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**Working Paper**

## Fiscal federalism and income inequality: An empirical analysis for Switzerland

Freiburger Diskussionspapiere zur Ordnungsökonomik, No. 19/5

**Provided in Cooperation with:**

Institute for Economic Research, University of Freiburg

*Suggested Citation:* Feld, Lars P.; Frey, Christian; Schaltegger, Christoph A.; Schmid, Lukas A. (2019) : Fiscal federalism and income inequality: An empirical analysis for Switzerland, Freiburger Diskussionspapiere zur Ordnungsökonomik, No. 19/5, Albert-Ludwigs-Universität Freiburg, Institut für Allgemeine Wirtschaftsforschung, Abteilung für Wirtschaftspolitik und Ordnungsökonomik, Freiburg i. Br.

This Version is available at:

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Freiburger **Diskussionspapiere**  
zur Ordnungsökonomik

Freiburg **Discussionpapers**  
on Constitutional Economics

# Fiscal Federalism and Income Inequality: An Empirical Analysis for Switzerland

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## Abstract

This paper analyzes the impact of fiscal federalism on income inequality and redistribution. Economic theory delivers contradicting arguments such that empirical evidence is needed to shed light on the relationship. To obtain such evidence, we rely on the ideal institutional setting of federalism in Switzerland. According to our findings, decentralization actually reduces income concentration if jurisdictional fragmentation is limited. We provide evidence that it is crucial to consider the interdependence of decentralization and fragmentation, since the inequality decreasing effect of fiscal decentralization is counteracted by the interaction with jurisdictional fragmentation. Interestingly, it is not redistribution via progressive taxes that drive our results. Instead, we find significant effects in pre-tax income.

*Keywords:* Federalism, Decentralization, Inequality, Income Concentration, Top Incomes, Redistribution, Switzerland

*JEL:* D31, H23, H77

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We would like to thank the participants of the 2017 Meeting of the European Public Choice Society in Budapest, the ZEW Public Finance Conference 2017 in Mannheim, the Annual Congress of the Swiss Society of Economics and Statistics 2017 in Lausanne, the Workshop on Political Economy 2017 in Silvaplana, the Annual Congress of the International Institute of Public Finance 2017 in Tokyo and the Brown Bag Seminar of the Federal Finance Administration October 2017 in Bern for their very helpful comments.

## 1. Introduction

Recent evidence of rising income inequality has drawn much attention to the determinants of the income distribution. According to an extensive study by the Organization for Economic Co-operation and Development (OECD) the upward trend in inequality in industrialized countries can be attributed to factors such as skill biased technological change, globalization, population ageing, changes in household structures (e.g. assortative mating), labor market liberalization and a reduced effectiveness of redistribution (OECD, 2011). While the OECD focuses on the common trends, there is in fact significant heterogeneity in income inequality among industrialized countries. Atkinson et al. (2011) find that since 1980 top income shares have increased considerably in English speaking countries while continental Europe and Japan exhibit a quite stable development.

Differences in institutions might explain this heterogeneity. Acemoglu and Robinson (2015) address the idea of a general law regarding the development of inequality in capitalist societies. They argue that the effects of economic shocks and opportunities on inequality depend strongly on political and economic institutions as well as their endogenous evolution. Institutions determine the supply of skills, the degree of investment in research and technology, how markets are regulated, how bargaining power is distributed and also to what degree the market outcome is corrected by redistribution. Acemoglu and Robinson (2015) conclude that in order to explain the distribution of income, institutional factors have to be put center stage. This paper follows up on this suggestion by focusing on the influence of one set of constitutional provisions, i. e., fiscal federalism, on inequality.

Traditionally, the theory of federalism assigns redistributional responsibilities to the federal level (Oates, 1972; Musgrave, 1959). Due to the mobility of individuals and firms, sub-federal jurisdictions are not able to implement effective redistribution policies (Stigler, 1957; Oates, 1999). While traditional theory focuses on redistribution via taxation, fiscal federalism might affect the distribution of income via a range of other channels. A decentralized organization of public expenditures involving sub-

federal jurisdictions with genuine autonomy (e.g. in the areas of education, child and health care provision, infrastructure etc.) may lead to more efficient and targeted public goods provision and result in a more equalized pre-tax income distribution. Whether positive or negative effects dominate remains largely an empirical question.

In examining the relationship between fiscal federalism and income inequality, the Swiss institutional setting provides an ideal framework to identify such effects on a sub-federal level. The consistent definition of variables and the treatment of confounding unobservables is a prevalent challenge in cross-sectional studies. Thanks to the common framework within the Swiss federation, such difficulties can largely be avoided by relying on cantonal heterogeneity.

Swiss cantons grant municipalities a varying degree of fiscal autonomy. At the same time, cantons also differ considerably regarding the distribution of income. Thus we may identify the impact of intertemporal changes in fiscal decentralization on inequality by panel regressions for Swiss cantons from 1945 to 2014. Canton fixed effects are implemented to control for time-invariant canton-specific unobservables and year fixed effects for any nationwide time-specific developments.

Our contribution to the literature can be summarized as follows. We measure decentralization between the state and local level by capturing tax revenues over which municipalities have actual autonomy. Importantly, we explicitly assess the interaction of (tax) decentralization with the level of jurisdictional fragmentation of cantons into municipalities. It seems obvious, that the number and size of local jurisdictions is very relevant regarding any effect of their fiscal autonomy. Further, the employed tax data allows for the consistent assessment of inequality over a long time horizon including developments at the very top of the income scale. It also allows for the essential discrimination between the impact on pre- and after-tax incomes as well as the effect on redistribution via progressive taxes. Finally, in order to account for possible endogeneity we propose intertemporal changes in geographical fragmentation as a source of exogenous variation in fiscal decentralization.

Our findings show that (tax) decentralization actually tends to reduce income concentration if jurisdictional fragmentation is limited. Interestingly, this is not the result

of additional redistribution via progressive taxes, since the effects are apparent in pre-tax incomes. Our results further show that the effect of fiscal decentralization crucially depends on the level of fragmentation. If there is a large number of jurisdictions on the sub-state level, decentralization might increase income inequality. Apparently, there is a level of jurisdictional fragmentation beyond which decentralization of tax revenues adversely impact the income distribution.

The remainder of this paper is organized as follows. In section 2 we briefly discuss the theoretical channels as well as previous empirical studies on the effect of fiscal federalism on income distribution. Section 3 describes the institutional background, our data and the model employed. The results of our baseline regressions follow in section 4. In section 5 several robustness tests are discussed and section 6 concludes.

## 2. Literature

In this brief review of the literature on fiscal federalism and its consequences for the income distribution we describe both effects on redistribution as well as on the pre-tax distribution. Additionally, we consider arguments for an interdependence of fiscal decentralization with jurisdictional fragmentation. Finally, we refer to the existing empirical research.

### 2.1. *Effects of Fiscal Decentralization on Redistribution*

In the model by Tiebout (1956) local jurisdictions compete by offering a bundle of public goods for a certain tax price. Income sorting emerges if high-income households reside more frequently in low tax jurisdictions. If different income groups tend to reside in different jurisdictions, fiscal decentralization impedes redistribution between them (Sinn, 2003). Mobility between jurisdictions enables high income earners to avoid progressive taxes and low income earners to move to jurisdictions with generous social benefits. Therefore, Stigler (1957) and Musgrave (1959) recommend to allocate the redistributive function to the level of government where mobility cost are highest.

Pauly (1973) argues however, that redistribution can be considered a local public good. If pure altruism is the reason for citizens to support redistribution, decentraliza-

tion may have an increasing effect on redistribution as residents are more sympathetic to the poor in their vicinity than to distant strangers. Even if the impetus for redistribution is more egoistic, such as the prevention of crime or the protection of real estate value, such motives are clearly geographically limited.

Furthermore, preferences about redistribution might vary considerably among communities. Within homogeneous rural municipalities an egalitarian income distribution might be much more valued than in a diverse urban communities. Also the cost and negative incentive effects of redistribution vary. Basic living cost, the risk of fraud and the effects on labor supply differ considerably between rural and urban jurisdictions. As all of these parameters affect the design of an optimal welfare program, a more decentralized social safety net may be more efficient in reducing inequality.

Finally, as the *Yardstick Competition* framework developed by Besley and Case (1995) shows, decentralization strengthens accountability of politicians. Because of the fundamental principal-agent problem between representatives and their electorate, policy distortions may occur. Redistribution policies may deviate from the actual preferences of voters. Decentralization introduces competition restricting the leeway of politicians at the local level. If, for example, income inequality increases and voters demand more redistribution (Meltzer and Richard, 1981), local representatives might react much more reliably. Otherwise incumbents might be punished in the next election as voters benchmark their performance against neighboring jurisdictions.

## 2.2. *Effect of Fiscal Decentralization on the Pre-tax Distribution*

While fiscal federalism might affect redistribution via taxation and welfare programs, it also impacts the provision of public goods that are relevant for distribution of pre-tax income.

If the benefits and costs of public goods can be restricted to a jurisdiction and there are no economies of scale due to centralization, a decentralized provision of public goods is optimal (Oates, 1999). In accordance with Oates' (1972) *Decentralization Theorem* this allows for a more efficient public goods provision adapted to the preferences and need of the local population. Certain public goods can have important distributional

effects (e.g. education, health provision, child care, public transport). Lower income groups, due to a higher dependency on public goods and basic services, presumably benefit most from efficiency in the public sector, especially by improving their chances to earn sufficient income in the labor market.

Potential caveats of decentralized public good provision are spillovers and externalities among jurisdictions. As local authorities will not take into account effects on neighboring jurisdictions, public goods tend to be underprovided. Therefore decentralization may also increase inequality through an inefficiently low level of public goods. Problems of spillovers and externalities can however be solved either by intergovernmental grants according to Pigou (1920) or by contract arrangements between local governments in the tradition of Coase (1960).

Besides the arguments of static efficiency, there is also a dynamic effect of fiscal federalism. Decentralization enables local jurisdictions to experiment with new forms of public policy. *Laboratory Federalism* will thus generate knowledge about the effectiveness of specific policies from which all jurisdictions benefit (Oates, 1999). With respect to inequality, policies that achieve a more equal pre-tax distribution might prove especially efficient, since they may replace redistribution and avert the corresponding adverse incentives. In a strongly decentralized system, where redistribution via progressive taxation is limited, achieving a more equitable pre-tax distribution seems of particular importance.

### *2.3. Interdependence between Decentralization and Jurisdictional Fragmentation*

While fiscal decentralization determines the degree of autonomy of local governments, fragmentation measures the number or the size of local jurisdictions. Some degree of fragmentation in the lower tiers of government is a necessary condition for decentralization to constitute a meaningful concept (Feld et al., 2010b). In the extreme case of only one local jurisdiction a vertical shift of autonomy from the upper tier to the local government level would be meaningless in terms of meeting local preferences. Accordingly, the *fragmentation hypothesis* by Brennan and Buchanan (1977, 1980) states that the impact of fiscal decentralization on the size of the state depends on the number

of alternative jurisdictions for taxpayers to choose from. It is therefore reasonable to assume that the distributional impact of fiscal decentralization strongly depends on the degree of fragmentation.

Fragmentation can be interpreted as a measure for the degree of competition (Brennan and Buchanan, 1980). A large number of small jurisdictions implies higher mobility of economic units among them. In a Tiebout model with a certain level of fiscal decentralization higher fragmentation increases competitive pressure on jurisdictions. Local progressive taxes, for example, will cause more severe reactions of taxpayers due to lower mobility cost. Generous social benefit schemes on a local level tend to attract more low income households. Thus, decentralized redistribution via taxes or transfers may be undermined by fragmentation.

Similar effects can undermine the provision of public goods. If jurisdictions are small, locally provided goods are more likely to exhibit spillovers and externalities. Increasing returns to scale are more prevalent. Hence, the benefits of decentralization tend to be lower if fragmentation is high. Decentralized public goods with important distributional impacts may be underprovided, particularly hurting low income groups.<sup>2</sup>

#### *2.4. Empirical studies*

According to theory, fiscal decentralization might affect the income distribution via a whole variety of channels. One effect that tends to increase income inequality is income sorting. Several studies for Switzerland actually provide evidence that high income households reside more frequently in low tax jurisdictions (Feld and Kirchgässner, 2001; Hodler and Schmidheiny, 2006; Schaltegger et al., 2011). This tends to inhibit redistribution through progressive income taxes (Roller and Schmidheiny, 2016). Kirchgässner and Pommerehne (1996) and Feld (2000) provide evidence of a limited impact of fiscally induced residence choices on the redistributive capacity of the welfare state. They study aggregate Gini coefficients in the context of tax competition in Switzerland by

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<sup>2</sup>As Tullock (1969) argues, this problem can be overcome if local jurisdictions authorize larger specialized entities with the provision of such services – on the condition that transaction cost are not prohibitive (Olson, 1969).

decomposing them with respect to revenue and expenditure as well as government levels. They find that an equally large share of income redistribution took place at the Swiss federal and the subfederal levels with an increasing share of the subfederal levels between 1977 and 1992. Beyond that theory suggests several inequality reducing channels inhibiting a clear prediction regarding the influence of fiscal federalism on the distribution of income.

So far only few studies have empirically assessed the full distributive effect of fiscal federalism. Based on a mainly cross-sectional analysis of 37 countries Neyapti (2006) finds that revenue decentralization has a decreasing effect on inequality if combined with indicators of good governance. Tselios et al. (2012) analyze the effect of fiscal decentralization in 13 Western European countries from 1995 to 2000. They show that fiscal federalism is associated with less inequality, particularly in regions with lower average incomes. Sepulveda and Martinez-Vazquez (2011) estimate the impact of the subnational share of expenditures based on a panel of 56 developed as well as developing countries covering the period between 1971 and 2000. They find that if the size of government exceeds around 20 percent of GDP, inequality tends to decrease with fiscal decentralization. Combined, these results suggest that as some necessary preconditions are satisfied (a minimal level of the size of government and good governance), fiscal federalism tends to have favorable distributional consequences.

Sacchi and Salotti (2014), however, note that most of the previously employed measures of fiscal decentralization capture the autonomy of subnational governments only imprecisely. Local expenditures for example are often to a significant degree mandated and spent on behalf of the central government. Hence actual fiscal decentralization may be overestimated by the subnational share. Similarly, subnational revenues derive to a considerable degree from transfer and grant payments by the central government. Even tax revenues might be generated by a fixed local share of national taxes completely outside of the autonomy of the local level of government. Sacchi and Salotti (2014) thus assess the different effects of seven more precise indices of fiscal decentralization constructed by Stegarescu (2005). Based on a panel of 23 industrial countries from 1971 and 2000 Sacchi and Salotti (2014) find no significant effects of four different

measures of expenditure decentralization, whereas revenue decentralization increases income inequality according to their results.

Another critical issue in this literature is the measurement of the income distribution. This concerns the income concept as well as the measure of inequality. Previous studies often employ international datasets that mix gross and net household income concepts. While the cross-sectional comparability of such data might be questioned, it is also quite reasonable to assume that the effects on gross incomes differ from the implications on disposable incomes after redistribution. With respect to the inequality index the literature commonly employs the Gini coefficient or other indices of general inequality. However, such aggregate measures may miss to apprehend opposite developments in different sections of the income distribution. In a recent paper Stossberg and Blöchliger (2017) therefore focus on percentile ratios to capture the distributive effects more precisely. Interestingly, they find an inequality increasing effect of fiscal decentralization in the lower part of the distribution (between the first decile and the median) and an inequality decreasing effect in the upper part (between the median and the 9<sup>th</sup> decile).

In this paper we contribute to the empirical literature in several ways. First, we capture fiscal federalism more precisely than previous studies which often do not distinguish between state and local tiers of government but aggregate both into one indiscriminate "subnational" level. In contrast, Swiss federalism allows us to focus on decentralization between cantons (state level) and municipalities (local level). More precisely, our measure captures tax revenues over which local governments have a high degree of autonomy.

Second, we explicitly assess as to how the impact of fiscal decentralization depends on jurisdictional fragmentation. Even though the number and size of jurisdictions is theoretically important, it has – to our knowledge – not yet been tested in the literature on the distributional effects of fiscal federalism.<sup>3</sup>

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<sup>3</sup>Feld et al. (2010b) consider fragmentation (measured by the number of municipalities in a canton) as one of several instruments of fiscal federalism assessing their effect on total government revenues

Third, we take into account a possible endogeneity of decentralization by implementing an instrumental variable approach based on a new instrument. We propose intertemporal changes in geographical fragmentation as a source of exogenous variation in fiscal decentralization.

Fourth, we apply alternative measures of both decentralization and fragmentation in robustness tests. By applying a reform variable for the former, we test a different proxy for *de jure* changes in the allocation of responsibilities between cantons and their municipalities.

Fifth, we capture the income distribution comprehensively. Contrary to previous studies this analysis exploits tax statistics which have several important advantages over survey data.<sup>4</sup> Federal tax data ensures cross-sectional comparability among cantons. Further, it allows for the consistent estimation of income inequality for over a long time horizon (1945 to 2014). This is important in order to assess the lasting impact of institutional factors such as fiscal federalism. Also, based on tax data we are able to cover the very top of the income scale reliably, whereas underrepresentation at the top is a well known weakness of survey data. Additionally, based on Frey and Schaltegger (2016) we are able to discriminate between the effects on pre- and after-tax incomes and we may also assess the impact of fiscal decentralization on redistribution due to progressive income taxes.

### 3. Data and Method

#### 3.1. Institutional Background

Switzerland's federal constitution guarantees widespread autonomy for its lower tiers of government with regard to both the expenditure and revenue side of the budget.

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based on a panel of Swiss cantons from 1980 to 1998. They find a decreasing effect of revenue decentralization on the size of government but no significant effect of fragmentation.

<sup>4</sup>Feld et al. (2010a) also use the tax statistics aggregated at the cantonal level. While their focus is on the effect of direct democracy on income (re-)distribution, they control for fiscal decentralization and tax competition in their econometric models showing a negative effect of fiscal decentralization on redistribution that is, however, only marginally significant.

The 26 cantons independently levy income, corporate or wealth taxes. Municipalities (Switzerland counts 2 222 local jurisdictions as of January 1<sup>st</sup>, 2018) individually decide upon a tax multiplier such that municipal tax rates are the product of the cantonal schedule and the municipal multiplier. This tax structure makes Switzerland one of the most decentralized countries in the world. With a cantonal share of 33 % in 2016 and a municipal share of 21 % of total tax revenue, respectively, Switzerland ranks second behind Canada (subnational share of 56 %).<sup>5</sup>

According to Brülhart et al. (2015) Switzerland additionally features a unique degree of municipal tax decentralization in international comparison based on two measures: the autonomous local tax share and jurisdictional fragmentation. The former denotes the municipal tax revenue that is solely determined at the local level and the latter measures the number of municipalities per 100 000 inhabitants. While some countries score high on one of the measures, Switzerland is the only country exhibiting high values for both measures resulting in the highest potential for tax competition at the municipal level.

The importance of lower government levels is especially pronounced with regard to progressive personal income taxes. In 2016, the cantons' income tax share amounted to 47 %, municipalities took 33 % and the federal government 20 %. This is explained by the fact that indirect taxes such as the VAT make up a more significant part of the federal government's tax revenues whereas cantonal and municipal governments are primarily financed by direct taxes. As a result, the cantonal and municipal tax setting is of considerable importance with respect to redistribution via income taxes. The sub-national level has substantial impact regarding the income distribution also on the expenditure side. Cantons and municipalities are responsible for 98% of health, 91% of education and 55% of social security spending (FFA, 2018).

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<sup>5</sup>OECD Revenue statistics as of September 2019.

### 3.2. Data on income distribution

The data on the distribution of income is based on the Swiss federal tax statistics. Dell et al. (2007) as well as Foellmi and Martínez (2017) employ this data source in order to determine the evolution of top income shares in Switzerland. As the federal income tax is levied by the cantonal tax authorities on their respective territory, consistent income data is available separately for each canton. Schaltegger and Gorgas (2011) use this institutional feature to estimate and compare income concentration on a cantonal level. Frey and Schaltegger (2016) determine the evolution of top income shares after taxes and also the redistributive effect of income taxes. Our analysis is based on their data set.<sup>6</sup> We employ several income distribution measures before as well as after taxes such as the Gini coefficient and the income shares of the top 10, top 5, top 1, top 0.5 and top 0.1 % on the income scale. Furthermore, we use the measure for the redistributive effect of *income* taxes as estimated by Frey and Schaltegger (2016) quantified by the percentage reduction in different inequality measures.

### 3.3. Data on fiscal federalism

Fiscal decentralization is commonly quantified by the share of public revenues and/or expenditures that accrue at the state and/or local level. Relying on expenditures may overstate local autonomy as local spending is, to a significant degree, determined as well as financed by higher tiers of government. Similarly, the share in total revenues may deliver a biased picture due to equalization payments and transfers. Hence, we specifically rely on local tax revenues that are solely determined by local authorities and whose receipts can be spent in line with local preferences. Our variable

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<sup>6</sup>The data set includes so-called special cases (“Sonderfälle”), i. e., high-net-worth immigrants who enjoy special tax treatment. The income variable available in the tax statistics is adjusted gross income (“Reines Einkommen”). It includes social security benefits, in particular old-age pensions, while social security contributions are deducted. Redistribution due to the social security system is thus already included. As the level of benefits is linked to contributions, this mainly constitutes within-household redistribution over the life cycle. However, since benefits are capped while contributions are not, the social security system also implies income redistribution between households. Due to data restrictions, this kind of redistribution cannot be neutralized and is thus included in the pre-tax income variable.

*decentr* is specified as the municipal share of total cantonal and municipal tax revenues. For an overview of the heterogeneity among cantons and over time see figures 1a and 1b. This variable can be interpreted as a *de facto* measure of the autonomy of the local level compared to the cantonal government.

Actual *de jure* autonomy of municipalities is determined by the allocation of public responsibilities between the different levels of government. This allocation is difficult to observe consistently over time and between cantons. As an alternative to identify changes in local autonomy, we may, however, rely on a series of cantonal reforms reallocating public responsibilities from municipalities to cantons. Flèche (2017) based on Rühli (2012) compiles a unique series of cantonal reforms in the time period 2000-2014. According to Flèche (2017), these reforms followed the introduction of both new public management reforms and the new fiscal equalization reform. In anticipation of those national reforms cantons had large incentives to reallocate public functions. Thus, the reforms can be considered exogenous from the perspective of cantons. At the same time, their timing was at the discretion of cantons and depended on the respective legislative process ensuring a quasi-random setting. As these reforms provide variation over a limited period of time and exclusively in the direction of centralization, we refrain from including this variable in our baseline specification. However, we use this variation as an alternative measure of tax decentralization (*centreform*) to test for the robustness of our baseline results in section 5.1.

Jurisdictional fragmentation is measured by the natural log of the number of municipalities per canton (*fragment*). This variable can be interpreted as the number of competitors and thus as the degree of competition among municipalities. The variation in this variable results mostly from within-canton mergers of municipalities. An exception is the secession of a large number of Berne's French speaking municipalities to found the canton of Jura in 1979. This secession substantially reduced the number of municipalities in the canton of Berne. For an overview of the variation in fragmentation see figures 2a and 2b.

Obviously, more populous cantons tend to incorporate more municipalities. Hence, our preferred fragmentation measure assigns more competitive pressure to municipal-

ties in larger cantons. An alternative notion of fragmentation is based on the size of municipalities. According to this view, the more populous the municipalities are the less fragmented is a canton. In section 5.2 we use this alternative fragmentation measure.

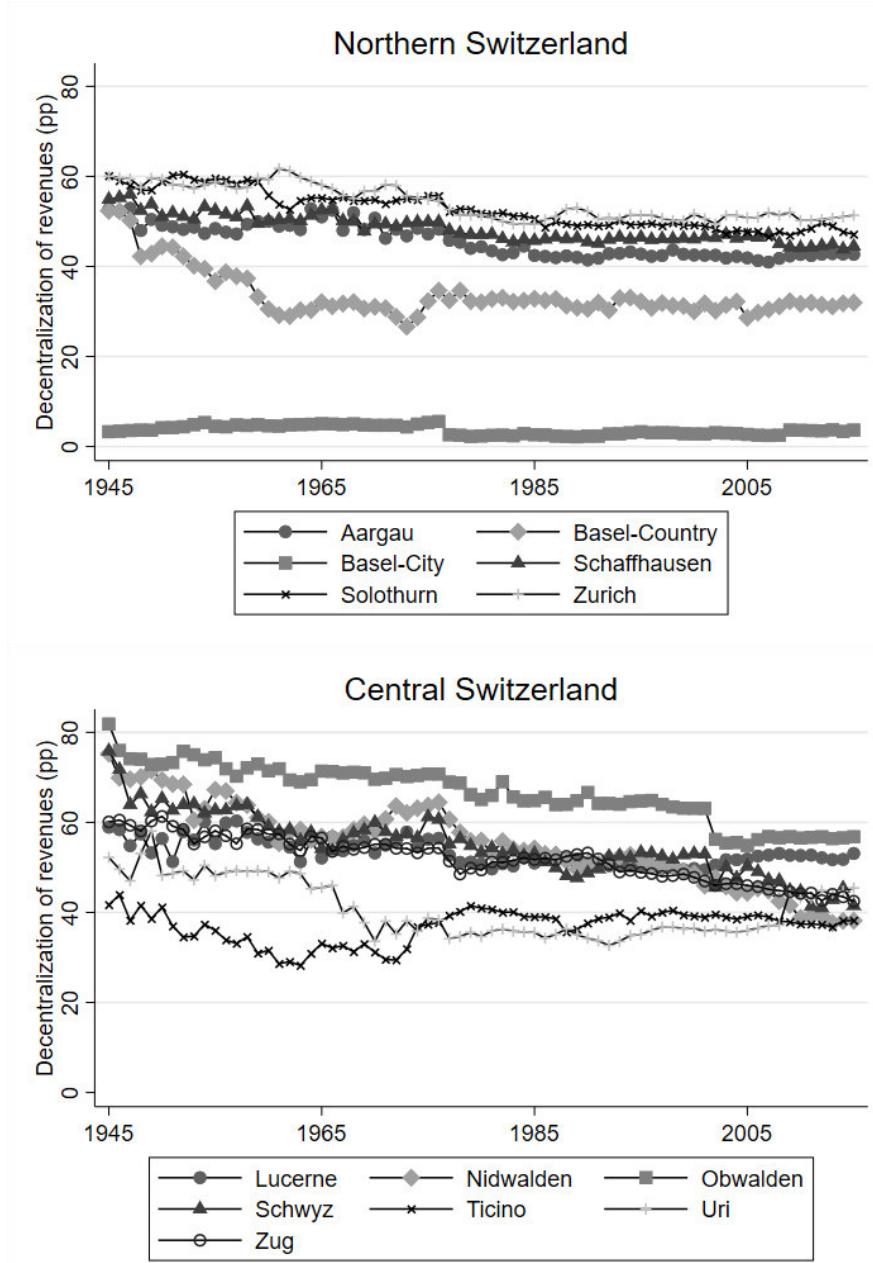


Figure 1a: Decentralization as the municipalities' share of total cantonal tax revenues (pp)

In addition, we account for the competitive and cooperative instruments of fiscal federalism on the cantonal level. As a measure of the cantonal tax burden we include

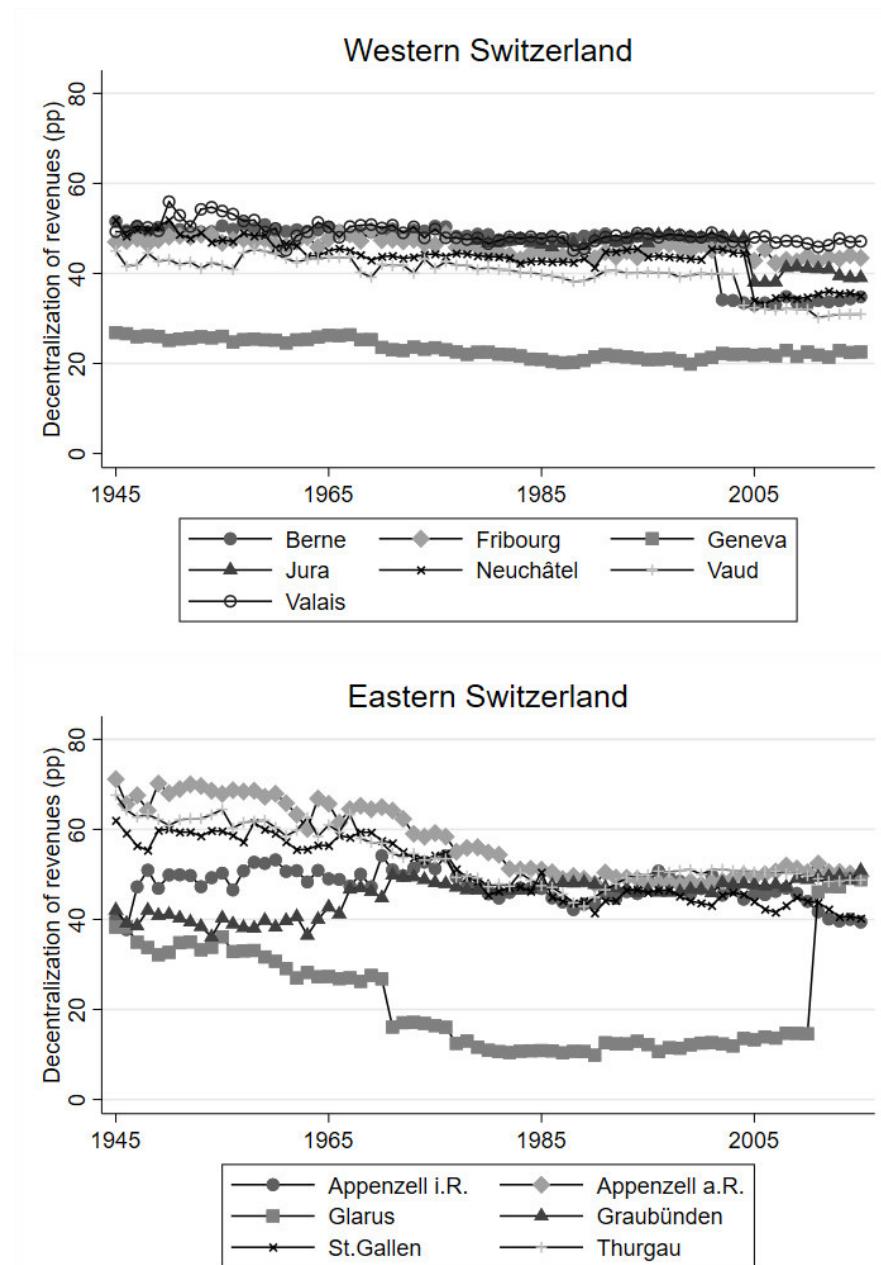


Figure 1b: Decentralization as the municipalities' share of total cantonal tax revenues (pp)

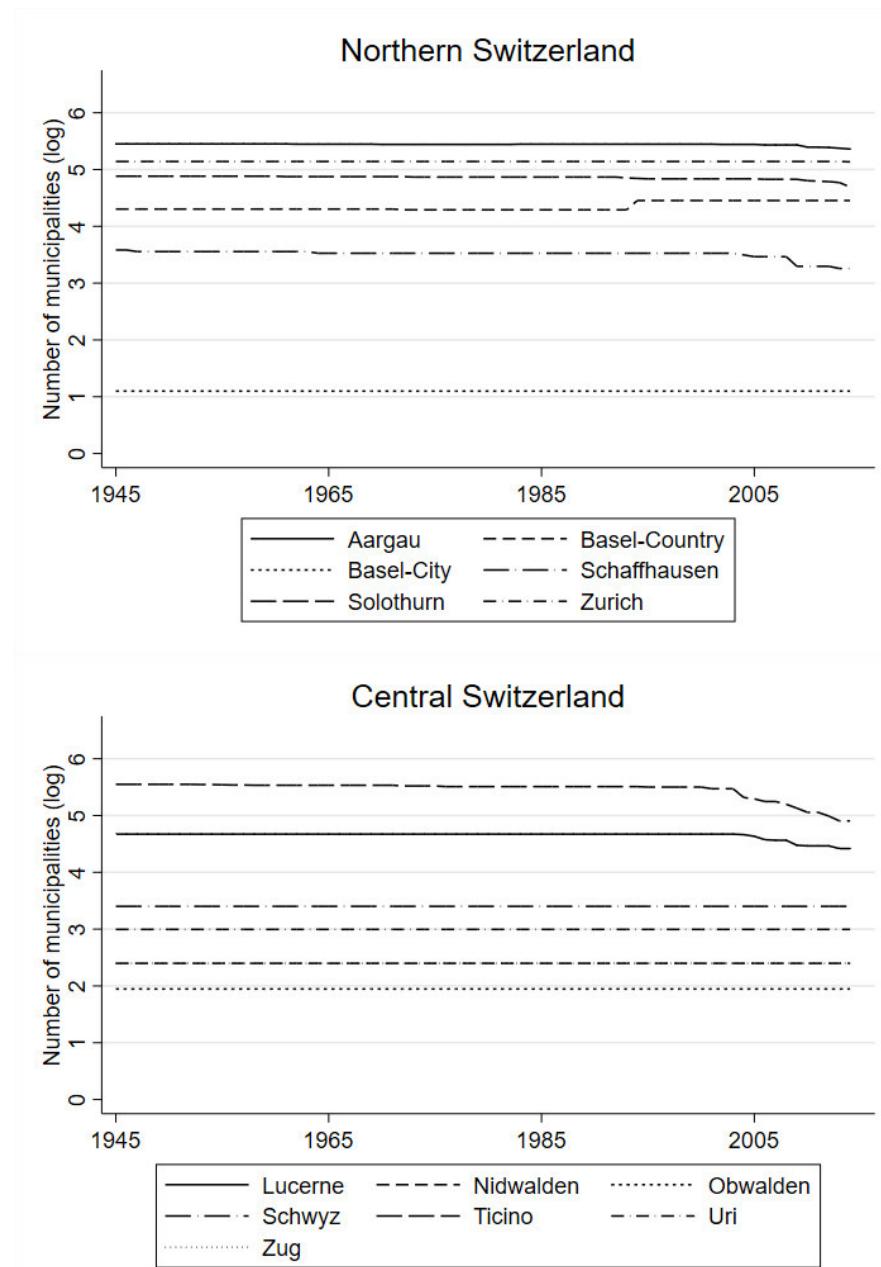


Figure 2a: Fragmentation of cantons (log number of municipalities)

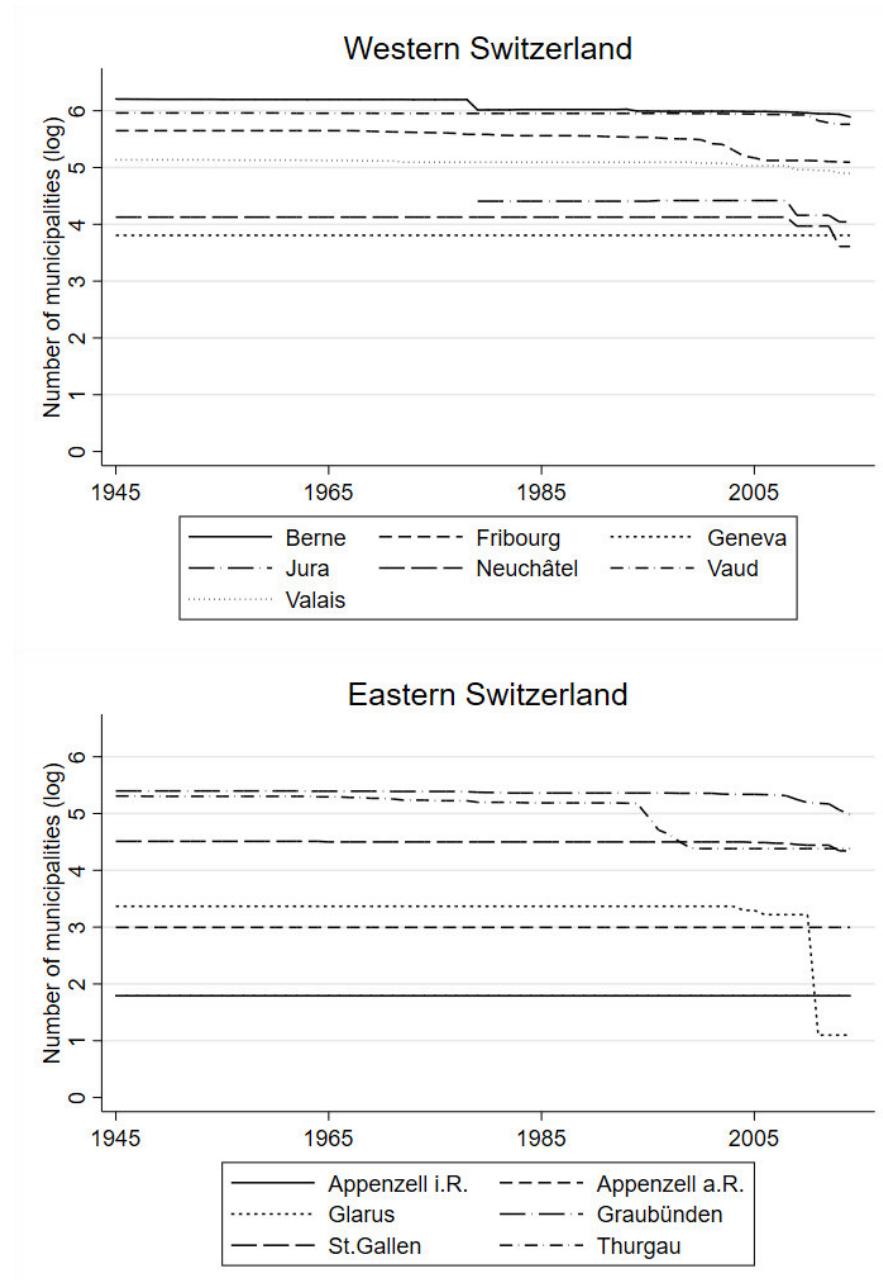


Figure 2b: Fragmentation of cantons (log number of municipalities)

the top marginal tax rate in our analysis (*topmargtax*). This variable is provided by Frey and Schaltegger (2016). It is based on a yearly publication by the Swiss Federal Tax Authorities on sub-federal income taxes in Switzerland (“Steuerbelastung in der Schweiz”). In order to account for tax competition induced by citizens’ mobility, we include a variable based on the top marginal tax rate in the neighboring cantons (*topmargtax\_neighb*). To define this variable we rely on the literature on strategic tax competition and tax mimicking (see Brueckner (2003), Revelli (2003) or Feld and Reulier (2009)). We assume that the influence of tax competition depends on the average tax burden in geographically adjacent cantons.

Finally, horizontal and vertical transfer payments are added to include the cooperative element of federalism into our analysis. We employ the revenues of cantons due to shared federal taxes (*federaltax\_share*). In addition, we assess the horizontal equalization payments due to the fiscal equalization scheme introduced in 1959 and significantly reformed in 2008 (*equalization\_transfers*). And finally, as a third separate variable we include grants from the federal level to the cantons which are earmarked for a certain purpose (*transfers\_earmarked*). All variables are expressed relative to a canton’s own tax revenues in order to capture the degree to which cantonal budgets depend on these transfers.

### 3.4. Econometric Model

Based on this data we estimate the following model,

$$\begin{aligned} \text{inequality}_{i,t} = & \beta_1 \text{decentr}_{i,t-1} + \beta_2 \text{decentr} * \text{frament}_{i,t-1} + \beta_3 \text{frament}_{i,t-1} \\ & + \boldsymbol{\gamma}' \mathbf{X}_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t} \end{aligned}$$

where  $i$  denotes the canton and  $t$  the tax period, respectively. The instruments of fiscal federalism are regressed on inequality before taxes (distribution of gross incomes), redistribution (decline in inequality measures due to progressive income taxes) and inequality after taxes (distribution of disposable income). For each of the three categories we use six variables based on different inequality measures (the Gini coefficient and income shares for the top 10 %, top 5 %, top 1 %, top 0.5 % and the top 0.1 % of the income distribution).

An interaction term is included in order to assess the interdependence of decentralization of tax revenues (*decentr*) and fragmentation (*fragment*). Based on theoretical considerations presented in section 2.3 we conjecture that this interaction effect to be considerable. In order to attenuate problems of reverse causality, following Sacchi and Salotti (2014), decentralization and the the interaction term are lagged for one period (see also section 4.5).

Our set of control variables,  $\mathbf{X}_{i,t}$ , includes competitive and cooperative instruments of fiscal federalism as described in section 3.3 as well as the log of aggregate cantonal income per capita (*inc\_pc*) and its squared term, the log of cantonal population, the unemployment rate (*unempl*), the population share between the age of 20 and 64 (*active\_population*), the crime rate (*crime*), the share of the foreign population (*foreigners*) as well as the share of protestants in the population (*religion*) (see table A.5 in the appendix for descriptive statistics).

For all specifications we include fixed effects for both cantons ( $\alpha_i$ ) and tax periods ( $\delta_t$ ) in order to capture unobservable, constant cantonal features as well as identical effects on all entities in each tax period.<sup>7</sup> The calculated Newey-West standard errors (clustered for canton and period) are robust to heteroscedasticity and autocorrelation (up to three periods). Furthermore, a panel unit root test was conducted for all dependent variables in order to consider non-stationarity. For our purposes the t-test by Pesaran (2007) is suitable because it does not require cross-sectional independence. Given the competitive nature of the federal system in Switzerland independence between cantons with respect to distributional measures based on tax statistics would be a strong assumption. The test's null hypothesis is strict assuming non-stationarity for all series. For the (re-)distribution measures in our sample the null is rejected for all but the Gini series (with up to two lags).

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<sup>7</sup>In 1979 the canton of Jura gained independence from the canton of Berne which we consider by adding an additional fixed effect for Berne after the separation of Jura.

## 4. Baseline Results

### 4.1. Baseline Specification for the Top 10 Percent

Table 1 presents the estimation results of the baseline models. We start with a parsimonious version in columns 1 and 2, regressing the top 10% income share on tax decentralization and fragmentation including only cantonal and period fixed effects as well as income per capita and its squared term as controls. In columns 3, 4 and 5 we add further controls for top marginal tax rates, federal transfer payments and other covariates of inequality respectively. Columns 1 and 2 show that tax decentralization reveals a significant effect only after including an interaction term with fragmentation. This is in accordance with the theoretical expectation that fragmentation has crucial implications regarding the impact of decentralization. Once the interaction is accounted for, the effect of tax decentralization remains quite stable over the different specifications in table 1 (columns 2 to 5). With the inclusion of additional controls the efficiency of the estimation increases.

According to our results, decentralization has a negative effect on top incomes if fragmentation is very low. The negative interaction term tends to counteract this effect with increasing fragmentation. The resulting marginal effects on the top 10% income share are presented in the upper panel of figure 3. The impact of decentralization depends on the number of municipalities per canton which varies between 3 and 362 in the last year of our sample. In accordance with the specification of the fragmentation variable it is represented on a logarithmic scale. If fragmentation is low, additional tax decentralization leads to a significantly reduced income share of the top 10%. Apparently, as the degree of competition at the local level is limited, an increase in the autonomy of municipalities leads to a lower income concentration at the top. The size of the effect is considerable. In a canton with 10 municipalities an increase of 10 percentage points in tax decentralization decreases the top 10% income share by about 2 percentage points. By way of comparison the effect of redistribution via progressive income taxes reduces the income share of the top 10% by around 5 percentage points in the mean of the whole sample. The higher the number of municipalities the lower the

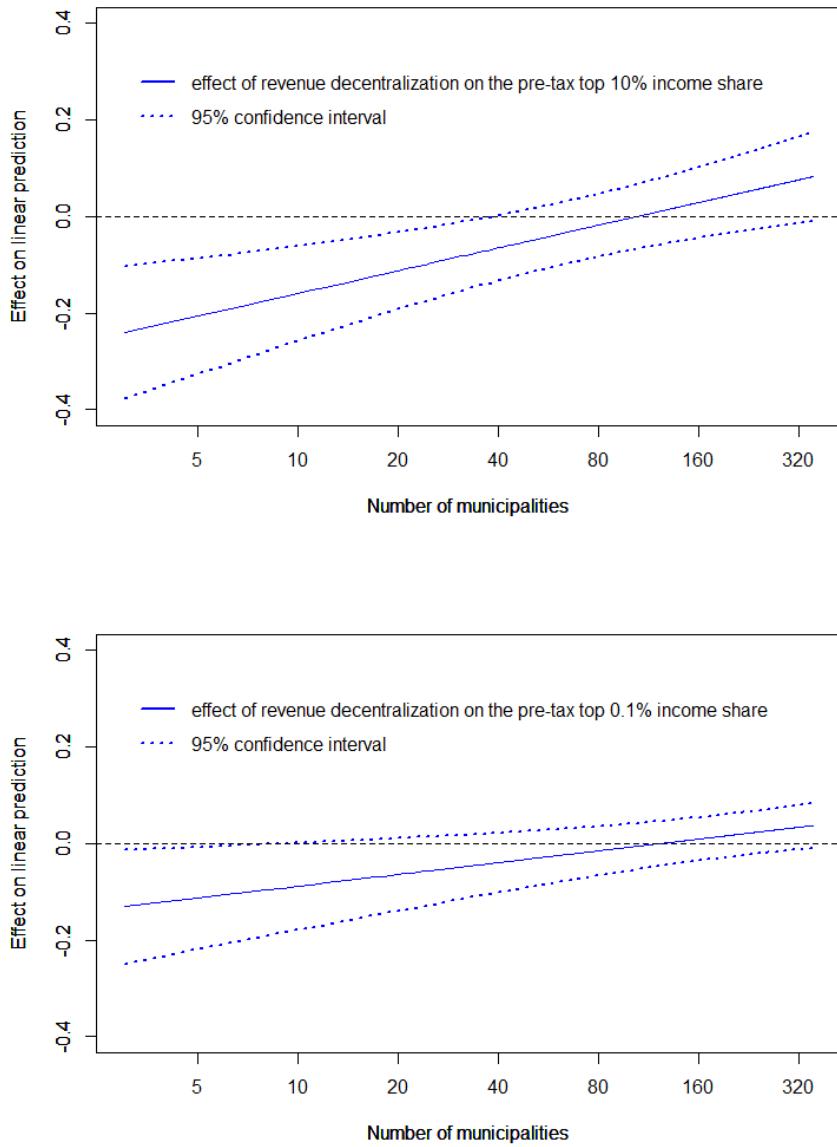
Table 1: Effect of decentralization on the top 10% income share before taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	top10	top10	top10	top10	top10	top10
decentralization(t-1)	-0.048 (-0.96)	-0.264** (-2.15)	-0.272** (-2.46)	-0.269*** (-2.72)	-0.315*** (-3.52)	-0.037 (-1.06)
fragmentationt-1	0.253 (0.28)	-2.906* (-1.74)	-3.096** (-1.99)	-4.618*** (-3.60)	-4.773*** (-3.82)	-0.970 (-1.00)
decentr*fragmt-1		0.057** (2.43)	0.050** (2.18)	0.050** (2.45)	0.068*** (3.42)	
inc_pc	-39.429*** (-9.06)	-40.118*** (-9.87)	-39.144*** (-9.57)	-29.138*** (-6.54)	-27.103*** (-8.05)	-28.171*** (-7.71)
inc_pc2	5.367*** (8.35)	5.374*** (9.17)	5.121*** (9.42)	3.572*** (5.89)	3.048*** (7.45)	3.236*** (6.61)
topmargtax			-0.230** (-2.02)	-0.179** (-2.30)	-0.184*** (-3.38)	-0.200*** (-3.45)
topmargtax_neighb			0.235*** (2.58)	0.249*** (2.66)	0.170** (2.36)	0.170** (2.15)
equalization_transfers				-0.186*** (-2.89)	-0.165*** (-3.04)	-0.184*** (-3.32)
federaltax_share				0.034 (0.92)	0.030 (0.87)	0.009 (0.27)
transfers_earmarked				0.000 (0.01)	0.002 (1.16)	0.001 (0.47)
controls	no	no	no	no	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.378	0.389	0.445	0.511	0.692	0.684
Wald-Test decentr		6.09**	6.09**	7.42**	12.54***	
Wald-Test fragment		6.72**	4.80*	12.98***	15.41***	

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Figure 3: Effect of decentralization on the top 10 percent (upper figure) and the top 0.1 (lower figure) income share subject to fragmentation (pre-tax income)



marginal effect. If the level of fragmentation surpasses 40 municipalities, the marginal effect of decentralization is not significantly different from zero anymore.

The top marginal tax rate and the respective average for neighboring cantons are included in column 3 of table 1 as control variables. High marginal tax rates distort occupational incentives particularly for high income earners and reduce reported incomes. This implies lower measured inequality. By contrast, if neighboring cantons set higher top marginal tax rates, we expect inequality to increase. A more competitive canton is likely to attract and retain high income residents, resulting in higher top incomes. The results are in accordance with these expectations and confirm previous findings regarding the effect of tax competition by Frey et al. (2017).

In column 4 we further add federal transfers payments as proxies for the interjurisdictional solidarity in the federal system. We find that higher revenues from the fiscal equalization scheme are related to a lower top income share. This relationship is unlikely to be the result of a causal effect. Instead the correlation probably arises due to the fact that cantons who lose economic resources (income, wealth and profits) relative to the cantonal mean, receive additional transfers according to the rules of the equalization scheme and at the same time tend to exhibit lower top incomes. However, cantons where income concentration tends to increase also grow richer in economic resources which requires them to pay more into the equalization scheme (negative transfers). Furthermore, we include the cantonal revenues from shared federal taxes as well as earmarked transfer payments from the federation to cantons but find no significant effects. Column 5 finally includes the additional control variables relevant for the development of income inequality as described in section 3.4. In column 6 it becomes apparent that without the inclusion of an interaction term with fragmentation we are not able to capture a significant effect of decentralization. In addition, we report Wald tests for the joint significance of decentralization and fragmentation including their respective interaction terms at the bottom of table 1.

Table 2: Effect of decentralization on income inequality before taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
decentralization(t-1)	-0.349*** (-3.20)	-0.315*** (-3.52)	-0.310*** (-3.15)	-0.272*** (-2.72)	-0.241** (-2.54)	-0.170** (-2.29)
fragmentation(t-1)	-5.326*** (-3.31)	-4.773*** (-3.82)	-4.716*** (-3.84)	-4.259*** (-3.61)	-3.785*** (-3.42)	-2.720*** (-3.10)
decentr*fragment(t-1)	0.096*** (3.66)	0.068*** (3.42)	0.067*** (3.38)	0.060*** (3.18)	0.052*** (2.97)	0.035*** (2.68)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.730	0.692	0.572	0.433	0.394	0.328
Wald-Test decentr	13.6***	12.5***	11.4***	10.7***	9.4***	7.9**
Wald-Test fragment	13.8***	15.4***	15.3***	13.2***	11.7***	9.6***
pivot municip	38	104	97	94	105	122

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

#### 4.2. Results for Different Inequality Measures

In table 2 the results of the baseline specification (column 5 in table 1) are presented for six different inequality measures of gross income as the dependent variable. Column 1 shows the effects on the Gini coefficient. Tax decentralization reduces the general level of inequality if fragmentation is very low. Again the interaction with fragmentation counteracts this effect. Compared to the effect on the top 10 % depicted in the upper panel of figure 3, the interaction exerts a stronger influence on the general level of inequality. The effects of decentralization on the incomes of the top 5 to 0.1 % are largely in line with the effects for the top 10 % regarding both direction and significance.

In order to facilitate the interpretation of the effect of decentralization we include pivot values of fragmentation at the bottom of table 2. They illustrate for which number of municipalities the point estimate of the marginal effect of decentralization is zero, because the diminishing effect of the decentralization is canceled out by the interaction with fragmentation. At higher levels of fragmentation the marginal effect of decentralization is positive. For the top income shares we find high pivot values around 100 municipalities, whereas the point estimate for the Gini coefficient is zero at 38 municipalities meaning that additional decentralization significantly increases the Gini coefficient even if fragmentation is moderate.

#### *4.3. Results for After-Tax Incomes*

So far we have assessed the effect of decentralization on the distribution of pre-tax incomes. Table 3 presents the findings with regard to the effects on inequality in after-tax incomes. The model matches our preferred specification (column 5 in table 1). The results are very similar to the findings regarding pre-tax income in table 2. If fragmentation is very low, we find that tax decentralization reduces inequality consistently for all the measures applied. As before however, the interaction term with fragmentation counteracts this effect. Figure 4 illustrates the marginal effects of tax decentralization for the Gini coefficient and the top 10 % in after-tax income. The effects are again quite similar to the marginal effects found for pre-tax income inequality. If fragmentation exceeds a certain threshold, decentralization might even have a significantly increasing effect on inequality. Again, pivot values of a zero marginal effect are relatively low for the Gini specification (41 municipalities per canton) and significantly higher for the top income shares (above 100). Generally, the pivot values for the marginal effect on after-tax inequality (in the lower part of table 3) are higher than in the estimations for pre-tax incomes (in table 2). Hence, the inequality increasing interaction effect of decentralization and fragmentation is less pronounced with regard to after-tax income inequality.

Figure 4: Effect of decentralization on the top 10 percent (upper figure) and the top 0.1 (lower figure) income share subject to fragmentation (after tax income)

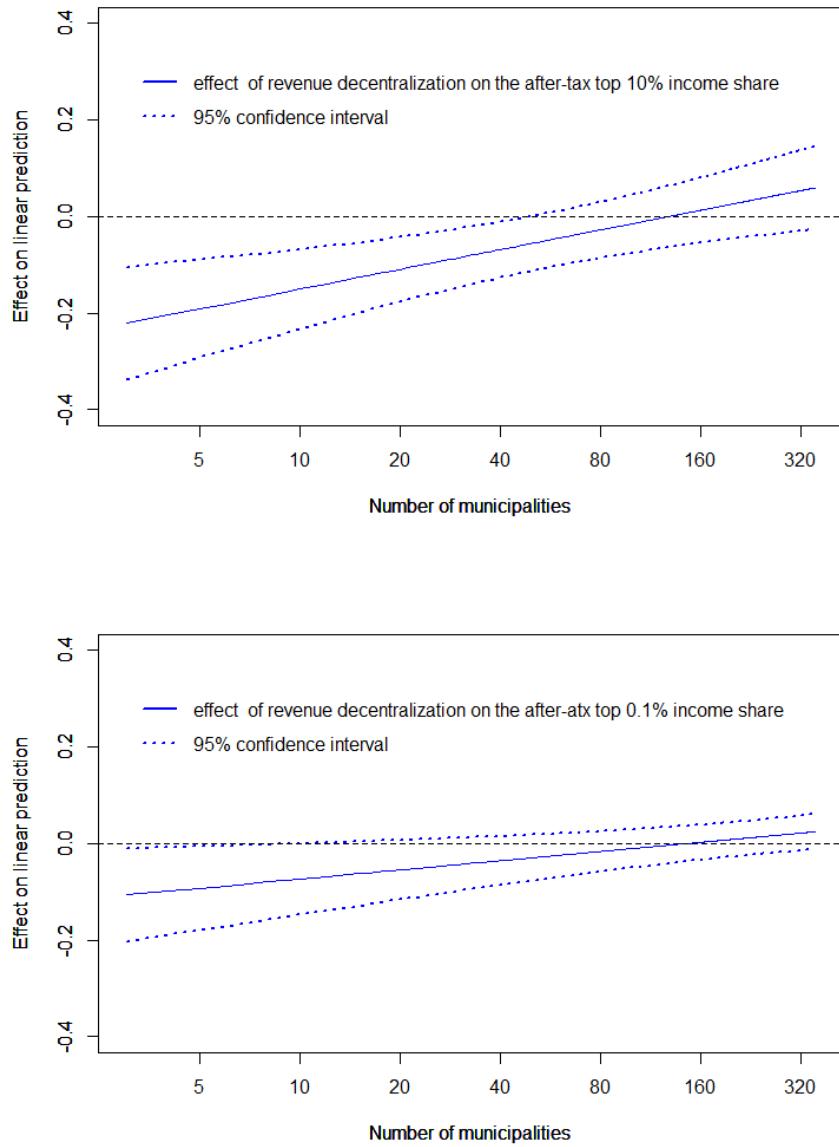


Table 3: Effect of decentralization on income inequality after taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.346*** (-3.20)	-0.286*** (-3.69)	-0.278*** (-3.31)	-0.236*** (-2.84)	-0.204*** (-2.59)	-0.137** (-2.27)
fragmentation(t-1)	-5.071*** (-3.31)	-4.358*** (-4.06)	-4.422*** (-4.21)	-3.855*** (-3.81)	-3.335*** (-3.54)	-2.262*** (-3.13)
decentr*fragment(t-1)	0.093*** (3.56)	0.059*** (3.29)	0.058*** (3.40)	0.051*** (3.25)	0.043*** (2.98)	0.027*** (2.60)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.750	0.707	0.592	0.447	0.401	0.323
Wald-Test decentr	12.8***	13.8***	11.8***	10.9***	9.3**	7.3**
Wald-Test fragment	13.3***	16.9***	18.3***	15.0***	12.7***	9.8***
pivot municip	41	128	121	107	115	144

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

#### 4.4. Results for Redistribution

The interaction between decentralization and fragmentation seems to exert a somewhat weaker effect on after-tax than on pre-tax incomes. This might imply an effect of decentralization on redistribution via income taxes. In a next step, we check for such effects directly. As explained above redistribution is defined as the relative reduction in inequality measures due to progressive income taxes. This measure can be interpreted as a redistributive tax burden. The model is again based on our preferred specification in column 5 of table 1. The top marginal tax rate is omitted however, given its close link to the dependent variables of redistribution. Instead variables for the distribution of pre-tax incomes are included. Inequality affects the redistributive impact of a progressive tax schedule as well as the preferences for redistribution of voters (see for example Meltzer and Richard (1981)).

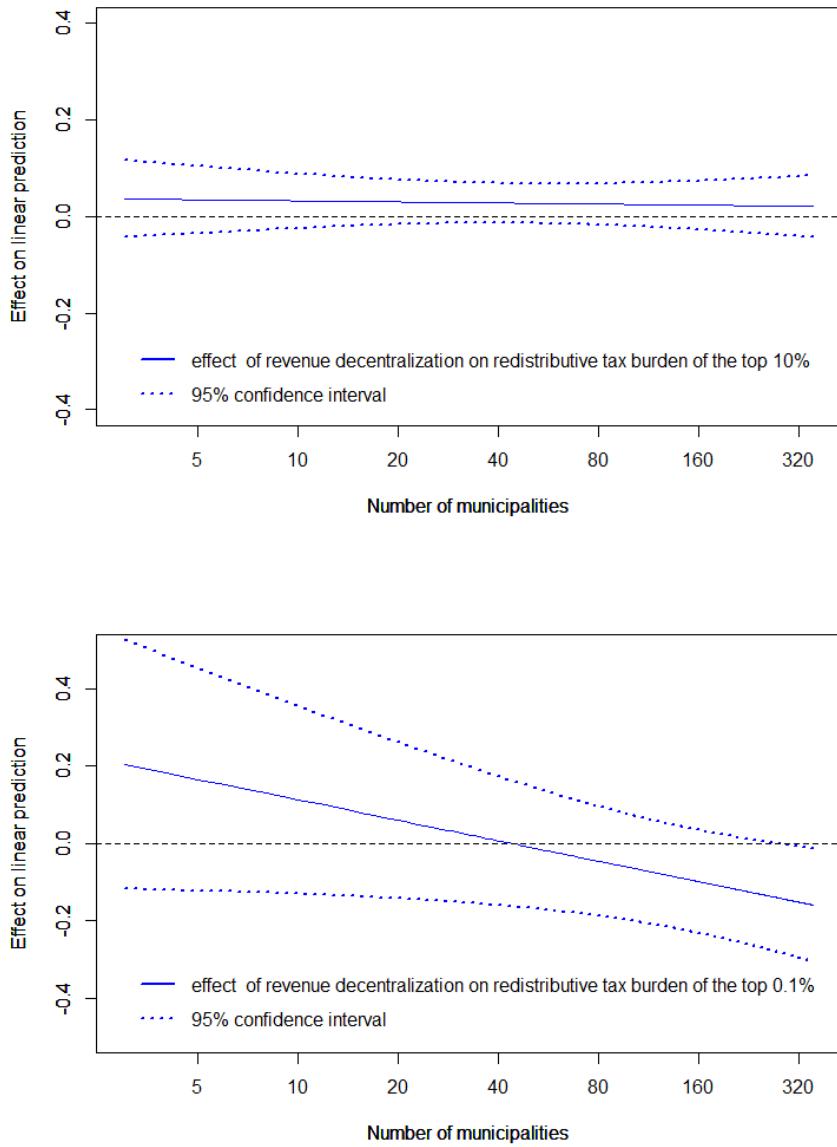
Table A.6 presents the results. We find no significant effects of decentralization on the general level of redistribution measured by the Gini coefficient as well as the redistributive tax burden of the top income earners. The marginal effects for the top 10 and top 0.1 % are depicted in figure 5. Even for the very top incomes they reveal insignificant effects of tax decentralization on redistribution subject to fragmentation.

Interestingly, a higher Gini coefficient leads to significantly less general redistribution (column 1). Also, a higher concentration of incomes at the top tends to diminish the progressive effect of the tax system (columns 2-6). This effect could be explained by an increased political influence of top earners due to the higher income concentration.

#### 4.5. Instrumental Variable Approach

The identification of the effect of fiscal federalism on income inequality is potentially affected by endogeneity problems. We cannot rule out a causal effect in the reverse direction. A reform of fiscal (de)centralization may be induced by developments in inequality. To address possible endogeneity of tax decentralization we implement an instrumental variable model.

Figure 5: Effect of decentralization on redistribution at the top 10 percent (upper figure) and the top 0.1 percent (lower figure) subject to fragmentation



#### 4.5.1. Federal Tax Harmonization

Valid instruments need to be correlated with tax decentralization and orthogonal to the error term of our main regression. Potential instruments are significant policy reforms in the federal and cantonal system of public finances which affect cantonal taxation heterogeneously but do not affect cantonal income inequality. As a first instrument we employ a dummy variable that accounts for the cantonal implementation of the federal tax harmonization law (*taxharm*). This legislation forced cantons to implement a new harmonized definition of the tax base. It was enacted into federal law in 1990. However, cantons were given leeway regarding implementation and introduced the new tax base in different years between 1995 and 2003. Hence, the dummy variable is no year fixed effect, but varies across time.

Harmonization of the tax base restricted tax competition between cantons to the tax schedule. Reduced flexibility regarding the tax base generally decreases competitive pressure. As a result, we expect cantonal tax revenues to increase. At the same time, the law has no effect on tax competition among municipalities, since within cantons the tax base is already harmonized. Hence, cantons should retain a larger share of tax revenues relative to municipalities. Our results confirm this: The implementation of the tax harmonization law exerts a significantly negative effect on tax decentralization within cantons (see table A.8). The instrument seems to be relevant.

While the cantons were forced by federal law to harmonize the tax base, autonomy concerning the progressivity was not affected. Hence, we may well assume that the law did not affect the income distribution (exclusion restriction). Including the tax harmonization variable as a regressor does not improve the explanatory power of our model of inequality. Further, as the new rules were determined at the federal level, we may exclude any reverse effects from inequality within cantons.

#### 4.5.2. Geographical Fragmentation

Another potential source of exogenous variation of fiscal decentralization is geography (Canavire-Bacarreza et al., 2017). In countries with a diverse physical geography distinct parts of the population may live under different conditions. As a result, demand

for public goods and services can differ considerably between regions. Requirements for public and private transport infrastructure depend on the natural environment. The optimal provision of health and education services is certainly very different in large agglomerations relative to sparsely populated mountainous areas. Thus, if a country is geographically very diverse, the efficiency gains of fiscal decentralization are greater. Furthermore, long distances between local populations in geographically large countries probably inhibit centralization forces. Panizza (1999) and Arzaghi and Henderson (2005) present theoretical models of the effects of geography on fiscal decentralization.

Canavire-Bacarreza et al. (2017) test such effects empirically. They measure geographical fragmentation by the probability that two random individuals' live in different altitudinal zones, weighted by the altitude distance between their places of residence. They provide evidence for a significant positive effect of this fragmentation measure on fiscal decentralization. Further, they also find a positive effect of the size of an area as well as the interaction between area and the altitude distances.

Obviously, physical geography is fixed across time and does not help identifying intertemporal effects of decentralization. Human geography, however, varies over time. As settlements develop, so does the dispersion of the population in geographical space. In Switzerland one can observe progressive urbanization, an expansion of agglomerations, stagnation in small rural communities and a depopulation of remote alpine valleys. Those dynamics induce intertemporal variance regarding the geographical dispersion of cantonal populations.

We intend to capture this variation by employing an intertemporal version of the geographical fragmentation measure of Canavire-Bacarreza et al. (2017). Basically, we add up altitude distances between all the municipalities in a canton, weighting each distance by the share of the population living in the respective municipalities in a certain year. In addition, we multiply this total altitude distance by the normalized area of a canton. The measure is calculated as follows:

$$geofrag_{ct} = \frac{area_k}{area_{k_{max}}} \sum_{j=1}^J \sum_{i=1}^N \left( w_{ij} \frac{n_{it}}{N_{ct}} \right)^2$$

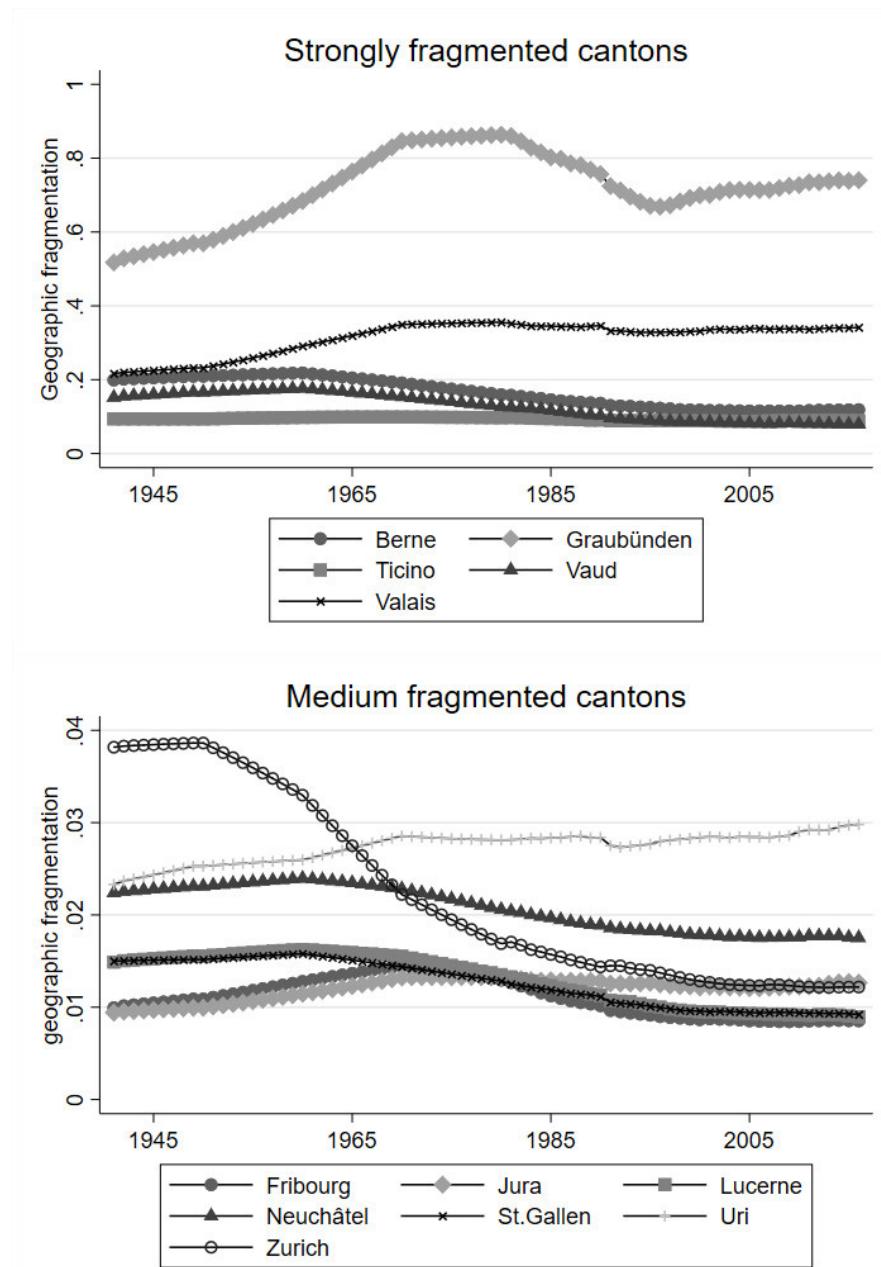


Figure 6a: Geographical fragmentation of the cantonal population

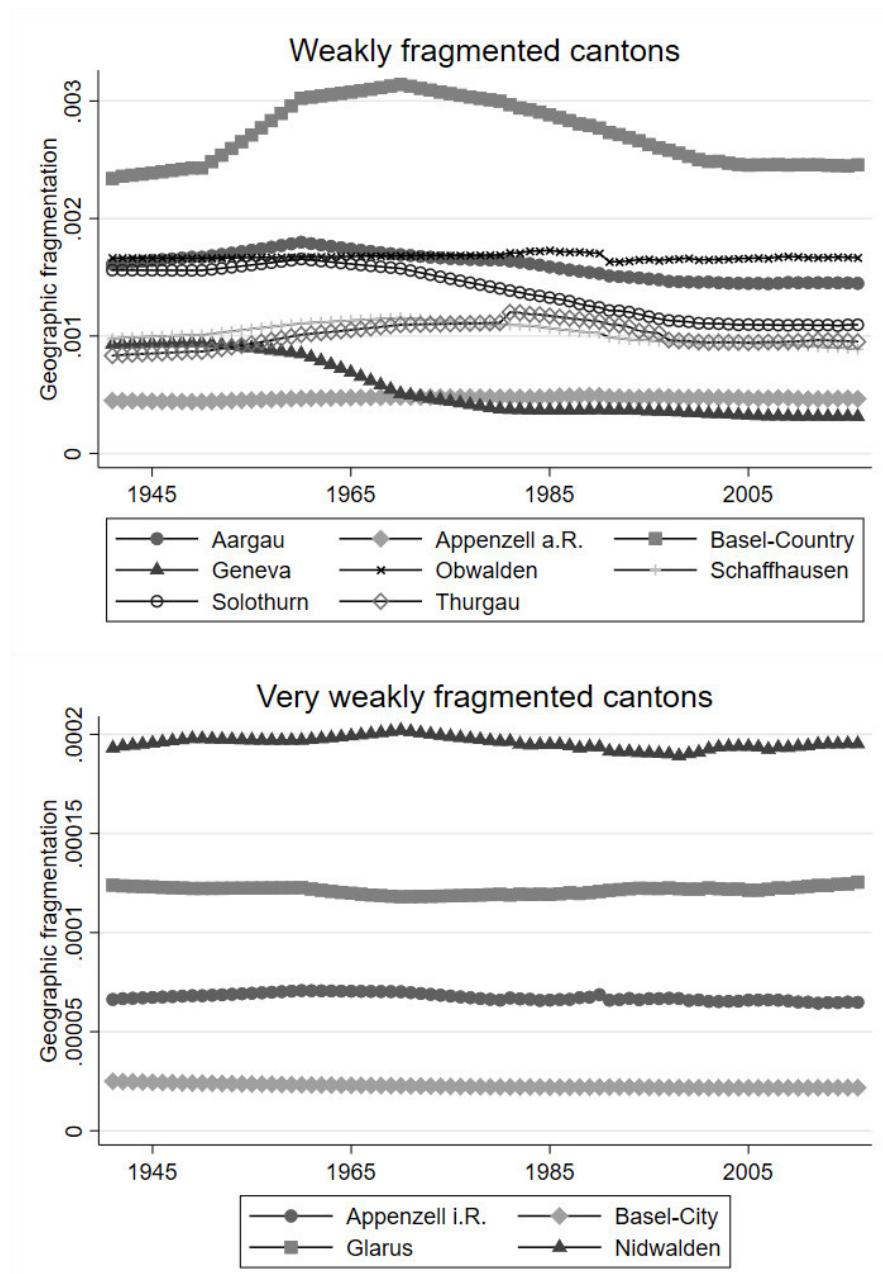


Figure 6b: Geographical fragmentation of the cantonal population

where the fraction  $n_{it}/N_{ct}$  denotes the share of municipality  $i$  of canton  $c$ 's total population at time  $t$  and  $w_{ij}$  is the altitude distance between municipality  $i$  and  $j$ , i. e., the difference in elevation between the two municipal centers.<sup>8</sup>  $area_{k_{max}}$  is the size of the canton with the greatest expansion.<sup>9</sup>

The development of geographical fragmentation is depicted in figures 6a and 6b. The intertemporal variation results from municipal differences in the population growth. The cantons of Zurich and Geneva show a distinctive decrease in geographical fragmentation since about 1950. This can be explained by disproportional growth of one respective city decreasing aggregate altitude distances between individuals. In contrast, the cantons of Graubünden and Basel-County show increasing geographical fragmentation after 1950, as municipalities in both upper and lower altitudes grew disproportionately.

We use this geographical fragmentation measure as a second instrument. Geographical dispersion of a cantonal population increases the heterogeneity in demand for public goods. Thus, we expect the measure to be positively correlated with fiscal decentralization. This is confirmed by the first stage yielding a significant positive effect of geographical fragmentation on decentralization (see table A.8). This instrument is thus relevant.<sup>10</sup>

Regarding the exclusion restriction we face a challenge common to the empirical literature on decentralization. Any institutional arrangement is the result of very complex historical and societal processes severely complicating the search for a truly exogenous instrument. In our case we need to rule out any effect from intertemporal changes in geographical fragmentation on the development of inequality that does not operate via fiscal decentralization. While a direct effect is implausible, omitted variables related

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<sup>8</sup>Municipal centers refer to a church, square, intersection or administration building in a municipality's main town. We rely on location data from 2016 and take into account all municipal mergers since 1945. This means for all the years before the merger we add up the populations of those municipalities which at some point until 2016 merge into one. Thus the measure for geographical fragmentation remains independent of municipal mergers.

<sup>9</sup>Graubünden is the largest canton with an area comprising 7 105 km<sup>2</sup>.

<sup>10</sup>Reduced form results are reported in table A.10 in the appendix.

to both income inequality and geographical dispersion may cause a bias. To account for this, we include a large number of control variables such as the top marginal tax rate, the tax rate of neighboring cantons, the size of the population, the unemployment rate, the age structure, the share of foreigners as well as fixed effects controlling for any time-invariant cantonal characteristics. By controlling for these forces we are able to rule out the problem of omitted variables to a large extent and thus we may assume the exclusion restriction to hold.

Moreover, we are confident to be able to rule out reverse effects from changes in inequality to geographical fragmentation. An increase in inequality might induce higher land prices and thus gentrification of preferred housing areas. Yet the replacement of one population by another and is very unlikely to affect the aggregate geographical dispersion of the population.

#### *4.5.3. Results of the IV model*

We use the two variables on the implementation of the tax harmonization law and the measure for geographical fragmentation to instrument for tax decentralization. Furthermore, we employ interactions of these instruments with fragmentation in order to instrument for the interaction of tax decentralization with fragmentation. The second-stage results of the IV-model are reported in table 4 for pre-tax table and A.9 for after-tax inequality. Based on the Kleibergen-Paap rk F statistic we can reject underidentification. Further, the Hansen J test of the overidentifying restrictions cannot reject the exogeneity of our instruments for all estimations except for the Gini-coefficent as the dependent variable.

The second-stage results confirm our previous findings for inequality before and after taxes. The basic pattern of the results remains very consistent with our previous estimations for all six measures of inequality (see also figure 7). We again find a reducing effect of decentralization if fragmentation is very low. As in the baseline model the interaction between decentralization and fragmentation counteracts these effects.

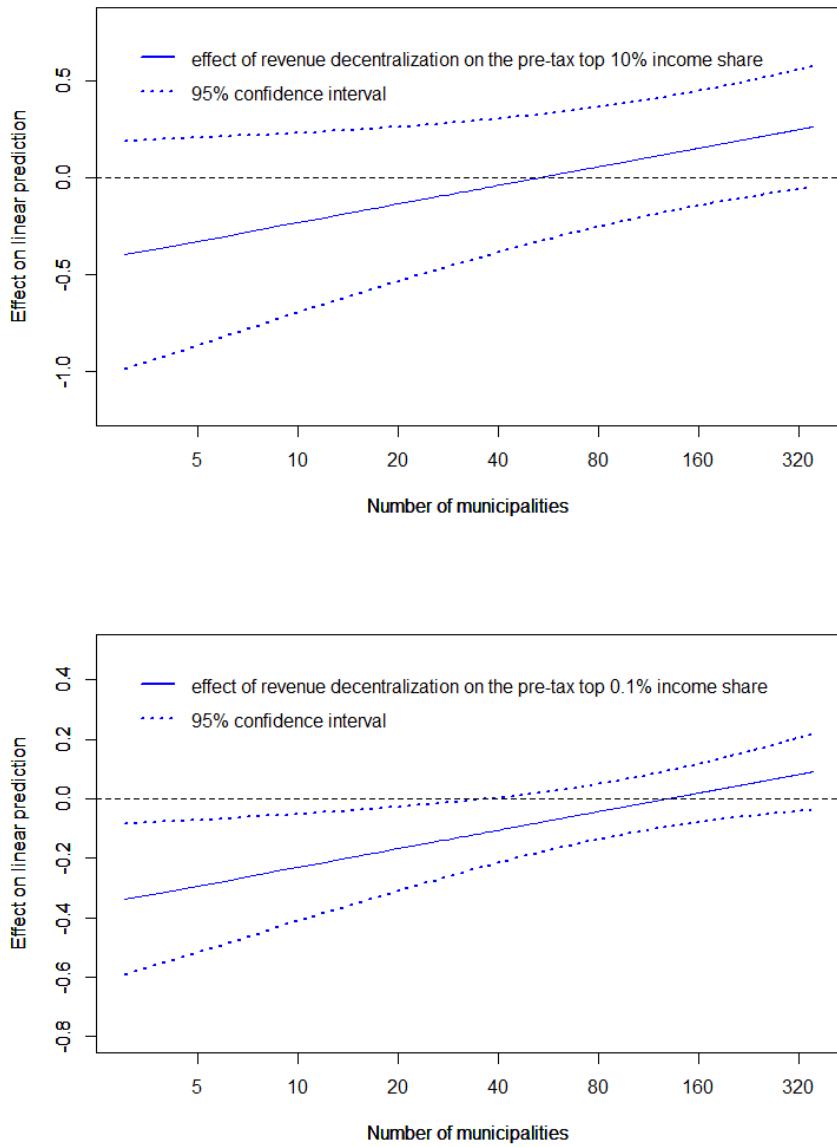
Table 4: IV-model - Effect of decentralization on income inequality before taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
decentralization(t-1)	-1.215** (-2.14)	-0.552 (-1.46)	-0.777** (-2.26)	-0.762*** (-2.75)	-0.657*** (-2.78)	-0.437*** (-2.65)
fragmentation(t-1)	-15.989** (-2.15)	-8.305* (-1.79)	-10.945** (-2.38)	-10.630*** (-2.64)	-9.162*** (-2.61)	-6.144** (-2.43)
decentr*fragment(t-1)	0.255** (2.28)	0.139** (2.06)	0.175** (2.53)	0.165*** (2.84)	0.140*** (2.81)	0.090*** (2.62)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
Instrumented	decentralization(t-1) decentr*fragment(t-1)					
Instruments	taxharm(t-1) taxharm*fragment(t-1) geofrag(t-1) geofrag*fragment(t-1)					
Kleibergen-Paap rk Wald F	20.1					
Hansen J stat	6.2	4.8	3.52	3.042	2.62	2.28
(p-val)	(0.04)	(0.18)	(0.17)	(0.22)	(0.27)	(0.32)
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.659	0.680	0.538	0.378	0.346	0.294
Wald-Test decentr	5.5*	5.5*	6.7**	8.1**	7.9**	7.0**
Wald-Test fragment	5.4*	4.5	6.6**	8.1**	7.8**	6.7**
pivot municip	117	53	86	102	109	128

Standard errors clustered for canton and period

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Figure 7: Effect of decentralization on redistribution at the top 10 percent (upper figure) and the top 0.1 percent (lower figure) subject to fragmentation



## 5. Robustness Tests

This section contains a series of tests to check the robustness of our results. As first and straightforward robustness check, we exclude the two cantons of Glarus and Basel-City from the sample. Glarus executed a very far reaching reform of the local government level in 2011 when its 25 municipalities were merged into just three. This reform affected fragmentation significantly. Furthermore, Basel-City is omitted due to its particular municipality structure. It consists almost exclusively of the city of Basel, which is cantonal jurisdiction, with only two additional municipalities. This structure has a distinct effect on decentralization which is by far the lowest in any canton (see figure 1a). Even with the exclusion of Basel-City and Glarus, we find effects consistent with our baseline results (see table A.7). Thus, we can rule out the possibility that the effects on the income distribution in table 3 are largely or solely driven by the large institutional changes in those cantons.

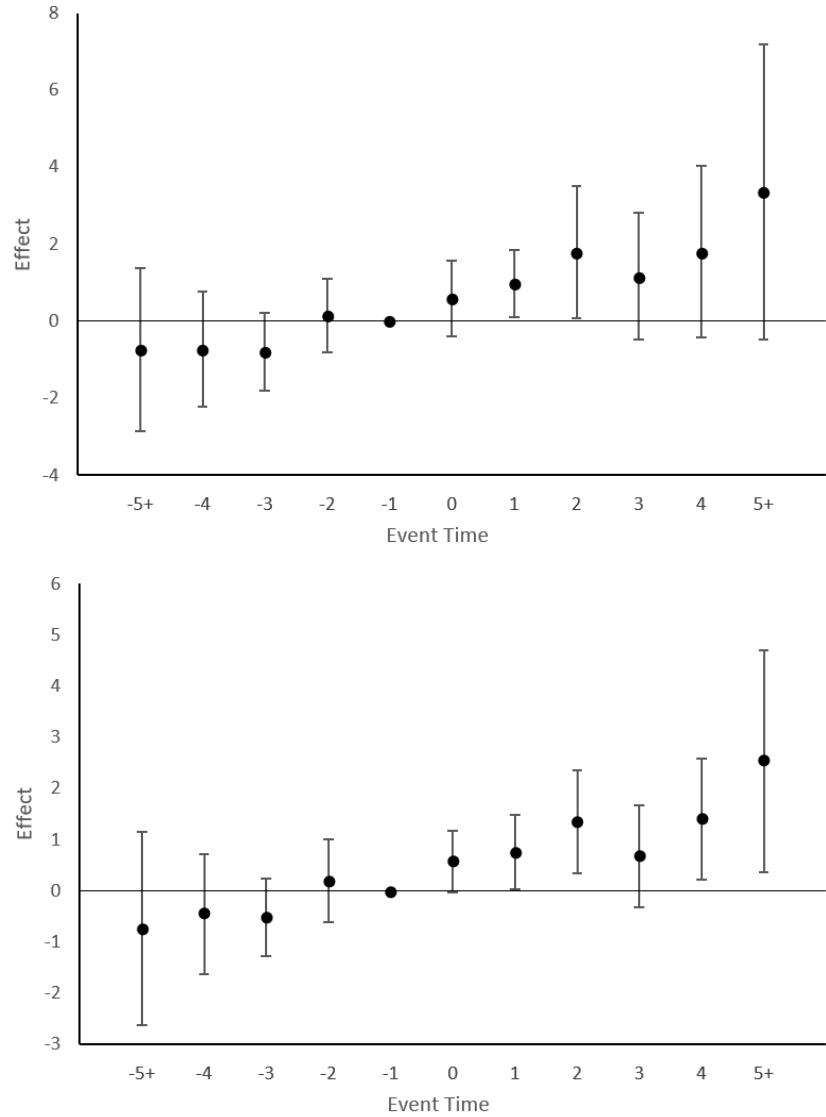
In the remainder of this section further robustness tests are executed. We estimate our model using an alternative measure for both decentralization as well as fragmentation and test spillover effects in a spatial autoregressive model.

### 5.1. Alternative Measure for Decentralization

So far we measure decentralization by the municipal share of total cantonal and municipal tax revenue. As mentioned in section 3.3 this can be interpreted as a *de facto* measure of fiscal decentralization. The measure may lead to biased results however. If a municipality aims to increase redistribution, it may change the composition of expenditures (e.g. by increasing social assistance and subsidies for child care instead of financing art museums and violin classes). Another possibility however, is to increase the municipality's tax multiplier and thus raise more revenue to finance local expenditures. In the second case *de facto* tax decentralization will increase automatically leading to biased result of our estimations.

To rule out this effect we would need to observe actual *de jure* fiscal autonomy i.e. the allocation of public functions between cantons and municipalities. This is very difficult to observe consistently over time and between cantons. However, Flèche

Figure 8: Event study results for the effect of centralization reforms in 15 cantons on the before tax income share of the top 10 percent (upper figure) and top 0.1 percent (lower figure)



(2017) based on Rühli (2012) compiles a unique series of cantonal reforms in the time period 2000-2014. Flèche (2017) exploits a particular situation in which the central government reforms provided motivation for cantons to reallocate public functions and resume responsibilities from municipalities. As a result, 15 out of 26 cantons enacted centralization reforms of this sort until 2014. As these cantonal reforms were induced by central government and did not emanate from the cantonal political process, they can be considered exogenous from the perspective of cantons. Further, since the timing of reforms was at the discretion of cantons we may assume a quasi-random setting. Obviously, these reforms provide variation exclusively in the direction of centralization and they were implemented over a limited period of 14 years. Due to these limitations, we refrain from using this variable as our baseline. However, we use this variation as an alternative measure of tax decentralization (*centreform*) to test for the robustness of our baseline effects.

Following Flèche (2017) we specify a dummy variable indicating the years after centralization reforms for the 15 respective cantons. We employ this variation to identify effects in an event study analysis. For this purpose, we use event time dummies for each year within a period from four years before to four years after implementation as well as the full periods before and after this eight year time window.

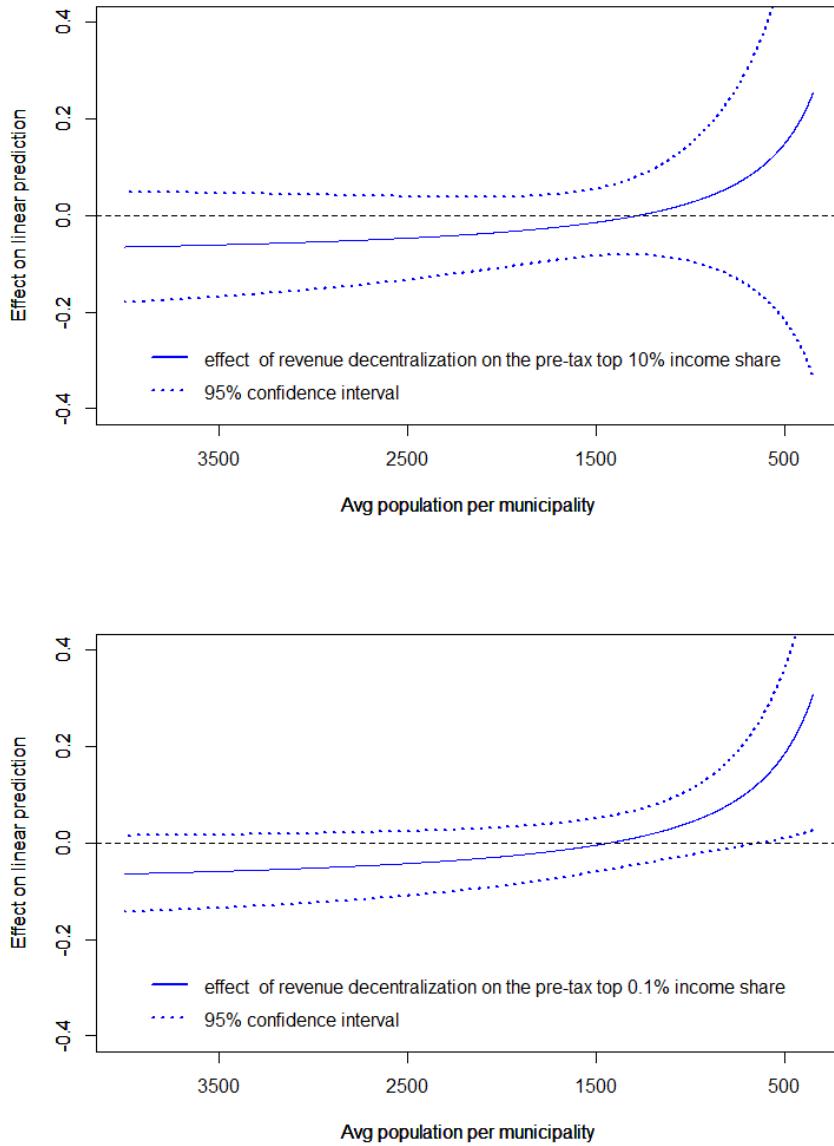
Figure 8 shows the results of a regression of the top 10% income share before taxes (upper panel) and the top 0.1% income share before taxes (lower panel) on those event time variables. The point of reference is the period one years before the implementation. No pre-trends are visible in the top income share. For the event time dummies one year and two years after implementation, we find significant effects for the income shares of the top 10% and the top 0.1% in the income scale. Apparently, centralization leads to an increase in income concentration. At the very top, we find significant lasting effects. Generally, these results confirm our previous findings.

### 5.2. Alternative Measure for Fragmentation

So far fragmentation has been measured by the log of the number of municipalities per canton (*fragment*). This variable can be interpreted as the number of competitors

and thus as the degree of competition at the local level. However, Swiss cantons differ considerably with respect to the size of their population. Evidently, larger cantons count more municipalities. Thus our fragmentation variable assigns a high degree of competition to large cantons. This is not a problem *per se* as our fixed effects model relies mainly on intertemporal variation in this measure for identification.

Figure 9: Effect of decentralization on the top 10 percent (upper figure) and top 1 percent (lower panel) income share subject to an alternative measure of fragmentation (before tax income)



Nonetheless, we check for robustness employing an alternative measure. Fragmentation may also be defined based on the size of municipalities. The larger the local jurisdictions are on average, the lower is fragmentation in a canton. To specify this alternative notion we normalize the number of municipalities by the population size of a canton. This measure corresponds to the inverse of the average population size of a canton's municipalities. However, population increases significantly over time. Thus this variable contains intertemporal variation based on cantonal population growth. Yet, this is not the variation we want to exploit to identify changes in the income distribution. In fact we have included the population size as a control variable. Therefore, we normalize our alternative fragmentation variable (*fragmentsize*) using the cantonal population size in 2014. As a result, the intertemporal variation in this variable results exclusively from mergers of municipalities and changes in cantonal territory, but not from population growth. Nonetheless, the normalization considers cross sectional differences in cantonal population size and measures the size of intertemporal variation based on changes in the average size of municipalities.

Table A.12 reports the results of our preferred specification of the model (column 5 in table 1) for inequality measures in after-tax incomes as the dependent variables and the alternative measure of fragmentation. The direction of the effects of decentralization remains consistent with the previous estimations in table 3. Decentralization exerts a negative effect on all the measures of inequality if fragmentation is very low. As before, the interaction with fragmentation counteracts this effect. Figure 9 shows the resulting marginal effect of tax decentralization on the top 10% and top 0,1% income share, respectively. In this specification the marginal effects do not depend on the number but on the average population size of municipalities.

If a canton's municipalities are large (and fragmentation is low), additional decentralization significantly reduces income concentration at the top. Apparently, large municipalities are able to achieve a more equal distribution if they assume additional means and responsibilities from the cantonal level. However, if a canton's municipalities are small (and fragmentation is high), additional decentralization might increase inequality. Smaller municipalities seem to lack the abilities to achieve a more equal

distribution. The point estimate of the marginal effect of decentralization on the top 10 % income share is zero if an average municipality counts 1279 residents (pivot value of municipality population). Historically, this is a low value which was approximated only by the two most fragmented cantons (Graubünden and Jura) in 2014. However, measured by the Gini coefficient the interaction of decentralization and fragmentation is stronger. The point estimate for the marginal effect is zero for cantons whose average municipalities counts 2272 residents. This general pattern of results largely confirms the findings of the baseline estimations.

### 5.3. Spatial Autocorrelation

A potential source of bias in our baseline model is spatial correlation in inequality among cantons. Due to spillover effects income inequality in one canton might depend on inequality in its neighboring cantons. Moreover, omitted spatial variables might cause spatial correlation in the error term. In mountainous and sparsely populated cantons for example the distribution of income might be inherently different than in urban cantons. In order to test for such effects we estimate a spatial autoregressive model with an autoregressive disturbance term

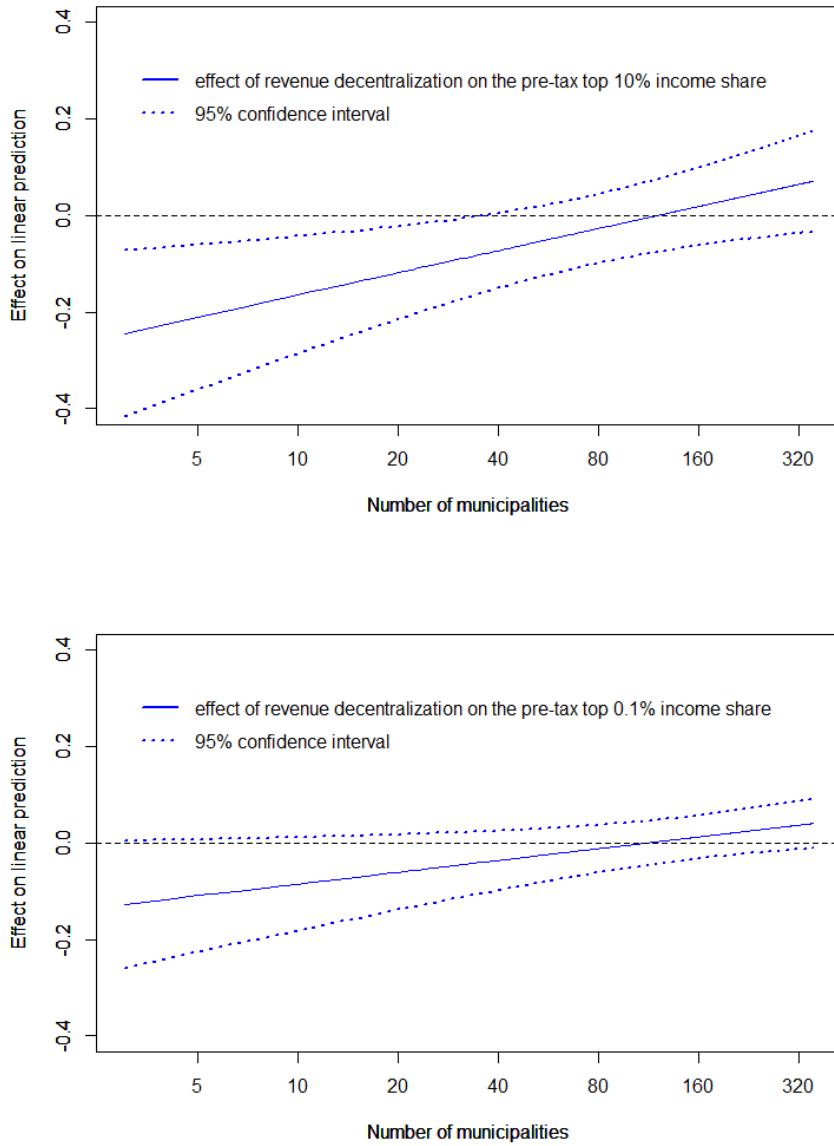
$$\begin{aligned} \text{inequality}_{it} = & \rho * w_{ij} * \text{inequality}_{jt} + \beta_1 \text{decentr}_{i,t-1} + \beta_2 \text{fragment}_{i,t-1} \\ & + \beta_3 \text{decentr} * \text{fragment}_{i,t-1} + \boldsymbol{\gamma}' \mathbf{X}_{it} + \alpha_i + \delta_t + \nu_{i,t} \\ \nu_{i,t} = & \lambda * w_{ij} * \varepsilon_{j,t} \end{aligned}$$

where  $w_{ij}$  denotes a spatial weighting matrix giving equal weight to all neighboring cantons  $j$  with a common border with canton  $i$ .  $\rho$  is the coefficient of spatial correlation in the dependent variable, and  $\lambda$  the spatial disturbance in the error term.

Testing this model reveals no spatial correlation in the dependent variable. For all inequality measures the coefficient  $\rho$  for the effect of a spatial lag is not significantly different from zero. This confirms the findings of Frey et al. (2017) who find no evidence for a spatial lag in cantonal income inequality. Figure 10 shows the marginal effects for two specifications subject to fragmentation.

However, for the Gini coefficient we find evidence for spatial autocorrelation in the error term. We report the results for a spatial error model in table A.13.  $\lambda$  is significant only in column 1. Spatial autocorrelation does not seem to be a problem regarding the top income shares. In addition, the spatial error model confirms the effects of tax decentralization and fragmentation of the baseline specification.

Figure 10: Effect of decentralization on the top 10 percent (upper figure) and top 0.1 percent (lower figure) income share subject to fragmentation (before tax income)



## 6. Conclusion

A theoretical prediction regarding the impact of fiscal federalism on income inequality is not straightforward. On one hand, Tiebout income sorting and tax competition may inhibit redistribution via progressive taxes. On another hand, fiscal decentralization can increase the efficiency of the public sector. Low income households, due to a higher dependency on public goods and basic services (e.g. education, health provision, child care, public transport), might benefit most from this. In fact, a negative effect on tax redistribution may be compensated by policies that achieve a more equal pre-tax distribution, for example, by enabling lower incomes to earn more in the labor market. Consequently, the overall impact of fiscal federalism on the income distribution primarily remains an empirical issue (Sepulveda and Martinez-Vazquez, 2011).

Swiss federalism provides a particularly well-suited institutional setting to empirically assess the effect of fiscal decentralization on inequality. The different cantons grant municipalities a varying degree of fiscal autonomy. At the same time, cantons also differ considerably regarding the distribution of income. Based on federal income tax statistics from 1945 to 2014 it is possible to assess income inequality very consistently on the cantonal level and over an extensive period of time (Schaltegger and Gorgas, 2011).

We provide evidence that fiscal decentralization measured by the municipal share of tax revenue diminishes concentration in pre- and post-tax incomes. Notably, we also find a significant interaction effect of tax decentralization with the number of municipalities in a canton. For high levels of such jurisdictional fragmentation we find no significant effect of tax decentralization or even an increasing marginal effect on inequality. Apparently, if the number of local jurisdictions in a canton is high, reflecting a high degree of competition among them, municipalities struggle to effectively reduce income inequality.

These findings are robust to a series of checks. In order to address potential endogeneity concerns, we employ an instrumental variable approach by exploiting a federal tax harmonization reform and a geographical fragmentation measure that captures al-

titude differences among municipalities in a canton.

The results also hold for alternative measures of fiscal federalism. Our baseline results are confirmed when relying on a series of cantonal reforms reducing public responsibilities of municipalities. The results are also robust to fragmentation defined as the inverse of the average population size of municipalities instead of their number. As long as municipalities, on average, exceed a certain population size, tax decentralization tends to decrease inequality. For cantons with very small municipalities and thus a high degree of fragmentation we again find no effect or even an inequality increasing effect. This finding could be explained by the lack of resources in small municipalities. Another explanation may lie in influential interest groups that are more successful at enforcing their self-interests in small municipalities.

Our results emphasize that it is essential to account for the level of jurisdictional fragmentation when assessing the impact of fiscal decentralization. We empirically confirm the prediction that the number as well as the size of local jurisdictions is relevant regarding the impact of fiscal autonomy. The combined assessment of tax decentralization and fragmentation yields more refined results and may explain conflicting evidence of previous empirical studies regarding the distributive effect of fiscal decentralization.

In part our findings confirm the propositions of the traditional theory of federalism, in the sense that we find inequality increasing effects if jurisdictional fragmentation is high. This lends support to the idea that in a very competitive environment local jurisdictions are unable to redistribute.

However, our results also show that there are important inequality decreasing effects of fiscal federalism in pre-tax income. If fragmentation is limited and municipalities exhibit a certain size, decentralization leads to lower inequality. This inequality reducing effect is not the consequence of increased redistribution but of more evenly distributed pre-tax incomes. Hence, decentralization may reduce income inequality quite efficiently without the inefficiencies related to redistribution. This finding suggests that the distributional effects of a decentralized public good provision are poorly understood and more insights are needed into the role of local governments and their impact on the pre-tax income distribution.

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## Appendix A. Descriptives

Table A.5: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
gini	1,068	43.24	4.99	26.62	63.32
top10	1,068	30.69	5.09	19.16	61.95
top5	1,068	21.23	4.49	13.38	50.34
top1	1,068	9.74	3.59	5.29	36.98
giniat	1,068	40.15	5.33	12.99	59.67
top10at	1,068	27.37	4.79	16.56	60.13
top5at	1,068	18.23	4.11	11.43	45.83
top1at	1,068	7.76	3.18	4.33	32.72
ginire	1,068	7.27	3.78	-11.25	63.91
top10re	1,068	16.49	4.06	3.51	30.5
top5re	1,068	18.91	4.07	1.47	31.35
top1re	1,068	23.49	4.81	-4.35	39.56
decentr	1,074	44.43	13.72	2.23	78.9
frament	1,074	114.33	117.09	3	495
inc_pc	1,074	44214	21772	3916	194321
topmargtax	1,074	21.94	5.93	4.7	49.89
topmargtax_neighb	1,074	22.28	4.18	8.41	49.56
transfers_earmarked	1,074	61.39	68.63	2.86	622.11
federaltax_share	1,074	17.28	11.48	5.75	97.34
equalization_transfers	1,074	1.87	7.88	-46.42	41.21
population	1,074	252311	269719	12757	1425538
unempl	1,074	1.15	1.36	0	6.15
active_population	1,074	0.59	0.04	0.49	0.68
left	1,074	22.99	14.86	0	85.7
crime	1,074	0.31	0.14	0.04	0.93
foreigners	1,074	14.67	7.6	1.98	40.95
religion	1,074	32	23.2	3.02	84.85
taxharm	1,074	0.34	0.47	0	1
geofrag	1,074	0.11	0.17	0	0.86
area	1,074	1550	1817	37	7105

Note: For 3 cantons the variables on income distribution are not available for the tax periods 2001 and 2002 due to missing information in the federal tax statistics.

Table A.6: Effect of decentralization on redistribution via income taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	ginire	top10re	top5re	top1re	top05re	top01re
decentralization(t-1)	0.007 (0.22)	0.040 (0.76)	0.082 (1.04)	0.187 (1.52)	0.212 (1.50)	0.289 (1.43)
fragmentation(t-1)	-0.280 (-0.49)	1.280** (2.14)	3.017*** (2.93)	5.382*** (2.99)	6.066*** (2.91)	7.789*** (3.17)
decentr*fragment(t-1)	-0.001 (-0.18)	-0.003 (-0.26)	-0.017 (-0.99)	-0.044* (-1.75)	-0.053* (-1.85)	-0.076** (-2.01)
gini(t-1)		-0.108** (-2.04)				
top10(t-1)			-0.139** (-2.26)			
top5(t-1)				-0.154** (-2.25)		
top1(t-1)					-0.245** (-2.20)	
top05(t-1)						-0.320** (-2.55)
top01(t-1)						-0.499*** (-2.99)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.610	0.630	0.592	0.488	0.485	0.594
Wald-Test decentr	0.1	1.8	1.1	3.5	4.3	6.0*
Wald-Test fragment	1.1	10.8***	11.2***	9.0**	8.5**	10.1***
pivot municip	—	—	—	71	55	41

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.7: Effect of decentralization on inequality after taxes - excluding cantons Glarus and Basel-City

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.385*** (-3.59)	-0.321*** (-4.09)	-0.320*** (-3.76)	-0.272*** (-3.14)	-0.237*** (-2.84)	-0.159** (-2.44)
fragmentation(t-1)	-3.235 (-1.40)	-2.801* (-1.79)	-2.466 (-1.58)	-1.953 (-1.49)	-1.692 (-1.43)	-1.085 (-1.27)
decentr*fragment(t-1)	0.088*** (3.45)	0.059*** (3.34)	0.058*** (3.34)	0.050*** (3.07)	0.043*** (2.82)	0.028** (2.43)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	population	unempl	active_population	left	crime	foreigners
N	984	984	984	984	984	984
$R^2$ (within)	0.745	0.705	0.600	0.464	0.419	0.341
Wald-Test decentr	13.0***	18.0***	14.4***	9.9***	8.2**	6.0**
Wald-Test fragment	13.2***	11.4***	11.5***	10.1***	8.7**	6.8**

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.8: IV approach: First Stage

	decentralization(t-1)
tax-harmonization(t-1)	-2.904*** (-5.86)
gfrag_area_ll	39.172*** (8.74)
fragmentation(t-1)	-8.571*** (-2.82)
canton & period fe	yes
controls	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion
N	1074
$R^2$ (within)	0.661

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.9: IV-model - Effect of decentralization on income inequality after taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-1.198** (-2.13)	-0.392 (-1.24)	-0.652** (-2.26)	-0.663*** (-2.73)	-0.561*** (-2.71)	-0.353** (-2.53)
lmuni_l1	-15.415** (-2.07)	-6.251 (-1.62)	-9.425** (-2.37)	-9.331** (-2.57)	-7.893** (-2.52)	-4.990** (-2.31)
decentr*fragment(t-1)	0.243** (2.21)	0.105* (1.80)	0.145** (2.44)	0.139*** (2.76)	0.116*** (2.70)	0.070** (2.44)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
Instrumented	decentralization(t-1) decentr*fragment(t-1)					
Instruments	taxharm(t-1) taxharm*fragment(t-1) geofrag(t-1) geofrag*fragment(t-1)					
Kleibergen-Paap rk Wald F	20.1					
Hansen J stat	5.2 (0.07)	3.2 (0.20)	2.7 (0.25)	2.4 (0.30)	2.4 (0.30)	2.4 (0.30)
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.692	0.697	0.567	0.394	0.355	0.291
Wald-Test decentr	4.9*	4.1	6.0**	7.7**	7.5**	6.4**
Wald-Test fragment	4.9*	3.3	6.0**	7.6**	7.3**	5.9*

Standard errors clustered for canton and period

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.10: IV-model - Reduced Form

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
taxharm(t-1)	3.757*** (2.80)	2.235** (2.32)	2.706*** (2.79)	2.356** (2.57)	1.880** (2.18)	0.998 (1.41)
taxharm*fragment(t-1)	-1.136*** (-6.13)	-0.718*** (-4.51)	-0.813*** (-5.11)	-0.732*** (-5.04)	-0.611*** (-4.53)	-0.379*** (-3.57)
geofrag(t-1)	98.544** (2.03)	96.093* (1.79)	76.467* (1.79)	48.363* (1.82)	34.955 (1.61)	13.346 (0.96)
geofrag*fragment(t-1)	-19.777** (-2.26)	-18.078* (-1.82)	-14.714* (-1.86)	-9.415* (-1.93)	-6.891* (-1.74)	-2.790 (-1.12)
fragmentation(t-1)	0.068 (0.11)	-0.439 (-0.79)	-0.410 (-0.74)	-0.468 (-0.94)	-0.468 (-1.05)	-0.439 (-1.28)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.734	0.693	0.575	0.438	0.397	0.326

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.11: Effect of centralization reform on inequality before taxes

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
cent-reform	5.307*** (3.17)	3.728** (2.03)	4.347** (2.07)	3.661* (1.92)	3.215* (1.86)	2.156* (1.71)
fragmentierung(t-1)	-0.561 (-0.50)	-0.740 (-0.70)	-0.776 (-0.72)	-0.800 (-0.87)	-0.745 (-0.92)	-0.604 (-1.03)
cent-reform*fragm(t-1)	-1.333*** (-3.31)	-0.650* (-1.80)	-0.809** (-2.00)	-0.743** (-2.01)	-0.654* (-1.94)	-0.440* (-1.77)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.723	0.689	0.569	0.427	0.389	0.322
Wald-Test cent-reform	10.9***	4.2	4.3	4.0	3.8	3.1
Wald-Test fragment	11.8***	4.5	5.6*	6.8**	6.9**	6.6**

Standard errors clustered for canton and period and Newey-West corrected

t statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.12: Effect of decentralization on inequality before taxes - with an alternative measure of fragmentation

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.168** (-2.21)	-0.096 (-1.10)	-0.115 (-1.32)	-0.132* (-1.68)	-0.128* (-1.78)	-0.099* (-1.87)
fragmentierung(t-1)	-17.089*** (-2.82)	-6.173 (-0.86)	-7.896 (-1.10)	-10.073* (-1.72)	-9.745* (-1.88)	-7.465** (-2.02)
decentr*fragment(t-1)	0.381*** (3.29)	0.122 (0.93)	0.161 (1.24)	0.202* (1.89)	0.191** (2.04)	0.143** (2.19)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked population unempl active_population left crime foreigners religion					
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.726	0.684	0.561	0.423	0.386	0.322
Wald-Test decentr	16.0***	1.2	1.8	3.6	4.2	4.8*
Wald-Test fragment	10.8***	0.9	1.6	3.6	4.2	4.8*
pivot municip.pop	2272	1279	1398	1531	1491	1435

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.13: Effect of decentralization on inequality before taxes - Spatial error model

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.348** (-2.56)	-0.316*** (-2.79)	-0.308*** (-2.61)	-0.268** (-2.31)	-0.236** (-2.16)	-0.166** (-1.97)
fragmentation(t-1)	-5.177*** (-2.61)	-4.894*** (-2.84)	-4.773*** (-2.80)	-4.218*** (-2.66)	-3.704** (-2.52)	-2.628** (-2.33)
decentr*fragment(t-1)	0.101*** (3.22)	0.066*** (2.65)	0.065*** (2.64)	0.059** (2.54)	0.051** (2.40)	0.035** (2.19)
controls	yes	yes	yes	yes	yes	yes
canton & period fe	yes	yes	yes	yes	yes	yes
controls	inc_pc inc_pc2 topmargtax topmargtax_neighb equalization_transfers federaltax_share transfers_earmarked					
	population unempl active_population left crime foreigners religion					
Spatial lambda	-0.167* (-1.74)	0.097 (1.49)	0.080 (1.42)	0.021 (0.44)	-0.012 (-0.25)	-0.054 (-1.06)
Variance sigma2_e	4.397*** (8.17)	4.280*** (5.06)	4.102*** (4.39)	3.464*** (3.80)	3.051*** (3.64)	1.998*** (3.28)
N	1025	1025	1025	1025	1025	1025
R <sup>2</sup> (within)	0.752	0.727	0.617	0.490	0.454	0.391
Wald-Test decentr	12.7***	7.8**	7.1**	6.6**	6.0**	5.1*
Wald-Test fragment	10.5***	8.3**	8.2**	7.4**	6.6**	5.6*

Standard errors clustered for canton; corrected for spatial autocorrelation

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.14: Effect of decentralization on the top 10% income share before taxes (including results for control variables)

	(1)	(2)	(3)	(4)	(5)	(6)
	top10	top10	top10	top10	top10	top10
decentralization(t-1)	-0.048 (-0.96)	-0.264** (-2.15)	-0.272** (-2.46)	-0.269*** (-2.72)	-0.315*** (-3.52)	-0.037 (-1.06)
fragmentation(t-1)	0.253 (0.28)	-2.906* (-1.74)	-3.096** (-1.99)	-4.618*** (-3.60)	-4.773*** (-3.82)	-0.970 (-1.00)
decentr*fragment(t-1)		0.057** (2.43)	0.050** (2.18)	0.050** (2.45)	0.068*** (3.42)	
inc_pc	-39.429*** (-9.06)	-40.118*** (-9.87)	-39.144*** (-9.57)	-29.138*** (-6.54)	-27.103*** (-8.05)	-28.171*** (-7.71)
inc_pc2	5.367*** (8.35)	5.374*** (9.17)	5.121*** (9.42)	3.572*** (5.89)	3.048*** (7.45)	3.236*** (6.61)
topmargtax			-0.230** (-2.02)	-0.179** (-2.30)	-0.184*** (-3.38)	-0.200*** (-3.45)
topmargtax_neighb			0.235*** (2.58)	0.249*** (2.66)	0.170** (2.36)	0.170** (2.15)
equalization_transfers				-0.186*** (-2.89)	-0.165*** (-3.04)	-0.184*** (-3.32)
federaltax_share				0.034 (0.92)	0.030 (0.87)	0.009 (0.27)
transfers_earmarked				0.000 (0.01)	0.002 (1.16)	0.001 (0.47)
population					2.517** (2.29)	1.751 (1.53)
unempl					-0.167 (-0.54)	-0.199 (-0.69)
active_population					35.624*** (2.87)	39.160*** (3.10)
left					-0.002 (-0.25)	0.005 (0.45)
crime					4.442** (2.49)	4.787*** (2.70)
foreigners					0.398*** (3.98)	0.347*** (3.08)
religion					0.013 (0.42)	0.023 (0.69)
canton & period fe	yes	yes	yes	yes	yes	yes
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.378	0.389	0.445	0.511	0.692	0.684

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.15: Effect of decentralization on income inequality before taxes (including results for control variables)

	(1)	(2)	(3)	(4)	(5)	(6)
	gini	top10	top5	top1	top05	top01
decentralization(t-1)	-0.349*** (-3.20)	-0.315*** (-3.52)	-0.310*** (-3.15)	-0.272*** (-2.72)	-0.241** (-2.54)	-0.170** (-2.29)
fragmentation(t-1)	-5.326*** (-3.31)	-4.773*** (-3.82)	-4.716*** (-3.84)	-4.259*** (-3.61)	-3.785*** (-3.42)	-2.720*** (-3.10)
decentr*fragment(t-1)	0.096*** (3.66)	0.068*** (3.42)	0.067*** (3.38)	0.060*** (3.18)	0.052*** (2.97)	0.035*** (2.68)
inc_pc	26.252*** (6.41)	-27.103*** (-8.05)	-13.377*** (-3.79)	1.550 (0.45)	3.610 (1.12)	4.495* (1.74)
inc_pc2	-2.994*** (-5.31)	3.048*** (7.45)	1.500*** (2.96)	-0.214 (-0.41)	-0.456 (-0.92)	-0.539 (-1.34)
topmargtax	-0.039 (-0.81)	-0.184*** (-3.38)	-0.180*** (-3.66)	-0.147*** (-3.61)	-0.129*** (-3.48)	-0.086*** (-3.14)
topmargtax_neighb	0.184*** (2.67)	0.170** (2.36)	0.152** (2.41)	0.130*** (2.60)	0.122*** (2.66)	0.090*** (2.75)
equalization_transfers	-0.130*** (-2.74)	-0.165*** (-3.04)	-0.182*** (-3.12)	-0.157*** (-3.04)	-0.136*** (-2.91)	-0.101*** (-2.85)
federaltax_share	0.066*** (2.62)	0.030 (0.87)	0.043 (1.16)	0.054 (1.45)	0.056 (1.52)	0.041 (1.41)
transfers_earmarked	0.004 (1.41)	0.002 (1.16)	0.002 (1.21)	0.004** (2.04)	0.005** (2.50)	0.005*** (2.98)
active_population	5.845*** (2.58)	2.517** (2.29)	2.700** (2.32)	2.455** (2.22)	2.067** (2.10)	1.273* (1.76)
unempl	0.141 (0.51)	-0.167 (-0.54)	-0.337 (-1.06)	-0.470 (-1.55)	-0.474* (-1.67)	-0.401 (-1.63)
popact	-6.474 (-0.32)	35.624*** (2.87)	22.017* (1.68)	4.264 (0.34)	1.262 (0.11)	-1.276 (-0.15)
left	0.005 (0.36)	-0.002 (-0.25)	-0.006 (-0.77)	-0.010** (-2.15)	-0.010*** (-3.30)	-0.009 (.)
crime	2.952 (1.57)	4.442** (2.49)	3.946** (2.34)	2.520* (1.76)	2.022 (1.63)	1.266 (1.40)
foreigners	0.410*** (3.63)	0.398*** (3.98)	0.381*** (4.06)	0.338*** (4.50)	0.306*** (4.55)	0.213*** (4.46)
religion	-0.037 (-1.35)	0.013 (0.42)	0.021 (0.68)	0.023 (0.85)	0.021 (0.89)	0.014 (0.90)
canton & period fe	yes	yes	yes	yes	yes	yes
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.730	0.692	0.572	0.433	0.394	0.328

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

Table A.16: Effect of decentralization on income inequality after taxes (including results for control variables)

	(1)	(2)	(3)	(4)	(5)	(6)
	giniat	top10at	top5at	top1at	top05at	top01at
decentralization(t-1)	-0.346*** (-3.20)	-0.286*** (-3.69)	-0.278*** (-3.31)	-0.236*** (-2.84)	-0.204*** (-2.59)	-0.137** (-2.27)
fragmentation(t-1)	-5.071*** (-3.31)	-4.358*** (-4.06)	-4.422*** (-4.21)	-3.855*** (-3.81)	-3.335*** (-3.54)	-2.262*** (-3.13)
decentr*fragment(t-1)	0.093*** (3.56)	0.059*** (3.29)	0.058*** (3.40)	0.051*** (3.25)	0.043*** (2.98)	0.027*** (2.60)
inc_pc	23.270*** (5.55)	-27.652*** (-8.92)	-14.464*** (-4.36)	-0.113 (-0.04)	2.004 (0.69)	3.264 (1.45)
inc_pc2	-2.639*** (-4.74)	3.132*** (8.35)	1.659*** (3.44)	0.013 (0.03)	-0.238 (-0.53)	-0.378 (-1.08)
topmargtax	-0.053 (-1.07)	-0.215*** (-4.18)	-0.203*** (-4.38)	-0.159*** (-4.16)	-0.137*** (-4.02)	-0.087*** (-3.60)
topmargtax_neighb	0.146** (2.03)	0.136** (2.14)	0.121** (2.23)	0.107** (2.56)	0.100*** (2.62)	0.073*** (2.74)
equalization_transfers	-0.107** (-2.26)	-0.144*** (-2.75)	-0.163*** (-2.93)	-0.138*** (-2.89)	-0.117*** (-2.75)	-0.084*** (-2.69)
federaltax_share	0.069*** (2.81)	0.030 (0.93)	0.041 (1.22)	0.050 (1.50)	0.050 (1.53)	0.036 (1.42)
transfers_earmarked	0.006** (2.22)	0.003* (1.66)	0.003 (1.62)	0.004** (2.19)	0.004*** (2.65)	0.004*** (3.25)
population	5.774*** (2.69)	1.792* (1.83)	1.830* (1.92)	1.734** (2.11)	1.408** (1.98)	0.800 (1.58)
unempl	0.037 (0.14)	-0.125 (-0.44)	-0.289 (-0.99)	-0.428 (-1.57)	-0.429* (-1.68)	-0.348 (-1.62)
active_population	-6.941 (-0.36)	37.824*** (3.35)	24.788** (2.10)	7.502 (0.68)	4.585 (0.46)	1.339 (0.18)
left	0.007 (0.50)	-0.000 (-0.00)	-0.004 (-0.54)	-0.008** (-2.13)	-0.009*** (-3.21)	-0.008*** (-5.66)
crime	1.376 (0.74)	3.259** (2.03)	2.813* (1.86)	1.620 (1.31)	1.301 (1.22)	0.795 (1.05)
foreigners	0.403*** (3.50)	0.342*** (3.79)	0.321*** (3.87)	0.274*** (4.17)	0.246*** (4.19)	0.164*** (4.03)
religion	-0.035 (-1.20)	0.016 (0.58)	0.022 (0.77)	0.021 (0.88)	0.018 (0.90)	0.013 (0.92)
canton & period fe	yes	yes	yes	yes	yes	yes
N	1068	1068	1068	1068	1068	1068
$R^2$ (within)	0.750	0.707	0.592	0.447	0.401	0.323

Standard errors clustered for canton and period; Newey-West corrected.

t-statistics in parentheses \* $p < 0.1$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

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