Fiscal Equalization Pushes Up Local Tax Rates: Evidence from Switzerland

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Abstract

This paper investigates how fiscal equalization affects local taxes. I study the incentive effect of equalization grants to raise tax rates in the context of a reform of a kinked inter-municipal equalization scheme in Switzerland, where the reform increased the equalization rate and the target fiscal capacity. I study whether the effects of equalization transfers are larger when considering "supramarginal" equalization rates which take into account discrete rather than marginal changes in the tax base. This could affect local tax setting when equalization schedules display kinks or discontinuities. Second, I study the effects of what I call "effective" equalization rates, i.e. changes in equalization grants relative to changes in tax revenue at the current tax rate. My baseline estimate from supramarginal equalization rates is 2-3 times larger than that found in previous comparable studies. I find no effect for effective equalization rates.

Keywords: fiscal equalization; tax competition; equalization rate; fiscal federalism; regional science

JEL: H71, H77, R51

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1. Introduction

How does fiscal equalization affect the policy incentives facing state and local governments? Delegation of spending and taxation responsibilities to sub-central governments often comes with policies aiming at the redistribution of fiscal resources between jurisdictions. Fiscal capacity equalization schemes are typically characterized by transfers decreasing with higher standardized tax revenues, i.e. fiscal capacity. This can distort tax-setting incentives: with mobile tax bases, transfers compensating for changes in the local fiscal capacity 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 might also have Leviathan preferences (Brülhart and Jametti, 2019), the resulting equilibrium tax rates could be sub-optimally high. In that case, fiscal equalization implies a standard equity-efficiency trade-off as known in many other policy contexts. Capturing precisely how and to which extent equalization grants impact taxation incentives is hence crucial.

In this paper, I study the effect of fiscal equalization on local taxation and propose two refinements to the empirical estimation of these incentive effects. My identification strategy relies on the reform of a kinked inter-municipal equalization schedule that naturally creates treated and control municipalities. This allows me to exploit an exogenous change in equalization rates, which measure how transfers change with a change in fiscal capacity, and transfers; I therefore estimate plausibly causal effects. I first examine how the reform impacted local taxes in an 'event-study' setup. In a second step, I quantify the effect of equalization rates on municipal tax rates by proposing two new measures: the "supramarginal" and "effective" equalization rates. The former can be thought of as answering the question *"How much do my equalization transfer payments increase when my fiscal capacity increases by 1 mio. Swiss Francs instead of 1 Swiss Franc?"*. Given that in practice equalization schedules tend to display kinks and discontinuities, this measure may deviate from marginal equalization rates. I compute this measure simulating shocks from 1 to 1 mio. Swiss Francs and from 0.01 to 100 ppt. to the municipalities' fiscal capacity, and then calculating the ensuing change in equalization transfers. The effective equalization rate on the other hand answers the question *"How much do my equalization transfer payments increase relative to my tax revenue for a given change in fiscal capacity?"*. This measurement acknowledges that the incentive effect of equalization grants might also depend on the current tax rate. I calculate this measure using simulation and conditioning on the current local tax rate.

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. I refer to equalization rates for discrete changes in tax bases as supramarginal equalization rates. Indeed, it is natural to conceive of local decision makers as reasoning in terms of discrete potential changes in their tax base – say by attracting a very wealthy family or a profitable firm.[1] Most of the existing literature, however, considers the implications of marginal changes in tax bases. Given that equalization schedules typically feature non-linearities (as in Germany, e.g. Egger et al., 2010, Japan, e.g. Miyazaki, 2020, or Canada, e.g. Smart, 2007), 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.

Second, a policy-relevant measure of equalization rates should not only consider statutory equalization schedules but ought also to 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, any change in transfer amounts through 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 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 mask potentially sizable heterogeneity and thus introduce measurement error.

My empirical results show large responses of tax rates to changes in marginal equalization rates (0.08 percentage points for a 1 percentage-point increase in the equalization rate) and even larger responses to changes in supramarginal equalization rates (0.28 percentage points for a 1 percentage-point increase in the equalization rate).[2] I however do not find statistically significant responses to effective equalization rates. Compared to past findings, my estimates on marginal equalization rates are among the largest and the coefficients on supramarginal rates are one order of magnitude higher than those estimated in the most recent literature.[3]

In their seminal work, Baretti et al. (2002) analyze German states tax policy and show that high marginal equalization rates are correlated with lower tax enforcement activity. When German states acquired the autonomy to set their own real estate transfer tax rate in 2007, incentive effects linked to equalization grants lead to higher taxes as shown by

[1]The idea of lumpy changes in the tax base has been investigated in the foreign direct investment literature, through models of jurisdictions bidding for a large multinational firm (e.g. Black and Hoyt, 1989; Davies and Eckel, 2010).

[2]These magnitudes are equivalent to elasticities of 0.033 for marginal equalization rates and 0.076 for supramarginal equalization rates.

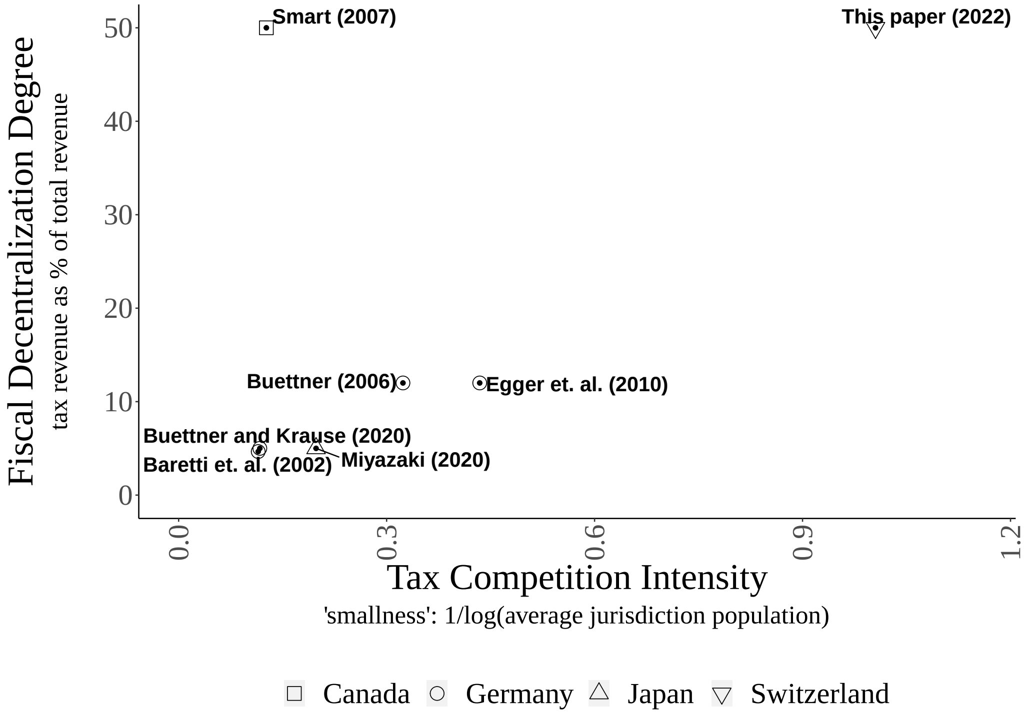
[3]See Table A1 for a concise overview of the point estimates along with details on the empirical set-up and methods in the recent literature.

Buettner and Krause (2020). Their findings suggest that German states reacted 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. Evidence of the incentive effect has also been found in Canadian provinces (Smart, 2007) or Australian territories (Dahlby and Warren, 2003). At the German local level, Buettner (2006) computes a comprehensive marginal "contribution rate" based on horizontal and vertical transfer functions from and to municipalities, 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 consolidated contribution rate. Egger et al. (2010), whose setting is very similar to mine, 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 fiscal capacity level. They show a positive causal impact of changes in statutory the equalization rate on local business tax rates. The authors measure tax responses of 0.04 percentage-points to an increase of 1 percentage-point in the marginal equalization rate. More recently, effects of equalization grants have also been empirically measured on broader fiscal policy aspects. Miyazaki (2020) shows using a regression-discontinuity design that equalization grants also impact taxation decisions on the intensive as well as the extensive margin. The author indeed shows that additional corporate taxes tend to be set in Japanese local jurisdictions facing higher marginal equalization rates. Holm-Hadulla (2020) furthermore provides causal evidence that equalization grants shift German municipal tax structure towards non-distortionary instruments by examining both local property and business taxes. His finding is consistent with local governments focusing on allocative rather than redistributive concerns.

Compared to this existing literature on incentive effects, the institutional framework of this study offers several attractive features. Figure 1 illustrates the special nature of my empirical setting compared to closely related literature. Firstly, one advantage is the large degree of autonomy of Swiss local jurisdictions on their own tax revenues.[4] While the existing literature has shown that various taxes respond to the incentives created by fiscal equalization, the examined tax instruments often generate a small fraction of the jurisdictions' total revenues. One could hence argue that local policy makers might only respond to incentives from equalization grants because only small portions of total budget are affected, and that the incentive effect might not hold if raising taxes has broader consequences on the overall tax bases. In contrast, municipalities in my setting have a single decision variable to set the tax level: a multiplier that is applied to the canton-level tax schedule, with a perfect overlap of tax bases. This makes jurisdictions' full tax policy stance quantifiable through a single number. Given that municipal taxes are raised on

[4]See Brülhart et al. (2015) for a broader comparison of Swiss municipalities' degree of fiscal autonomy at the international level.

Figure 1: Recent literature on the incentive effects of fiscal equalization



Notes: 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 income 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 et al., 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 et al., 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.

personal income and wealth as well as on corporate income and capital, changes in the municipal multiplier affect a very broad local tax base, which makes up most of their tax revenues. Local tax multipliers in Switzerland govern in fact 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 et al., 2010; Holm-Hadulla, 2020), Japanese municipal capital tax rates (Miyazaki, 2020) or German state-level tax rates (Baretti et al., 2002; Buettner and Krause, 2020).

A second advantage of my empirical setting is that Swiss municipalities are small (with a median population of around 1,000 inhabitants). In fact, identifying incentive effects between few largely populated states, such as in studies from Smart (2007) or Buettner and Krause (2020), might reveal to be more complex because of the increased likelihood that policy makers do not behave as price-takers, which relates to the implicit assumption made by most empirical studies that jurisdictions are 'small within a large federation'.[5] In comparison, local jurisdictions in this study are small, thus set in a homogeneous institutional and economic environment which makes them highly comparable and ensures that policy makers behave as price-takers exposed to the pressures of tax competition (Brülhart and Jametti, 2019). To the best of my knowledge, this is the first empirical study to investigate the impact of equalization grants on a fiscal instrument which encompasses a very large portion of total revenues while studying atomistic jurisdictions.

Moreover, this paper studies the reform of a fiscal capacity equalization scheme which displays a specific characteristic: the standardized rate used to compute fiscal capacity is exogenously decided by the upper-level government. This means that I am able to ignore mechanical effects of tax changes on the fiscal capacity measure, which Buettner and Krause (2020) and Dahlby and Warren (2003) refer to as the 'equalization rate effect', and focus on how equalization grants affect local fiscal policy incentives through tax-base mobility. This type of tax-setting incentive is more telling on how policy makers generally respond to fiscal equalization because it is not dependent on a specific institutional set-up.

The remainder of the paper is organized as follows. Section 2 introduces the theoretical framework of this study. 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. Theoretical framework

The policy incentives created by fiscal equalization can be analysed based on the canonical tax competition model of Zodrow and Mieszkowski (1986) and Wilson (1986), in the spirit of Köthenbürger (2002). This model considers a small jurisdiction within a large and fragmented federation. Local governments compete for a mobile factor and face a fiscal capacity equalization scheme with a statutory equalization rate α. Using this set-up, I show that the net effect of a small change in the equalization rate on equilibrium tax rates can be decomposed into an incentive and a redistribution effect.

Suppose a federation that is composed of a large number N of jurisdictions i, which are in turn composed of many (identical) households. Identical firms produce output with a strictly concave production function $F(K_i, L_i)$, using labor L_i and capital K_i, and exhibiting constant returns to scale. Each household inelastically supplies one unit of immobile labor and is endowed with capital $\overline{K}_i$. Capital is fully mobile across jurisdictions and fixed

[5] Köthenbürger (2002) shows that predictions of the incentive effect of fiscal equalization are more ambiguous for large regions than for small jurisdictions, especially when considering the effects of taxes on the representative tax base used to determine whether a jurisdiction is a contributor or recipient. In other words, tax policy decisions from larger jurisdictions are more likely to have general equilibrium effects through the equalization system.

at the national level.[6] The production function can be written in its intensive form $f(k_i)$, where k_i describes the capital-labor ratio for jurisdiction i. The average capital-labor ratio can be described as k^*.[7] Capital and labor markets are perfectly competitive. This ensures that net rates of return are equalized across jurisdictions at rate r. Capital is therefore allocated according to the net-of-tax return, which is embodied in the arbitrage condition $f'(k_i) - \tau_i = r$, where τ_i is the capital tax rate. Jurisdictions are assumed to be too small to affect the economy-wide net return on capital. These assumptions imply that $\frac{dk_i}{d\tau_i} = \frac{1}{f''(k_i)} < 0$.

Households in each jurisdiction derive utility from a private good c_i and a public good g_i. Private consumption is paid through (residual) wage income $w_i = f(k_i) - f'(k_i)k_i$ and capital income rk^*. Public goods are funded by tax revenue $\tau_i k_i$ and by equalization transfers from a tax capacity equalization scheme $\alpha(k^* - k_i)$.[8] Jurisdictions are either "contributors" or "recipients" according to their relative capital-labor ratio. The equalization scheme is characterized by the statutory equalization rate α which defines how much of the difference between actual and target tax base level is received/payed in equalization transfers. This parameter is set at the federal level. Following the literature on tax competition, I assume a quasilinear utility such that the consumer problem is given by

$$\max_{c,g} U_i = c_i + \Gamma(g_i) \tag{2.1}$$

$$s.t.\ \ c_i = f(k_i) - f'(k_i)k_i + rk^* \tag{2.2}$$

$$g_i = \tau_i k_i + \alpha(k^* - k_i). \tag{2.3}$$

The optimization problem of jurisdiction i can be written as

$$\max_{\tau_i} W_i = f(k_i) - f'(k_i)k_i + rk^* + \Gamma(\tau_i k_i + \alpha(k^* - k_i)). \tag{2.4}$$

[6] I follow here the standard set-up of the model which designates the mobile factor as 'capital'. However, this can be interpreted as any type of mobile production factor (Keen and Konrad, 2013). Any mobile tax base can hence be thought of instead of capital and any immobile factor instead of labor (Holm-Hadulla (2020) uses land for instance).

[7] Note that $\frac{\partial k^*}{\partial \tau_i} = 0$ given the small size of jurisdiction i. 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.

[8] In this setting, fiscal capacity is directly measured by the tax base k_i, which makes the fiscal equalization system equivalent to a tax-base equalization scheme. I hence do not integrate a parameter (usually the federation average tax rate) mapping the tax base into fiscal capacity. This better reflects my empirical setting where the standardizing rate is decided by the upper-level government. See Köthenbürger (2002) for a theoretical investigation on tax base versus tax revenue equalization schemes.

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

$$\underbrace{-k_i}_{\frac{\partial c_i}{\partial \tau_i}} + \underbrace{\Gamma_g}_{MRS_i} \underbrace{[k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}]}_{\frac{\partial g_i}{\partial \tau_i}} = 0. \tag{2.5}$$

Re-arranging equation (2.5) yields $MRS_i \equiv \Gamma_g = -\frac{\partial c_i}{\partial \tau_i} / \frac{\partial g_i}{\partial \tau_i} \equiv MCPF_i$, where $MCPF_i$ stands for the marginal cost of public funds. Benevolent governments therefore set the tax rate by equating the cost of raising one more unit of public funds to households' marginal rate of substitution.

2.1 The incentive effect of fiscal equalization

I am interested in how the choice of the local tax rate changes following an exogenous shock to the statutory equalization rate α. For that, I use equation (2.5) in order to derive an explicit expression:

$$\frac{d\tau_i}{d\alpha} = \Omega^{-1}\Big[\underbrace{-\Gamma_{gg}(k^* - k_i)(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i})}_{\text{redistribution effect}} + \underbrace{\Gamma_g \frac{dk_i}{d\tau_i}}_{\text{incentive effect}}\Big], \tag{2.6}$$

where

$$\Omega = -\frac{dk_i}{d\tau_i} + \Gamma_{gg}\Big[k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}\Big]^2 + 2\Gamma_g \frac{dk_i}{d\tau_i} < 0 \tag{2.7}$$

is the second order condition for the local governments' optimization problem. An increase in the equalization rate yields two possibly countervailing effects. On the one hand, the slope of the budget constraint of local governments is affected by the change in α: this designates the "incentive effect" of fiscal equalization. On the other hand, the level of the budget constraint is affected through an increased volume of equalization transfers. I refer to this as the "redistribution effect".[9] 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 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 through the balanced budget constraint.[10]

[9]The redistribution effect was first mentioned in Köthenbürger (2002) and can be interpreted as an income effect shifting the jurisdictions' budget constraint in parallel fashion.

[10]As equation (2.6) suggests, the net effect for local governments can be negative. This is illustrated in Figure B1. See a more detailed analysis in Appendix B. of the effects of a change in the equalization rate on the net effect between the redistribution and incentive effects.

The existence of the redistribution effect depends critically on the benevolence assumption because the parallel shift of the local budget constraint translates into higher (lower) public good consumption for recipients (contributors), and hence a change of the residents' marginal rate of substitution. 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 agents' disutility from higher taxes which impact private consumption.[11] In the literature, Egger et al. (2010) or Smart (2007) choose this approach and drop the benevolent assumption. Buettner (2006) on the other hand integrates parallel shifts of the budget constraint by investigating grants that are unconditional on the jurisdictions' tax base which he calls "virtual grants". In my setting, the income effect created by transfers is linked to more redistribution from contributors to recipients. The increase in transfers affects local taxes in the same way as grants unconditional on the tax base, but the positive or negative change in transfers depends on whether a jurisdiction is contributor or recipient of the equalization system.
In practice, most equalization systems are however characterized by additional grants from upper-level governments that may depend on on local factors directly unrelated to the local tax-base (think of topographic features for instance). A change in these transfers would also yield a shift of the local budget constraint similarly as the redistribution effect. In Appendix B., I show that an exogenous increase in additional vertical transfers lowers the optimal tax rate of a local government. This analysis is analogous to the effect of virtual grants on equilibrium tax rates studied by Buettner (2006). In the empirical analysis of this study I control for income effects created by local budget constraint shifts by including a variable capturing the total variation in equalization transfers from the horizontal equalization mechanism and vertical grants.

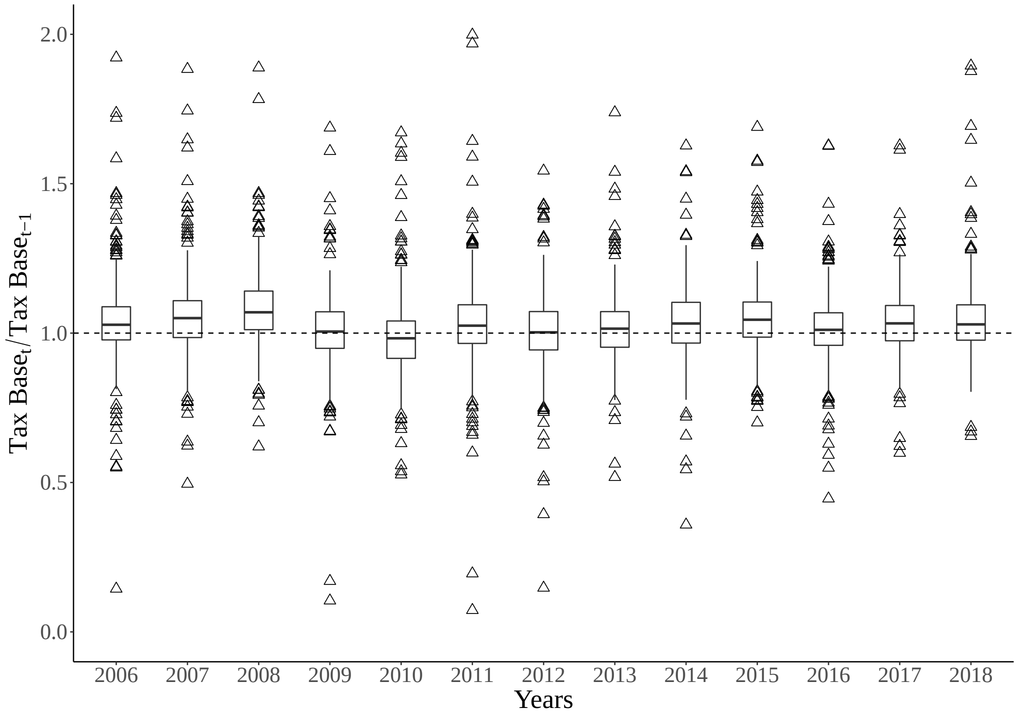
2.2 Supramarginal equalization rates

Changes in the tax base in the above sketched model are supposed to be infinitesimal, meaning that local taxes react and the equalization system adjusts to marginal variations in the tax base. In reality, these changes are created by new incoming households, a firm leaving the jurisdiction or a big inheritance received by a resident for instance. From the point of view of the local policy maker, expected variation in the tax base, and hence in equalization grants, might be discrete. The perceived rate of equalization might therefore only be acknowledged by the local government when considering larger tax base shocks.[12] Using my data on municipalities in the canton (state) Bern, Switzerland, I compute yearly

[11] I relax the benevolence assumption in Appendix B. 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 resident.

[12] This echoes the salience argument in the taxation literature (e.g. Chetty et al., 2009) and is somewhat comparable to individuals' perceptions of marginal vs. average tax rates.

Figure 2: Yearly changes in the local tax base

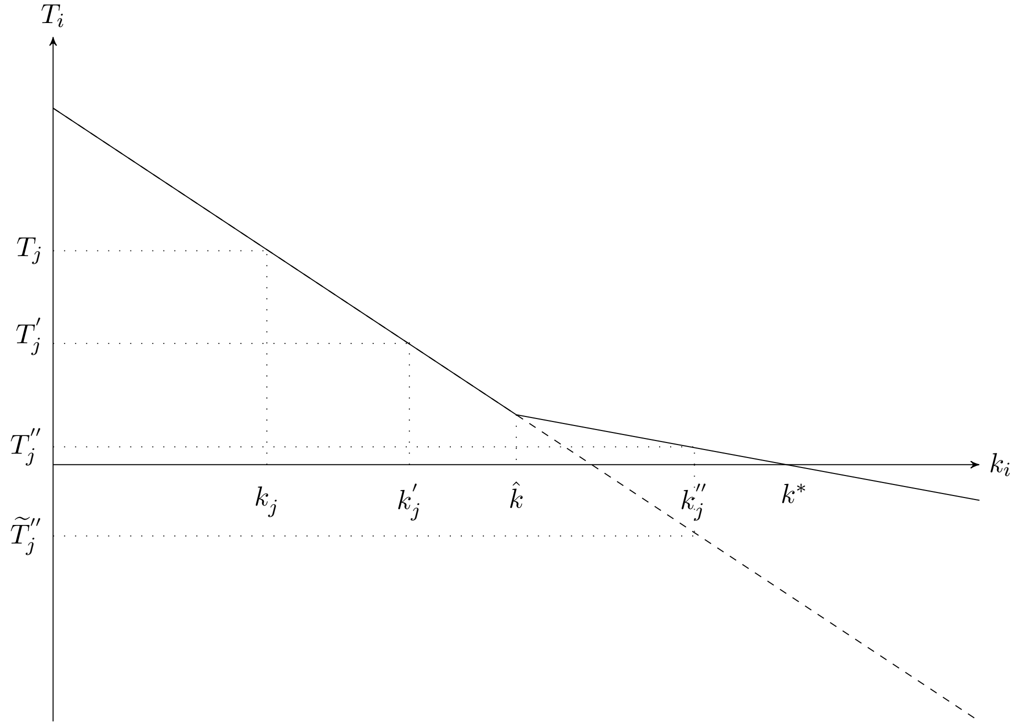


Note: This figure shows the yearly change in the consolidated municipal tax base for years 2005-2018. Triangles above and below correspond to 'outliers' such that their value is larger or smaller than 1.5 times the inter-quartile range. A relative change in the tax base of 1 means that tax base in year t is the same as in year $t-1$.

changes in the local consolidated tax base between 2006 and 2018. This is shown in Figure 2. Although the median yearly evolution in the tax base is small and rather stable, the large number of outliers show that the spread of these changes is actually quite large. It is hence not unusual to have municipalities that sometimes double or reduce by half their tax base from one year to another. Considering larger changes in the tax base might hence be warranted to more precisely capture tax responses to equalization grants.

In the economic literature, Keen and Konrad (2013) recognizes that the Zodrow and Mieszkowski (1986) and Wilson (1986) class of tax competition models interpret capital k_i as a continuous, homogeneous good. However, tax bases can be "lumpy", e.g. local governments bid in order to attract a large multinational plant or firm (see e.g. Black and Hoyt, 1989; Haufler and Wooton, 1999; Kind et al., 2000; Davies, 2005; Davies and Eckel, 2010; Ferrett and Wooton, 2010). The discontinuous nature of variations in a jurisdictions' tax base can be thought of in our framework as shocks of various intensities on the tax base (by attracting a new firm or investment) which in turn impact equalization grants. To see this, let $T_i(k_i) = \alpha(k^* - k_i)$ represent the equalization function observed by jurisdiction i. Totally differentiating and rearranging the equation gives $\alpha = -dT_i/\, dk_i$. The equalization rate can hence be thought in terms of large or small changes in capital dk_i and its corresponding changes in grants dT_i. Drawing from the results of the literature on

Figure 3: Non-linear equalization grants scheme



Note: This figure illustrates a stylized non-linear equalization transfers function. The horizontal axis refers to per-capita fiscal capacity k_i and the vertical axis to the equalization transfers amounts T_i. For jurisdiction j, a small or larger shock on the tax base do not yield the same equalization rate.

FDI, the relevant equalization rate perceived by local policy makers plausibly would not be a marginal equalization rate (i.e. infinitesimally small changes in the tax base) but what I designate as a "supramarginal" equalization rate (i.e. for larger, discrete changes in the tax base). If the equalization schedule is linear, marginal and supramarginal equalization rates are equivalent. If the equalization schedule however displays kinks or discontinuities, these may differ. This distinction is particularly relevant in empirical applications as most equalization transfer functions have non-linearities.

Figure 3 illustrates a stylized non-linear equalization function characterized by a statutory equalization rate which varies with the tax base level k_i (recall that it is equivalent to the fiscal capacity in my setting). Jurisdictions with a tax capacity below k^* receive transfers while those above contribute. Note that the transfer function exhibits a kink at threshold value $\hat{k}$ which is set exogeneously. Let j be a jurisdiction with tax base k_j, receiving amount T_j of transfers. With a small positive increase in the tax base, bringing j to tax base value $k_j^{'}$, jurisdiction j will observe a change of transfers $T_j - T_j^{'}$. For this marginal change in the tax base, the equalization rate can be computed as $\alpha = -(T_j^{'} - T_j)/(k_j^{'} - k_j)$. Now imagine a large shock on the tax base, moving j to $k_j^{''}$. Under a linear equalization scheme, as the dashed line suggests, the equalization rate would be computed as $\tilde{\alpha} = -(\widetilde{T}_j^{''} - T_j)/(k_j^{''} - k_j)$ instead of the actual equalization rate $\alpha = -(T_j^{''} - T_j)/(k_j^{''} - k_j)$. In the empirical application of this paper, I therefore take into account the discrete nature of changes in the tax base by distinguishing between the marginal and supramarginal equalization rate when studying the effect of the reform of a discontinuous equalization scheme on local taxes.

2.3 Effective equalization rates

Recent reports on the German and Swiss equalization systems emphasized the need to not only investigate "nominal" equalization rates, calculated solely based on tax base or capacity variations, but also "effective" equalization rates, which take into account the tax revenue generated by the change in the tax base (Burret et al., 2018; Leisibach and Schaltegger, 2019). The effective equalization rate is defined as $\alpha^e = \alpha/\tau_i = -dT_i/\ \tau_i dk_i$, where τ_i is the local tax rate. The idea behind this measure is that for an increase in the tax base dk_i, local policy makers consider the tax revenue generated by the increase in the tax base minus the foregone equalization transfers due to from the tax base increase. To see this, think of jurisdiction j considering a tax cut in order to attract additional capital. A decrease in the tax rate leads to change in total revenue $-\partial g_i/\partial\tau_i = -k_i - (\tau_i - \alpha)\frac{dk_i}{d\tau_i}$. The tax decrease would mechanically diminish total revenues by $-k_i$, but capital inflows will increase total revenues at rate $\tau_i\frac{dk_i}{d\tau_i}$ and simultaneously decrease equalization transfers at rate $\alpha\frac{dk_i}{d\tau_i}$. Tax setting incentives may thus depend on the current tax rate: if the local tax rate is higher than the nominal equalization rate, a tax-base inflow would generate a net gain in revenue for the municipality whereas for jurisdictions with a tax rate below the nominal equalization rate a tax-base inflow implies a net loss of revenue. Keeping local taxes constant, an increase in the nominal equalization rate means an increase in the effective equalization rate. In turn, an increase in the effective equalization rate means that for a given capital inflow the net revenue gain of total revenue is smaller. I therefore additionally implement the effective equalization rate variable in the econometric analysis in order to capture potential heterogeneous responses to a change in the nominal equalization rate conditional on jurisdictions tax rates.

3. Empirical strategy

3.1 Municipal fiscal policy, capacity equalization and the 2012 reform

Switzerland is a highly fiscally decentralized country that delegates much of its taxing powers to sub-federal governments: cantons and municipalities. This federal fiscal architecture includes an equalization system between cantons (states), and they in turn implement equalization schemes among their municipalities.[13] In my empirical investigation I look at the canton of Bern, which is the second most populous canton and has the

[13]For a detailed description of within-canton equalization systems, see Rühli (2013).

largest number of municipalities with 352 local jurisdictions in 2017. 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. Municipal fiscal policy decisions are then based on the tax multiplier that is applied to the comprehensive tax base and schedule as defined at the canton level.[14]

Bern's municipal fiscal equalization scheme consists of vertical and horizontal transfers. The former contain canton-municipality cost-sharing payments and additional transfers from the canton. The latter stem from a fiscal capacity equalization system designed to reduce the spatial inequalities arising from differential tax base levels across municipalities. In the remainder of this paper, let B_i refer to the fiscal capacity of municipality i. This measure of the revenue raising capacity of a municipality is computed as the total tax base of the jurisdiction multiplied by a standardized tax multiplier that is chosen by the canton.[15] The focus of this paper is on incentives created by the horizontal transfers scheme.

Formally, total equalization transfers for municipality i at time t are governed by the following function:

$$T_{i,t} = \alpha_{i,t}(B_t^* - B_{i,t}) + \Lambda_{i,t}, \tag{3.1}$$

where the statutory equalization rate is defined as

$$\alpha_{i,t} = \begin{cases} \alpha, & \text{if } B_{i,t} \geq \lambda B_t^* \\ 1, & \text{if } B_{i,t} < \lambda B_t^*, \end{cases} \tag{3.2}$$

and $\Lambda_{i,t}$ represents vertical transfers between the canton and the municipality. Tax capacity $B_{i,t}$ is computed as $B_{i,t} = \overline{\omega} k_{i,t}$, where $\overline{\omega}$ is the unique standardizing multiplier and $k_{i,t}$ the comprehensive tax base of municipality i averaged over the three previous years. $B_t^* = \overline{\omega} k_t^*$ is the cantonal average tax capacity. Municipalities face a discontinuity in the equalization schedule at λB_t^*, where $\lambda \in [0, 1]$. The fraction λ determines the target threshold (called the *Mindestausstattung*) under which local jurisdictions face full equalization through additional transfers from the canton. For municipalities with tax capacity levels below the threshold, any small change in the harmonized tax capacity is fully compensated by a change in equalization transfers ($\alpha = 1$). Municipalities above the target face a statutory equalization rate $\alpha \in [0, 1]$ which is decided at the cantonal level by decree. Municipalities co-fund some public-transport, social security and other expenditures decided at the cantonal level through a cost-sharing scheme. Additional

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

[15] This harmonizing multiplier is set by decree from the cantonal government, who computes it as a weighted average of the local tax multipliers. Since the first implementation of the equalization system in 2002, this standardized tax multiplier has changed only in the 2012.

vertical transfers consist of subsidies to municipalities determined by various municipal characteristics. Appendix C. lists all transfer categories included in $\Lambda_{i,t}$ both before and after the reform.

In 2012, cantonal authorities decided to increase of the statutory equalization rate α and the target threshold coefficient λ, and to decrease the standardized tax multiplier.[16] This reform is illustrated in Figure 4, keeping the average tax capacity constant. The statutory equalization rate was raised from 0.25 to 0.37 and the target threshold parameter λ from 80% to 86%. The unique harmonizing multiplier was lowered from 2.4 to 1.65.[17] The reform additionally entailed permanent changes in vertical transfers and the cost-sharing scheme included in $\Lambda_{i,t}$. The reform contained a restructuring of cost-sharing transfers between municipalities and the canton.[18] Furthermore, the new equalization system removed a category of vertical transfers that were partially conditional on the tax multiplier and replaced them with grants relying only on measurable geographic and socio-demographic characteristics. I discuss potential confounding issues of the reform in the following subsection.

3.2 Identification strategy

I use the 2011-2012 change in faced statutory equalization rates to define treatment groups. A municipality is labeled as treated if it observed a change in statutory equalization rate between 2011 and 2012. Those with fiscal capacity slightly above the pre-reform target threshold in 2011 saw their statutory equalization rate increase by 75 percentage points whereas those already above the post-reform target threshold observed an increase of 12 percentage points. Those below the 2011 target fiscal capacity level did not see any change in their statutory equalization rate.[19] A map of the treatment status by municipality is

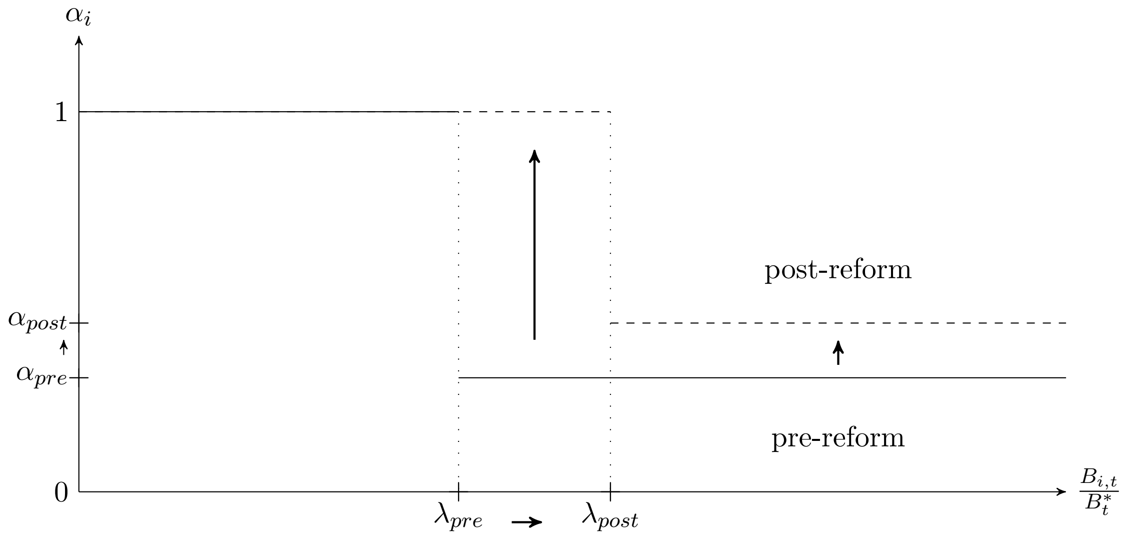
[16] From 2008 on, the cantonal executive branch (with a left-of-center majority) expressed concerns that horizontal transfers were not redistributive enough and that vertical transfers set wrong incentives for municipalities, especially with respect to grants conditional on the current municipal multiplier. 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-of-center parliamentarians) as well as municipality associations were consulted and largely approved the project.

[17] Note that the standard multiplier affects fiscal capacity measures $B_{i,t}$ of all jurisdictions the same way. All else being equal, a change in $\overline{\omega}$ does not affect the ranking of municipalities since it shifts the average fiscal capacity B_t^* as well. Therefore, had the reform been only a change in the standardized multiplier, only transfer amounts would have been affected and not whether a municipality is above or below the target level.

[18] In particular grants for schooling and social security have been reorganized through the reform. See Appendix C. for more details

[19] As Figure 4 suggests, the treated could be separated into a "High-treatment" intensity (increase of 0.75 percentage points) and a "Low-treatment" intensity (increase of 0.12 percentage points). As the high-

Figure 4: The equalization schedule in Bern and the 2012 reform



Note: The horizontal axis represents the municipal tax capacity relative to the cantonal average. The vertical axis shows the corresponding statutory equalization rate. Cantonal authorities implemented a reform in 2012 by increasing of the statutory equalization rate and the minimum endowment threshold. Full lines represent the pre-reform schedule, dashed lines the post-reform schedule.

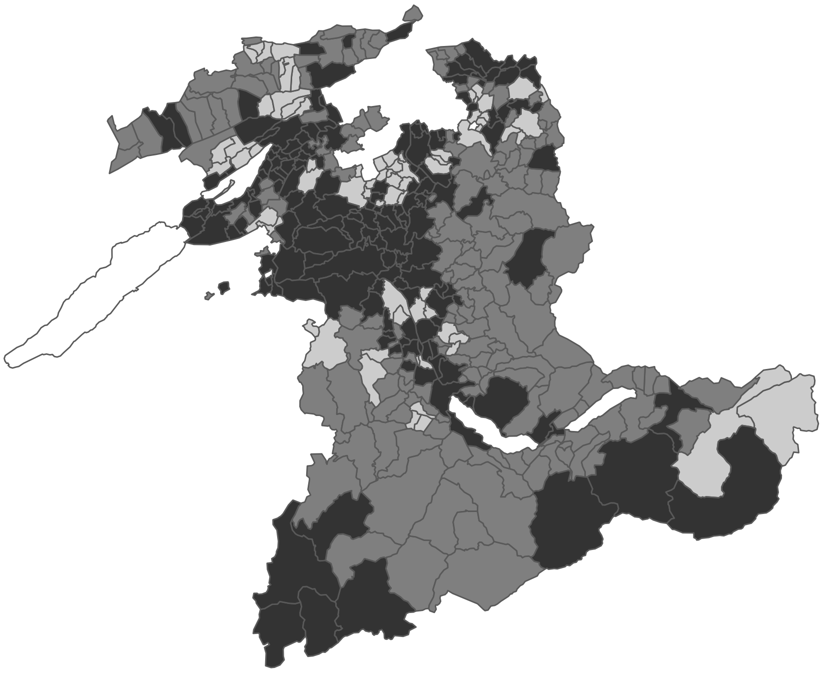
shown in Figure 5.

Trough the change in the statutory equalization rate and the standardized multiplier, the reform also impacted effective equalization rates. Since $B_{i,t}$ is defined here as the tax capacity of a municipality, the effective equalization rate can be written as $\alpha_i^e = \frac{\overline{\omega}}{\tau_i}\frac{dT^{FE}}{dB_{i,t}} = \frac{\overline{\omega}}{\tau_i}\alpha_i$. The concurrent change in the statutory equalization rate α_i and the harmonizing rate therefore both affected the effective equalization rate α_i^e for some municipalities. Keeping tax multipliers constant, local governments either saw a decrease in their effective equalization rates by -75 percentage-points or an increase 1.05 percentage points. When examining these effective equalization rates, I hence do not compare a control and treated group but estimate average causal responses to a change in the 'dosage' of the treatment (Angrist and Imbens, 1995; Callaway et al., 2021). The assumptions related to this type of analysis are discussed in Subsection 3.4 .

Several concerns might arise concerning the causal identification of the incentive effect using this reform. First, changes in the equalization rate might also be due to endogenous changes in the tax base, which in turn affects the fiscal capacity measure at hence might explain the change in equalization rate, including between 2011 and 2012. As Figure D1 illustrates, the jurisdictions' relative fiscal capacity changed little right before and after the reform. This is partly due to the fact that fiscal capacity measures are computed based on three years averages. A large persistent tax base shock might hence take 2-3

treatment municipalities represent only around 10% of my sample municipalities, I do not have enough statistical power to consider the two groups separately in my baseline analysis; I nonetheless examine the two separate treated groups as robustness.

Figure 5: Map of the treated and control municipalities



Note: This figure shows the treatment status of municipalities according to their change in statutory equalization rate in 2012. Light-gray areas represent municipalities that amalgamated between 2007-2017 which therefore have to be excluded from the sample.

years before materializing into a change of the fiscal capacity measure. However, given the small size of the examined jurisdictions, substantial rank variations can occur. I therefore carry out the subsequent baseline empirical analysis of this paper removing 'unstable' municipalities, which are local governments that changed statutory equalization rate during years after the reform (and usually have fiscal capacity close to the target threshold).[20] One might also consider the concurrent change in the standardized rate as potentially blurring the identification of changes in the equalization rate α. Recall that the standardized multiplier shifts the horizontal equalization transfers schedule for all municipalities the same way, including the average fiscal capacity and thus the minimum target threshold. This change alone did not affect the position of a municipality on the equalization schedule between 2011 and 2012, and hence does not impact my definition of a treated or control municipality. More practically, the panel structure of my data allows me to control for shocks affecting all municipalities in a given year; changes in the harmonizing multiplier

[20] As robustness I also conduct part of my empirical estimations including unstable municipalities, but instrumenting the equalization rate following Gruber and Saez (2002). I detail this procedure in Subsection 3.4 .

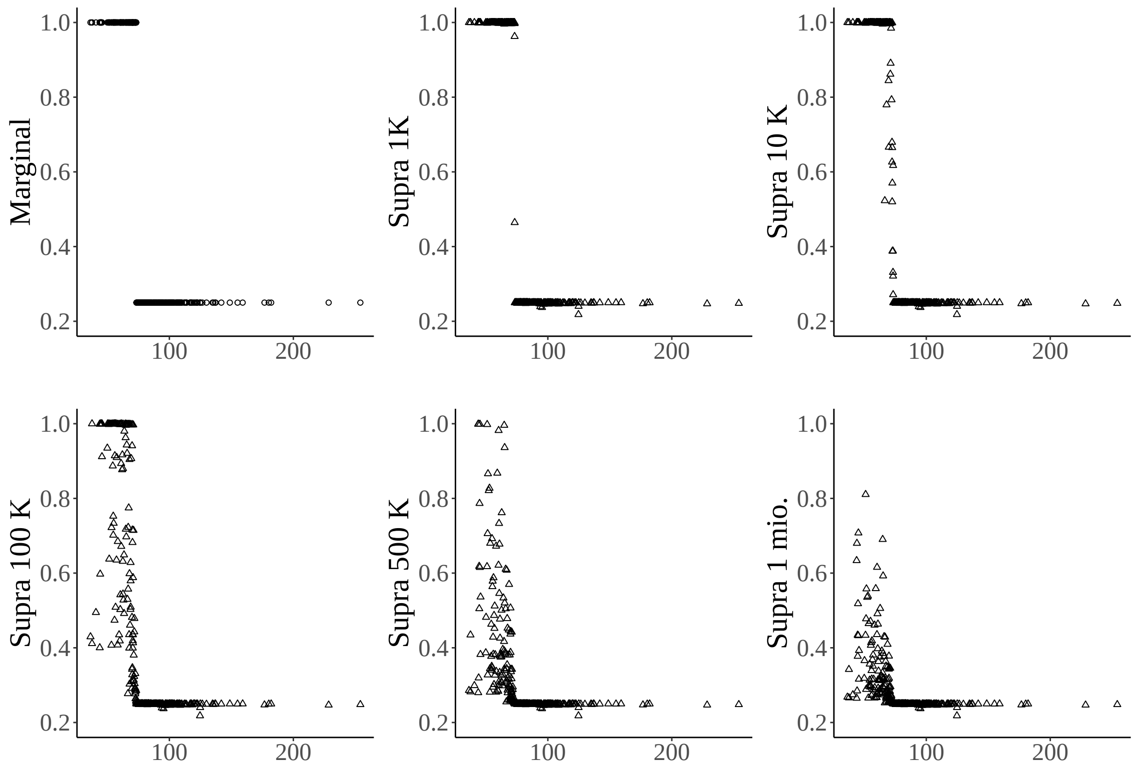
can therefore be controlled for. Similarily as Egger et al. (2010), I focus my identification strategy on the statutory equalization rate α_i which changed differently across municipalities.

As the reform entailed several changes in the vertical grants (see Appendix C. for more details), one potential threat to identification might be related to the removal of a class of transfers that was conditional jointly on a high tax multiplier level and road length per capita or total surface per-capita. The aim of these transfers was to help fund municipalities with high infrastructure cost. The value of this category of transfers (which were granted to both treated and control municipalities) represented on average around $\sim 3\%$ of the total amount of transfers from the horizontal and vertical schemes. Their weight in municipalities budgets was low as they represented less than 5% of total tax revenues on average (compared to the average 25% of horizontal grants). Conceptually however, the removal of this type of transfers taken in isolation would have eliminated any incentive to keep taxes superficially high, and hence could have led to tax cuts. To test this thought experiment, in Appendix H. I conduct an event-study on the control municipalities, whose tax-setting incentives were unaltered with respect to the horizontal equalization scheme. I differentiate between control municipalities that received such transfers at least once before the reform and those who never received such transfers. My results show that the two groups' tax multipliers' cumulative change cannot be statistically distinguished within the 4 years after the reform, but are statistically different in 2016 and 2017. Given the full autonomy of municipalities with respect to setting their tax multipliers, the extensive information sessions that have occurred prior to the new system and the rapid tax responses to the reform in 2012 (as shown in Figure G1), it seems plausible that the significant coefficients for 2016 and 2017 might be related to other trends. These results coupled to the relatively low quantitative importance of this type of transfers makes it unlikely that this concurrent change in incentives pose a serious threat to my identification strategy.

3.3 Data sources and computation of the equalization rate measures

To analyze the effect of the reform on local fiscal policy, I draw on published data from two main sources. On the one hand, the statistical office of the canton Bern provides detailed information on fiscal equalization transfers, the tax base, tax multipliers and government spending. On the other hand, socio-economic and political measures such as municipal population, share of foreigners and right-to-center votes at the last national election are taken from the national statistical office. The baseline sample of my analysis is composed of municipalities which did not merge during the sample period 2007-2017, and did not observe a change in statutory equalization rate between 2013 and 2017. By excluding the latter I ensure that the variation in equalization rates in my econometric analysis stems solely form the 2012 reform. My balanced panel data set is composed of 285 municipalities

Figure 6: Marginal and supramarginal equalization rates



Note: These graphs display marginal and supramarginal equalization rates computed based on the 2011 tax base values. The horizontal axis represents the relative fiscal capacity and the vertical axis the value of the equalization rate faced by the municipality.

for the years 2007-2017. The symmetric window around the 2012 revision of the equalization mechanism has been chosen as to minimize capturing potential effects related to the first introduction of the equalization system in 2002.[21]

Thanks to the detailed data on tax bases, tax multipliers and the formulae used by the cantonal authorities, I construct marginal, supramarginal and effective equalization rates using simulation. These alternative measures are computed along two dimensions according to the following formulas:

$$\alpha_{i,t} = \left| \frac{\Delta T^H_{i,t}}{\overline{\omega_t}(\Delta k_{i,t})} \right|, \tag{3.3}$$

$$\alpha^{\text{e}}_{i,t} = \frac{\overline{\omega_t}}{\tau_{i,t}} \cdot \alpha_{i,t}. \tag{3.4}$$

[21]Figure G1 provides first hand evidence on the reaction of municipalities to the 2012 reform. The figure shows the cumulative change in average tax multipliers with respect to the 2011 level for treated and control municipalities. The treated municipalities gradually adjusted their multipliers following the increase in the statutory equalization rate in 2012. There is no graphical evidence of potential differential pre-trends explaining the post-reform divergence in tax multipliers.

$\Delta T^H_{i,t}$ is the the difference in horizontal equalization transfers after the tax base shock Δ, $\alpha_{i,t}$ is the "nominal" equalization rate, $\alpha^{\mathrm{e}}_{i,t}$ the effective equalization rate, $\tau_{i,t}$ is the current tax multiplier, $\Delta k_{i,t}$ the difference in comprehensive tax base due to the simulated shock and $\overline{\omega_t}$ the harmonizing multiplier.

The computed measures of equalization rates can be differentiated along two lines. On the one hand I vary the magnitude of the shock to the tax base with positive nominal or proportional shocks Δ. More specifically, I simulate nominal shocks of 1, 1K, 10K, 100K, 500K, 1mio. Swiss Francs, and proportional shocks of 0.01, 0.1, 1, 10, 50 and 100 percentage-point magnitude. Small shocks of 1CHF or 0.01 percentage-points are equivalent to what has been implemented in the existing literature such as in Buettner (2006), Baretti et al. (2002) or more recently in Buettner and Krause (2020). I refer to these as marginal equalization rates. To give a quantitative sense of the larger shock values, let us think of the average municipality in my sample, which has around 2'700 residents and a comprehensive tax base of 3,4 mio. CHF. For this local government, a 500K CHF tax base shock is equivalent to a 15% increase in their tax base. For such a shock to occur, a plausible scenario would be that the resident population population increases by 5% (assuming new residents earn the Swiss median monthly wage of 6'000 CHF). Given municipal residents' growth rates shown in Figure E1, this would not be uncommon. Alternatively, the tax base shock could stem from a new incoming firm. According to detailed tax base data from the SINERGIA project,[22] a 500K tax base shock would mean an increase of 2,5% of the corporate profits within the average municipality. Such shocks, i.e. larger than 1 CHF or 0.01 percentage-point, yield what I call supramarginal equalization rates. Since the equalization schedule is discontinuous, a sufficiently large shock to the tax base of a municipality located to the left of the target threshold 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.[23] Figure 6 displays simulated supramarginal equalization rates from different (nominal) shock magnitudes for year 2011.[24] The marginal equalization rate computed with a 1 Swiss Franc shock mimics Figure 4. As shocks grow in magnitude, more and more municipalities lose their eligibility to the additional transfers and end up facing a lower supramarginal equalization rate than their statutory rate.

On the other hand I distinguish nominal and effective equalization rates according to whether the shock is considered relative to the fiscal capacity or to the tax revenue condi-

[22] See https://www.fiscalfederalism.ch/.

[23] Note that a detailed spreadsheet incorporating formulas of the equalization system is available to municipalities in canton Bern (publicly accessible on `https://www.fin.be.ch/de/start/themen/Finanzen/FinanzundLastenausgleich/finanzplanungshilfe0.html`). Using this tool, local officials can simulate population growth rates and their effect on income (or direct changes in the tax base) and in turn equalization grants.

[24] In Appendix G. can be found the equivalent graphical representations for proportional shocks and effective equalization rates.

tional on the current tax rate, as shown respectively in equations (3.3) and (3.4). Figures G3 and G4 show that the variation across municipalities of effective equalization rates is much larger than for nominal rates given the tax multiplier differentials between municipalities.

Appendix F. contains summary statistics for my variables and a short comment on the measured equalization rates.

3.4 Econometric approach

In order to measure the incentive and redistribution effects induced by the fiscal equalization reform, my strategy is twofold. I first analyze 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 examine and quantify incentive effects by considering my alternative measures for the equalization rate.

The reform as an event-study

The impact of the reform is estimated by

$$log(\tau_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\lambda} + \epsilon_{i,t}, \tag{3.5}$$

where $\tau_{i,t}$ is the tax multiplier of municipality i at time t and $D_{i,t}$ is an indicator function taking the value 1 for the treatment group in the post-reform period. The model contains municipality-level time varying controls $\mathbf{X}_{i,t}$ (net equalization transfers, share of population, net debt, 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 or district specific time trends in order to capture idiosyncratic trends and shocks at different spatial scales. β_1 measures the average treatment effect. 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 two-way fixed-effects regression:

$$log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t E_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}, \tag{3.6}$$

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, with the last pre-reform period as the reference year. 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 ascertain that the two group of municipalities did not have diverging levels in local taxation prior to the reform.

Dose-response framework

To estimate the elasticity of tax multipliers with respect to the equalization rate, I use a "dose-response" approach where I study how the before-after change in equalization rates and equalization transfers impacted local tax multipliers.[25] Having constructed the different measures of equalization rates, I jointly estimate the following equations, where I also take into account total government spending:

$$\Delta log(\tau_{i,t}) = \beta_1^1 \Delta log(\alpha_{i,t}^{j,\delta}) + \beta_2^1 \Delta T_{i,t}^{FE} + \Delta \mathbf{C}_{i,t} \boldsymbol{\eta}^{\mathbf{1}} + \varepsilon_{i,t}^1 \tag{3.7}$$

$$\Delta log(g_{i,t}) = \beta_1^2 \Delta log(\alpha_{i,t}^{j,\delta}) + \beta_2^2 \Delta T_{i,t}^{FE} + \Delta \mathbf{C}_{i,t} \boldsymbol{\eta}^{\mathbf{2}} + \varepsilon_{i,t}^2, \tag{3.8}$$

whereby $\Delta\tau_{i,t}$ is the change in tax multiplier, $\Delta g_{i,t}$ is the change in per-capita total expenditure, $\Delta log(\alpha_{i,t}^{j,\delta})$ is the change in 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}. $\Delta T_{i,t}^{FE}$ is the change in total equalization transfers. Time varying controls $\Delta \mathbf{C}_{i,t}$ are also included.

This second econometric setting differs from the previous 'standard' difference-in-difference approach because I allow the treatments (i.e. the different equalization rate measures) to differ in their dosage. The now multi-valued nature of the treatment entails further assumptions than the standard parallel trends. Callaway et al. (2021) show that a *strong* parallel trends assumption is needed: the change in outcomes of all units is the same had they experienced dosage d, for all values d. In my context, this means that any municipality would have had the same tax response, had they faced a change in their equalization rate of a given magnitude. While there are (yet) no statistical tests to assess the likelihood of this assumption to hold, economic intuition can help. In light of the theoretical model presented above, the incentive effect from equalization grants boils down to the fact that an increase in the equalization rate makes it cheaper (in terms of tax base) to increase taxes. The magnitude of the response is notably a function of the tax-base elasticity as shown in equation (2.6). Therefore, if one is willing to assume that an increase in taxes depreciates the tax base similarly across municipalities, then the strong parallel trends assumptions is likely to hold. One threat to this might be linked to agglomeration economies of cities and productive centers (Brülhart et al., 2012): the mayor of a larger city might be subject to weaker sensitivity of her tax bases to local taxes. In my sample, the four largest municipalities in terms of population (Bern, Köniz, Biel and Thun), which concentrate 25% of the total population, might be subject to agglomeration economies. The remaining municipalities, which average around 1'900 inhabitants are less likely to be affected and hence more plausibly have similar tax reactions to fiscal equalization. Since these smaller jurisdictions make up the vast majority of my sample, the strong parallel

[25] In my baseline estimation, I average over 2007-2011 for the pre-reform period and 2013-2017 for the post-reform period. In Appendix L. I also explore the time profile of the responses of tax multipliers.

trends is likely to hold. Additionally, population is included as a time-varying control in my estimations. For robustness, I nonetheless also estimate the dose-response equations excluding the large productive center municipalities.

As discussed in Subsection 3.2 , time variation in nominal marginal and supramarginal equalization rates is solely due to the 2012 reform given that my basline sample does not include unstable units. However, this is potentially not the case for effective equalization rates and total equalization transfers. They in fact additionally vary with underlying socio-economic factors and tax policy changes (especially for effective equalization rates). To ensure that the variation of these variables on local tax multipliers is solely due to the reform, I borrow an instrumental variable approach from the literature on personal income taxes (Gruber and Saez, 2002; Blundell et al., 1998; Buettner and Krause, 2020) and estimate equations (3.7) and (3.8) using 3SLS.[26] The procedure consists in constructing counterfactual effective equalization rates keeping the economic environment constant before and after the reform. More precisely, I keep tax-bases and tax rates constant at their 2011 levels and compute counterfactual post-reform effective equalization rates. For net equalization transfers, I use the 2012-2011 difference in net transfers as the instrument for its subsequent variation. Change in these counterfactual variables captures solely the change in rules from the reform that is plausibly exogenous.

Given that I instrument effective equalization rates, the setting becomes 'fuzzy' with respect to these specific treatments. As De Chaisemartin and d'Haultfoeuille (2018) show, this requires additional assumptions; namely what the authors refer to as the 'stable treatment effect over time' and the 'homogeneous treatment effect between groups' assumptions. Intuitively, the former states that the average treatment effect at any given dosage should not change over time while the later says that the local average treatment effect should be the same within the treated and control. In my setting, these assumptions translate into firstly a stable effect of a change in the dosage of effective equalization rates on local taxes. Given the permanent nature of the change in the equalization formulae induced by the reform, incentives shouldn't change over time. Secondly, the same tax response should be assumed for a given dosage of this treatment across municipalities. This is very close to (but slightly stronger than) the strong parallel trend assumption examined earlier (Callaway et al., 2021). As mentioned, agglomeration economies might a likely source of heterogeneity in tax responses; so I address this issue by taking out the four most populated municipalities as a robustness.

Since I do not model explicitly government spending in the theoretical framework, I focus the analysis and solely present results of (3.7), where β_1^1 is the elasticity of the tax multiplier with respect to the equalization rate and β_2^1 is the semi-elasticity of the tax multiplier with respect to the net equalization transfers. The results from estimation of

[26]Hausman specification tests systematically reject (for all regressions) the alternative hypothesis according to which the 2SLS estimator is consistent but the 3SLS is not.

Table 1: Difference-in-difference results

Dependent variable:	$\log(\tau_{i,t})$			
	(1)	(2)	(3)	(4)
$D_{i,t}$	0.0149*	0.0156**	0.0126***	0.0080*
	(0.0080)	(0.0079)	(0.0032)	(0.0043)
Controls	no	yes	yes	yes
District-specific linear time trends	no	no	yes	no
Municipality-specific linear time trends	no	no	no	yes

Note: $D_{i,t}$ is an indicator function taking 1 for treated municipalities in the post-reform period. All specifications contain year and municipality fixed effects. Time-varying controls include net equalization transfers, share of population, 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. # of observations: 3135.

equation (3.8) can nevertheless be found in Appendix M..

4. Results

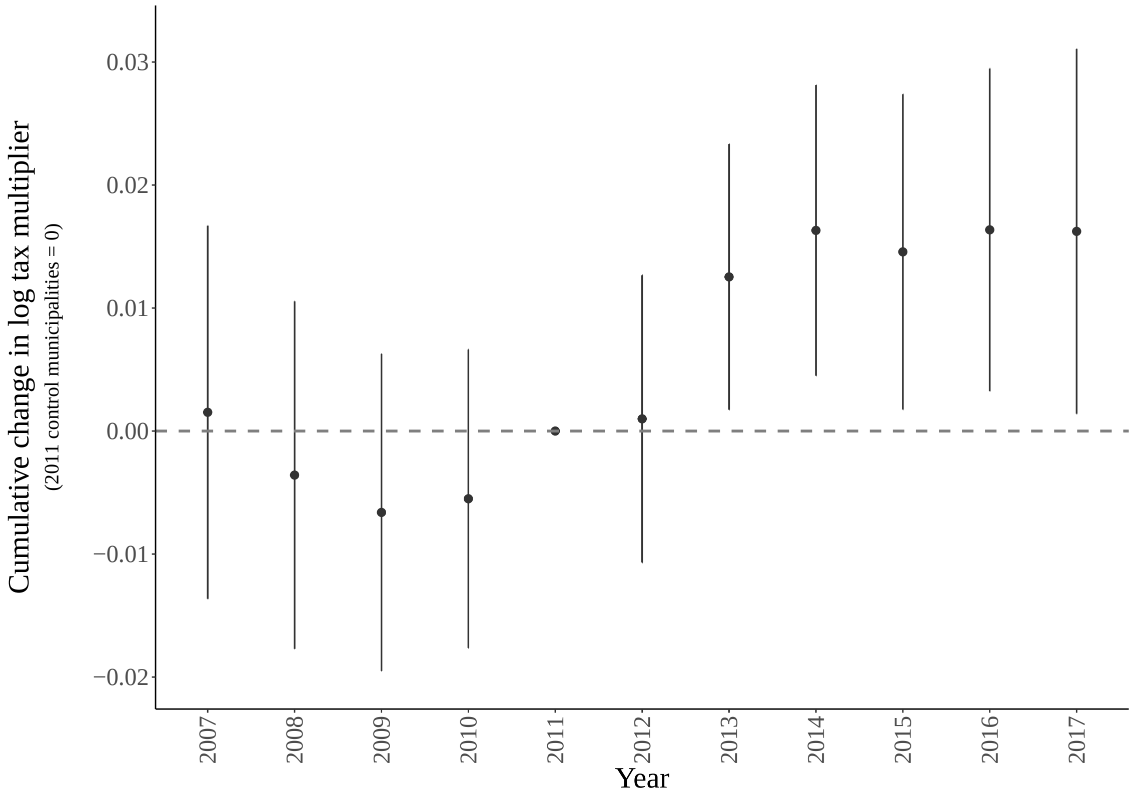
4.1 Event-study analysis

Table 1 displays results of the difference-in-difference estimation. Coefficients in columns (1) and (2) show a positive impact of the reform on local tax multipliers for the treated municipalities without and with time-varying controls. In columns (3) and (4), I add respectively municipality specific and district specific linear time trends. Adding municipality-level linear time trends considerably reduces the estimated coefficient and slightly increases its standard error. 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 subsequent to the reform.

Figure 7 shows that in periods prior to the reform, treatment and control municipalities cannot be statistically distinguished. From 2012 on, treated 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 municipalities.[27]

[27] In Appendix J., I separate high- and low-treatments among the treated municipalities. Figures J1 and J2 show that high-treatment municipalities have larger but imprecise estimates while low-treatment coefficients are lower but more precisely estimated.

Figure 7: Event-study estimates



Note: This figure displays the coefficients and 95% confidence intervals of treatment-year dummies according to equation (3.6). The regression includes municipality and year fixed effects and a set of time-varying controls (net equalization transfers, share of population, share of foreigners, relative harmonized revenue and share of right-wing votes at the last national election). 2011 is used as the reference year. Standard errors are clustered at the municipality level. Numerical values and can be found in Appendix J..

The robustness of these findings is tested by first performing two standard falsification tests in Appendix K.: once addressing the timing concern, then the treatment assignment. I first carry out estimation of equation (3.5) with artificial treatment years 2010, 2009 and 2008 on a sub-sample including only pre-reform years. Results shown in Table K1 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 Table K2 are close to zero and not statistically significant.
One might also wonder whether low tax capacity municipalities are a good counterfactual for high tax capacity municipalities, which could differ in many ways. To address this, I estimate equation (3.5) using only the control municipalities and replacing the treated dummy by placebo treatment dummies computed based on fiscal capacity. More specifically, I draw 100 random treatment thresholds along the 10th to 90th percentile interval of the 2011 fiscal capacity distribution within the sub-sample. Thanks to these artificial thresholds, I am then able to create placebo dummy treatments according to whether a

Table 2: 3SLS regressions: nominal equalization rates

Dependent variable:	Δ log($\tau_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Statutory rate							
Δ log nominal equalization rate	0.033***						
	(0.009)						
Δ Net equalization transfers	−0.037						
	(0.023)						
Shock magnitude	Statutory						
Weak instruments test (p-value): T^{FE}	0.00						
Panel B: Nominal shocks							
Δ log nominal equalization rate		0.033***	0.032***	0.031***	0.030**	0.048***	0.057***
		(0.009)	(0.009)	(0.009)	(0.012)	(0.017)	(0.022)
Δ Net equalization transfers		−0.037	−0.036	−0.036	−0.036	−0.034	−0.032
		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude		+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00
Panel C: Proportional shocks							
Δ log nominal equalization rate		0.033***	0.033***	0.032***	0.037***	0.066***	0.078***
		(0.009)	(0.009)	(0.009)	(0.011)	(0.018)	(0.022)
Δ Net equalization transfers		−0.037	−0.037	−0.037	−0.036	−0.034	−0.031
		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude		+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows estimation results of equation (3.7) with nominal equalization rates. Coefficients on log nominal equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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, 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. # of observations: 570.

given municipality was strictly above or below the artificial threshold in 2011. Figure K1 shows the estimates of these regressions, ordered by value of the fiscal capacity threshold dictating the placebo treatment. Among the 100 regressions, none of the difference-in-difference estimates is significantly different from 0. This result suggests that comparing high to low fiscal capacity municipalities is not problematic to my analysis.

4.2 Dose-response results

Based on the specifications of the equalization rate defined in equations (3.3) and (3.4), 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 (3.7). 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 equal-

Table 3: 3SLS regressions: effective equalization rates

Dependent variable:	Δ log($\tau_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Nominal shocks						
Δ log effective equalization rate	0.011	0.010	0.004	−0.008	−0.015	−0.053
	(0.012)	(0.012)	(0.013)	(0.017)	(0.030)	(0.047)
Δ Net equalization transfers	−0.038	−0.038	−0.037	−0.036	−0.035	−0.033
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude	+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: Proportional shocks						
Δ log effective equalization rate	0.011	0.011	0.008	−0.004	−0.008	−0.028
	(0.012)	(0.012)	(0.013)	(0.016)	(0.029)	(0.042)
Δ Net equalization transfers	−0.038	−0.038	−0.038	−0.036	−0.036	−0.035
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows estimation results of equation (3.7) with effective equalization rates. Coefficients on log effective equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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, 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. # of observations: 570.

ization rate but with more imprecision. This is confirmed when looking at correlations between statutory and simulation-based equalization rates shown in Tables I1 and I2 : equalization rates 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 statistically significant elasticities reaching the value of 0.07 for 100 percentage-point shocks. Correlation Tables I1 and I2 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 equalization rates because they conceive of changes to their tax base in discrete terms. This suggests that past studies analyzing kinked or discontinuous equalization schedules have potentially 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 decrease in the 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. These results suggest that using the effective equalization rate to measure the incentives created by equalization grants is not appropriate. Local policy-makers seemingly do not think of the equalization scheme in terms of their tax revenues but rather in terms of tax-base.

I perform several robustness checks on my dose-response results. Given that the main results shown in Tables 2 and 3 are based on period aggregated data, I first perform sensitivity tests regarding the post-reform year selection in Appendix L. for nominal equalization rates and for effective equalization rates. Similarly to Egger et al. (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. Secondly, I test the sensitivity of my results to the exclusion of "unstable" municipalities who saw a change in their statutory equalization rate after 2012. I therefore estimate (3.7) and (3.8) using the sample with unstable municipalities and instrumenting nominal equalization rates by their counterfactual constructed based on the Gruber and Saez (2002) approach to filter out the variation due to the unstable jurisdictions. Results can be found in Appendix M., Figures M1 and M1 and are qualitatively the same as when using my baseline sample.

In order to ensure that assumptions of strong parallel trends and homogeneity in local average treatment effects hold (De Chaisemartin and d'Haultfoeuille, 2018; Callaway et al., 2021), I additionally estimate baseline regression equations (3.7) and (3.8) without the 4 most populous local jurisdictions of my sample, which might face different tax-base elasticities due to agglomeration economies. This in turn could could lead to heterogeneity in responses to a given dosage of the treatment, i.e. increase in the equalization rate measure. Tables M3 and M4 show the estimation results for nominal and effective equalization rates. Coefficients change slightly when looking at nominal shocks, but the results remain qualitatively the same as in my baseline.

Changes in the slope of municipal budget constraints by the reform have been shown to impact tax setting by the various estimates on equalization rates. On the other hand, I do not find evidence of a redistribution effect created by the shift in local budget constraints linked to variation in total equalization grants. In Tables 2 and 3, the coefficients on the instrumented change in net equalization transfers show a negative sign but are not significantly different than 0. One plausible conclusion from this observation would be 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 B. demonstrates that a higher weight put on revenue maximization by jurisdictions is linked to lower redistribution effects. The same idea holds when considering variation in vertical transfers which create an income effect. If municipalities are non-benevolent, fiscal equalization might not be efficiency enhancing but rather lead to sub-optimally high taxes. Based on the estimation results from equation (3.8), shown in Appendix M., the change in equalization transfers however led to a positive impact on total expenditure. An other explanation for the non-existence of income effects could consequently be attributed to the so-called "flypaper effect". This phenomenon is documented empirically and theoretically as a recurring "anomaly": changes in inter-governmental grants tend to translate into larger expenditure than tax rates responses (Inman, 2008; Bailey and Connolly, 1998; Dahlberg et al., 2008; Allers and Vermeulen, 2016; Leduc and Wilson, 2017).

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 two 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 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.

I use a reform in a Swiss canton's inter-municipal equalization system to estimate incentive effects. The reform entailed an increase of the statutory equalization rate for municipalities above a minimum threshold tax capacity. 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 effective 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 0.078. My baseline estimate of the elasticity of local tax rates with respect to marginal equalization rates is of 0.033. 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 there is no measurable response of tax rates to effective equalization rates. 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.

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Appendix

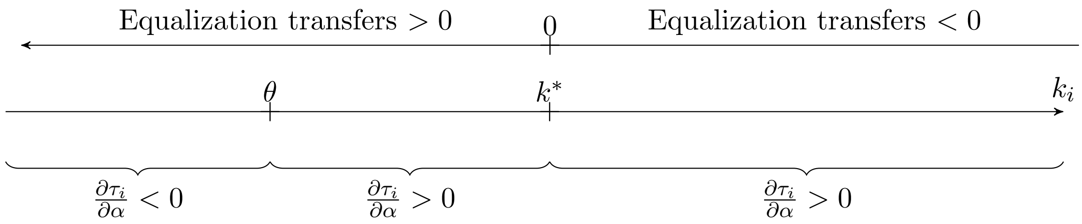
A. Literature: Empirical set-up and estimates

Table A1: Overview of the recent empirical literature on incentive effects

(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
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	CH	DiD, 3SLS	mun.	tax multiplier	2007-2017	nominal marginal nominal supra-marginal effective marginal effective supra-marginal	+0.08ppt +0.25ppt NA NA

Note: Columns correspond to: **(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)

Figure B1: Net effect of a small change in α



Note: θ represents the tax base value at which the income and incentive effect fully offset each-other.

B. Theoretical extensions

The θ-threshold

In this section, 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 optimal 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

$$\left.\frac{d\tau_i}{d\alpha}\right|_{k_i=\theta_i} = \frac{-\Gamma_{gg}(k^*-\theta_i)(\theta_i+(\tau_i-\alpha)\frac{dk_i}{d\tau_i})+\Gamma_g\frac{dk_i}{d\tau_i}}{-f''(\theta_i)\left[\frac{dk_i}{d\tau_i}\right]^2+\Gamma_{gg}(\theta_i+(\tau_i-\alpha)\frac{dk_i}{d\tau_i})^2+2\Gamma_g\frac{dk_i}{d\tau_i}} \overset{!}{=} 0,$$

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

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:

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

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

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

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: $\frac{\partial\theta(\alpha,\gamma_i,s_i)}{\partial\gamma_i}$: 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

$$\left.\frac{d\tau_i}{d\alpha}\right|_{k_i=\theta_i}=\frac{\gamma(-\Gamma_{gg}(k^*-\theta_i)(\theta_i+(\tau_i-\alpha)\frac{dk_i}{d\tau_i})+\Gamma_g\frac{dk_i}{d\tau_i})+(1-\gamma)(\varpi\frac{dk_i}{d\tau_i})}{\gamma(-f''(\theta_i)\left[\frac{dk_i}{d\tau_i}\right]^2+\Gamma_{gg}(\theta_i+(\tau_i-\alpha)\frac{dk_i}{d\tau_i})^2+2\Gamma_g\frac{dk_i}{d\tau_i})+(1-\gamma)2\frac{dk_i}{d\tau_i}}\overset{!}{=}0$$

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

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., 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:

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

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

$$\frac{\partial}{\partial\gamma_i}(-\gamma\Gamma_g\frac{dk_i}{d\tau_i}-(1-\gamma)(\varpi\frac{dk_i}{d\tau_i}))=(1-\Gamma_g)\frac{dk_i}{d\tau_i}\lesseqgtr 0.$$

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). [28] 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 $\frac{d\tau_i}{d\alpha}$ as $\gamma_i \to 0$ gives the following result

$$\lim_{\gamma_i \to 0} \left[\frac{\gamma(-\Gamma_{gg}(k^* - k_i)(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}) + \Gamma_g \frac{dk_i}{d\tau_i}) + (1-\gamma)(\overline{\omega}\frac{dk_i}{d\tau_i})}{\gamma(-f''(k_i)\left[\frac{dk_i}{d\tau_i}\right]^2 + \Gamma_{gg}(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i})^2 + 2\Gamma_g \frac{dk_i}{d\tau_i}) + (1-\gamma)2\frac{dk_i}{d\tau_i}} \right] = \frac{1}{2} > 0,$$

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.

[28] 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.

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 utility. 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

$$\max_{\tau_i} \Omega_i = \gamma(f(k_i) - f'(k_i)k_i + rk^* + \Gamma(\tau_i k_i + \alpha(k^* - k_i))) + (1-\gamma)(\tau_i k_i + \alpha(k^* - k_i));$$

The first order condition then writes as

$$\gamma\{-f''(k)\frac{dk_i}{d\tau_i}k_i + \Gamma_g[k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}]\} + (1-\gamma)\{k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}\} = 0.$$

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.

$$\frac{d\tau_i}{d\alpha} = \frac{\gamma(-\Gamma_{gg}(k^* - k_i)(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i}) + \Gamma_g\frac{dk_i}{d\tau_i}) + (1-\gamma)(\varpi\frac{dk_i}{d\tau_i})}{\gamma(-\frac{dk_i}{d\tau_i} + \Gamma_{gg}(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i})^2 + 2\Gamma_g\frac{dk_i}{d\tau_i}) + (1-\gamma)2\frac{dk_i}{d\tau_i}}$$

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.

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 section, 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 equation (2.6). In order to investigate this "pure" redistribution effect, I add the unconditional transfers parameter Λ_i to the local governments budget constraint. This gives

$$g_i = \tau_i k_i + \alpha(k^* - k_i) + \Lambda_i \tag{B.1}$$

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:

$$\frac{d\tau_i}{d\Lambda_i} = \frac{-\overbrace{\left[k_i + \tau_i \frac{dk_i}{d\tau_i} - \alpha \frac{dk_i}{d\tau_i}\right]}^{g_\tau} \overbrace{\frac{\partial \Gamma_g(.)}{\partial \Lambda_i}}^{\frac{\partial MRS_i}{\partial \Lambda_i}}}{\underbrace{-\frac{dk_i}{d\tau_i} + \Gamma_{gg}(k_i + (\tau_i - \alpha)\frac{dk_i}{d\tau_i})^2 + 2\Gamma_g \frac{dk_i}{d\tau_i}}_{S.O.C.}}. \tag{B.2}$$

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.[29]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 $\frac{d\tau_i}{d\Lambda_i} < 0$. 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.[30] My empirical results do not show sign

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

[30]This theoretical finding is however 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

of the existence of such redistribution effects on tax rates.

named as the "flypaper effect" (see Lundqvist (2015); Leduc and Wilson (2017) or Dahlberg et al. (2008) for causal analysis)

C. Institutional context: equalization transfers before and after the reform

Before the 2012 reform, the *Gemeinde mit hoher Gesamtsteueranlage* category of vertical transfers were aimed at municipalities with high "structural needs". To be eligible for these conditional transfers, a municipality had to have a multiplier above 110 and the surface per-capita higher than 80% of the median or a multiplier above 110 and street lengths per-capita higher than 80% of the median. The reform replaced these transfers by geo-topographic and socio-demographic characteristics (see the following tables) . This change does not affect my identification strategy for two reasons. Firstly, the conditional transfers were mostly targeted at municipalities in the control group which have high tax burdens, which means that the reform did not affect tax-setting incentives for those jurisdictions which face an equalization rate of 1. Second, the pre-reform condition for being eligible for these further vertical grants was a high tax multiplier: the potential incentive created by the abolishing of this condition would rather be to decrease taxes, not increase them. In Appendix H. I test whether the abolishing of the conditional nature of these transfers affected municipal tax multipliers by implementing an event-study on the control group, which saw no incentive change from the reform. I show that controls which received these conditional transfers cannot be statistically differentiated from controls which never received conditional transfers.

Table C1: Detailed equalization transfers pre-reform

Before the 2012 reform		
Transfer	**Conditional on**	**Description**
Disparitätenabbau	tax capacity; statutory equalization rate	horizontal equalization system.
Mindestaustattung	tax capacity; target threshold	additional transfers if below target tax capacity
Pauschale Abgeltung	discretionary	additional transfers for "centrality costs" for cities of Bern, Thun, Biel, Burgdorf and Langenthal.
Gemeinde mit hoher Gesamtsteueranlage	tax multiplier + road length per-capita or surface per-capita	transfers for municipalities with high structural costs related to infrastructure and maintenance.
Lastenausgleich		vertical cost-sharing scheme.
- Teachers	number of pupils; population; number of classes	
- Welfare transfers	population	
- Social security	population	
- Public transports	population; number of public transport stops	

Note: This table details the various transfers before the equalization reform of 2012.

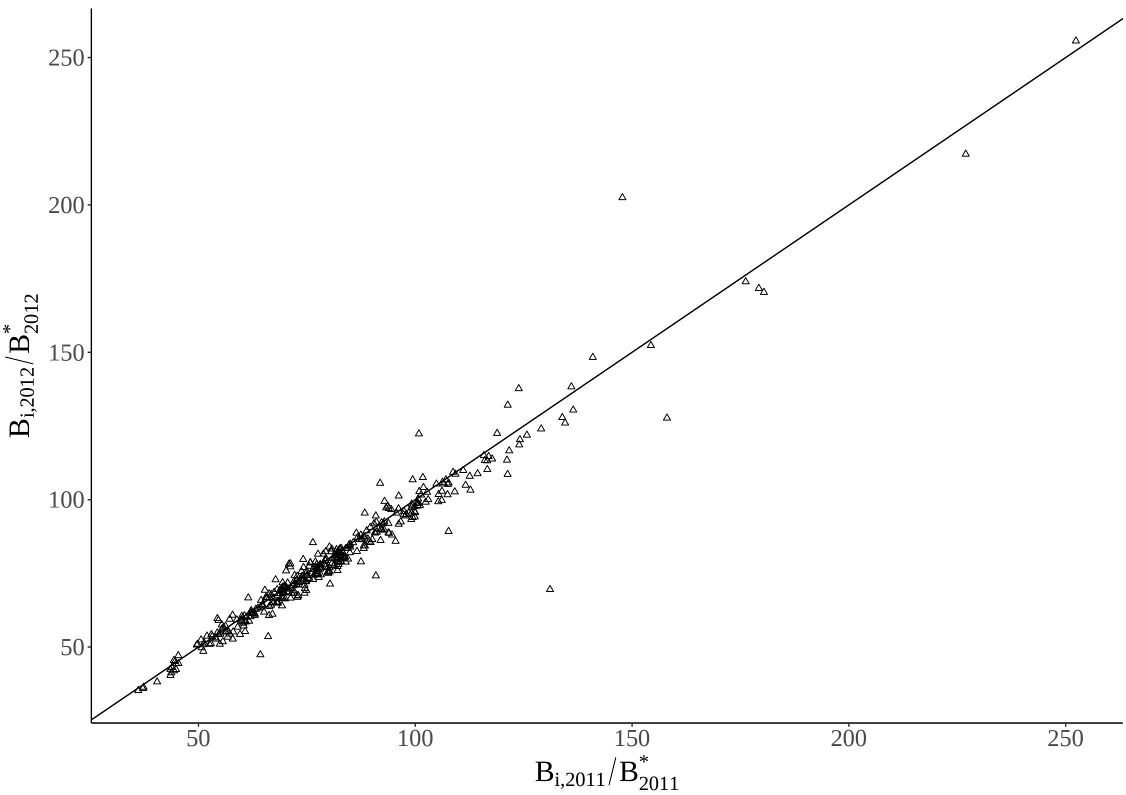
Table C2: Detailed equalization transfers post-reform

After the 2012 reform		
Transfer	**Conditional on**	**Description**
Disparitätenabbau	tax capacity; statutory equalization rate	horizontal equalization system.
Mindestaustattung	tax capacity; target threshold	additional transfers if below target tax capacity
Pauschale abgeltung	discretionary	additional transfers for "centrality costs" for cities of Bern, Thun, Biel, Burgdorf and Langenthal.
Gemeinde mit übermässigen geo-topografischen Lasten	road length per-capita or surface per-capita	transfers for municipalities with high structural costs related to infrastructure and maintenance.
Gemeinde mit übermässigen sozio-demografischen Lasten	number of unemployed, social security recipients, refugees	transfers for social composition of municipalities
Lastenausgleich		vertical cost sharing scheme.
- Teachers	teachers hours worked	
- Welfare transfers	population	
- Social security	population	
- Public transports	population; number of public transport stops	
- Family allowances	population	
- New task-sharing	population	

This table details the various transfers after the equalization reform of 2012.

D. Relative fiscal capacity change 2011-2012

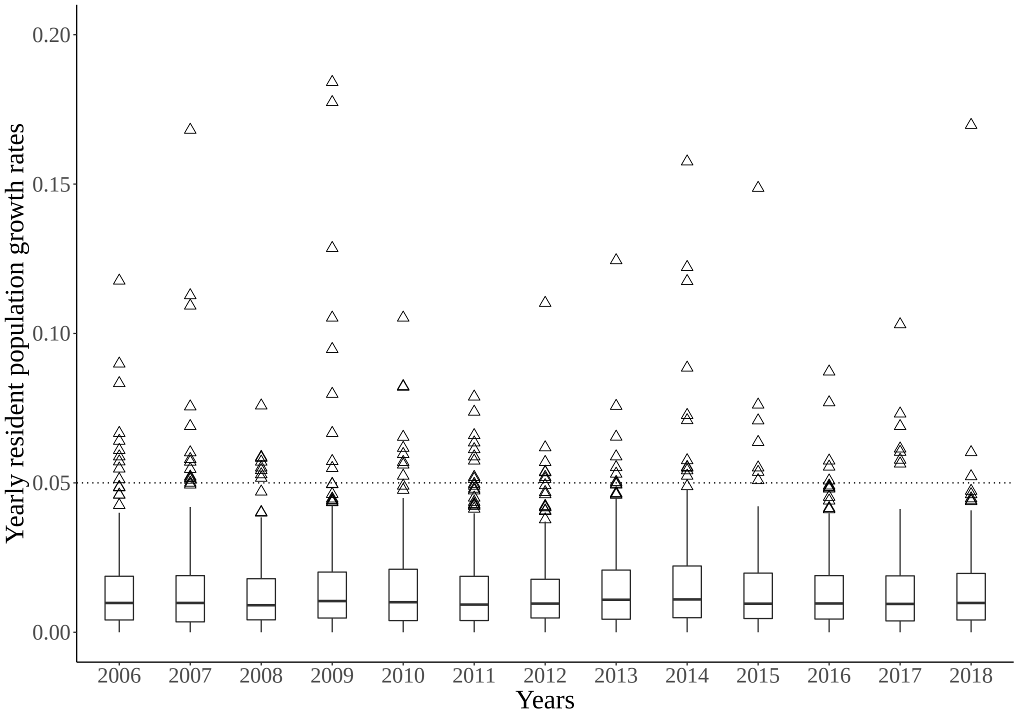
Figure D1: Change in relative fiscal capacity



Note: This figure shows the change in the relative fiscal capacity $B_{i,t}/B_t^*$ between years 2011 and 2012. Observations on the 90° line are municipalities that have the exact same relative fiscal capacity between both years.

E. Municipal residents change

Figure E1: Yearly residents growth rates



Note: This figure shows the yearly growth rates in the municipal resident population for years 2005-2018. Triangles above and below correspond to 'outliers' such that their value is larger or smaller than 1.5 times the inter-quartile range. The dotted line marks a resident growth rate of 5%.

F. Analysis Sample

Table (F1) displays the summary statistics of the analysis sample. Panel (A) lists the dependent and control variables that are used in my estimations. Bottom panel (B) 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, larger than their nominal counterparts. This is explained by average municipal tax multipliers that are lower than the harmonizing rate.[31] Recall that net equalization transfers consist of the sum of vertical and horizontal transfers. Net equalization bill is on average negative, meaning that the average municipality pays more than it receives from the equalization system. This is driven by the vertical transfers $\Lambda_{i,t}$, where municipalities are net contributors to the canton.

[31] Appendix I. presents 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.

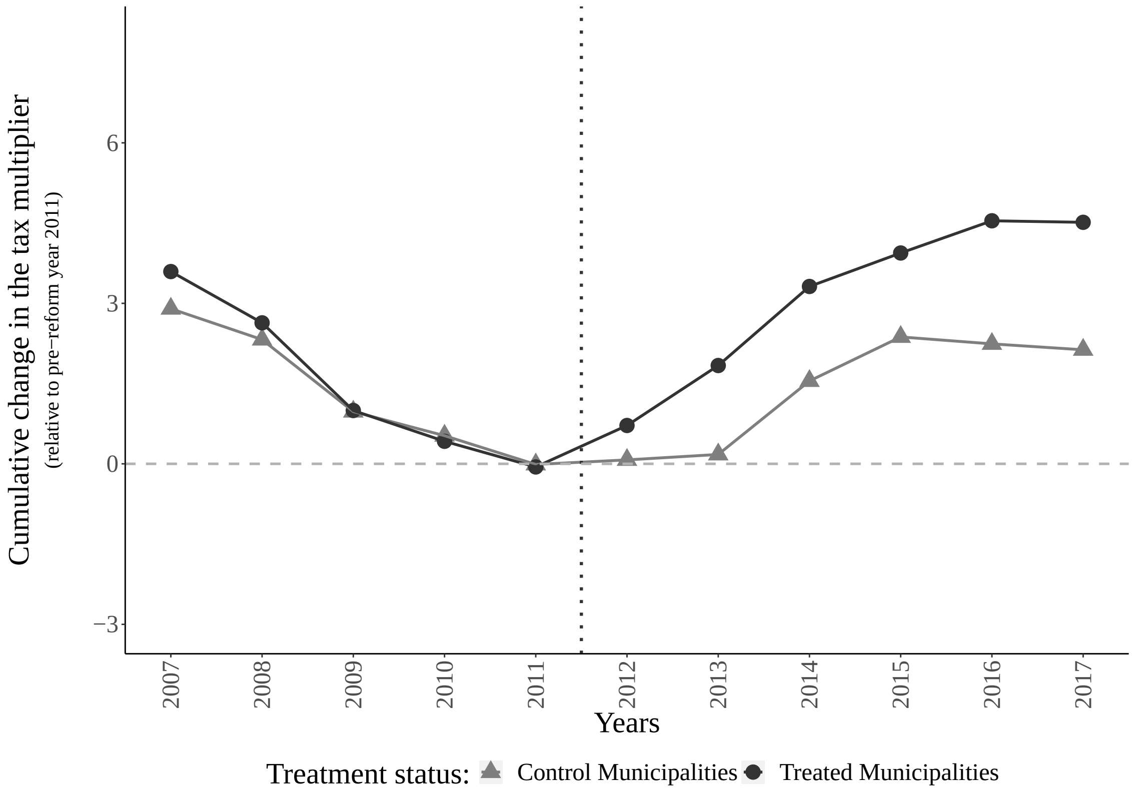
Table F1: Summary statistics

	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

Note: This table displays the summary statistics of the variables in my empirical analysis. 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.

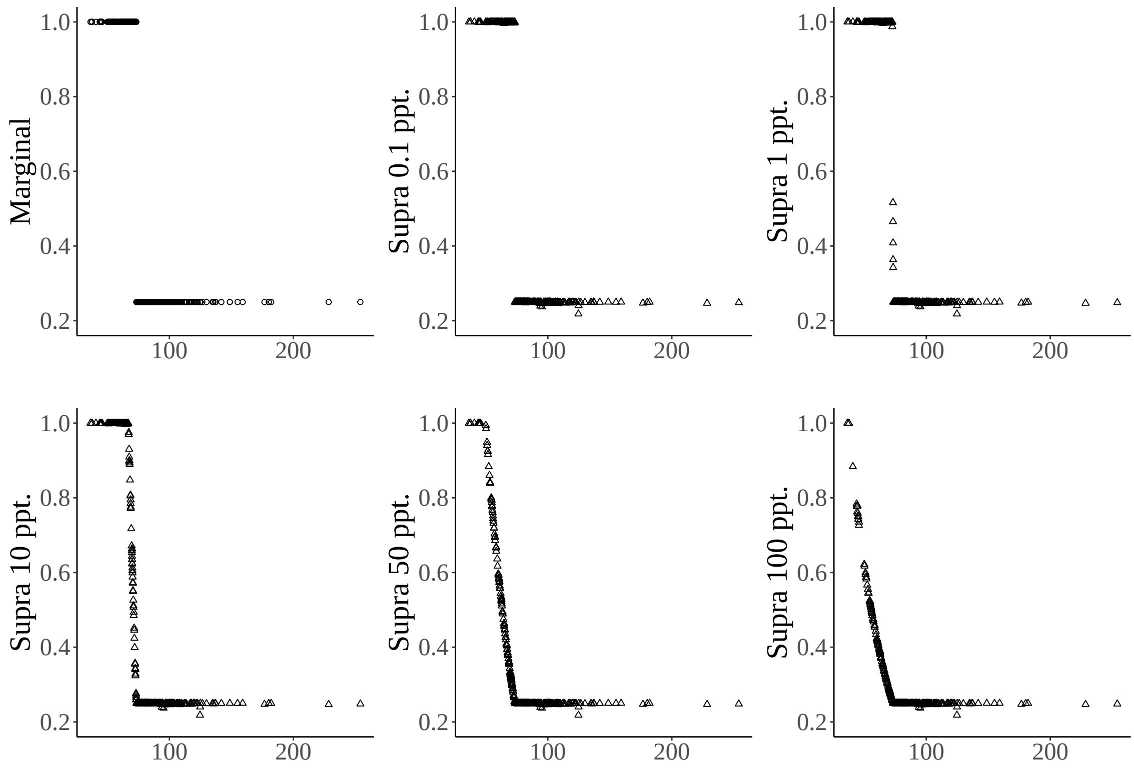
G. Data and descriptive evidence

Figure G1: Descriptive evidence: changes in the municipal tax multipliers



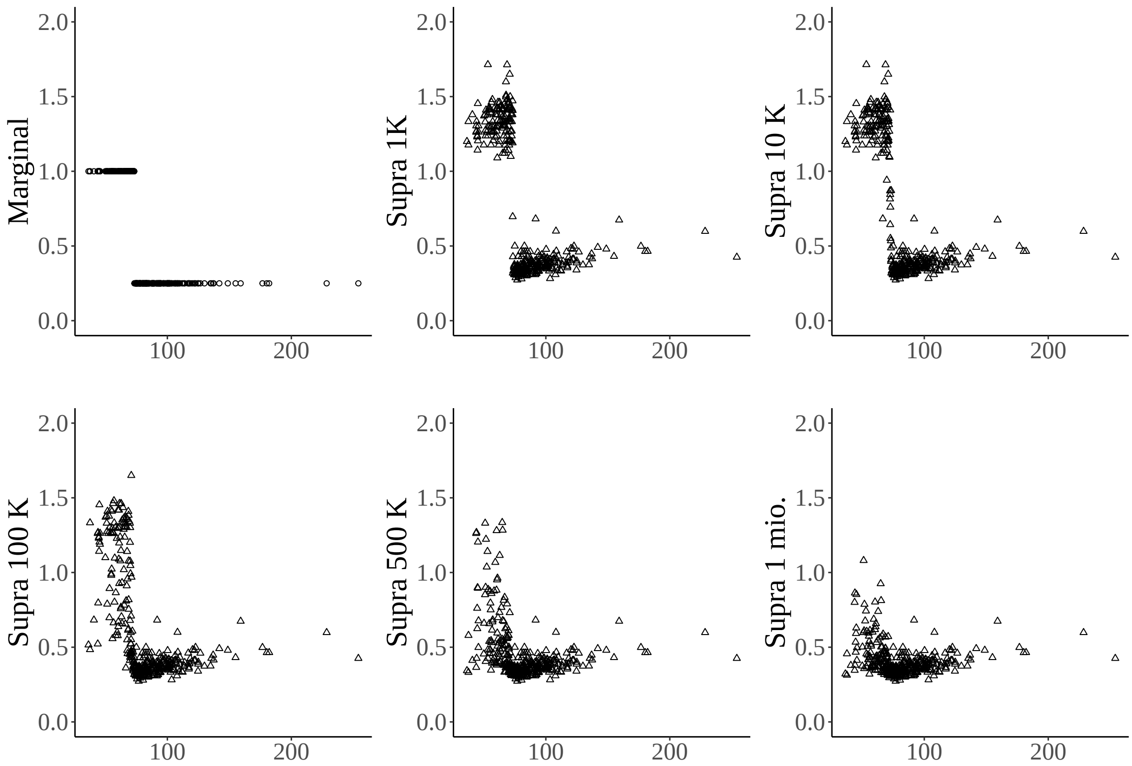
Note: These graphs display marginal and supramarginal equalization rates computed based on the 2011 tax base values. The horizontal axis represents the relative fiscal capacity and the vertical axis the value of the equalization rate faced by the municipality..

Figure G2: Marginal and supramarginal equalization rates: proportional shocks



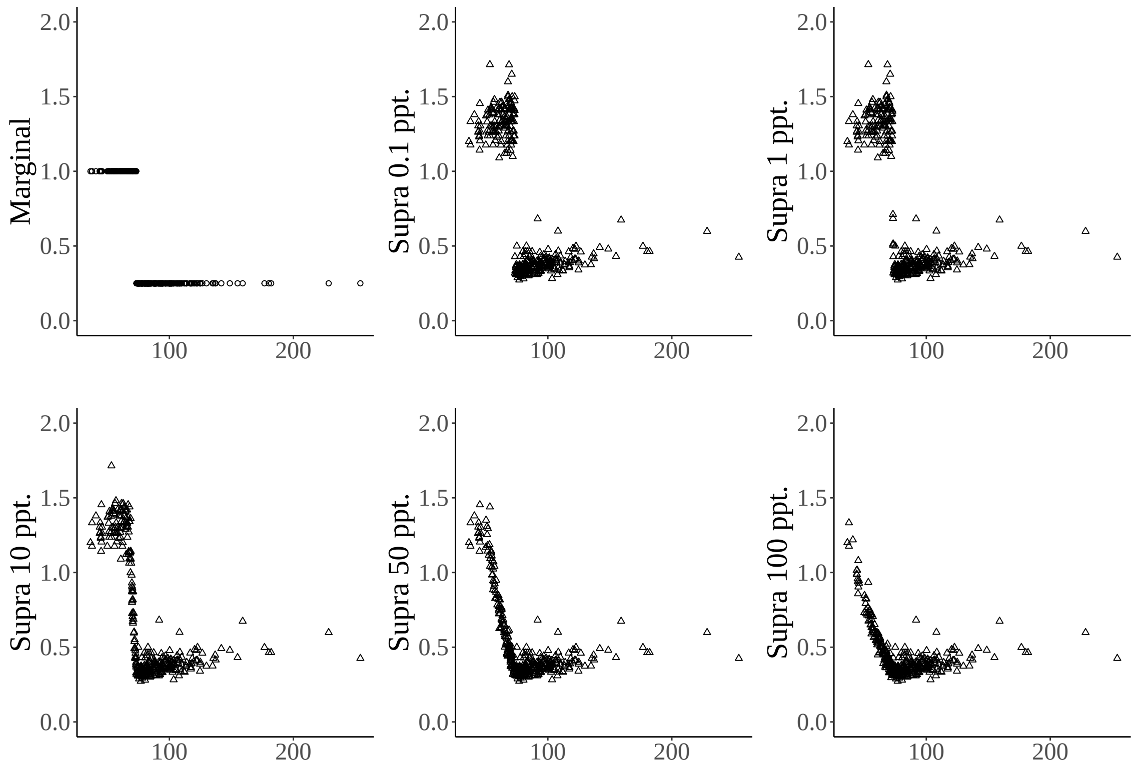
Note: These graphs display marginal and supramarginal equalization rates computed based on the 2011 tax base values and proportional shocks. The horizontal axis represents the relative fiscal capacity and the vertical axis the value of the equalization rate faced by the municipality.

Figure G3: Marginal and supramarginal effective equalization rates: nominal shocks



Note: These graphs display marginal and supramarginal effective equalization rates computed based on the 2011 tax base values and nominal shocks. The horizontal axis represents the relative fiscal capacity and the vertical axis the value of the equalization rate faced by the municipality.

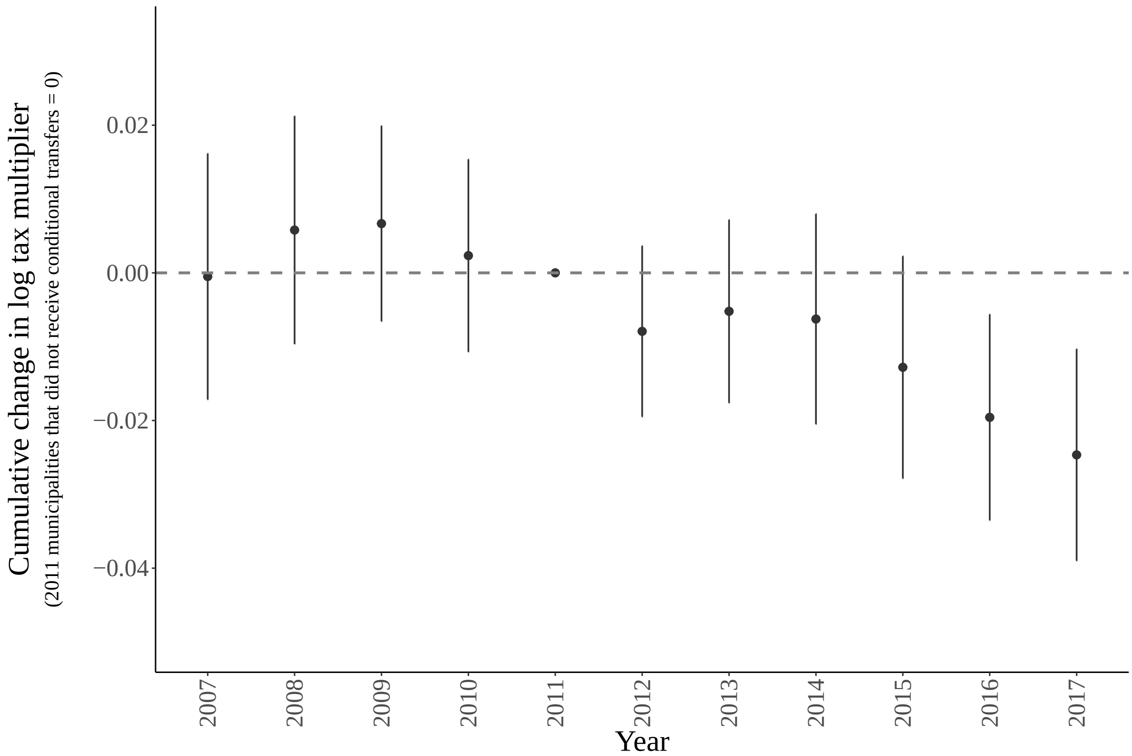
Figure G4: Marginal and supramarginal effective equalization rates: proportional shocks



Note: These graphs display marginal and supramarginal effective equalization rates computed based on the 2011 tax base values and proportional shocks. The horizontal axis represents the relative fiscal capacity and the vertical axis the value of the equalization rate faced by the municipality.

H. Event-study: did the abolishing of conditional transfers change incentives?

Figure H1: Robustness: conditional transfers



Note: This figure shows the coefficients of the event-study regression $log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{t=2007, t\neq 2011}^{2017} \beta_t C_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}$ on the control group, where I compare municipalities that received the class of transfers conditional on the tax multiplier at least once before the reform.

The reform of 2012 changed the conditions for receiving a class of vertical transfers named "Gemeinde mit hoher Gesamtsteueranlage". These transfers were, before 2012, conditional on the tax multiplier being above median and either the road length per-capita or the total surface of the municipality per capita above 80% of median levels. This changed with the reform which removed the condition on the tax multiplier and renamed the transfers "Gemeinde mite übermässigen geo-topografischen Lasten". See C. for more details on vertical and horizontal equalization grants transfers. In order to test whether the abolishing of the conditional nature of these transfers affected the tax-setting incentives of municipalities, I conduct an event-study type of approach on the control group, which did not see a change in their statutory equalization rate (and hence no simultaneous incentives change). I create two sub-groups within the controls: the treated-controls are municipalities which received the class of transfers conditional on the tax multiplier at least once before the reform, and the control-controls which did not. Figure (H1) shows results for the following equation:

$$log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t C_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}, \tag{H.1}$$

where $C_{i,t}$ is an indicator function taking the value 1 for year t and if control municipality i is part of the treated-controls, with the last pre-reform period as the reference year. I include time and municipality level fixed-effects δ_i, ψ_t as well as time varying controls $\mathbf{X}_{i,t}$. Results from Figure (H1) show that except around 2016-2017, the two sub-groups of the control municipalities cannot be statistically differentiated from another. This suggests that the removal of the conditional nature of this class of transfers has little effect on tax-setting incentives of municipalities.

I. Equalization rates: correlation coefficients

Table I1: Correlation matrix of nominal equalization rates - nominal shocks

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***

Note: Statutory equalization rates are 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.

Table I2: Correlation matrix of nominal equalization rates - proportional shocks

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***

Note: 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.

Table I3: Correlation matrix of effective equalization rates - nominal shocks

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***

Note: 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.

Table I4: Correlation matrix of effective equalization rates - proportional shocks

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***

Note: 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.

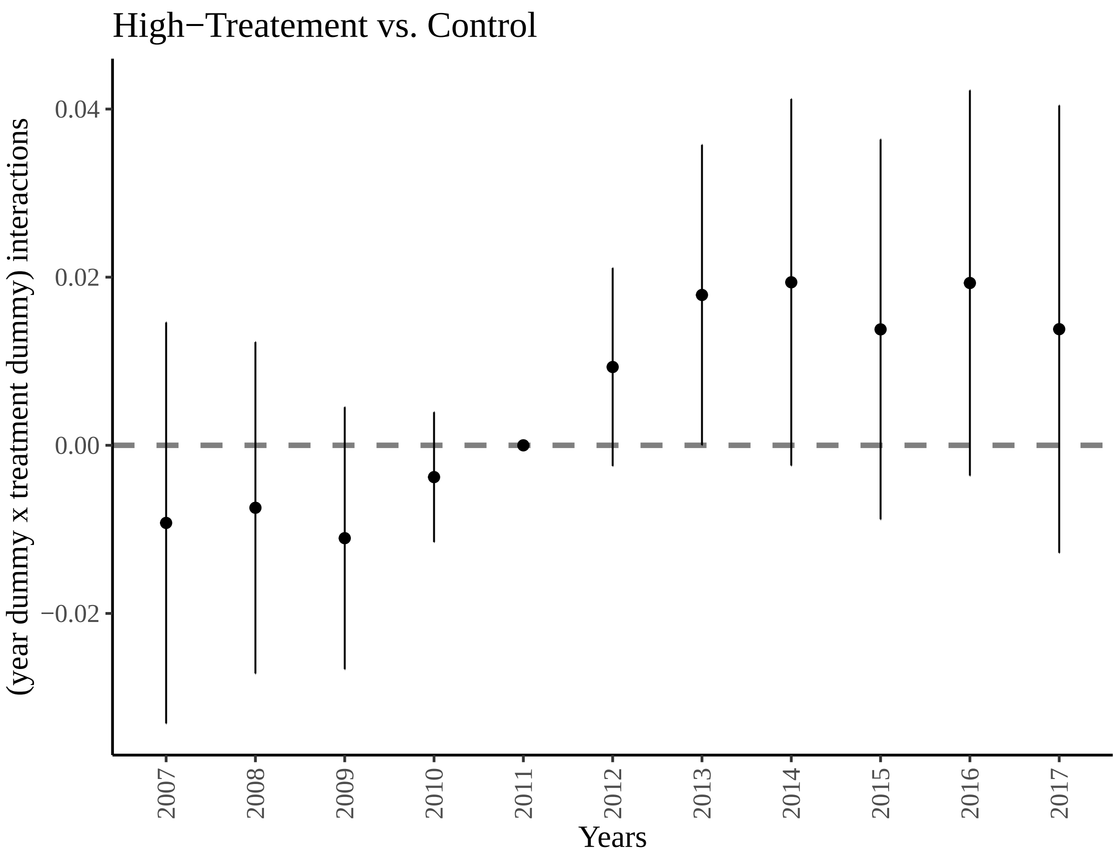
J. Event-study extensions

Table J1: Two-way fixed effects regression results

Dependent variable	$\log(\tau_{i,t})$
$D^T_{i,2007}$	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)

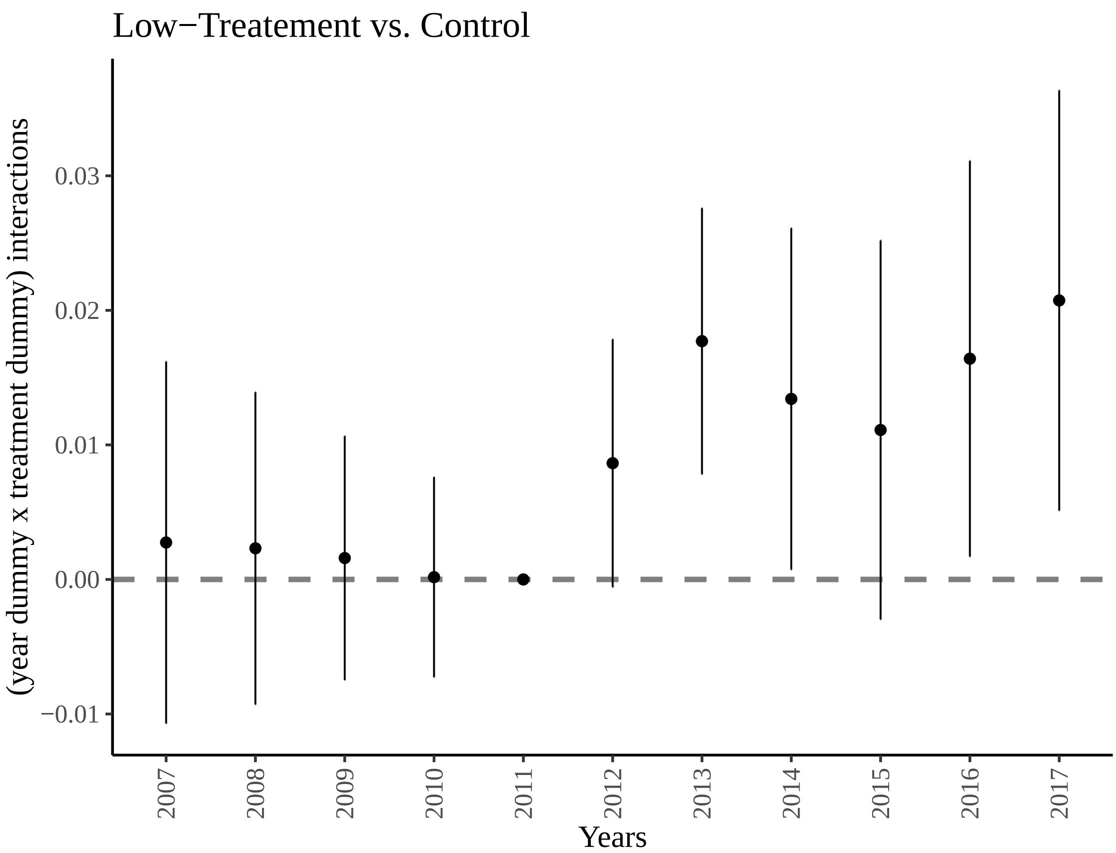
Note: This table gives the β_t coefficients on the regression $log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{t=2007, t\neq 2011}^{2017} \beta_t E_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + e_{i,t}$. Controls $\mathbf{X}_{i,t}$ include share of population, share of foreigners, relative harmonized revenue 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. # of observations: 3135.

Figure J1: Treatment effect dynamics for municipalities receiving the "High-Treatment"



Note: This figure shows the β_t^H coefficients on the regression $log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t^H H_{i,t} + \sum_{\substack{t=2007 \\ t\neq 2011}}^{2017} \beta_t^L L_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + \varepsilon_{i,t}$. $H_{i,t}$ is a dummy taking one if municipality i is in the high-treatment group and $L_{i,t}$ is a dummy taking one if municipality i i in the low-treatment group. Controls $\mathbf{X}_{i,t}$ include share of population, net debt, 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.

Figure J2: Treatment effect dynamics for municipalities receiving the "Low-Treatment"



Note: This figure shows the β_t^L coefficients on the regression $log(\tau_{i,t}) = \psi_t + \delta_i + \sum_{\substack{t=2007 \\ t \neq 2011}}^{2017} \beta_t^H H_{i,t} + \sum_{\substack{t=2007 \\ t \neq 2011}}^{2017} \beta_t^L L_{i,t} + \mathbf{X}_{i,t}\boldsymbol{\gamma} + \varepsilon_{i,t}$. $H_{i,t}$ is a dummy taking one if municipality i is in the high-treatment group and $L_{i,t}$ is a dummy taking one if municipality i i in the low-treatment group. Controls $\mathbf{X}_{i,t}$ include share of population, net debt, 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.

K. Difference-in-difference: placebo regressions

Table K1: Falsification test: placebo treatment year

Dependent variable	$\log(\tau_{i,t})$					
	(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	no	yes	no	yes	no	yes

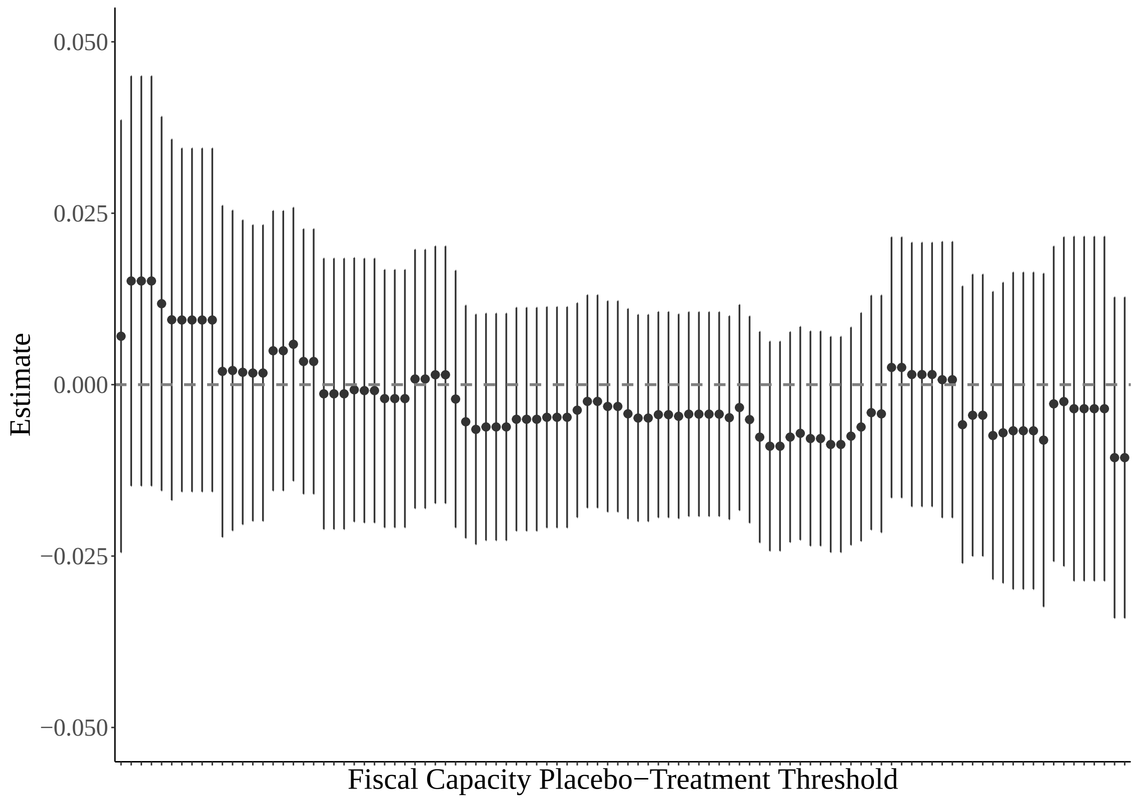
Note: Regression $log(\tau_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t}^T + \mathbf{X}_{i,t}\lambda + \epsilon_{i,t}$ is run on pre-reform years (2007-2011) using 2008, 2009 and 2010 as placebo treatment year. $D_{i,t}^T$ is an indicator function taking 1 for treated municipalities in the post placebo treatment 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, 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. # of observations: 1425.

Table K2: Falsification test: Placebo treatment group

	Dependent variable	
	$\log(m_{i,t})$	
	(1)	(2)
$D_{i,t}$	-0.001	0.006
(placebo-treated × period)	(0.008)	(0.008)
Controls	no	yes

Note: Regression $log(\tau_{i,t}) = \mu_t + \phi_i + \beta_1 D_{i,t} + \mathbf{X}_{i,t}\lambda + \epsilon_{i,t}$ 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, 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. # of observations: 3135.

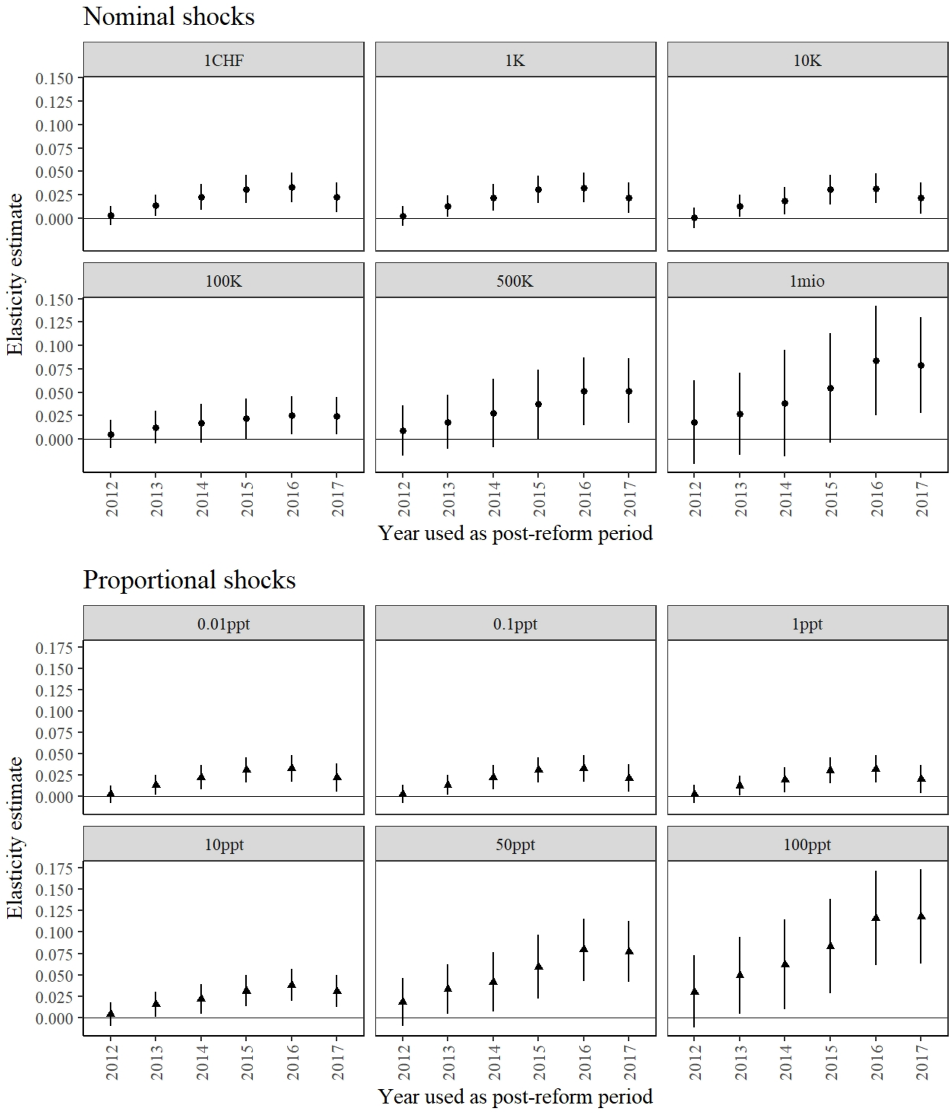
Figure K1: Falsification test: placebo treatment among control units



Note: This figure shows the difference-in-difference estimates from equation (3.5) within the control group, with 100 randomly drawn placebo-treatment thresholds along fiscal capacity. Controls include share of population, net debt, 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.

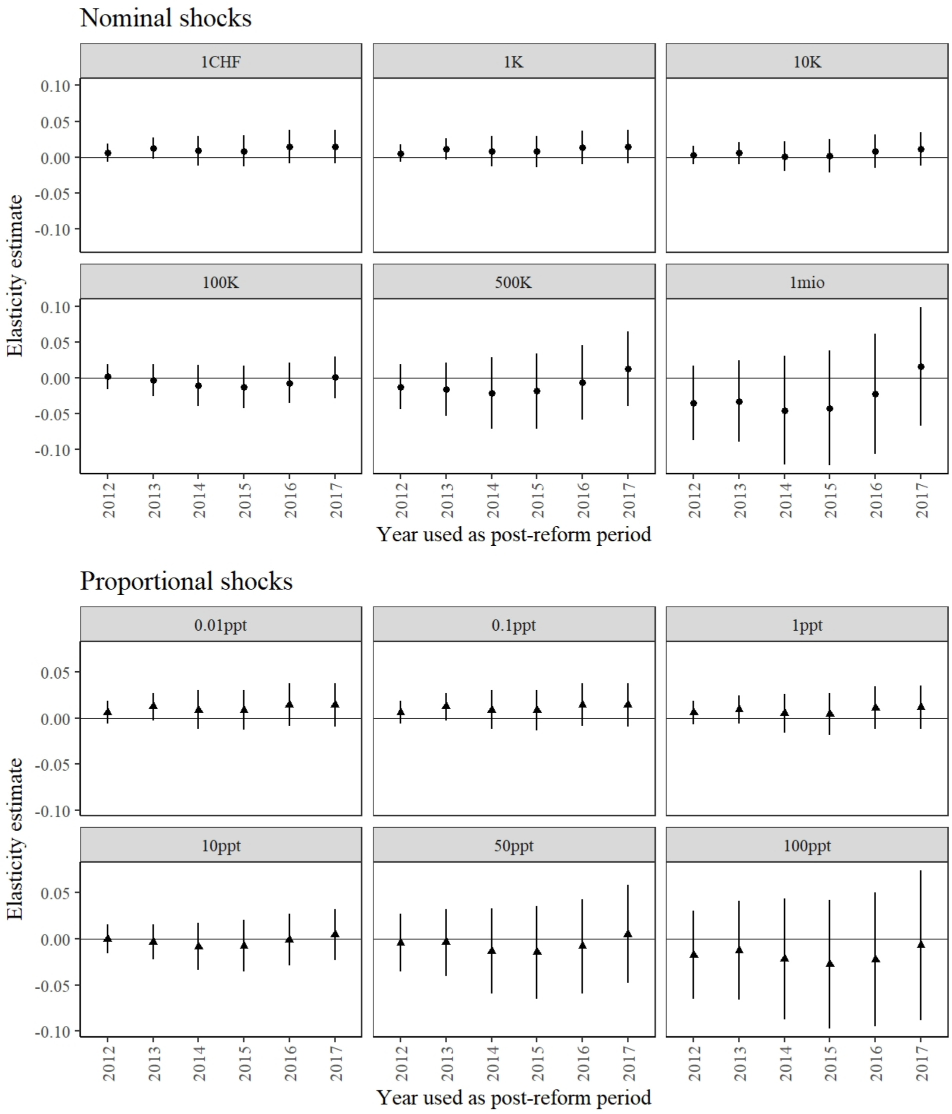
L. Yearly elasticity estimates

Figure L1: Elasticity estimates dynamics: nominal equalization rates



Note: These coefficient plots exhibit elasticity measures on nominal marginal and supramarginal 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 $log(\tau_{i,t}) = \beta_1^1 log(\alpha_{i,t}^{\text{nominal},\delta}) + \beta_2^1 T_{i,t}^{FE} + \mathbf{X}_{i,t}\boldsymbol{\eta^1} + \rho_t + \xi_i + \varepsilon_{i,t}^1$ and $log(g_{i,t}) = \beta_1^2 log(\alpha_{i,t}^{\text{nominal},\Delta}) + \beta_2^2 T_{i,t}^{FE} + \mathbf{X}_{i,t}\boldsymbol{\eta^2} + \rho_t + \xi_i + \varepsilon_{i,t}^2$. I plot here β_1^1.

Figure L2: Elasticity estimates dynamics: effective equalization rates



Note: These coefficient plots exhibit elasticity measures on effective marginal and supramarginal 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 $log(\tau_{i,t}) = \beta_1^1 log(\alpha_{i,t}^{\text{effective},\delta}) + \beta_2^1 T_{i,t}^{FE} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{1}} + \rho_t + \xi_i + \varepsilon_{i,t}^1$ and $log(g_{i,t}) = \beta_1^2 log(\alpha_{i,t}^{\text{effective},\delta}) + \beta_2^2 T_{i,t}^{FE} + \mathbf{X}_{i,t}\boldsymbol{\eta}^{\mathbf{2}} + \rho_t + \xi_i + \varepsilon_{i,t}^2$. I plot here β_1^1. The effective equalization rates are instrumented using their respective counterfactual.

M. Dose-response robustness and extensions

Table M1: 3SLS regressions: nominal equalization rates - including unstable municipalities

Dependent variable:	Δ log($\tau_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Statutory rate							
Δ log nominal equalization rate	0.026**						
	(0.011)						
Δ Net equalization transfers	−0.028						
	(0.021)						
Shock magnitude	Statutory						
Weak instruments test (p-value): α	0.00						
Weak instruments test (p-value): T^{FE}	0.00						
Panel B: Nominal shocks							
Δ log nominal equalization rate		0.026**	0.025**	0.021*	0.020	0.050**	0.063***
		(0.011)	(0.011)	(0.012)	(0.015)	(0.020)	(0.024)
Δ Net equalization transfers		−0.028	−0.028	−0.027	−0.025	−0.023	−0.020
		(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)
Shock magnitude		+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): α		0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00
Panel C: Proportional shocks							
Δ log nominal equalization rate		0.026**	0.026**	0.025**	0.024*	0.056***	0.067***
		(0.011)	(0.011)	(0.012)	(0.014)	(0.021)	(0.023)
Δ Net equalization transfers		−0.028	−0.028	−0.028	−0.026	−0.023	−0.020
		(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Shock magnitude		+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): α		0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.7) on nominal equalization rates estimated on the sample including unstable units. Coefficients on log nominal equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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 share of population, 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. # of observations: 650.

Table M2: 3SLS regressions: effective equalization rates - including unstable municipalities

Dependent variable:	Δ log($\tau_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Nominal shocks						
Δ log effective equalization rate	0.011	0.010	0.004	−0.012	−0.030	−0.090**
	(0.012)	(0.012)	(0.013)	(0.017)	(0.029)	(0.044)
Δ Net equalization transfers	−0.028	−0.028	−0.026	−0.024	−0.023	−0.022
	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.020)
Shock magnitude	+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: Proportional shocks						
Δ log effective equalization rate	0.011	0.011	0.009	−0.005	−0.019	−0.046
	(0.012)	(0.012)	(0.013)	(0.016)	(0.028)	(0.037)
Δ Net equalization transfers	−0.028	−0.028	−0.027	−0.025	−0.024	−0.023
	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.021)
Shock magnitude	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.7) on effective equalization rates estimated on the sample including unstable units. Coefficients on log effective equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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 share of population, 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. # of observations: 650.

Table M3: 3SLS regressions: nominal equalization rates - without most populated jurisdictions

Dependent variable:	Δ log($\tau_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Statutory rate							
Δ log nominal equalization rate	0.031***						
	(0.009)						
Δ Net equalization transfers	−0.035						
	(0.023)						
Shock magnitude	Statutory						
Weak instruments test (p-value): T^{FE}	0.00						
Panel B: Nominal shocks							
Δ log nominal equalization rate		0.031***	0.030***	0.029***	0.027**	0.045**	0.054**
		(0.009)	(0.009)	(0.009)	(0.012)	(0.017)	(0.022)
Δ Net equalization transfers		−0.035	−0.034	−0.034	−0.034	−0.032	−0.030
		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude		+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00
Panel C: Proportional shocks							
Δ log nominal equalization rate		0.031***	0.031***	0.030***	0.034***	0.063***	0.074***
		(0.009)	(0.009)	(0.009)	(0.011)	(0.018)	(0.022)
Δ Net equalization transfers		−0.035	−0.035	−0.035	−0.034	−0.032	−0.029
		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude		+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.7) on nominal equalization rates excluding municipalities of Bern, Thun, Biel and Köniz. Coefficients on log nominal equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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, 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. # of observations: 562.

Table M4: 3SLS regressions: effective equalization rates - without most populated jurisdictions

Dependent variable:	Δ log($\tau_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Nominal shocks						
Δ log effective equalization rate	0.008	0.007	0.002	−0.011	−0.020	−0.059
	(0.012)	(0.012)	(0.013)	(0.017)	(0.030)	(0.047)
Δ Net equalization transfers	−0.036	−0.035	−0.035	−0.033	−0.032	−0.030
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude	+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: Proportional shocks						
Δ log effective equalization rate	0.008	0.008	0.006	−0.006	−0.011	−0.031
	(0.012)	(0.012)	(0.013)	(0.016)	(0.029)	(0.042)
Δ Net equalization transfers	−0.036	−0.036	−0.035	−0.033	−0.033	−0.032
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Shock magnitude	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.7) on effective equalization rates excluding municipalities of Bern, Thun, Biel and Köniz. Coefficients on log effective equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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, 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. # of observations: 562.

Table M5: 3SLS regressions: nominal equalization rates - government spending

Dependent variable:	Δ log($g_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Statutory rate							
Δ log nominal equalization rate	0.003						
	(0.025)						
Δ Net equalization transfers	0.148^{**}						
	(0.064)						
Shock magnitude	Statutory						
Weak instruments test (p-value): T^{FE}	0.00						
Panel B: Nominal shocks							
Δ log nominal equalization rate		0.003	0.004	0.001	0.029	0.060	0.106^{*}
		(0.025)	(0.025)	(0.026)	(0.033)	(0.048)	(0.060)
Δ Net equalization transfers		0.148^{**}	0.149^{**}	0.149^{**}	0.149^{**}	0.151^{**}	0.157^{**}
		(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Shock magnitude		+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00
Panel C: Proportional shocks							
Δ log nominal equalization rate		0.003	0.003	0.004	-0.002	0.020	0.051
		(0.025)	(0.025)	(0.026)	(0.030)	(0.051)	(0.063)
Δ Net equalization transfers		0.148^{**}	0.148^{**}	0.148^{**}	0.148^{**}	0.149^{**}	0.152^{**}
		(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Shock magnitude		+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): T^{FE}		0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.8) on nominal equalization rates. Coefficients on log nominal equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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 share of population, net debt, 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. # of observations: 570.

Table M6: 3SLS regressions: effective equalization rates - government spending

Dependent variable:	Δ log($g_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Nominal shocks						
Δ log effective equalization rate	−0.029	−0.029	−0.043	−0.008	−0.039	−0.058
	(0.034)	(0.034)	(0.035)	(0.047)	(0.084)	(0.132)
Δ Net equalization transfers	0.153**	0.153**	0.155**	0.150**	0.153**	0.152**
	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)	(0.058)
Shock magnitude	+1CHF	+1K	+10K	+100K	+500K	+1mio
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00
Panel B: Proportional shocks						
Δ log effective equalization rate	−0.029	−0.029	−0.032	−0.074*	−0.159**	−0.247**
	(0.034)	(0.034)	(0.035)	(0.043)	(0.081)	(0.116)
Δ Net equalization transfers	0.153**	0.153**	0.154**	0.158**	0.166***	0.167***
	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Shock magnitude	+0.01ppt	+0.1ppt	+1ppt	+10ppt	+50ppt	+100ppt
Weak instruments test (p-value): α^e	0.00	0.00	0.00	0.00	0.00	0.00
Weak instruments test (p-value): T^{FE}	0.00	0.00	0.00	0.00	0.00	0.00

Note: This table shows regression estimates from (3.8) on effective equalization rates. Coefficients on log effective equalization rates can be interpreted as elasticities. Each column in each panel is characterized 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 share of population, net debt, 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. # of observations: 570.