0$ we get the pure leviathan case. It is worth mentioning that a higher degree of benevolence means a weaker incentive effect from fiscal equalization because local policy makers will take into account the optimal mix of public and private goods for the representative citizen. Since my empirical results do not show significance in a possible redistribution effect (through the net equalization transfers variable) in tables 2 or 3, I conclude that the benevolence level of local governments must be rather low.

A.5 The θ-threshold

In this subsection, I look at how different parameters may change the net effect of a reform changing the level of the nominal equalization rate α. More precisely I investigate how changes in the equalization rate, jurisdiction size or benevolence level move the threshold level of k_i where the net effect of a small increase in α leads to a decrease in the equilibrium tax rate due to larger redistribution effects than incentive effects.

As I have noted previously, according to how scarce the relative level of tax base is for a certain region, there may be a negative net effect of the equalization rate on the local tax rate. Threshold θ expresses the level of tax base k_i at which the the net effect is null, i.e. where the redistribution effect is perfectly offset by the incentive effect. Let me write this formally for the purely benevolent case as

$$\left.\frac{\partial \tau_i}{\partial \alpha}\right|_{k_i=\theta_i} = \frac{-\Gamma_{gg}\bar{t}(k^* - \theta_i)(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}) + \Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i}}{-f''(\theta_i)\left[\frac{\partial k_i}{\partial \tau_i}\right]^2 + \Gamma_{gg}(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})^2 + 2\Gamma_g \frac{\partial k_i}{\partial \tau_i}} \stackrel{!}{=} 0,$$

$$\Leftrightarrow \underbrace{-\Gamma_{gg}\bar{t}(k^* - \theta_i)(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})}_{\text{redistribution effect } <0} = \underbrace{-\Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i}}_{\text{Incentive effect } >0}.$$

I will henceforth refer to the left hand size (LHS) of the above equation as the "redistribution effect" and the right hand side (RHS) as the "incentive effect". An interesting element of analysis is to investigate how the threshold moves on the k_i space when different variables and parameters move. This allows me to understand why certain relatively poor regions may actually decrease their τ_i when the equalization rate increases and how this proportion increases or decreases. Given that I have many relatively small (but of different sizes) regions, the threshold θ may be interpreted as a measure of the fraction of jurisdiction relying solely on transfers and not on their own fiscal revenues.

Let the solution to the equation above be the function $\theta_i = \theta(\alpha, \gamma_i, s_i)$. I now investigate the effect of these exogenous parameters on the level of θ by slightly perturbing the latter in the above equation and observe how the magnitude of income and incentive effects are affected.

I: $\frac{\partial \theta(\alpha,\gamma_i,s_i)}{\partial \alpha}$: How does the equalization rate shift θ? Let us first lay interest on the redistribution effect. Intuitively, it is increased as the equalization rate directly determines the level of transfers to the recipient. This is confirmed formally by the following expression:

$$\frac{\partial}{\partial \alpha}(-\Gamma_{gg}\bar{t}(k^* - \theta_i)(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})) = -\bar{t}\frac{\partial k_i}{\partial \tau_i} > 0.$$

The way α affects the RHS of the initial equality is less clear as it affects the MRS.

I find that

$$\frac{\partial}{\partial\alpha}(-\Gamma_g\bar{t}\frac{\partial k_i}{\partial\tau_i}) = -\Gamma_{gg}\bar{t}^2\frac{\partial k_i}{\partial\tau_i}(k^*-\theta_i) < 0.$$

Indeed a larger contribution rate around the threshold value θ means that the net effect becomes negative! Since the two effects move in opposite directions, I can say that the threshold moves to the right on the k_i space such that $\frac{\partial\theta(\alpha,\gamma_i,s_i)}{\partial\alpha} > 0$. This means that as α grows, so does the proportion of regions "dependent" on transfers.

II: $\frac{\partial\theta(\alpha,\gamma_i,s_i)}{\partial s_i}$: Let us now focus on the level of fragmentation (i.e. size of the regions). The response of the LHS and the RHS of the holding equality will happen through a change in the sensitivity of the region to changes in local tax rates. Thus, first note that $\frac{\partial|\frac{\partial k_i}{\partial\tau_i}|}{\partial s_i} < 0$, i.e. an increase in size decreases the sensitivity of tax base with respect to the local tax-rate in absolute value. I therefore get the two following results:

$$\frac{\partial}{\partial s_i}\left|-\Gamma_g\bar{t}\frac{\partial k_i}{\partial\tau_i}\right| < 0 \quad \text{and} \quad \frac{\partial}{\partial s_i}\left|-\Gamma_{gg}\bar{t}(k^*-\theta_i)(\theta_i+(\tau_i-\alpha\bar{t})\frac{\partial k_i}{\partial\tau_i})\right| > 0.$$

As the two effects move in opposite directions in this case as well, the threshold shifts to the right. The intuition behind this result is that if a federation is "less fragmented" in the sense that the size of jurisdiction i gets larger in terms of resident population, then the tax bases of these regions become less sensitive to changes in local tax rates. In turn this diminishes the responsiveness of local tax rates to changes in the equalization rate, lessening thereby the incentive effect.

III: $\frac{\partial\theta(\alpha,\gamma_i,s_i)}{\partial\gamma_i}$: I have considered until now only a purely benevolent objective of the government. Let us re-introduce the intermediate case in order to understand how the level of benevolence may affect the threshold. Thus I have that

$$\left.\frac{\partial\tau_i}{\partial\alpha}\right|_{k_i=\theta_i} = \frac{\gamma(-\Gamma_{gg}\bar{t}(k^*-\theta_i)(\theta_i+(\tau_i-\alpha\bar{t})\frac{\partial k_i}{\partial\tau_i})+\Gamma_g\bar{t}\frac{\partial k_i}{\partial\tau_i})+(1-\gamma)(\bar{t}\frac{\partial k_i}{\partial\tau_i})}{\gamma(-f''(\theta_i)\left[\frac{\partial k_i}{\partial\tau_i}\right]^2+\Gamma_{gg}(\theta_i+(\tau_i-\alpha\bar{t})\frac{\partial k_i}{\partial\tau_i})^2+2\Gamma_g\frac{\partial k_i}{\partial\tau_i})+(1-\gamma)2\frac{\partial k_i}{\partial\tau_i}} \stackrel{!}{=} 0$$

$$\Leftrightarrow \underbrace{-\gamma\Gamma_{gg}\bar{t}(k^*-\theta_i)(\theta_i+(\tau_i-\alpha\bar{t})\frac{\partial k_i}{\partial\tau_i})}_{\text{redistribution effect}>0} = \underbrace{-\gamma\Gamma_g\bar{t}\frac{\partial k_i}{\partial\tau_i}}_{\text{Incentive Effect }>0}\ \underbrace{-(1-\gamma)(\bar{t}\frac{\partial k_i}{\partial\tau_i})}_{\text{Leviathan Effect}>0}.$$

Note that the effects taken from the benevolent case are highlighted by the degree of benevolence parameter γ_i and on the RHS I have a new element which depicts the "leviathan effect" which pressures local tax-rates upward. Let us now observe how the threshold moves with the level of benevolence. As for point I. and II., I will observe how the different mitigating effects are influenced by an increase in γ_i and how the θ-threshold adapts. Concerning the redistribution effect, I get the following unambiguous result:

$$\frac{\partial}{\partial \gamma_i}(-\gamma \Gamma_{gg}\bar{t}(k^* - \theta_i)(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})) = -\Gamma_{gg}\bar{t}(k^* - \theta_i)(\theta_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}) > 0.$$

Turning now to the incentive and Leviathan effect, an increase in the degree will on one hand increase the incentive effect of the contribution rate but on the other hand decrease the Leviathan effect. Note that the net effect will depend on the size of the MRS, i.e. Γ_g in my case. This therefore writes as

$$\frac{\partial}{\partial \gamma_i}(-\gamma \Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i} - (1-\gamma)(\bar{t}\frac{\partial k_i}{\partial \tau_i})) = (1 - \Gamma_g)\bar{t}\frac{\partial k_i}{\partial \tau_i} \lesseqgtr 0.$$

In this particular tax competition context, it makes sense to assume that $\Gamma_g > 1$ given that local governments balance budgets and tend to set sub-optimal levels of publicly provided good (given race-to-the-bottom tax competition). [33] Given the assumption that the MRS is larger than unity, the net-effect of the the incentive and Leviathan effect is positive. This leads to the fact that the redistribution effect increases at a faster rate than the RHS given the mitigating influence of the Leviathan effect while increasing γ_i. As a consequence, θ increases. This makes intuitive sense since taking the limit of $\frac{\partial \tau_i}{\partial \alpha}$ as $\gamma_i \to 0$ gives the following result

$$\lim_{\gamma_i \to 0}\left[\frac{\gamma(-\Gamma_{gg}\bar{t}(k^* - k_i)(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i}) + \Gamma_g \bar{t}\frac{\partial k_i}{\partial \tau_i}) + (1-\gamma)(\bar{t}\frac{\partial k_i}{\partial \tau_i})}{\gamma(-f''(k_i)\left[\frac{\partial k_i}{\partial \tau_i}\right]^2 + \Gamma_{gg}(k_i + (\tau_i - \alpha\bar{t})\frac{\partial k_i}{\partial \tau_i})^2 + 2\Gamma_g\frac{\partial k_i}{\partial \tau_i}) + (1-\gamma)2\frac{\partial k_i}{\partial \tau_i}}\right] = \frac{1}{2}\bar{t} > 0,$$

which is unambiguously positive for all jurisdictions, independently of their size and thus of their mobile factor sensitivity (i.e. semi-elasticity of local tax base k_i with respect to τ_i). This implicitly means that in the fully Leviathan case, $\theta_i = 0$. Therefore, my assumption of a MRS larger than one seems to be supported by this result.

33. Relaxing this assumption would lead to say that the public good is *over*-provided. Thus, $\Gamma_g < 1$ and this would lead to a decrease as a net effect of the incentive and leviathan effect. In turn the θ-threshold would need to increase as to keep the equality holding (and would have to decrease more than in the under-provision case given the net-sign of the incentive and leviathan effect) Therefore, even when relaxing the under-provision assumption, the result that $\frac{\partial \theta(\alpha, \gamma_i, s_i)}{\partial \gamma_i} > 0$ is robust.

A.6 Summary Statistics

	N	Mean	St. Dev.	Min	Max
Panel A: Municipal characteristics					
Municipal tax multiplier	3,575	1.707	0.214	0.840	2.280
Net equalization transfers	3,575	−0.819	0.458	−3.072	1.294
Share of foreigners	3,575	8.073	5.980	0.000	33.444
Right-to-center votes at last national election	3,575	63.594	10.908	32.813	93.296
Harmonized relative tax base	3,575	81.653	26.005	24.823	287.704
Treated	3,575	0.503	0.500	0	1
Government spending	3,575	5.461	2.289	2.419	86.617
Net Debt	3,575	−2.294	3.340	−41.560	6.163
Population	3,575	2.704	8.304	0.039	129.829
Panel B: Equalization rates					
Statutory equalization rate	3,575	0.621	0.341	0.250	1
Nominal equalization rates:	-	-	-	-	-
+0.01 ppt. shock	3,575	0.619	0.341	0.250	1
+0.1 ppt. shock	3,575	0.619	0.341	0.250	1
+1 ppt. shock	3,575	0.614	0.339	0.250	1
+10 ppt. shock	3,575	0.572	0.315	0.250	1
+50 ppt. shock	3,575	0.456	0.221	0.250	1
+100 ppt. shock	3,575	0.400	0.151	0.250	1
+1CHF shock	3,575	0.619	0.341	0.250	1
+1K shock	3,575	0.619	0.341	0.250	1
+10K shock	3,575	0.610	0.337	0.250	1
+100K shock	3,575	0.532	0.290	0.250	1
+500K shock	3,575	0.417	0.183	0.250	1
+1mio shock	3,575	0.373	0.117	0.250	1
Effective equalization rates:	-	-	-	-	-
+0.01 ppt. shock	3,575	0.677	0.362	0.267	1.649
+0.1 ppt. shock	3,575	0.677	0.362	0.267	1.649

+1 ppt. shock	3,575	0.672	0.360	0.267	1.649
+10 ppt. shock	3,575	0.625	0.329	0.267	1.649
+50 ppt. shock	3,575	0.500	0.217	0.267	1.453
+100 ppt. shock	3,575	0.442	0.140	0.267	1.379
+1CHF shock	3,575	0.677	0.362	0.267	1.649
+1K shock	3,575	0.677	0.362	0.267	1.649
+10K shock	3,575	0.667	0.355	0.267	1.649
+100K shock	3,575	0.582	0.298	0.267	1.649
+500K shock	3,575	0.458	0.170	0.267	1.335
+1mio shock	3,575	0.413	0.100	0.267	1.119

Table 4: Summary Statistics. In panel A, share of foreigners and right-to-center votes are taken from the Swiss national statistical office. The rest are retrieved from the statistical office from canton Bern. In panel B, statutory equalization rates are computed based on the harmonized tax base level. Nominal and effective marginal and supramarginal equalization rates are then computed using simulation. All monetary variables are in thousands of CHF per-capita. Population is in thousand of inhabitants.

A.7 Nominal marginal and nominal supramarginal equalization rates

Nominal shock	Statutory	1CHF	1k CHF	10k CHF	100k CHF	500k CHF
Statutory						
1 CHF	1.00***					
1k CHF	1.00***	1.00***				
10k CHF	0.98***	0.98***	0.98***			
100k CHF	0.83***	0.83***	0.84***	0.87***		
500k CHF	0.62***	0.62****	0.63***	0.65***	0.83***	
1mio. CHF	0.56***	0.56***	0.57***	0.58***	0.76***	0.96***

Table 5: Correlation matrix of nominal equalization rates computed with fixed shocks of varying magnitudes. Statutory equalization rate is computed according to relative harmonized tax base level. Marginal equalization rates are based on 1CHF shocks on the tax base. Supramarginal equalization rates are computed using 1K, 10k, 100k, 500k and 1mio CHF shocks. Significance corresponds to *p<0.1; **p<0.05; ***p<0.01. # of observations: 3575.

Proportional shock	Statutory	0.01 ppt	0.1 ppt	1 ppt	10 ppt	50 ppt
Statutory						
0.01 ppt	1.00***					
0.1 ppt	1.00***	1.00***				
1 ppt	0.99***	0.99***	0.99***			
10 ppt	0.91***	0.91***	0.91***	0.93***		
50 ppt	0.72***	0.72***	0.72***	0.73***	0.84***	
100 ppt	0.64***	0.64***	0.64***	0.65***	0.75***	0.96***

Table 6: Correlation matrix of nominal equalization rates computed with proportional shocks of varying magnitudes. Statutory equalization rate is computed according to relative harmonized tax base level. Marginal equalization rates are based on 0.01ppt shocks on the tax base. Supramarginal equalization rates are computed using 0.1ppt, 1ppt, 10ppt, 50ppt and 100ppt CHF shocks. Significance corresponds to *p<0.1; **p<0.05; ***p<0.01. # of observations: 3575.

A.8 Effective marginal and effective supramarginal equalization rates

Nominal shock	Statutory	1 CHF	1k CHF	10k CHF	100k CHF	500k CHF
Statutory						
1 CHF	0.91***					
1k CHF	0.91***	1.00***				
10k CHF	0.89***	0.97***	0.98***			
100k CHF	0.75***	0.80***	0.80***	0.84***		
500k CHF	0.50***	0.53***	0.53***	0.56***	0.79***	
1mio. CHF	0.36***	0.41***	0.41***	0.44***	0.66***	0.95***

Table 7: Correlation matrix of effective equalization rates computed with fixed shocks of varying magnitudes. Effective rates are conditioned on current municipal tax multipliers. Statutory equalization rate is computed according to relative harmonized tax base level. Marginal equalization rates are based on 1CHF shocks on the tax base. Supramarginal equalization rates are computed using 1K, 10k, 100k, 500k and 1mio CHF shocks. Significance corresponds to *p<0.1; **p<0.05; ***p<0.01. # of observations: 3575.

Proportional shock	Statutory	0.01 ppt	0.1 ppt	1 ppt	10 ppt	50 ppt
Statutory						
0.01 ppt	0.91***					
0.1 ppt	0.91***	1.00***				
1 ppt	0.90***	0.99***	0.99***			
10 ppt	0.82***	0.90***	0.90***	0.92***		
50 ppt	0.61***	0.67***	0.67***	0.68***	0.81***	
100 ppt	0.49***	0.55***	0.55***	0.57***	0.69***	0.94***

Table 8: Correlation matrix of effective equalization rates computed with proportional shocks of varying magnitudes. Effective rates are conditioned on current municipal tax multipliers. Statutory equalization rate is computed according to relative harmonized tax base level. Marginal equalization rates are based on 0.01ppt shocks on the tax base. Supramarginal equalization rates are computed using 0.1ppt, 1ppt, 10ppt, 50ppt and 100ppt CHF shocks. Significance corresponds to *p<0.1; **p<0.05; ***p<0.01. # of observations: 3575.

A.9 Event-study regression

	Dependent variable
	$\log(m_{i,t})$
$D^T_{i,2007}$	0.002
	(0.008)
$D^T_{i,2008}$	-0.004
	(0.007)
$D^T_{i,2009}$	-0.007
	(0.007)
$D^T_{i,2010}$	-0.006
	(0.006)
$D^T_{i,2012}$	0.001
	(0.006)
$D^T_{i,2013}$	0.013
	(0.006)
$D^T_{i,2014}$	0.016
	(0.006)
$D^T_{i,2015}$	0.015
	(0.007)
$D^T_{i,2016}$	0.016
	(0.007)
$D^T_{i,2017}$	0.016
	(0.008)
Net equalization transfers	-0.039
	(0.008)
Controls	✓
Year FE	✓
Municipality FE	✓
# of observations	3135

Table 9: Treatment effect dynamics. This table gives the β_t coefficients on the regression $log(m_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t E_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}$. Controls $\mathbf{X}_{i,t}$ include share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Standard errors are heteroskedasticity robust and clustered at the municipal level. 2011 is used as reference year.

A.10 Difference-in-difference: placebo year

	Dependent variable					
	$\log(m_{i,t})$					
	(1)	(2)	(3)	(4)	(5)	(6)
$D_{i,t}^{2010}$	0.001	−0.001				
(treated × post-2010)	(0.004)	(0.004)				
$D_{i,t}^{2009}$			−0.001	−0.004		
(treated × post-2009)			(0.005)	(0.005)		
$D_{i,t}^{2008}$					−0.002	−0.006
(treated × post-2008)					(0.005)	(0.005)
Placebo Treatment Year	2010	2010	2009	2009	2008	2008
Controls	∅	✓	∅	✓	∅	✓
Year FE	✓	✓	✓	✓	✓	✓
Municipality FE	✓	✓	✓	✓	✓	✓
# of observations	1425	1425	1425	1425	1425	1425

Table 10: Falsification test: placebo treatment year. Regression $log(m_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t}^T + \mathbf{X}_{i,t}\lambda + \epsilon_{i,t}$ is run on pre-reform years (2007-2011) using 2008, 2009 and 2010 as placebo treatment year. $D_{i,t}^T$ is an indicator function taking 1 for treated municipalities in the post placebo treatment year T. Treatment assignment is unchanged, meaning that municipalities who saw an increase in their statutory equalization rate in 2012 are considered as treated. Control variables include net equalization transfers share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Standard errors are heteroskedasticity robust and clustered at the municipal level.

A.11 Difference-in-difference: placebo status

	Dependent variable	
	$\log(m_{i,t})$	
	(1)	(2)
$D_{i,t}$	-0.001	0.006
(placebo-treated × period)	(0.008)	(0.008)
Controls	∅	✓
Year FE	✓	✓
Municipality FE	✓	✓
# of observations	3135	3135

Table 11: Falsification test: placebo treatment group. Regression $log(m_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t} + \mathbf{X}_{i,t}\lambda + \epsilon_{i,t}$ is run on all years (2007-2017) but with a placebo treatment assignment based on the recipient or contributor status in 2011. $D_{i,t}$ is an indicator function taking 1 for placebo-treated municipalities in the post-reform years. Control variables include net equalization transfers share of population, net debt, government spending, share of foreigners, relative harmonized revenue and share of right wing votes at the last national election. Standard errors are heteroskedasticity robust and clustered at the municipal level.

A.12 Elasticity measures: nominal equalization rates

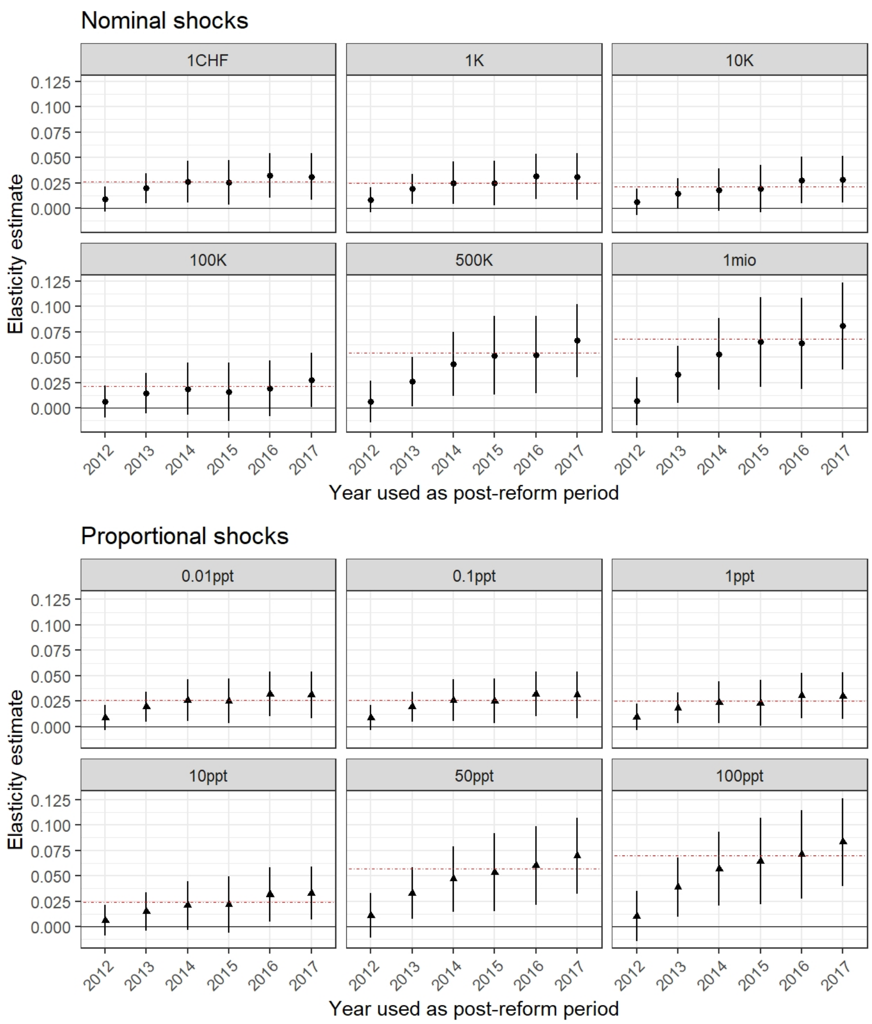

Figure 7: These coefficient plots exhibit elasticity measures on nominal marginal and supra-marginal equalization rates according to year chosen as post-reform period. Variables are averaged over 2007-2011 for the pre-reform period. The coefficient and 90% confidence interval stem from the 3SLS jointly estimating $log(m_{i,t}) = \beta_0^1 log(g_{i,t}) + \beta_1^1 log(\widehat{\alpha_{i,t}^{\text{nominal},\Delta}}) + \beta_2^1 \widehat{T_{i,t}^{FE}} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{1}} + \rho_t + \xi_i + \varepsilon_{i,t}^1$ and $log(g_{i,t}) = \beta_0^2 log(m_{i,t}) + \beta_1^2 log(\widehat{\alpha_{i,t}^{\text{nominal},\Delta}}) + \beta_2^2 \widehat{T_{i,t}^{FE}} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{2}} + \rho_t + \xi_i + \varepsilon_{i,t}^2$. I plot here β_1^1. The equalization rates are instrumented using their respective counterfactual. Red horizontal line represents the estimate using the post-reform period as average over years 2013-2017 (coefficients from Table 2).

A.13 Elasticity measures: effective equalization rates

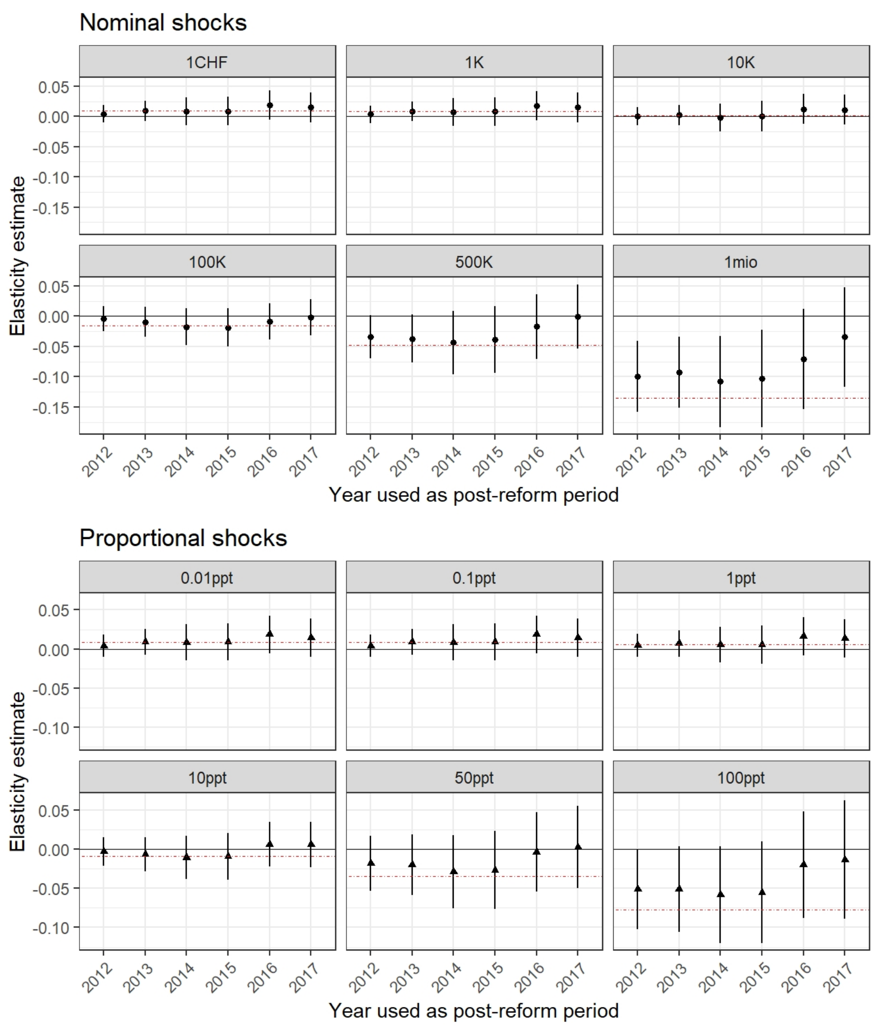

Figure 8: These coefficient plots exhibit elasticity measures on effective marginal and supra-marginal equalization rates according to year chosen as post-reform period. Variables are averaged over 2007-2011 for the pre-reform period. The coefficient and 90% confidence interval stem from the 3SLS jointly estimating $log(m_{i,t}) = \beta_0^1 log(g_{i,t}) + \beta_1^1 log(\widehat{\alpha_{i,t}^{\text{effective},\Delta}}) + \beta_2^1 \widehat{T_{i,t}^{FE}} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{1}} + \rho_t + \xi_i + \varepsilon_{i,t}^1$ and $log(g_{i,t}) = \beta_0^2 log(m_{i,t}) + \beta_1^2 log(\widehat{\alpha_{i,t}^{\text{effective},\Delta}}) + \beta_2^2 \widehat{T_{i,t}^{FE}} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{2}} + \rho_t + \xi_i + \varepsilon_{i,t}^2$. I plot here β_1^1. The equalization rates are instrumented using their respective counterfactual. Red horizontal line represents the estimate using the post-reform period as average over years 2013-2017 (coefficients from Table 3).